Cape Peninsula
University of Technology

NUTRITIONAL APPRAISAL OF TSABANA, A DIETARY INTERVENTION PRODUCT FOR THE FOUR-MONTH- TO FIVE-YEAR-OLD AGE GROUP, AND ASSESSMENT OF ITS ACCEPTANCE AND USE IN RURAL DISTRICTS OF BOTSWANA

by

BOGADI KOPONG

Thesis submitted in fulfilment of the requirements for the degree

Master of Technology: Consumer Sciences: Food and Nutrition

in the Faculty of Applied Sciences at the Cape Peninsula University of Technology

Supervisor: Dr I. Venter

Co-supervisor: Dr M. Opperman

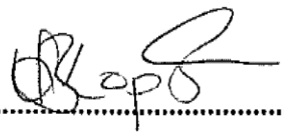
Cape Town
Dec 2013

CPUT copyright information

The dissertation/thesis may not be published either in part (in scholarly, scientific or technical journals), or as a whole (as a monograph), unless permission has been obtained from the University.

DECLARATION

I, **Bogadi Kopong**, declare that the contents of this thesis represent my own unaided work, and that the thesis has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

Signed.....  ..... **Date**.....09/12/2013.....

ACKNOWLEDGEMENTS

I wish to thank:

- Almighty God for leading me through this journey, giving me strength, wisdom and the ability to carry out this thesis.

- My supervisor Dr Irma Venter, for her guidance, mentorship, support and encouragement.

- My co-supervisor Dr Maretha Opperman, for her support and assistance.

- Mrs Corrie Uys, for the statistical analysis of the data.

- My God-given amazing parents and family for their support, encouragement and abundant love.

- The Botswana Ministry of Health, Department of Health Research Unit, for their spport and assistance.

- The clinic personnel and the study participants, for taking part in the study.

- My friend Mr Selalelo Mpotokwane, for his assistance with the questionnaire translation.

- The Cape Peninsula University of Technology, for the provision of the postgraduate bursary.

- My friends, for supporting and helping me in achieving my goal.

DEDICATION

This thesis is dedicated to the entire Kopong family for their love and support.

SUMMARY

Child undernutrition is the outcome of numerous complex and interrelated factors. It is considered a worldwide health concern, also in Botswana. Undernourished infants are especially vulnerable to develop nutritional deficiencies and diseases. Tsabana was developed as a weaning food to improve the diet quality of undernourished infants in Botswana but also as a dietary intervention product for the four-month- to five-year-old age group to improve the nutritional status of Batswana children. The study undertook a theoretical nutritional appraisal of Tsabana and assessed its acceptance and use in rural districts of Botswana.

A quantitative approach that incorporated a survey was used as the research design for the study. A pre-tested questionnaire consisting of close-ended questions in the multiple choice format was used to collect the data on the field acceptance and use of Tsabana. The questionnaire was completed by 105 caregivers of infants aged six to 36 months old visiting the selected clinics with the research sites the Ngamiland, North East, Central and Kweneng rural districts.

The energy, macro- and micronutrient content adequacy of Tsabana was compared to the Codex Alimentarius Standard for Processed Cereal-based Foods for Infants and Young Children (Codex Standard 074) and the Proposed Nutrient Composition for Fortified Complementary Foods (PNCFCF). Sorghum and soya are the two major ingredients of Tsabana which contribute to its protein and energy provision. The nutrient appraisal revealed that the level of energy provided by Tsabana is more than the specified Codex Alimentarius Standard composition but slightly less than the PNCFCF specified range, whereas the protein level is within the specified ranges as put forward by both the Codex composition and the PNCFCF, respectively. The results further revealed that in comparison to the PNCFCF the content of vitamins A, E, C and pyridoxine, zinc, iodine and iron were less than the specified ranges. The content of vitamins A and D met the compositional guidelines of the Codex Alimentarius Standard.

The micronutrient provision of Tsabana in relation to the World Health Organization (WHO) recommended nutrient intakes was mostly adequate except for pyridoxine which was inadequately provided for both seven- to 18-month-old (33% provision) and one- to three-year-old (52% provision) infants at the daily rations of 75 gram (g) and 200 g powder respectively. Some minerals also were provided at inadequate amounts, e.g. iodine at a daily

provision of 42% as well as iron at 26% for seven- to 12-month-old and 12- to 18-month-old infants both provided at a daily ration of 75 g Tsabana powder. Zinc was only provided at 19% of the WHO recommended intake for seven- to 12-month-old and 14.8% for 12- to 18-month-old infants. As with the absence of omega-3 and omega-6 fatty acids, the minerals selenium and copper are not provided by Tsabana.

The micronutrient fortification compounds used in Tsabana for the mineral and vitamin additions as vitamin A palmitate, cholecalciferol, vitamin E acetate, calcium pantothenate, carbonate and tri-calcium phosphate (ratio 1:18:482), zinc sulphate and potassium iodate are readily bioavailable, but not the vitamin A and vitamin E compounds used. The iron fortificant used is not stipulated on the Tsabana package.

The field survey results revealed that Tsabana was well accepted by the infants as perceived by their caregivers as the majority indicated that Tsabana was enjoyed (80%) and that it tasted nice (71.4%). The majority (78.1%) of the caregivers also indicated that the wellbeing of the infants improved on receiving Tsabana. Most (51.4%) of them also knew that Tsabana is more nutritious than other cooked porridges. Tsabana though was not used properly as most of the caregivers fed Tsabana to the infant only once a day (60.9%) instead of two to three times (for infants six- to 18-month-olds) and did not use enough water (3½ cups) (76.2%) to cook one feeding of Tsabana as stipulated on the Tsabana package.

The product use factors, which include the number of daily Tsabana feedings provided, the addition of sugar to the cooked Tsabana, the amount of water used to cook one feeding of Tsabana and the cooking period of one feeding were the factors significantly ($p < 0.05$) linked to the perceived infant acceptance of Tsabana. The number of daily Tsabana feedings was linked to the perceived enjoyment of Tsabana ($p < 0.05$) and its perceived texture ($p < 0.05$) and colour ($p < 0.05$) acceptance. While the addition of sugar to the cooked Tsabana was linked to its perceived enjoyment ($p < 0.05$), the amount of water used to its perceived taste acceptance ($p < 0.05$) and the cooking period of one feeding to its perceived colour acceptance ($p < 0.05$). For instance, more caregivers in relation to the enjoyment of Tsabana and its colour and texture acceptance who perceived it not to be enjoyed and not having a nice colour or texture, indicated not to feed it daily in comparison to caregivers who perceived that Tsabana was enjoyed by the infants and that it had a nice colour and texture.

The caregiver perceived infant wellbeing improvement through the provision of Tsabana and the perceived difference between Tsabana and other cooked porridges were the only two

clinic-related factors which significantly ($p < 0.05$) influenced the infant acceptance of Tsabana as perceived by the caregivers. For instance, while the majority (86.2%, 84.8% and 80%, respectively) of the caregivers who perceived the infant taste acceptance of Tsabana as very nice, nice or acceptable indicated that providing Tsabana to the infant improved the infant's wellbeing, the majority (80%) who perceived it as not tasting nice indicated that providing Tsabana to the infant had not improved the infant's wellbeing. More than half of the caregivers who perceived the infant texture acceptance of Tsabana as acceptable (59.4%) or nice (56.8%) indicated that Tsabana provides more nutrition to the infant. However, less than half (46.2%) of the caregivers who perceived the texture of Tsabana as not nice indicated that it provides more nutrition to the infant.

The caregiver education level was the only demographic factor that significantly ($p < 0.05$) influenced the acceptance of Tsabana. The majority (90.3%) of the caregivers who attained a secondary education level (form 1 to form 4) and higher, perceived the infant texture acceptance of Tsabana as nice, acceptable or not nice. In contrast, the majority who perceived the texture acceptance as very nice attained either no schooling/standard one to seven (73.9%) and not a secondary level or higher (26.1%). It could be speculated that caregivers who attained a higher education level may be more critical of such attributes such as the texture acceptance of Tsabana.

Most (59%) of the caregivers indicated that they did not receive any information regarding Tsabana from the clinic personnel. Caregiver education on Tsabana and infant nutrition will impart sufficient knowledge and skills to prepare, store and adequately feed Tsabana to their infants as well as provide a variety of foods in adequate amounts to contribute to their optimal growth and development. This is a vital undertaking as it was evident from the study that most of the factors that influenced the acceptance of Tsabana were the product use factors. The study additionally found that foods such as meat, poultry and fish, as well as fruit and vegetables, which should be included in the daily dietary provision, were provided to most of the study infants on a weekly basis only.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Terms/Acronyms	Definition/Explanation
ALA	Alpha linolenic acid
CBC	Communication for behavioral change
CFS	Commercially fortified supplement
CRSP	Collaborative Research Support Programme
CSB	Corn-soy-blend
DHA	Docosahexaenoic acid
DNA	Deoxyribonucleic acid
EFAs	Essential fatty acids
EPA	Eicosapentaenoic acid
GBG	Golden-briend-grellety
HDDS	Household Dietary Diversity Score
HIV/AIDS	Human Immune Deficiency Virus/Acquired Immune Deficiency Syndrome
I.U.	International Units
LA	Linoleic acid
NCHS	National Centre for Health Statistics
NFCS	National Food Consumption Survey
NHR	Nutritional rehabilitation homes
NRC	National Rehabilitation Centre
PEM	Protein energy malnutrition
PMTCT	Prevention of mother-to-child transmission
PNCFCF	Proposed Nutrient Composition for Fortified Complementary Foods
RNA	Ribonucleic acid
RUTF	Ready-to-use therapeutic food
SD	Standard deviation
UNICEF	United Nations International Children's Emergency Fund
USAID	United States Agency for International Development
WHO	World Health Organization

CLARIFICATION OF BASIC TERMS AND CONCEPTS

Child: 'Any human being below the age of 18 years and includes babies, small children, older children and adolescents' (UN, 2002:2).

Dietary diversity: The number of food groups which have been consumed during the past 24 hours, 48 hours or even seven days or the variety of foods from several food groups consumed over a period of time to provide a quality diet with all the nutrients needed by the body for growth and optimal health (Arimond & Ruel, 2004:19; Oldewage-Theron & Kruger, 2011:420).

Dietary intervention: Purposely planned action designed with intent of changing a diet-related behaviour, risk factor, or aspect of health status for an individual, target group, or population at large (Lacey & Pritchett, 2003:1063).

Food fortification: 'The addition of one or more essential nutrients to a food, whether or not it is normally obtained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in specific population groups' (FAO, 1996:3).

Food security: All people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life (WHO, 2001).

Food variety: The number of individual food item types consumed per day, per 24 hour recall or per seven days (Oldewage-Theron & Kruger, 2011:420).

Household diversity score: The number of food groups consumed over a reference period of 24 or 48 hours or even seven days (Swindale & Ohri-Vachaspati, 2005:67).

Infant: **'**A young child between ages of one month to 12 months (WHO, 2001a)

Stunting: The height-for-age less than two standard deviations below the median of the National Centre for Health Statistics standards (Kruger *et al*., 2010:90).

Underweight: The weight that is lower than two standard deviations (or 'z scores') below the median expected weight for age (Walton & Allen, 2011:418).

Recommended Dietary Allowance (RDA): 'The average daily nutrient intake level that is sufficient to meet the nutrient requirements of nearly all (97% - 98%) individuals in a life stage and gender group' (Butte *et al*., 2004:446).

Weaning: 'A gradual introduction of food to an infant so that he/she gets accustomed to food other than breast milk, not withstanding the fact that it is normally referred to as cessation of breast-feeding' (Grueger, 2013:1).

Weaning period: The period during which an infant gradually goes from receiving breast milk or formula exclusively to that of consuming adult food or the transition of infants from only receiving breast-feeding or infant formula to complete reliance on other household foods (Ohiokpehai *et al*., 1994:206).

CHAPTER 1

INTRODUCTION

1.1 Statement of the research problem

The Botswana Ministry of Health provides the fortified weaning food, Tsabana, to infants to specifically alleviate infant undernutrition and nutritional deficiencies. Several population-based surveys however indicate that child malnutrition is a persistent problem in Botswana which seems to especially occur in its rural districts (Botswana Ministry of Health, 2010). This suggests uncertainties regarding the nutritional adequacy, consumer acceptance and use of Tsabana, in particularly rural districts.

1.2 Backgroud to the research problem

Enhancing and maintaining the nutritional status of its people, especially the children, is an important commitment for the government of Botswana. To achieve this goal, the government has implemented a few nutrition intervention programs. The provision of Tsabana to infants was one of the programs introduced to offer a source of readily available essential nutrients likely to be missing in Batswanean infants' home diets, such as energy and most micronutrients including iron, zinc, vitamin A and the B vitamins (Nnyepi, 2004:52).

Tsabana is foremost a weaning food developed to improve the diet quality of infants in Botswana, but also a dietary intervention product to improve the nutritional status of Batswana children under five years of age (under 5's) particularly the undernourished. It is provided monthly at no cost by health clinics across Botswana to pre-school children, when the children are brought for growth monitoring (Mugabe *et al*., 1998:86). It is manufactured from a sorghum and soya blend with sorghum being the main ingredient which is also the staple food in Botswana (Maruapula, 1993:79). The development of Tsabana came about in 1992 as a replacement of the corn and soya milk blend received (product named Malutu) which was originally donated by the United States Agency for International Development (USAID) as one of the feeding programs to children in Botswana in the mid 1980's. In 1990 Malutu was phased out and the Botswana Ministry of Health developed Tsabana to replace Malutu (Nnyepi, 2004:55).

Despite this concerted effort to alleviate malnutrition (as defined by underweight) in children by introducing the feeding program of Tsabana, it is still not fully efficient. It had been observed that malnutrition in under 5's is still substantial in some parts of the country such as the rural areas Mabutsane and Kweneng West. According to a study that was done in 2007 in Mabutsane, the prevalence of underweight was 11.5%, stunting 27.6% and wasting 4.7% (Botswana Ministry of Health, 2010). Several population-based surveys in Botswana indicate that child malnutrition is a persistent problem and that there are significant disparities in its prevalence, especially occurring in semi-rural and extremely rural districts (in particular the Kgalagadi, Kweneng and Ngami districts) compared to more urban districts (Botswana Ministry of Health, 2010).

1.2.1 Tsabana nutritional appraisal

During the development of Tsabana, emphasis was placed on its nutritional provision of adequate energy and protein as macronutrient. Sorghum, the basis of Tsabana, is one of the cereals that constitute a major source of protein and minerals for millions of people in Africa. This cereal is mainly considered a subsistence crop because of its unique tolerance to drought and adaptation to dry tropical and sub-tropical ecosystems throughout the world (Kebakile *et al.*, 2003:2). Like other grains, sorghum protein is generally low in essential amino acids, such as lysine and threonine. Lysine is not only important for proper growth, but plays an essential role in the production of creatinine, a nutrient responsible for converting fatty acids into energy. Lysine also helps the body to lower cholesterol and absorb calcium. It futhermore plays an important role in the formation of collagen, a substance important for bones, connective tissues and muscle protein formation, aiding in speedy recovery from injuries and surgery (Gropper, 2000:389). Threonine is an important constituent in many body proteins and is necessary for the formation of tooth enamel protein, elastin, and collagen. Threonine also plays a minor lipotropic role, controlling fat buildup in the liver. It also has a mild glucose-sparing effect and is a precursor of the amino acids glucine and serine. It is furthermore one of the immune-stimulating nutrients which promotes and stimulates the growth of the thymus (an immune cell producing gland in the upper chest) (Haas, 2006:48).

Although sorghum is rich in minerals, the mineral bioavailability varies from less than 1% for iron to greater than 90% for sodium and potassium. The nutrient bioavailability is particularly important to consider because sorghum is the main ingredient in the production of Tsabana,

and a staple food of Botswana. The presence of tannin and polyphenols in sorghum grain interferes with the bioavailability of some nutrients. The main antinutrient found in grains is phytate, which binds to vitamins, minerals and enzymes to make them unavailable to the body (Doudu *et al*., 2003:119). Phytates have an affinity for minerals such as calcium, magnesium, iron, copper and zinc, which are also the main minerals found in grains (Doudu *et al*., 2003:120).

Some other antinutritional factors in sorghum are trypsin and amylase inhibitors. These compounds are known to interfere with mineral, protein and carbohydrate metabolism, respectively (Herzberg *et al*., 1990:251). Several traditional household methods of cooking could be used to enhance the bioavailability of micronutrients in sorghum based-diets. For example, thermal processing (boiling) aim to increase the physicochemical accessibility of micronutrients and decrease the content of antinutrients, such as phytates (Hortz & Gibson, 2007:1097).

Tsabana also contains an amount of soy flour. Soybeans have also become one of the popular and mostly used legumes in Botswana. They are widely used because it is inexpensive, and a source of dietary protein. Its protein content (40%) is higher than beef (18%) (IITA, 1990:220), though with a similar amino acid composition to beef (Sipos, 2002:2), chicken (20%), fish (18%) and groudnuts (23%). Apart from proteins, soybeans also contain carbohydrates (32%), fat (20%), vitamins and minerals (5%) and fibre (3%), which is why they are extensively used in infant feeding foods (IITA, 1990:220). Soybeans have become the 'golden nugget of nutrition' because of the combination of nutrients it provides (McArthur *et al*., 1988:920).

During the extrusion process of making Tsabana, sorghum and soybeans are dehulled and premixed in a proportion of 3:1 (75% sorghum and 25% soya), hammer-milled and sifted through a sieve (two to three millimeters) to produce a course flour. The mixture is then extruded with wet cooking at 150˚C to 160˚C. Wet cooking involves direct injection of water or steam into the product (Botswana DLG & MoH, 2001). This flour mixture should be cooked according to the packaging instructions and consumed cool (Botswana DLG & MoH, 2001).

During the development of Tsabana the nutritional adequacy of its micronutrient content was not fully ascertained. This is of great importance to support the nutritional provision of the product. Sorghum, being the main ingredient in the production of Tsabana, is low in protein and in amino acids like lysine. Soyabeans being high in protein and the amino acid lysine is mixed together with sorghum to complement the protein content of sorghum. The protein and lysine deficiencies in sorghum are thus overcome in the Tsabana product development by the addition of soyabeans. Although extrusion and other processing treatments are used to remove or destroy the antinutritional factors present in sorghum and soyabeans, it still makes a nutritional appraisal of Tsabana important, especially with regards to its micronutrient provision. A theoretical nutritional appraisal of Tsabana was therefore undertaken in particular regarding its trace element content and also fat inclusion as a macronutrient for the provision of the essential fatty acids (EFAs) as an initial verification measure before further measures such as a product nutrient composition analysis is undertaken.

1.2.2 Tsabana consumer acceptance and use

It is speculated that caregivers receiving Tsabana lack information on its nutrition and health benefits and use (e.g. why the product should be cooked for only 15 minutes in what quantities and how often infants should eat the product) or they may not understand the benefits. Lack of this information may promote inappropriate use of Tsabana; for example, caregivers cook the product longer (for 30 minutes or more) than the stipulated time. Prolonged cooking might affect some nutrients which are not heat resistant, e.g., vitamin C as well as all B-vitamins which are lost easily in cooking water. Folate levels will also decrease with prolonged heating. These nutrients are all needed by infants for growth and development (Williams, 1993:196). Prolonged cooking of Tsabana can also affect the palatability of the product because it tends to be very soft if cooked for too long. The product should still be a little gritty for infants to enjoy chewing while being fed and could impact the acceptability of the product.

To increase the palatability of the product, guidelines such as adding oil or margarine to the product are indicated on the product packaging which may not be affordable to families in the semi- or extremely rural districts. The addition of oil may not only be important for consumer acceptance of the product, but also for energy and fatty acid provision as no source of fat is incorporated in the Tsabana formulation.

The availability of the product may be a further impacting factor as it is not available in semi- or extremely rural districts at a close range. The traveling distance from the depot to the clinics may also impact consistent distribution and as a result supply. This may cause the clinics being without stock causing a shortage for those in need of the product.

1.3 Aims and objectives of the research

The aims of this study were firstly to theoretically appraise the nutritional adequacy of Tsabana, and secondly to determine its acceptance by six- to 36-month-old infants as perceived by their caregivers and the caregiver use in the rural villages of the Nhabe, Central, Kweneng and North East districts of Botswana. The majority of infants who are brought to the clinics to collect Tsabana fall within the age group of six to 36 months.

The specific objectives were:

- To determine if the energy, macro- and micronutrient composition of Tsabana meet the Codex Alimentarius Standard for processed cereal-based foods for infants and young children and the Proposed Nutrient Composition for Fortified Complementary Foods (PNCFCF).

- To determine the extent to which feeding Tsabana to six- to 36-month-old infants/children provides in the nutrient needs of these infants in comparison to the World Health Organization (WHO) recommended nutrient intakes.

- To determine the acceptance of Tsabana in terms of its sensory attributes (enjoyment, taste, colour and texture) by six- to 36-month-old infants/children in the rural villages of the Nhabe, Central, Kweneng and North East districts as perceived by their caregivers.

- To determine the product use, clinic-related and participant demographic factors that influence the caregiver perceived infant acceptance of Tsabana in terms of its sensory attributes.

- To determine how Tsabana is used in the field by the caregivers considering the preparation (ingredients and amount used), cooking (period), serving (temperature) the frequency of product use and the product amount provided and how this compares to the product use instructions on the packaging.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The weaning diet must supply adequate energy in the form of carbohydrate, protein and fat, along with adequate vitamins and minerals (Wardlaw & Insel, 2000:620), as the weaning period represents a stage of rapid growth and mental development of the infant. The most rapid growth of the brain, for instance, occurs from five months before birth to ten months after birth. At the end of the first year of life, the brain, being the first organ to attain full development, has achieved 70% of its adult weight (Wardlaw & Insel, 2000:620).

Protein energy malnutrition (PEM) is the continuum of the various levels of inadequate protein and energy intake between starvation (no food intake) and adequate nourishment. Although infants and children in developing countries of the African continent dramatically show this type of malnutrition, it can occur in persons of any age. Inadequate intake of food and consequently essential nutrients leads to undernutrition, resulting in inadequate physical growth and deterioration of health (FAO/WHO, 1998; USAID, 2002). In developing countries the high prevalence of undernutrition (PEM and micronutrient deficiencies) is most critical in the fetal and neonatal stages, as well as the under 5's (Sheikholeslam *et al*., 2004:737).

Micronutrients that are often deficient in the dietary intake of infants living in developing countries and which are essential to child growth and development are vitamin A, iron, zinc and folate with calcium and iodine also possibilities for deficiencies. The dietary intervention strategies available for curbing undernutrition, as well as micronutrient deficiencies, include adequate provision of complementary feeding, ensuring household dietary diversity and food security, provision of nutrition education especially to mothers and food fortification. Food fortification is the commonly used intervention strategy as in Botswana where Tsabana is provided. Cereals as the fundamental staple food of most developing countries are used as the preferred vehicles for food fortification with Tsabana containing sorghum as the staple food. Currently wheat flour, maize flour and rice and cooking staples, such as sugar and oil, are being used around the world as vehicles to improve vitamin and mineral health (Nemer *et al.*, 2001:37). For food fortification to be effective in alleviating micronutrient deficiencies,

nutrient bioavailability, as the degree to which food nutrients are available for absorption and utilization in the body must be considered. The forms of the micronutrients added must as a result be regarded in addition to the amounts added (Nemer *et al.*, 2001:37)

2.2 Weaning period and cereal weaning foods

Transition from breast-feeding by infants to complete reliance on other food or the time when an infant gradually goes from receiving breast milk exclusively to that of adult food is commonly defined as the weaning period (Ohiokpehai *et al*., 1994:206). Some authors indicate that weaning is a gradual introduction of food to an infant's diet so that he/she gets accustomed to food other than breast milk, not withstanding the fact that it is normally referred to as the cessation of breast-feeding (Grueger, 2013:1). This period lasts about 18 to 24 months so that mothers can gradually introduce weaning foods during this time. During the first six months of life, all nutrients required by an infant can be provided by breast milk. As a consequence there's no dietary need for the introduction of solid food to infants before then (WHOa, 2001).

At the age of six to 23 months, most infants need an adequate provision of additional foods besides for the provision of breastmilk. This it is the time of peak incidence of growth faltering, micronutrient deficiencies and infectious illnesses often attributed to an inadequate dietary provision (Dewey & Brown, 2003:25). The purpose of introducing solid foods to the infant diet is to therefore complement breast milk and to ensure continued provision of adequate nutrients as the young child needs to grow optimally. This goal is only achieved when these weaning foods are prepared and fed to infants under hygienic conditions and given in adequate proportions and combinations (Akaninwor & Okechukwu, 2004:15).

Local Botswana weaning foods are traditionally cereal porridges, but these can be improved nutritionally through fortification. Weaning food must adhere to the following nutritional requirements: high energy content; low viscosity, i.e., of an acceptable thickness/consistency; balanced proteins (containing all essential amino acids), vitamins (particularly A, D, folic acid and the B group) and minerals (mainly iron, zinc and calcium); no antinutritional components; affordable; and of safe microbiological quality (Ohiokpehai *et al*., 1994:204). According to Temesgen (2013:3) the compositional guidelines for weaning foods per dry weight are:

protein content at 20%, fat levels up to 10%, moisture content 5% to 10%, and total ash content not more than 5%.

Cereal proteins are limiting in the amino acid lysine. On the other hand pulses, e.g., beans, are rich in lysine and methionine. Therefore these two food sources complement each other. So most weaning mixes are made from cereals and pulses (Ohiokpehai *et al*., 1994:204). Processing of such weaning mixes improves the taste and nutrition, for example, through application of heating and fortification, respectively. Extrusion processing is used during the production of Tsabana. Soyabeans are added to sorghum and extruded, and then the blend is fortified with vitamins and minerals (Ohiokpehai *et al*., 1994:206). Such micronutrient fortified weaning foods are beneficial in infant diets to prevent micronutrient deficiencies that can result in undernutrition (Clausen *et al.*, 2005:88), particularly in developing countries like Botswana.

Inadequate nutrition at the weaning stage of life can be reflected by impaired physical and mental development and achievement in later life. In promoting the use and benefits of these manufactured micronutrient fortified weaning foods, continuous training and education of manufacturers, caregivers and the general public by trained experts is necessary (Ohiokpehai *et al*., 1994:206).

2.3 Child undernutrition

Malnutrition refers to the insufficient, excessive or imbalanced consumption of nutrients which also relates to its different prevalence forms. Malnutrition affects physical growth, cognitive development, reproduction, physical work capacity, and consequently impacts on human performance, morbidity and mortality. It is an underlying factor in many diseases for both children and adults, and it is particularly prevalent in developing countries, where it mostly affects preschool aged children. Factors that contribute to malnutrition are many and varied (Sharifzadeh *et al.,* 2010:436). According to Maruapula (1993:79) undernutrition, as reflected in insufficient dietary consumption in malnutrition, is the most prevalent public health problem in many developing countries, including Botswana. Undernutrition, measured or classified as weight-for-age (underweight) based on z-scores at ≤ 2 standard deviations, in the under 5's in Botswana was 15% in 1993 and 14.9% in 1999 (Tharakan & Suchindran, 1999:843).

Ruel (2008) indicated that micronutrient deficiency among children continues to be a serious nutritional concern in developing countries like Botswana, Ghana, Malawi, Zimbabwe and Tanzania, since the diets are usually cereal based which provide energy, with little diversity and minimal micronutrients. Drought periods which are regular occurrences in developing African countries, like Botswana, furthermore contribute to poor household food security and undernourished children (Maruapula, 1993:83). According to Maruapula (1993:84), clinic attendance rises considerably in Botswana, in such times. Households with under 5's would then be eligible for government welfare handouts, such as food baskets. The monthly child monitoring and clinic attendance decreases during normal agricultural years because of better household food security (Maruapula, 1993:84).

2.3.1 Protein energy malnutrition as representation of child undernutrition

PEM, 'the silent emergency of the world', is the most lethal form of malnutrition and in particular undernutrition. It is viewed as an imbalance between the supply and demand of energy and protein to ensure optimal growth and functioning of the body (FAO/WHO, 1998; USAID, 2002). Other sources view PEM as a consequence of chronic and cumulative failure to meet physiological and nutritional requirements (Guiro *et al.*, 1987:1071; Barners, 1989:176).

The most vulnerable victims of PEM and most susceptible to PEM's characteristic growth impairment are the under 5's because of their high energy and protein need and their vulnerability to infection (Sharifzadeh *et al.*, 2010:436). It is currently the most widespread and serious health problem of children in the world with the focus on its severe forms (FAO/WHO, 1998; USAID, 2002). PEM is self-perpetuating within the poor population and economically struggling nations (see Table 2.1) and must be clearly demarcated from generalized famine following disasters such as warfare, droughts, floods or earthquakes. Its peak incidence is immediately after epidemics or infections, illness and diarrhoea. In any country, the prevalence rates will be influenced by season, the availability of food, incidence of infection and the state of development of the health services (Sharifzadeh *et al.*, 2010:436).

Table 2.1: Prevalence of protein energy malnutrition among children under five years of age in developing regions, 1995 (obtained from Müller & Krawinkel, 2005:280)			
Developing region	**Prevalence of protein energy malnutrition**		
	Underweight (%)[a]	**Stunting (%)[b]**	**Wasting (%)[c]**
Africa	28	39	8
Asia	35	41	10
Latin America and Caribbean	10	18	3

[a] Low weight-for-age (Z scores <-2 SD)

[b] Low height-for-age (Z score <-2 SD)

[c] Low weight-for-height (Z score <-2 SD)

< = below; SD = standard deviation

2.3.2 Causes of child undernutrition

The United Nations International Children's Emergency Fund (UNICEF) conceptual framework of child malnutrition (Figure 2.1) shows the causes related to malnutrition with reference to undernutrition. To prevent or treat the different forms of malnutrition the factors causing the condition need to be evaluated. The different causes are interlinked and include immediate, underlying and basic causes (UNICEF, 2004). All factors operate together and not independently (Williams, 2005:405). UNICEF (2004) indicates the immediate causes of childhood undernutrition as insufficient dietary intake in addition to stress and trauma from poor psychosocial care and disease (as severe or frequent infections).

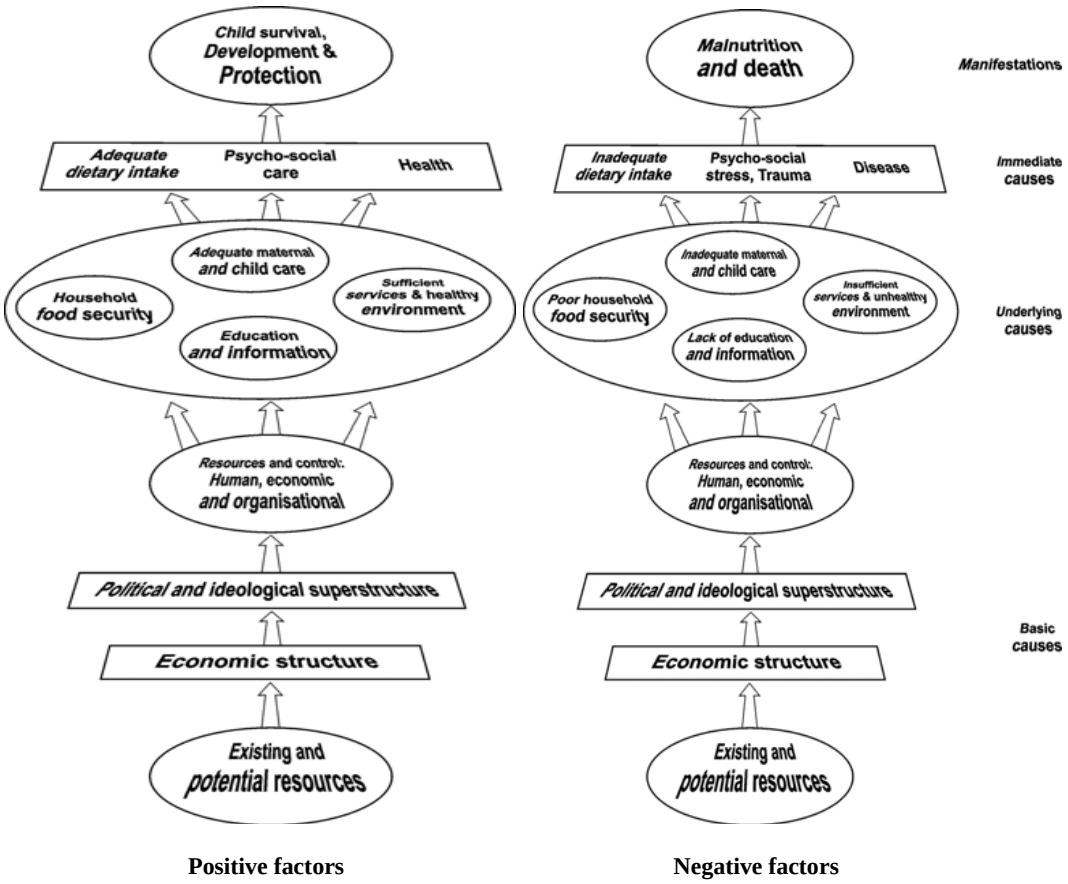


Figure 2.1: United Nations International Children's Emergency Fund (UNICEF) conceptual framework of the causes of malnutrition (positive/negative) (obtained from UNICEF, 2004)

a. Inadequate dietary intake

Insufficient dietary intake may refer to poor breast-feeding practices, early weaning or delayed introduction of solid foods to infant diets resulting in insufficient protein and energy along with other nutrients in the diet. Malnutrition develops when the food ingested does not meet the nutritional needs, in particular the protein and energy needs, of the child (UNICEF, 2004; Williams, 2005:405; Piercecchi-Marti *et al*., 2006:671). Even though breast milk is rich in high quality protein, prolonged exclusive breast-feeding causes a delay in introducing weaning foods which can result in micronutrient deficiencies as human milk is low in iron and zinc contents (Kalanda *et al*., 2006:403).

Other factors leading to low energy and protein intakes and nutrient deficiencies seen in children with the delay in giving children family foods are the increased use of diluted cow's milk and vegetable foods (Torún & Chew, 1994:952). Inadequate food intake can also be linked to child neglect and abuse (UNICEF, 2004; Williams, 2005:405).

Further factors contributing to the development of PEM I particular in the African context include cultural and social practices that lead to the exclusion of certain foods due to food and dietary fads (preference for alternative foods) and migration from rural areas to urban slums (Torún & Chew, 1994:951; Piercecchi-Marti *et al*., 2006:671; Torún, 2006:882). Food taboos and ignorance in Africa, especially in West Africa, can result in weaning foods of poor nutritional quality (Ojofeitimi *et al*., 2003:24). In a study that was conducted in two villages in Nigeria, 22.5% of mothers indicated that there were cultural food taboos related to complementary foods in their villages and households. Children were not given eggs, meat and fish because it was believed that they will grow up to be thieves (Ojofeitimi *et al*., 2003:24). Dietary choices are also influenced by parents' nutritional ignorance and true or perceived food allergies (Katz *et al*., 2005:69). Other factors that influence food intake include health status, growth and personal choice related to diet (Vorster & Hautvast, 2002:6)

When income decreases, the quality and quantity of food also decreases. Consistent evidence supports theory that when unemployment and low wages are presenting factors, families eat cheaper food, which is less nutritious, leading to weight loss and malnutrition (UNICEF, 2009a). As food products derived from animals are usually more expensive, children's intake of proteins and nutrients from these foods decrease with poverty (Christiaensen & Alderman, 2001).

b. Disease

Malnutrition and infection increase child mortality rates due to their synergy. Poor food intake linked with loss of nutrients from vomiting, diarrhoea, malabsorption and fever, all lead to nutritional deficiencies. These have serious consequences for the growth and immune system of infants and children. Infections can cause undernutrition by decreasing food intake, impairing nutrient absorption, increasing metabolic requirements, and by direct nutrient loss. Thus, a child whose immune system is already suppressed becomes vulnerable to infection and is caught up in a vicious cycle of malnutrition and infection (Nemer *et al.*, 2001:5).

Most deaths of children aged six to 24 months are related to malnutrition and infection (Torún, 2006:882). Inadequate dietary intake and poor nutritional status go hand in hand. It is uncommon for well nourished children to die from diarrhoea. Therefore maintaining a good

nutritional status can help with the improvement of child survival (Jackson *et al*., 2006:708). Caulfield *et al*. (2004:193) reported that the principal causes of deaths in young children globally in 2004 were: diarrhoea (60.7%), pneumonia (52.3%), measles (44.8%) and malaria (57.3%). All these diseases also worsen nutritional status. Some additional causes associated with child mortality indicated by Müller and Krawinkel (2005:282) and UNICEF (2009b) include prenatal causes and acute respiratory infections. It takes time for a malnourished child to recover from respiratory and diarrhoeal diseases and therefore the risk of morbidity and mortality is higher. Repeated illnesses contribute to ill health and compromised nutritional status (Pereira, 1991:143).

i. Diarrhoea

Diarrhoea tends to be more severe and lasts longer in poorly nourished children for whom the mortality rate is also higher. The mortality of malnutrition is increased with all types of diarrhoea, but appears to be highest for persistent diarrhoea (Nemer *et al.,* 2001:8). Malnutrition presents a challenge to Botswana where about 470 malnourished children died in 2006 during a diarrhoea outbreak where children were nof breastfed and the outbreak appeared to be more associated with bottle feeding (BCSO, 2000).

ii. Acute respiratory infections

There is a two to three-fold increased risk of death from lower respiratory infections and pneumonia in poorly nourished children, regardless of the organism causing the infection (Nemer *et al.*, 2001:8).

iii. Malaria

Relatively few studies have reported on the nutritional status of children with malaria, but the ones that have been published suggest a higher risk of death for malnourished children (Nemer *et al.*, 2001:8).

iv. Measles

The evidence for an effect of malnutrition on death from measles is unclear. Hospital-based studies have reported a relationship, but this is not supported by community-based studies. This is consistent with previous work that has pointed to other factors, such as overcrowding, intensity of exposure and patterns of disease transmission, as more important risk factors for measles related mortality (Aaby, 1991:478).

v. Human Immune Deficiency Virus/Acquired Immune Deficiency Syndrome

An important area of research is the contribution of malnutrition to Human Immune Deficiency Virus/Acquired Immune Deficiency Syndrome (HIV/AIDS) mortality as nutritional status appears to affect HIV-related disease progression and mortality (Piwoz & Preble, 2000:27). A review by Piwoz and Preble (2000:27) examined preliminary evidence that improving nutritional status may improve some HIV-related outcomes. Studies found that low blood levels of several nutrients, specifically micronutrients such as vitamins A, C, E and the B-complex and low haemoglobin, were associated with faster HIV disease progression and reduced survival on controlling for various conditions such as antiretroviral use, dietary intake, and CD4 cell count, an indicator of HIV disease progression (Piwoz & Preble, 2000:27). Several reviews have been published on the role of micronutrients in HIV disease progression and mortality. These reviews concluded that micronutrient deficiencies associated with HIV vary across populations according to the disease stage, are associated with an accelerated progression of HIV infection to AIDS and are predictive of AIDS-related mortality (Friis & Michaelsen, 1998:159).

In 2005, the national adult HIV prevalence exceeded 15% in eight countries of the Southern Africa sub-region of Sub-Saharan Africa, namely Botswana, Lesotho, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe (NACA, 2008:9). Botswana has been hard hit by HIV/AIDS. In 2009 an estimated 300 000 adults lived with HIV or one quarter of the population aged 15 years and over. Considering that Botswana has a population of under two million, the epidemic has reached disturbing proportions. The country has an estimated adult HIV prevalence among 15- to 49-year-olds of 24.8%, the second highest in the world after Swaziland (UNAIDS, 2010).

The percentage of HIV positive pregnant women attending antenatal clinics in Botswana has remained steady since 2005, at around 33%. In the absence of any interventions, around a third of babies born to HIV-positive mothers will thus become infected with HIV during pregnancy and delivery or through breast-feeding. This rate can be reduced substantially through the use of antiretroviral treatment and safer feeding practices (NACA, 2008:9).

A prevention of mother-to-child transmission (PMTCT) program was the first program to distribute antiretroviral drugs in Botswana (Beck *et al.*, 2008). When the initial participation of women in the PMTCT program was low, the Government initiated training and recruitment programs for PMTCT counsellors, and later with routine HIV testing of all pregnant women. HIV positive mothers who choose to avoid breast-feeding are given a year's free supply of infant formula (Rollnick, 2002:4).

2.3.3 Types of child undernutrition

Globally, malnutrition in its undernourished form is a risk factor for illness and death, with millions of pregnant women and young children being affected due to infections and a poor and inadequate diet. Undernutrition, however, increases the risk and worsens the severity of infections (Müller & Krawinkel, 2005:282). Infants and young children are most affected by undernutrition as they have increased nutritional needs to support growth (Torún & Chew, 1994:952; Torún, 2006:883). Undernourished children thus have a higher risk of dying than children with an optimal nutritional status. The three types of undernourishment related malnutrition are underweight, stunting and wasting (Caulfield *et al*., 2004:193).

a. Underweight

Low weight-for-age is an indicator of undernutrition (Duggan & Golden, 2006:519).The underweight child is a common presentation of PEM (Wittenberg, 2004:203). When a diet is chronically insufficient in protein and/or energy there will be a slowing down of linear height (stunting), with failure to gain weight or weight loss (Wittenberg, 2004:203), which is quickly seen when the child is exposed to an acute food shortage (Golden & Golden, 2000:517). Underweight children must be identified early through regular growth monitoring of particularly their weight and in addition their height (Wittenberg, 2004:204; UNICEF, 2009a:13). Underweight children are also in danger of becoming severely malnourished. If

their nutritional status gets worse, or if they contract diarrhoea, or some other infection, they become so malnourished that they are at risk of the malnutrition conditions kwashiorkor or marasmus. They may die as a result of kwashiorkor or marasmus. The underweight child is thus always in danger (King *et al*., 1972:116).

Consistent reports on malnutrition (Tharakan & Suchindran, 1999:843; BCSO, 2000) for children six to 24 months indicate that in Botswana this age group is a concern. Many of these children are born adequately nourished, but begin to deteriorate in growth after six months of age. In support of this observation is the relatively low rate of low birth weight in Botswana compared to other countries in the Southern Africa region. Low birth weight is an indicator that is used to assess child malnutrition at birth. Observations from several studies in Botswana estimate that the prevalence of low birth weight ranges from 8% (BCSO, 2000) to about 13% (BCSO, 2009). Despite the fact that there has been an increase in the prevalence of low birth weight, the prevalence of low birth weight in Botswana has remained lower than that reported for Africa (14%), Sub-Saharan Africa (15%), developing countries (16%) and the least developed countries (17%) (UNICEF, 2009c:11).

b. Stunting

Stunting is an indicator of longer term nutritional status or deficiencies (Shetty, 2002:321; UNICEF, 2009c:11) and indicated by low height-for-age (Duggan & Golden, 2006:519). Stunting is also referred to as ‘failure to thrive’ or ‘growth faltering’ which indicates inadequate growth or slow height (and weight) gain in the infant and young child (Müller & Krawinkel, 2005:280; Williams, 2005:404; Duggan & Golden, 2006:519). It is an illness that occurs during times of rapid growth and development and is usually observed in infants and children younger than five years (UNICEF, 2009c:11). Stunting is an indication of chronic malnutrition and long-term insufficient diet because of a chronic energy deficiency (Duggan & Golden, 2005:519; Müller & Krawinkel, 2005:280; Williams, 2005:404) and the first clinical sign of more severe malnutrition (Piercecchi-Marti *et al*., 2006:671). As stunting is due to long-term undernutrition, it takes time to develop and for recovery. This ‘nutritional’ growth faltering is not only due to underfeeding, but may also occur due to infection (Golden & Golden, 2000:517), psychological turmoil, socio-economic deprivation or underlying illnesses (Williams, 2005:401).

c. Wasting

Wasting is indicated by a low weight-for-height, occurring at any age (Shetty, 2002:321) and is used as an indicator for identifying severe acute malnutrition (UNICEF, 2009c:13). Growth failure in wasting is marked by both 'thinness and shortness' (Golden & Golden, 2000:517). Inadequate food intake leads to weight loss and growth retardation and when it is prolonged it leads to body wasting and emaciation (Torún & Chew, 1994:950; Torún, 2006:881). When growth is acutely affected the child falls behind one who is actively growing (Golden & Golden, 2000:517), with a body weight and height less than optimal for the child's age (Shetty, 2002:321). 'Clinical wasting' is the term used to describe recent severe fat loss due to illness or severe food restriction (Duggan & Golden, 2006:519).

2.3.4 Prevalence and global perspective of child undernutrition

In many developing countries, only about seven out of ten children who are born live to reach their fifth birthday. The three children in every ten who die, mostly do so some soon after birth. Many die because they are underweight and malnourished or because diseases like measles can cause their demise when they are underweight. Of the seven children who live, three may have been undernourished at some time before they are five years old, and they may not grow up with the mental development and achievement they might have obtained being well nourished (Kar *et al*., 2008:31). The prevalence of underweight in Botswana is 14.9% (Tharakan & Suchindran, 1999:843). In South Africa, undernutrition is mainly prevalent amongst Black, Coloured and Asian children and especially in the lower socio-economic communities (Krige & Senekal, 1997:14).

Stunting affects about 195 million children younger than five years in the developing world, and about one in three children in Africa (UNICEF, 2009c:15). The incidence of stunting in some places, such as parts of India, is between 50% and 60 % (Mother and Child Nutrition, 2007). The prevalence in the developing world has been declining from 40% in 1990 to 29% in 2008. The decline was small in Africa and went from 38% in 1990 to 34% in 2008. This was due to the population growth of children younger than five years. Those with stunting actually increased from 43 million in 1990 to 52 million in 2008 (UNICEF, 2009c:15). In Botswana there is a 29.6% stunting prevalence among children (Tharakan & Suchindran, 1999:843). The South African National Food Consumption Survey (NFCS) of 1999 (South

Africa. Department of Health, 2006:3) revealed that stunting is a major problem in South Africa that affects children between the ages of one and nine years with a prevalence of 21.6%. Children living on commercial farms and in tribal and rural areas were the most severely affected. Children in rural communities are thus at a greater risk of becoming stunted (low height-for-age) than children living in urban areas. Children living in informal housing had the highest prevalence of stunting and the lowest was seen in children whose mothers are well educated.

A child is wasted when the weight-for-height is less than 70% of the median (Williams, 2005:406). Of the children younger than five years old in the developing countries, 13% are wasted and 5% are severely wasted (about 26 million). Africa and Asia are the two continents with high rates of wasting that exceeds 15%. Out of 134 countries, 32 of these countries have a wasting prevalence of 10% or more. Ten countries are contributing to about 60% of all wasted children. In South Africa the prevalence of wasting is 5% to 9.9% (UNICEF, 2009b) and in Botswana the prevalence of wasting is 7.1% (Tharakan & Suchindran, 1999:843).

In 1990 an estimated one out of three children (177 million) younger than five years in the developing world were or had been malnourished at one stage in their lives. The estimation was based on a height-for-age below two standard deviations (SD) of the National Centre for Health Statistics (NCHS) median. In countries where the prevalence of malnutrition is high, the total number of malnourished children has also not decreased with an increase in population size (Torún & Chew, 1994:951). Ayaya *et al*. (2004:417) stated that malnutrition is still one of the leading causes of morbidity and mortality in under 5's and according to Kilic *et al.* (2004:383) severe PEM still affects two to three percent of the pediatric population worldwide.

The State of the World's Children report published by the UNICEF in 1998 stated that malnutrition is a 'silent emergency' leading to almost seven million child deaths (approximately 55% of all child deaths) annually. Three quarters of children dying are mildly to moderately malnourished with no obvious outward signs of problems (Jones, 1998:634). In 2000 to 2002 an estimated 852 million children were malnourished, of which approximately 815 million were in developing countries (Müller & Krawinkel, 2005:279) (see Table 2.2) and 34 million in developed countries (Vorster & Hautvast, 2002:4). During 2000 to 2002 malnutrition was directly responsible for about 300 000 deaths per year and indirectly for

about half of all deaths in young children (Müller & Krawinkel, 2005:279). In 2004 an estimated 55% of child deaths worldwide were the result of undernutrition (Caulfield *et al*., 2004:195).

Table 2.2: Estimated prevalence of undernourished children in developing countries by region in the year 2000 (obtained from Shetty, 2002:321)

Region	**Prevalence of child undernutrition**	
	Underweight (%)[a]	**Stunting (%)[b]**
Africa	28.5	35.2
Asia	29.0	34.4
Latin America and Caribbean	6.3	12.6

[a] Low weight-for-age (Z scores <-2 SD)

[b] Low height-for-age (Z score <-2 SD)

< = below; SD = standard deviation

2.4 Nutritional needs of infants and young children

During childhood the demand for energy is relatively high because it is the initial years of growth and development with rapid growth velocity. Protein provides the building material for tissue growth, while vitamins and minerals are essential for tissue maintenance and overall energy metabolism that also requires adequate energy provision (Escott-Stump, 2012:919).

2.4.1 Energy

Infant growth depends on the provision of adequate energy for tissue building and energy expenditure. The total energy content of the infant's diet must be maintained within controlled limits. Insufficient energy intake could lead to failure to thrive, whereas an energy intake in excess of requirements may lead to obesity. The 'energy density' (amount of energy in a given quantity of food) is therefore important (IOM, 2010).

The energy requirement for a 12-month-old infant weighing 10 kilogram (kg) is about 4 000 kilojoules (kJ) per day. Such an infant would therefore need 200 gram (g) to 400 g of cereal per day just to meet the energy needs (Friis & Michaelsen, 1998:159). Nutrient inadequacies are made worse by infants receiving a very low number of feedings per day (Gibson *et al*.,

1998:764). Various energy rich foods such as sugar, margarine or peanut butter are added to infant porridge, thereby increasing the energy content. Although the provision of household complementary food increase the energy intake, the nutrient density of the household complementary food is still low (Faber, 2004:379).

2.4.2 Macronutrients

Macronutrients (carbohydrates, proteins and fats and oils) are referred to as those nutrients which the body requires in large amounts for the formation of body tissues and to regulate all body processes (NRC, 2008:1760).

a. Carbohydrates

The main source of energy is carbohydrates which must be provided sufficiently to help prevent malnutrition. Excess carbohydrate is usually converted to glycogen and fat and stored in the body for further utilization (Whitney *et al*., 2002:71). Consuming carbohydrates is essential for physical activity, maintenance of the body temperature and internal physiological processes (Arimond & Ruel, 2004:20). A balanced diet should provide at least 55% of the energy provision as carbohydrates (NRC, 2008:1760). The type of carbohydrate that is included in the food is also important, as babies need carbohydrate that is easily digestible (Barners, 1989:173). Good sources of carbohydrates as staple foods in the infant diet are mainly foods of plant origin, such as cereals, rice, bread, sorghum, millet, maize, oats, beans, peas and potatoes (FAO, 1998).

b. Proteins and essential amino acids

Protein is a major component of most body cells and contributes to the formation of muscle, skin, hair, blood and blood clotting factors, antibodies, enzymes, vision and cell growth (Wardlaw & Insel, 1996:131). Protein intake is one of the key elements in preventing PEM which is caused by lack of both proteins and carbohydrates (Wardlaw & Insel, 1996:131). Dietary diversity relates primarily to the intake of protein from animal sources, which are considered to be of high quality, compared to plant protein which lacks some of the essential amino acids (Swindale & Bilinsky, 2006). Nine of the 20 amino acids are essential amino acids because they are the only ones the human body cannot make. They are important in

genetic and metabolic conditions and used in special amino acid products for the treatment of liver diseases or kidney failure. They also reduce muscle breakdown and speed recovery of hospitalized patients stressed by severe illness and injury (Escott-Stump, 2012:922).

Breast milk and infant formulas provide sufficient protein to meet infants' needs if consumed in amounts necessary to meet energy needs. In later infancy, sources of protein in addition to breast milk and infant formula include meat, poultry, fish, egg yolks, cheese, yogurt, legumes and cereals and other grain products. Protein in animal foods contains sufficient amounts of all the essential amino acids needed to meet protein requirements. In comparison, plant foods contain low levels of one or more of the essential amino acids. However, when plant foods low in one essential amino acid are eaten with animal foods or other plant foods that are high in that amino acid, e.g., legumes such as pureed kidney beans (low in methionine and high in lysine) and grain products such as mashed rice (high methionine and low in lysine), sufficient amounts of all the essential amino acids are made available to the infant body. Thus, plant foods, in appropriate amounts and combinations are able to supply the essential nutrients required for maintenance of adequate health and body function. A combination of soy protein, which is high in lysine, with a cereal that contains a relatively good concentration of other amino acids results in a nutritional complementation with the protein quality of the mixture greater than that for either protein source alone (Young & Pellett, 1994:1208S).

c. Fats and essential fatty acids

A balanced diet requires that fats should contribute at most 30% of total energy intake per day, and should be consumed in small amounts since they constitute a concentrated source of energy (NRC, 2008:1761). One g of fat provides 38 kJ compared to one g of carbohydrates or protein which provide 17 kJ (NRC, 2008). Fats enhance the taste and acceptability of foods, with lipid components determining in large part the texture, flavour and aroma of foods. In addition, fats slow gastric emptying and intestinal motility, thereby affecting satiety (Uauy & Dangour, 2009:76). Dietary lipids provide EFAs and facilitate the absorption of lipid-soluble vitamins. Lipids are a major energy source in the infant diet and are therefore necessary for normal growth and physical activity. Fat also constitutes the major energy store in the body; the energy content of adipose tissue on a wet weight basis is seven- to eight-fold higher than that of tissue containing glycogen or protein (Uauy & Dangour, 2009:76).

Sources of fats and oils should mainly be of plant origin such as sunflower oil, peanut oil and olive oil for the provision of EFAs (Whitney *et al*., 2002:55). The selection of fat sources for infant complementary foods must consider the safety of fat sources and not only the level of fat absorption. This is especially relevant for developing countries where fats included in foods given to young children are low-cost oils or by-products of industrial processing. Since fats are structural components of tissues, especially neural tissues, omega (n-3) and omega (n-6) fatty acids must be provided by the diet (Uauy & Dangour, 2009:90).

Two families of fats, the n-3 family and the n-6 family, are vital for people of all ages, including infants (Morris, 2004:86). The n-3 fatty acid alpha linolenic acid (ALA) and n-6 fatty acid linoleic acid (LA) cannot be manufactured by the human body and must be obtained through the diet and are therefore termed EFAs (Pavlovski, 2009:910). ALA is the parent compound of the n-3 family. The human body can convert ALA in a limited extent to the long-chain n-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA). ALA is the main n-3 fatty acid in human breast milk. Another unique role for ALA in infant nutrition is to prevent an n-3 fatty acid deficiency. During pregnancy the maternal diet should include marine sources to provide for n-3 and after birth infants should obtain their n-3 and n-6 fatty acids from breast milk or infant formula (Morris, 2005:86).

An increasing number of newborn infants are developing marginal and aggressive forms of EFA deficiency. Detecting and correcting these imbalances early will reduce, or reverse the incidence of many infantile and childhood diseases (Pavlovski, 2009:910). EFAs are in particular related to neural function and cognitive development and are essential for brain development in infants (Pavlovski, 2009:910). DHA makes up 97% of the fatty acid content of the human brain (Bailes & Mills, 2010:1617).

The dietary advice for children should be consistent with advice for the adult population: an intake of EFAs equivalent to one to two fatty fish meals per week or approximately 500 milligram (mg) of EFAs per day in order to reduce cardiovascular risk. Promoting this intake in children should also be compatible with an adequate n-3 supply during pregnancy and lactation. Children aged two to 18 months in a family setting form part of the household and could thus consume at least one to two meals of fatty fish per week, which is recommended for the adult population (Kris-Etherton & Innis, 2007:1599).

2.4.3 Micronutrients

Micronutrients refer to the essential nutrients (vitamins and minerals) required by human beings which is usually required in small quantities for infants and young children (see Table 2.3) to stimulate growth, development and maintenance of body cells and tissues (FAO, 1998; Kennedy *et al*., 2003:8).

Table 2.3: Recommended micronutrient intakes for infants and young children[a]

Micronutrients	**Recommended intake per day**	
	Infants (7 - 12 months)	**Young children (1 – 3 years)**
Vitamin A (ug[b] Retinol Equivalents)	500	300
Folic acid (ug)	80	150
Iron (mg)[c]	11	7
Calcium (mg)	270	500
Zinc (mg)	3	3
Selenium (ug)	20	20
Copper (ug)	220	340
Iodine (ug)	130	90

[a] Obtained from National Academies Press, 2001

[b] ug = micrograms

[c] mg = milligrams

According to Clausen *et al*. (2005:89) micronutrient malnutrition remains one of the largest nutritional problems worldwide, affecting people in both developed and developing countries. Micronutrients are essential in the diets of young children to prevent nutrient deficiency diseases and malnutrition (IYCFC, 2006:3). The micronutrients contained in the diet of young children are often inadequate to meet their nutritional needs, resulting in micronutrient deficiencies (NRC, 2008:1761). Micronutrient deficiencies are most prevalent in areas where the diet lacks variety, commonly in developing countries. When people cannot afford to diversify their diets with adequate amounts of fruit, vegetables and animal-source foods that contain large amounts of micronutrients, deficiencies are likely to occur. In addition a minimum amount of fat or vegetable oil is required in the diet for adequate absorption of the fat-soluble vitamins A, D, E and K (Kennedy *et al*., 2003:8).

Micronutrient deficiencies affect about two billion people in the world. Vitamin A, iron and folate are often deficient in developing countries (FAO, 1998). Globally 740 million people are deficient in iodine of which 300 million live with goitre and 20 million with brain damage

from maternal iodine deficiency and/or during their foetal development. About two billion people are deficient in zinc and one billion have iron deficiency anaemia (Müller & Krawinkel, 2005:283). Only some of the most generally mentioned micronutrients needed by infants and young children are addressed below.

a. Vitamin A

Globally, vitamin A remains the most important and preventable cause of early blindness (Williams, 2005:60) as vitamin A is required for good eye sight/vision and assist to maintain the health of the immune system (Müller & Krawinkel, 2005:282). Human milk is an important source of vitamin A and can meet a large proportion of the needs of infants and young children (presented in Table 2.3). Non-breastfed children who do not receive vitamin A from animal source foods such as meats, liver, fish oils, egg yolk and whole milk may not receive sufficient vitamin A (Lutter & Dewey, 2003:3016S). Vitamin A deficiency can interfere with ocular function, impaired growth and reproduction as well as increased morbidity and mortality as a result of respiratory and diarrhoeal disease (Nemer *et al*., 2001:12). Vitamin A deficiency also contributes to the development of anaemia (Müller & Krawinkel, 2005:282). The age group at highest risk for vitamin A deficiency is children from six months to six years since during the complementary feeding period the child moves from a diet based on breast milk to one based on cereals and possibly not that varied (Nemer *et al*., 2001:11).

The term vitamin A includes carotenoids that are dietary precursors of retinol. Carotenoids are polyisoprenoids, of which more than 600 forms exist (Azais-Braesco & Pascal, 2000:1326S). The most common and available are the three forms α-carotene, β-carotene and β-cryptoxanthin. Carotenoids are solubilized into micelles in the intestinal lumen from which they are then absorbed into the duodenal mucosal cells by a passive diffusion mechanism. Carotenoids, especially non-synthetic β-carotenes are not toxic even at the high levels of intake unlike preformed vitamin A. However, the absorption efficiency decreases as the amount of dietary carotenoids increases, so it is always advisable to take appropriate amounts. Synthetic β-carotenes were used in some epidemiological studies and were shown to be toxic in high doses. Too much preformed vitamin A tends to interfere with the beneficial action of vitamin D in the body (Azais-Braesco & Pascal, 2000:1327S).

The protective qualities of α-carotene, β-carotene and β-cryptoxanthin are mostly attributed to their ability to convert to vitamin A. They are found in plant foods such as spinach, pumpkin, squash, carrots, mango, papaya and apricots (WHO/FAO, 1998). These three carotenoids are extensively researched for their application in supporting the immune system, in cardiovascular diseases, cataracts and macular degeneration of the eyes (Azais-Braesco & Pascal, 2000:1328S). In 2005 about 250 million people, mainly young children and pregnant women in developing countries, still had vitamin A deficiency (Müller & Krawinkel, 2005:282). In 2007 the prevalence of vitamin A deficiency was about 25% among pre-school children in South Africa (Mother and Child Nutrition, 2007). In 2005 the prevalence of vitamin A deficiency in Botswana was about 26% among pre-school children and 19% among pregnant women. Alpha- and β-carotenes are safe to use during pregnancy, while vitamin A supplements are not (WHO, 2009).

b. Folic acid

Folic acid aids in normal growth of cells, which is especially important in infants and children. Folic acid is a water-soluble vitamin necessary for the synthesis of nitrogen containing compounds which are essential for the biosynthesis of nucleotides, the building blocks of deoxyribonucleic acid (DNA) and ribonucleic acid (RNA) (WHO/FAO, 1998). It is thus a key substance in cell growth and reproduction through aiding the formation of nucleoproteins and haemoglobin. A form of anaemia, nutritional megaloblastic anaemia, occurs during folate deficiency. Since tissue growth requires additional folate, folate deficiency and its resulting anaemia is a risk in growing infants and young children. Folic acid deficiency anaemia most commonly occurs in infants and results in a decrease in red blood cell production. Infants who have a folic acid deficiency may show signs of chronic fatigue, palpitations, weakness, nausea, low body weight, headache, fainting, irritability and yellowing of the skin. Green leafy vegetables, citrus fruit juices, legumes and fortified cereals are good food sources of folate to supply in the nutritional need of infants and young children (presented in Table 2.3). Folic acid provided through synthetic folic acid (pteroylmonoglutamate) appears to be highly bioavailable (WHO/FAO, 1998).

c. Iron

Iron is an essential part of haemoglobin, myoglobin and various enzymes. Iron deficiency is the main cause of microcytic anaemia, which lead to adverse health effects (Müller & Krawinkel, 2005:4). The symptoms are mainly fatique, impaired cognitive development, reduced growth and physical strength (Müller & Krawinkel, 2005:282). Causes of iron deficiency in the infant are low birth weight, early introduction of whole cow's milk, vegetarian weaning as well as low socio economic surroundings which impair the dietary provision (Williams, 2005:408). Iron deficiency is common in the first year of life, where the main food is milk, especially formula and cow's milk which are low in iron (Wittenberg, 2004:210).

Thirty seven percent of the world's populations suffer from iron deficiency anaemia (Mother and Child Nutrition, 2007). Globally about 25% of pre-school children are deficient in iron while the proportion of children in Africa with iron deficiency anaemia is 68% (UNICEF, 2009c:210). The estimated prevalence of anaemia in children younger than four years in developing countries is 46% to 66%, half of which are thought to be iron deficiency anaemia (Stoltzfus *et al.*, 2005:145).

Iron differs from other minerals because iron balance in the human body is regulated by absorption only because there is no physiological mechanism for excretion. Close to 90% of daily iron needs are obtained from endogenous sources, namely the breakdown of circulating red cells. There are two types of exogenous dietary iron sources, namely non-haeme iron which is present in both plant foods and animal tissues and haeme iron which comes from haemoglobin and myoglobin in animal food sources (Hurrel & Engli, 2010:1461S). Plant sources of iron include spinach and beetroot, while animal food sources include meat, liver, fish and seafood (WHO/FAO, 1998). The iron need of infants and young children is presented in Table 2.3.

Haeme iron, because of its higher and more uniform absorption, is estimated to contribute 40% and more of the total absorbed iron. It is highly bioavailable and little affected by dietary factors (National Academies Press, 2001:292). Dietary factors such as phytates in plant-based diets, polyphenols in beverages (tea, coffee and wine), vegetables, fruit and legumes, calcium, ascorbic acid and animal protein (milk and egg proteins) have been reported to influence iron

absorption (Hurrel & Engli, 2010:1461S). The consumption of tea was a frequent practice among children in Mongolia and Cambodia (Anderson *et al*., 2008:148). Polyphenols in tea are likely to have an adverse effect on non-haeme iron absorption particularly in complementary diets such as that provided by Mongolia because of the low content of ascorbic acid and animal protein, the two enhancers of non-haeme iron absorption (Lander *et al*., 2010:1304).

d. Calcium

Of all the minerals in the body, calcium is present in the largest amount accounting for up to two percent of the total body weight (Williams, 1993:221; Gross, 1999:7). Most of the body calcium (99%) is in the bones and teeth with the metabolic function being to build and maintain skeletal tissue by developing cartilage into bone. Calcium is one of the most important elements in the diet because it is a structural component of bones, teeth, and soft tissues and is essential in many of the body's metabolic processes. The individual impact of calcium is on bone development in children and its rate of deposition in the skeleton is highest in newborn infants, decreasing to a very low level by the time people have stopped growing (Gross, 1999:7; Bronner & Pansu, 1998:10). Calcium deficiency is recognized as a major contributor to rickets in children in Africa. Rickets and poor bone mineralization subsequently appear during the first years of life. The fetus is relatively protected from maternal calcium deficiency, but calcium deficiency rickets can result from low intakes in children (Thacher *et al*., 2006:3) (see Table 2.3 for the calcium need of infants and young children). On the cellular level, calcium is used to regulate the permeability and electrical properties of biological membranes (such as cell walls), which in turn control muscle and nerve functions, glandular secretions, and blood vessel dilation and contraction. Calcium is also essential for proper blood clotting. Children absorb a higher percentage of their ingested calcium than adults because their needs during growth spurts may be two or three times greater per body weight than adults (Gross, 1999:7).

e. Zinc

Zinc functions mainly as an essential constituent of cell enzyme systems and has a key role in protein digestion (Williams, 1993:253). A zinc deficiency can interfere with a variety of biological functions, such as gene expression, protein synthesis, skeletal growth, immunity

and appetite (Müller & Krawinkel, 2005:282). Zinc deficiency is estimated to affect a third of the world's population, and is the fifth leading risk factor for illness and disease in developing countries (IZNCG, 2004:149S). Globally, severe, prolonged episodes of diarrhoea are often the cause of zinc deficiency. Signs of deficiency in this situation include failure to thrive and a classical skin rash (Williams, 2005:410). A low weight-for-age is associated with micronutrient deficiency and zinc deficiency contributes to growth retardation in young children (Caulfield *et al.*, 2004:195). Human milk contains high levels of bioavailable zinc, but the content decreases over the first six months of lactation. Late (after three to four months of age) zinc deficiency can occur if extremely low birth weight (less than one kg) preterm infants are fed human milk (Müller & Krawinkel, 2005:282). Good dietary sources of zinc to meet the nutritional need of infants and young children (see Table 2.3) are lean red meat, whole grain cereals, pulses and legumes (WHO/FAO, 1998).

f. Selenium

Selenium is an essential trace mineral of fundamental importance to human health. As a constituent of selenoproteins, selenium has structural and enzymatic roles as antioxidant being a protective agent against heavy metal toxicity and diseases such as cancer and cardiovascular disorders (Rayman, 2000:233). For infants and children, however, the core of selenium-providing foods may be much smaller than for adults, considering their unvaried diet. Therefore, selenium should be added to infant milk formula in order to prevent a lack of selenium. Numerous studies suggest that deficiency of selenium is accompanied by loss of immunocompetence, probably not unconnected with the fact that selenium is normally found in significant amounts in immune tissues such as the liver, spleen, and lymph nodes (Rayman, 2000:233). Good dietary sources of selenium which can contribute to the nutritional need of infants and young children (see Table 2.3) are liver, shellfish, fish, meat, poultry and wheat (Rayman, 2000:239). Selenium compounds are generally very efficiently absorbed by humans, and selenium absorption does not appear to be under homeostatic control. The absorption of the selenite form is greater than 80% whereas that of selenomethionine or as selenite may be greater than 90% (WHO/FAO, 1998).

g. Copper

Copper is an essential trace element that is important for the health of all living organisms (micro-organisms, plants, animals and humans). In humans, copper is vital for metabolic processes and the proper functioning of organs. It is necessary for proper bone growth, development and maintenance, the connective tissue, brain and heart. Copper aids the absorption and utilization of iron, the formation of red blood cells, the metabolism of cholesterol and glucose, and the synthesis and release of life-sustaining proteins and enzymes. In turn these enzymes generate cellular energy and regulate oxygen transport, blood clotting and nerve transmission. The severe damage of cells which are caused by free radicals can also be neutralized with the assistance of copper (Stern, 2010:120).

Copper is the fundamental mineral responsible for the normal growth and development of human fetuses, infants and children. Copper is accumulated rapidly in the liver of the human fetus during the last trimester of pregnancy. A healthy baby has four times the concentration of copper at birth compared to a full-grown adult. Human milk is fairly low in copper. As a result the neonates's liver stores fall rapidly after birth, supplying copper to the fast-growing infant body during the breast-feeding period. These supplies are essential to aid such metabolic functions as cellular respiration, melanin pigment and connective tissue synthesis, iron metabolism, free radical defense, gene expression, and normal functioning of the heart and immune systems in infants (Ralph & McArdle, 2001).

Copper must be ingested from dietary sources since it cannot be formed by the human body. The best dietary sources include seafood (especially shellfish), organ meat (e.g. liver), whole grains, legumes (e.g. beans and lentils), nuts (especially peanuts and pecan nuts) and several fruits (including lemons and raisins) (Sadhra *et al.*, 2007:228) which are not dietary items commonly encountered in the infant diet to meet their copper need (see Table 2.3).

h. Iodine

Iodine aids the energy metabolism, normal growth, proper functioning of the thyroid, prevention of goiter and reproduction. With the iodization of salt, iodine deficiency has been almost eliminated worldwide. Fortification resulted in fewer goiters, stillbirths and mental or growth retardation. The iodine content of vegetables varies by the content of the local soil.

Iodized salt, seaweed and seafood are the good sources of iodine (Escott-Stump, 2012:934). The iodine needed per day by infants and young children is presented in Table 2.3.

2.5 Dietary intervention strategies for curbing undernutrition in infants and children

Despite the work done on malnutrition and the reduced prevalence of underweight and stunting in some regions, the number of cases hasn't changed over the last number of years (Müller & Krawinkel, 2005:6) with about 30% of all children in low- and middle-income countries still underweight (Mother and Child Nutrition, 2007). Malnutrition is and will continue to be a health threat to developing countries, especially in Southern Asia and Sub-Saharan Africa (Müller & Krawinkel, 2005:284) and might actually be rising in the developing world such as Africa because of the HIV pandemic (Oyelami & Ogunlesi, 2007:65). Inadequate nutrition might be caused by lack of access to sufficient food or by lack of food variety or quality, especially for the provision of micronutrients of high bioavailability. However, caregivers might not make the best use of available resources because of cultural beliefs and practices, lack of knowledge of the best foods for young children even when available in the home, and inappropriate advice (Allen & Gillespie, 2001:27). In these circumstances, interventions that provide additional complementary food can prevent growth retardation (Caulfield *et al.*, 1999:185). Moreover, it is well recognized that the most nutritionally vulnerable groups are infants and young children six to 24 months, as their needs for vitamins and minerals are high relative to the amount of food they consume (Dewey & Brown, 2003:19). Furthermore, the physical and cognitive consequences of micronutrient malnutrition during these periods of the life cycle may be irreversible (Lozoff *et al*., 2006:36).

Programs involving fortification of staple foods for the general population with certain key micronutrients, e.g. iron, vitamin A, zinc and iodine, are expanding in many countries but the problem of nutrient deficiencies will not be solved by this for the six to 24 month age group because infants and young children eat too little of the fortified staple foods to obtain an adequate dose of each essential nutrient (Dewey *et al*., 2009:284). In 2005 a study was conducted in South Africa to evaluate the effectiveness of a vitamin-fortified maize meal to improve the nutritional status and growth of one- to three-year-old undernourished African children. The maize was fortified with vitamin A, thiamine, riboflavin and pyridoxine (Nesamvumi *et al.*, 2005:462). The study though showed that the children who were more

undernourished with a lower nutritional status had better responses to the intervention than those with a better nutritional status. It was therefore prudent to conclude that fortification of a staple food such as maize meal influenced the growth of one- to three-year-old children, especially those who were undernourished (Nesamvumi *et al.*, 2005:465).

In 2009 the WHO adopted a new process by which recommendations for safe and effective micronutrient interventions are developed, ensuring the use of best practices and available evidence in this regard. Guideline development is underway for interventions covering iron and vitamin A supplementation, home fortification with multiple micronutrient powders and fortification of staple foods (Pena-Rosas *et al.*, 2012:197S).

2.5.1 Complementary feeding provision and its accompanying guidelines

The introduction of solid foods to infants in addition to breast-feeding, usually at around six months of age through about two years, is referred to as complementary feeding. The types and amounts of food fed at this stage are critical to ensure continuous infant growth and development. Good nutrition during this period is vital to prevent stunting, which may be irreversible (Schroeder *et al.*, 1995:1053S; Lutter, 2000:61). The introduction of complementary foods to infants should not be initiated before 17 weeks but should also not be delayed beyond 26 weeks considering their nutritional needs and developmental abilities (Agostoni *et al*., 2008:100). Figures from different European countries indicate a wide variation in the age of introducing complementary foods, with several deviations from the current WHO recommendation to introduce complementary feeding only from the age of sixth months onwards. For example, 34% of mothers in Italy reported introducing complementary foods before four months (Giovannini *et al*., 2004:494). In Germany 16% had done so by three months (Koletzko *et al*., 2000:1393), whereas in the United Kindom (UK) 2005 Infant Feeding Survey, 51% of infants were reported to have received complementary foods before four months (Bolling *et al*., 2005:231).

During the early 2000's a WHO-commissioned systematic review of the optimal duration of exclusive breast-feeding compared infant outcomes with exclusive breast-feeding for six months versus three to four months (Kramer & Kakuma, 2004:64). All of the studies from the developed world were mostly observational. The review concluded that there were no differences in growth between infants exclusively breastfed for three to four months versus

six months. An analysis of observational data from a trial of breast-feeding promotion in Belarus, however, found that during the period from three to six months, infants who were exclusively breastfed for six months experienced less morbidity from gastrointestinal infection compared to those exclusively breastfed for three months (Kramer *et al*., 2003:291). Continued exclusive breast-feeding for up to six months is thus recommended along with the introduction of complemetary feeding at this time. Infant formula may be used in addition or instead of breast milk.

In addition there are differences between countries in the recommended age for the introduction of cow's milk. Most countries recommend waiting until 12 months, but according to recommendations from some developed countries, e.g., Canada, Sweden and Denmark, cow's milk can be introduced from the age of nine or ten months. The main reason for delaying its introduction is to prevent iron deficiency because cow's milk is a poor source of iron. Studies showed that cow's milk intake above 500 millilitres (ml) per day was associated with iron deficiency in infants (Thorsdottir *et al*., 2003:506; Gunnarsson *et al*., 2004:903).

Lutter (2000:62) examined current infant complementary feeding guidelines from national and international organizations, which are similar in promoting the gradual introduction of soft, pureed foods, eventually progressing to eating family foods. The specifics of when the various foods should be introduced, how often they should be given, their energy and vitamin content, micronutrient supplementation, and other aspects though varied considerably. Information on the frequency and quality of complementary feeding (which changes as the child grows) is vital so that the child receives adequate energy and nutrients. It is furthermore possible to develop complementary foods appropriate to a range of economic and social conditions, but their use depends on mothers (caregivers) understanding how the foods can best be used (Lutter, 2000:62).

a. Food consistency

As the infant gets older the food consistency (and variety) should be gradually increased, adapting to the infant's requirements and abilities. Infants can have pureed, mashed and semi-solid foods starting at six months. By eight months most infants can also consume "finger foods" (snacks that can be eaten on their own). By 12 months, children can be fed the same

types of foods as consumed by the rest of the family. Foods that have a shape and/or consistency that may cause it to become lodged in the trachea may cause choking. Items such as nuts, grapes and raw carrots must therefore be avoided (WHOb, 2001).

b. Meal frequency and energy density

As the child get older it is essential to increase the number of times she/he is fed complementary foods. The appropriate number of feedings is dependent on the energy density of the local foods and the usual amounts consumed at each feeding. For an average healthy breastfed infant, complementary foods should be provided as meals two to three times per day at 6 to 8 months of age and three to four times per day at 9 up to 24 months of age. The provision of snacks that are nutritious (such as a piece of fruit or bread or chapatti with nut paste) is recommended and may be offered once to twice per day, as desired. Snacks are defined as foods eaten between meals, usually self-fed, convenient and easy to prepare. More frequent meals may be needed if the energy density or amount of food per meal is low, or the child is no longer breastfed (WHOb, 2001).

c. Nutrient content

It is important to provide a variety of foods to ensure that the nutrients needed by infants and their growth are met. Food sources such as meat, poultry, fish or eggs should be eaten daily or as often as possible as they provide numerous key nutrients including iron and zinc. Diets that do not include animal foods cannot meet the nutrient needs of infants at this age unless nutrient supplements or fortified products are provided. Carotene (precursor for vitamin A)-rich fruits and vegetables should in addition be eaten daily with meals to enhance iron absorption and diets with adequate fat content be provided to enhance dietary energy density (WHOb, 2001).

d. Food choice

Infants can be fed either home- or commercially prepared infant foods. Research does not support introducing foods in a particular order; however, it is recommended to introduce one ‘single-ingredient’ new food at a time to determine the infants’ acceptance of each food before combining different ingredients (e.g. try plain infant rice cereal before rice cereal

mixed with fruit) (Kleinman, 2004:106). Allowing at least seven days between the introduction of each new 'single-ingredient' food is generally accepted although some nutrition experts acknowledge that complementary foods can be introduced at intervals of two to four days if the infant is developmentally ready. Infants should be introduced small amounts (about one to two teaspoons) of a new food at a time (this allows an infant to adapt to a food's flavour and texture) and be observed closely for adverse reactions such as rash, wheezing, or diarrhoea after feeding a new food. By following these guidelines, an infant will have time to become acquainted with each new food and the caregiver will be able to easily identify any adverse reactions or difficulties digesting each new food (Butte *et al*., 2004:444).

i. Home-prepared (traditional) infant food

Foods prepared for the infant at home (mostly traditional foods) can be equally nutritious and more economical than commercially prepared infant food. The caregiver using home-prepared infant foods has more control over the variety and texture of the food than with commercially prepared infant foods. However, home-prepared infant foods must be appropriately modified for infants to safely consume them. As an infant's feeding skills progress, the thickness and lumpiness can gradually be increased and the food texture can progress from pureed to ground, fork mashed and eventually diced (Butte *et al*., 2004:442).

In addition to soya bean porridge the grains that are mostly used to make home-prepared infant foods include rice (mashed), cereal porridge and maize as well as sorghum porridge (Agbon, 2011:14). When cooking is needed for vegetables (e.g. broccoli, cabbage, carrots, cauliflower, green beans, green peas, potatoes and sweet potatoes) and fruit they should be boiled with a small amount of water or steamed until just tender enough to be pureed or mashed. Fresh ripe and soft fruits can be mashed without cooking (e.g. apricots, avocado, bananas, melon, pears and plums). Hands should always be washed thoroughly before preparing meat, poultry and fish. Fat, skin and bones from meat, poultry and fish have to be removed before cooking. After cooking the deboned meat, poultry and fish, they should be cut into small pieces and pureed to the desired consistency (Kleinman, 2004:106).

The most recent and promising approach for preventing dietary inadequacies for the six to 24 month age group is home fortification of complementary foods (the foods that are consumed in addition to breast milk, after six months of age) (Dewey *et al*., 2009:284). Home

fortification (also called point-of-use fortification and complementary food supplements) (Nestel *et al*., 2003:316) makes it possible to provide the appropriate amounts of micronutrients needed by this age group, regardless of how much they eat and without the need to make major changes in dietary practices (Dewey *et al*., 2009:284). Three approaches have been used for home fortification: micronutrient powders (MNP) (e.g. 'sprinkles'), water dispersible or crushable micronutrient tablets (e.g. 'foodlet') and lipid-based or fortified spreads (e.g. 'nutributter') added to food just before feeding (Nestel *et al*., 2003:316; Dewey *et al*., 2009:284).

'Sprinkles' are a vitamin and mineral mix packaged in small sachets containing a daily dose of micronutrients which should be mixed with food just before consumption (Zlotkin *et al*., 2001:791). Micronutrient sprinkles use encapsulated forms of some micronutrients to permit multiple nutrient combinations with acceptable stability and taste. To date, sprinkles have included combinations of two or more of the following nutrients: iron, vitamin C, zinc, vitamin A and iodine (Zlotkin *et al*., 2001:635). The powder is virtually tasteless and, upon addition to food, causes minimal detectable changes to the taste, colour and texture of the food. It is in particular recommended for children under five years of age in areas where micronutrient deficiencies and malnutrition are prevalent (Rah *et al*., 2011:191S). Sprinkles containing iron, vitamin A, zinc and vitamin C (as an absorption enhancer rather than for nutritional purposes) have been shown to be efficacious in treating anaemic children aged 6 to 24 months in Ghana (Zlotkin *et al*., 2001:635), indicating that they are as effective as iron sulfate drops (Zlotkin *et al*., 2001:791). In Cambodia, sprinkles added to home-prepared complementary foods increased the haemoglobin concentration of infants six to 18 months old (Giovannini *et al*., 2006:306).

The term 'foodlet' was created to describe a crushable micronutrient tablet due to it being midway between a pharmaceutical product and a food supplement (Gross, 2000:17). The advantage of such a formulation is that the users may perceive adding the crushed tablet to food to be more food-based rather than a medical intervention. The 'foodlet' was developed and used in a multicenter supplementation trial in infants and young children in Peru, Indonesia, Vietnam and South Africa (Nestel *et al*., 2003:317). Results showed that adding the foodlet (micronutrient containing crushable tablet) to complementary foods also increased the haemoglobin concentration of infants in South Africa (Smuts *et al.*, 2005:653S).

Lipid-based or fortified spreads are used in therapeutic feeding to treat severely undernourished children (Collins & Sadler, 2002:1824). It is prepared by mixing dry powdered ingredients (i.e. dried milk products, precooked soy flour, sugars, malto-dextrin, minerals and vitamins) with a vegetable fat such as peanut butter. Spreads are made without water and can thus be safely stored at home without any risk of pathogenic bacterial proliferation. It can also be consumed as a snack when used as a commercially fortified supplement (CFS). Because infants aged six to 12 months may have difficulty in swallowing a thick paste, mixing it into traditional porridge just before serving it may be more appropriate (Nestel *et al*., 2003:318).

A peanut-based spread which was evaluated in refugee children three to five years of age in Algeria was very well accepted and was associated with reductions in the prevalence of stunting and anaemia (INN, 1999). No adverse reactions to the peanut-based spread were reported. With the high-nutrient-density versions of this product, only a spoonful per day is needed to meet the micronutrient needs of infants. This can be mixed with whatever complementary food is normally available (Dewey & Brown, 2003:20) In Malawi undernourished infants six to 17 months of age consuming lipid-based nutrient supplements also had a greater haemoglobin concentration than those who received no supplements (Kuusipalo *et al*., 2006:525).

ii. Commercial infant food

Commercially prepared infant foods are safe and nutritious alternatives for a caregiver to use when not preparing infant foods at home. Commercially prepared infant foods that are mostly fed to infants are infant cereal, mashed rice, noodles, mashed or pureed vegetables and fruits which are plain with no added ingredients like syrup, sugar or dry milk and infant and unpasteurized juices (Kleinman, 2004:109).

When developing weaning foods manufacturers take into account the following nutrient aspects:

- Carbohydrate: It is the main source of energy and its intake must be controlled. If given in excess it may be converted into fat and stored as such in the body. The type of carbohydrate that is included in the food is also important, as babies need carbohydrate that is easily digestible (National Academies Press, 2006:103).

- Protein: An adequate amount of protein must be provided in the diet, as protein is the principal material of tissues and found in body fluids and secretions. The protein ingested must contain specific amounts of each of the essential amino acids, e.g., lysine at 4.2 g per 100 g and cystine at 2.0 g per 100 g.

- Fat: Infants must receive an adequate amount of fat, as it is a major source of energy and it represents a concentrated form of energy. Fat provides EFAs and lack of these EFAs cause the skin of the infants to be dry and thickened and become susceptible to inflammation in the folds of the groin or axilla, e.g. linoleic acid at 0.71 microgram (ug) per 100 g (National Academies Press, 2006:123).

- Fibre: Unlike adults, infants do not benefit from a high fibre intake and therefore fibre levels must be controlled. Fibre can interfere with the absorption of essential minerals, and because infants have a small stomach capacity it is difficult to consume sufficient quantities of fibre rich foods to meet energy requirements (National Academies Press, 2006:113).

- Vitamins and minerals: Added vitamins and minerals may be needed to ensure an adequate intake and restore losses, which may occur during processing. Riboflavin (vitamin B2) at 60 ug per 100 g, magnesium at 6 milligram (mg) per 100 g, and calcium at 50 mg per 100 g are supposed to be added to compensate for losses (National Academies Press, 2006:167).

2.5.2 Household dietary diversity

For decades researchers have been promoting the consumption of a variety of foods to ensure a sufficient intake of all the essential nutrients to ensure a healthy life. Household dietary diversity can be used as an indicator for assessing food access and nutritional intake of a household (Swindale & Ohri-Vachaspati, 2005:66). Dietary diversity refers to the variety of foods from several food groups consumed over a period of time to provide a quality diet with all the nutrients needed by the body for growth and optimal health (Swindale & Ohri-Vachaspati, 2005:67). The Household Dietary Diversity Score (HDDS) is defined as the number of food groups consumed over a reference period of 24 or 48 hours or even seven days preceding the interview (Swindale & Ohri-Vachaspati, 2005:67). The HDDS is a user

friendly indicator of dietary diversity whereby a highly varied diet raises the dietary diversity score and the intake of micronutrients thereby leading to improved family health, especially the nutrition of children (Hoddinott & Yohannes, 2002:116).

Studies conducted in Mali, Kenya, Ghana, Malawi, Guatemala and Nigeria confirmed that dietary diversity scores are linked to nutrient adequacy (Arimond & Ruel, 2004:19). In Kenya, for instance, increased dietary diversity improved the nutrient adequacy among children aged four to eight years. Steyn *et al.* (2005:10) found that the nutritional status of children in Limpopo improved from four to 24 months due to increased dietary diversity as a result of dietary nutritional interventions, as did Clausen *et al*. (2005:87) in a study of elderly people in Botswana.

Lack of dietary diversity and food variety in the diets of poor populations in Botswana and other developing countries like Zimbabwe, Zambia, Malawi, Ghana and Tanzania, reflects a high reliance on starchy staple foods, resulting in diets that often include no animal products and only a few fresh fruits and vegetables, with inadequate micronutrient provision (Clausen *et al.*, 2005:87). According to Faber *et al*. (2008:159) in a study conducted in Sekhukhune, South Africa, one of the poorest districts in the Limpopo province, the average HDDS score for one-to eight year old children was 3.6. The dietary diversity indicator is more significant when it is measured in households that consume four or fewer types of foods which in developing countries may consist of cereals only (Swindale, 2007). Steyn *et al.* (2005:9) found that a cut-off point below four indicates a diet of poor quality.

On average, if households consume six or more different foods, this will be an indicator that they have sufficient access to both macro- and micronutrients (Clausen *et al.*, 2005:88). A high food variety score is associated with urbanization, higher education and a higher number of meals, since urban households have better access to income with a higher access to a variety of foods (Clausen *et al.*, 2005:88).

2.5.3 Mother and child nutrition education and knowledge

To attain good health and nutritional status, people need sufficient knowledge and skills to grow and/or purchase, process, prepare, and feed their families a variety of foods in the right quantities and combinations (FAO, 1997:5). This requires a basic knowledge of what

constitutes a nutritious diet and how people can best meet their nutritional needs from the available resources. Undesirable habits and nutrition-related practices, which are often based on insufficient knowledge, traditions and taboos or poor understanding of the relationship between diet and health, can adversely affect nutritional status. However, people can adopt healthier diets and improve their nutritional well-being by changing their food and nutritional attitudes, knowledge and practices, if sufficient education and motivation is provided to do so (FAO, 1997:5). It is recommended that nutrition education form an important integral part of any intervention program to improve the nutritional status of children and other target groups (Sharma & Nagar, 2006:141).

Knowledge of appropriate food preparation practices is important, so that food can be handled and cooked in a manner that will prevent nutrient losses (Krige & Senekal, 1997:22). Therefore disseminating the right kind of nutrition information would definitely make a difference in improving the nutritional status of children (Faber & Benadé, 2002:32). Caregiving or care practices for children include such food and nutrition aspects as feeding practices (refers to the manner in which the child is fed during the day, timing of feeding, meal frequencies and termination of feeding), food types (refers to different foods provided to and eaten by the child), food preparation (refers to cooking of food and getting it ready to be eaten), and food storage (refers to the manner in which food is kept before and after preparation) (FAO, 1997:20).

Nutrition education and training of mothers is necessary to change feeding practices and provide correct dietary information. Nutrition education can easily be incorporated into primary health care programs. Health workers and nutritionists can educate rural mothers about the importance of adequate weaning, food practices and infant health. The importance of varying the baby's diet and practicing good hygiene when handling and storing infant food should be included in the training. The teaching and training of rural mothers can have a long term impact on weaning practices and the nutritional status of children (Faber & Benadé, 2002:46).

Caregivers and children who received nutrition education changed their attitudes or poor practices with regard to food choices, preparation and consumption (Krige & Senekal, 1997:22). The results of a study conducted by Sharma and Nagar (2006:141) in two rural villages of India revealed that after educating mothers (on aspects of childcare), the majority

of mothers indicated that their practices with regard to childcare (especially feeding practices) were not good and that the education received helped to change their wrong beliefs and poor care practices. Therefore, proper education can bring about many changes in people, more appropriately so in the case of women as it is said that when a woman is educated, then the whole family is educated (Sharma & Nagar, 2006:142). In the Philippines, a weaning education program led to a reduction in the prevalence of malnutrition from 64% to 42% (Nnanyelugo *et al*., 1990:46).

Nutrition education has been used to improve complementary feeding practices in several developing countries. Caulfield *et al*. (1999:183) recently reviewed 16 such programs in 14 different countries. The programs generally included formative research to assess appropriate recipes for enriched complementary foods using local ingredients to determine the acceptability and feasibility of the foods to be promoted. The foods developed were mostly and usually grain-based porridges enriched with good sources of protein, energy and micronutrients. Key messages usually included exclusive breast-feeding for four to six months, feeding complementary foods three to five times per day, use of nutrient-rich foods or recipes for complementary feeding, age-appropriate guidelines regarding the consistency of the foods, hygienic methods of food preparation and storage and continuance of breast-feeding.

Most programs that evaluated infant growth reported a positive impact. In Congo, mothers in the intervention zone received nutrition education sessions in groups or at home by local educators who encouraged recommended feeding practices and demonstrated the preparation of improved complementary foods using cassava, peanut or pumpkin butter and malted maize flour. Despite positive changes in maternal knowledge and practices, there was no improvement in the growth of infants aged four to 27 months, which led the investigators to conclude that micronutrient deficiencies may have limited the growth response to the improved foods (Dewey & Brown, 2003:23).

In Ghana, a Credit with Education Program was conducted. This program coupled women with education in the basic of health, nutrition, birth timing and child spacing. The nutrition topics focused on promotion of exclusive breastfeeding for about six months, use of complementary foods enriched with ingredients such as fish powder, peanuts, beans, egg, milk and red palm oil, nutritious snacks such as mashed fruits and vegetables, increased

feeding frequency, dietary variety, hygienic practices and feeding during and after illness. The program showed large effects on improved feeding practices and there was an improvement in the weight and height of infants aged 12 to 24 months (Dewey & Brown, 2003:24).

Communication for behavioral change (CBC) is one of the main strategies in improving community nutrition through increasing peoples' knowledge and motivation for change. It is used for achieving different nutritional goals, such as improving complementary nutrition methods, increasing the acceptance of food supplements and the consumption of fortified foods. Women, especially mothers, are the key target group for modifying food habits for the health of both themselves and their children. This is especially important in rural areas where mothers experience hard physical labour, multiple pregnancies and inadequate diets (Sheikholeslam *et al*., 2004:738).

Evaluation of CBC programs on a large scale, aiming at mothers who care for children, has shown that they were effective in improving the nutritional status of children. One CBC program, the Heart Model, has been implemented in Vietnam, Bangladesh and Haiti (Allen & Gillespie, 2001:28). It was part of a comprehensive intervention program for growth monitoring, iron and vitamin A supplementation and infection treatment. In this approach, mothers participated in educational sessions held in their homes or visited rehabilitation centres for two weeks and were trained in preparing nutritious meals for their undernourished children using locally available foods. The program has been successful in preventing undernutrition among children in Haiti and Vietnam (Sheikholeslam *et al*., 2004:738).

In the Islamic Republic of Iran, nutrition education was first implemented in 1995, in rural areas of the Chahar-Mahal and Bakhtyari province (Malekafzali, 2000:239). In this program, mothers with children under two years were educated in their homes using cooking demonstrations by community health workers and trained volunteer rural grandmothers. Raw materials for preparing baby foods were provided by the mothers and the cooked meals were distributed among their children. The success of this program in improving the nutritional status of rural children led to its implementation across the whole health network of the country. Experiences of this program have shown that practical nutrition education for mothers provides opportunities for education about other issues such as growth monitoring, breast-feeding, diarrhoea and other diseases (Malekafzali, 2000:241).

A study by UNICEF of 23 national projects in South-East Asia showed that the literacy of mothers is an essential factor in children's growth and that increased literacy improves the nutritional status of children (New, 1995). In an intervention plan to reduce undernutrition among children in rural areas of the Islamic Republic of Iran over three years, a literacy program for women resulted in a 10% increase in the number of literate women. This was thought to have played an important part in reducing undernutrition measures among children after the intervention (Sheikholeslam, 1999). Several studies have shown that education of mothers about nutrition not only decreased the proportion of underweight children, but also decreased child mortality. It also had positive long-term effects on the children's future development (Dhanamitta, 1998). For example, in a study conducted in rural Lesotho, the effect of maternal schooling was mediated through increased nutrition knowledge, and probably better care services. This study indicated that poor mothers cannot translate nutrition knowledge into optimal child-care practices (Ruel *et al*., 1999:20).

Large-scale educational interventions have been effective in changing the way caregivers feed infants, thereby increasing their dietary intake, and improving child growth. In countries where government health services provide wide coverage and are easily accessible, these services are a logical and more sustainable channel for educational interventions (Caulfield *et al.*, 1999:186). To address malnutrition among children, the Government of Botswana has put in place different strategies such as a program for providing health and nutrition education. This program has the potential to improve child feeding practices in households and through the clinics, to conduct growth monitoring and immunization, and in addition to control gastric diseases. However, it has to be noted that some of these strategies have made no nutritional impact due to the various factors related to malnutrition, such as inadequate food intake, diseases, low household food security, poor child care and protection, and the absence of essential services, including that related to education, health, housing and sanitation (Maruapula, 1993).

2.5.4 Food fortification

2.5.4.1 Description and fortification conditions

Food fortification is the commercial addition of one or more essential nutrients to a food, whether or not it is normally obtained in the food, for the purpose of preventing or correcting

a demonstrated deficiency of one or more nutrients in specific population groups (FAO, 1996:3). Food fortification is a non-therapeutic intervention and delivery mechanism that, when properly implemented, serves as a good preventative measure that has a broad impact as it reaches large numbers of people. Important elements needed for successful food fortification are the selection of an accessible, low-cost and widely consumed vehicle, and active participation of the food industry. Although food fortification cannot always reach 100% of populations with micronutrient deficiencies, it can make an enormous difference for expanding populations that regularly purchase and consume commercially processed foods. Examples of successful food vehicles are cereals such as rice, corn and wheat flour, fats and oils, dairy products such as milk, and condiments such as sugars, spices, and starches (Nemer *et al.*, 2001:37).

Certain micronutrients are sometimes not naturally present or available in local foods, such as an adequate amount of iodine. This can be due to lack of iodine in the soil where crops are grown, or in the case of other micronutrients, such as iron or vitamin A, due to problems of bioavailability and unbalanced diets. In such cases food fortification with micronutrients may help in overcoming the deficiency problems (FAO, 1996:2).

Prudent handling of vitamin and mineral additions in food processing requires a sound understanding of the characteristics of these compounds, their stabilities to various unit operations, solubilities and reactivities with other compounds. Many forms of micronutrients have been developed to render them more suitable for use under a wide range of applications (FAO, 1996:2).

The major problems involved in fortifying foods include the identification of suitable vehicles, selection of appropriate fortificant compounds, determination of technologies to be used in the fortification process and the implementation of appropriate monitoring mechanisms to determine whether the goals of the program are being met. Reliable methods for determining micronutrient status are required both in establishing the need for food fortification and in monitoring its nutritional impact (FAO, 1996:2).

2.5.4.2 Micronutrient fortificant forms and bioavailability

Fortification is the process of adding vitamins and/or minerals to foods to increase their overall nutritional content. In addition to salt, numerous staple foods present tremendous opportunities for providing micronutrients to large populations. Currently, wheat flour, maize flour and rice and cooking staples such as sugar and oil are being used around the world as vehicles to improve vitamin and mineral health (Nemer *et al.*, 2001:37). Bioavailability is the degree to which food nutrients are available for absorption and utilization in the body (National Academies Press, 2001:86).

a. Vitamin A

Children/Infants need the lipid or fat soluble form of vitamin A, e.g α- and β-carotenes, which are mostly found in rich yellow, orange and green vegetables and fruits and which have a high degree of bioavailability (National Academies Press, 2001:86). Issues of bioavailability may nonetheless apply to plant sources of provitamin A carotenoids. There is some evidence that orange fruits (e.g., papaya, mango and pumpkin) are more effective than dark green leafy vegetables for improving vitamin A status. Orange fruits may also be a more acceptable option for vitamin A provision because in many cultures there is reluctance to feed dark green leafy vegetables to infants (Dewey & Brown, 2003:18). In the fortification of food with vitamin A, vitamin A palmitate (preformed vitamin A) is the form used which occurs naturally in animal food sources (National Academies Press, 2001:86).

b. Vitamin D

The absorption of vitamin D is affected by the type of vitamin D consumed. Vitamin D_3 is known as cholecalciferol (Armas *et al*., 2004:5387). Technically there are three forms of vitamin D_3, namely calcifediol, calcitriol and cholecalciferol. Cholecalciferol is the only one that is ingested either through food, supplements or by way of sun absorption. Vitamin D_3 is the natural form of vitamin D that is most commonly obtained through exposure to the sun. Vitamin D_3 is more readily absorbed and more effectively utilized by the human body than is vitamin D_2. Supplemental vitamin D is available both as vitamin D_2 (ergocalciferol) and vitamin D_3 (cholecalciferol), and these two forms have for long been regarded as equivalent. However, some studies have suggested that vitamin D_2 is less effective than vitamin D_3 in

humans. Vitamin D_3 is thus more bioavailable than vitamin D_2 (Armas *et al*., 2004:5388). Cholecalciferol is practically insoluble in water and slightly soluble in vegetable oils (Armas *et al*., 2004:5388).

c. Vitamin E

As vitamin E is a lipid soluble vitamin and its bioavailability depends on or is influenced by its dispersion in the intestinal lumen and the co-ingestion of other fat components, namely fatty acids and plant sterols, dietary fat generally promotes its absorption. It is therefore recommended that its supplements be taken with a meal containing fat (Landvik, 2004:784). The predominant form in the body comprising over 90% of vitamin E is α-tocopherol present in human plasma and tissues. RRR- α-tocopherol is the form of α-tocopherol that occurs naturally in food. The 2-R-stereoisomeric form is a synthetic form of α-tocopherol that occurs in fortified foods and supplements. Synthetic α-tocopherol includes eight stereoisomers of α-tocopherol in equal amounts but only four of these isomers are in the 2-R-stereoisomeric form and are biologically active as vitamin E. Synthetic vitamin E may be listed on the label of fortified foods or supplements as dl- α-tocopheryl acetate or dl- α-tocopheryl succinate (Gagnė *et al*., 2009:210).

Vitamin E is an important lipophilic antioxidant. Tocopherol acetate is inactive both biologically and as an antioxidant. It must first be hydrolized to free phenols of α-tocopherol in the gut before the absorption of the vitamin can occur. Of all the forms of vitamin E, α-tocopherol is normally the most used fortificant as it has the highest bioavailability (Sen *et al*., 2006:3). The α-tocopherols are the exclusive form of vitamin E in leaves of plants and seeds. However, most manufacturers use synthetic α-tocopherol forms of vitamin E rather than the natural α-tocopherols from plants (Sen *et al*., 2006:2). Synthetic α-tocopherol used in fortified foods and supplements provides less than half of the vitamin E activity in the body (Gagnė *et al*., 2009:210).

It is also necessary and advisable that manufacturers use other forms of vitamin E and not only the α-tocopherols. Tocotrienols are the primary form of vitamin E in the seed endosperm of most cereal grains such as wheat, rice and barley. The neuroprotective, antioxidant, anti-cancer and cholesterol lowering properties of tocotrienold are more powerful than that of tocopherols (Sen *et al*., 2006:2) and its utilization therefore considered as food fortificant.

d. Iron

Iron bioavailability varies widely between the iron compounds used. The colour of the iron compound is often a critical factor when fortifying lightly coloured foods. Foods sensitive to colour and flavour changes are usually fortified with water-insoluble iron compounds of low bioavailability. The use of more soluble iron compounds (e.g. iron sulphate) often leads to the development of off-colours and off-flavours due to reactions with other components of the food material, but they have the advantage of being highly bioavailable (Hacherl *et al*., 2001:4886).

Commonly used supplemental sources include ferrous sulfate (iron sulfate), ferrous carbonate (iron carbonate) and ferric oxide (iron oxide). Bioavailability of these iron sources from most to least available is sulfate, carbonate and then the oxide form. Of all the iron compounds most frequently utilized, iron oxide (ferric oxide) has the lowest bioavailability. Iron oxide has been reported to have very little nutritional value (Hacherl *et al*., 2001:4886). The iron compounds recommended by the WHO to be used as fortificants are ferrous sulphate, ferrous fumarate and ferrous pyrophosphate. Many cereal foods, however, are fortified with low-cost elemental iron powders, which are not recommended by the WHO and these have even lower bioavailability (Hurrel & Engli, 2010:1463S).

The advantage of direct supplementation is that the dose and form of the nutrients (i.e., bioavailability) can be specified to ensure that the infant absorbs the appropriate amount, although uncertainties remain about the interactions among nutrients and between supplemental nutrients and food components. The disadvantages include the risk of accidental poisoning of children in the household, the cost of supplements and containers, potentially low compliance if caregivers believe that the supplements cause adverse reactions or get tired of giving them every day, and dependency on a distribution system based outside the local community. The use of micronutrient preparations that can be mixed with complementary foods in the household may avoid some, though not all, of the disadvantages listed above (Dewey & Brown, 2003:19). To date, sprinkles have been evaluated the most extensively as intervention product to treat and prevent nutritional anaemia. The iron in sprinkles is ferrous fumarate, which is micro-encapsulated to prevent the iron from interacting with food (Dewey *et al*., 2009:284).

e. Zinc

Zinc is not easily absorbed in the body unless first attached to another substance. For this reason, many zinc manufacturers have "chelated" zinc to organic compounds and amino acids. This form of zinc has undergone a process called chelation, whereby the organic molecules have been given an electrical charge that allows them to positively attract the charged mineral (in this case zinc). This creates a temporary increase in the complexity and concentration of the mineral within the molecule. Each molecule packs higher concentrations of zinc through a process of attaching the mineral to something else, such as an amino acid. The belief is that this helps the body better absorb the mineral. There is much debate as to whether the process actually increases absorption. Some studies show that chelating minerals has an insignificant effect on absorption when compared to the general conditions in the digestive system (Edward, 2009). Supplemental zinc is also available in an inorganic form that is provided as a non-chelated type, usually as zinc sulfate or zinc oxide (Edward, 2009).

There are currently five zinc compounds that may be used in fortifying foods: zinc sulphate, chloride, gluconate, oxide and stearate. The solubility of the mineral compound is only one important factor that affects the mineral bioavailability. Zinc sulphate is the second most used source of zinc. It is more soluble than zinc oxide but its stability depends on the food matrix to which it is added (Rosado, 2003:2987S). In a study by Herman *et al*. (2002:816) it was reported that the absorption of zinc from wheat flour fortified with iron sulphate was acceptable, but zinc sulphate fortification appeared to reduce iron absorption. The results suggest that caution should be exercised when considering whether to fortify iron fortified flours with zinc especially zinc sulphate.

Zinc gluconate is one of the most popular forms of dietary zinc fortification. Zinc gluconates are created by a process of industrial manufacturing. This process essentially ferments glucose, offering a supplemental product with an extremely long shelf-life. The body absorbs very little of this processed form as the bioavailability of these chemicals is virtually none (Edward, 2009).

The use of zinc oxide has some advantages over the use of other zinc compounds because it is more stable and does not significantly change the food to which it is added (Rosado, 2003:2987S). However, the lower solubility of zinc oxide might reduce zinc absorption

compared with zinc sulphate (Herman *et al.*, 2002:816). Available studies though show no significant difference in zinc absorption from foods fortified with either zinc oxide or zinc sulphate, which are the cheapest chemical forms of zinc that are generally recognised as safe for human consumption (Brown *et al*., 2007:174).

Zinc acetate is another chemically-altered form of zinc. The acetates are more absorbable than the gluconates. This form of zinc, also known as zinc salt dihydrate and zinc diacetate, is created by adding acetic acid to zinc carbonate or zinc metal. It is not a recommended form of zinc to use in food fortification or as supplements (Edward, 2009).

Zinc orotate is zinc that has been chelated to orotic acid. This type of zinc is most readily absorbed by the human body's cellular membranes. Research has found that the orotate forms of zinc are more neutrally charged, as compared to other types of zinc. This allows them to pass through the membranes of cells easily, and they thus offer the highest amounts of accompanying mineral atoms into the cells, leading to higher tissue concentrations of zinc. Zinc orotates contain many antioxidant properties that can help protect human health, while offering body cells the most readily absorbable form of zinc (Edward, 2009).

f. Iodine

Iodine is ingested in two chemical forms which both are suitable for use as food fortificants, namely, iodate and iodide. They are usually added as the potassium salt, but sometimes as the calcium or sodium salt. Iodide is rapidly and completely absorbed in the stomach and duodenum (Marwaha & Gopalakrishnan, 2011:7). Iodate, widely used in many countries as an additive to salt (National Academies Press, 2001:259), is reduced in the gut and absorbed as iodide. Iodates are less soluble in water than the iodides, but more resistant to oxidation and evaporation and stable under adverse climatic conditions (Marwaha & Gopalakrishnan, 2011:7). The Codex Alimentarius standard for food grade salt permits the use of the sodium and potassium salts of iodides and iodates in the iodization of salt (The National Academies Press, 2001:259).

g. Selenium

The diet is the major source of selenium and about 80% of dietary selenium is absorbed depending on the type of food consumed. Selenium bioavailability is strongly dependent on the chemical form found in food. Selenocompounds found in both plants and animal tissues includes selenite, selenite and selenocysteine which are especially well absorbed. The overall absorption of all forms of selenium is relatively high (70% - 90%) (Cabrera-Vique & Navarro-Alarcon, 2008:119).

2.5.4.3 Region specific actions

Weaning foods or complementary foods are also often developed for provision or use on a national level to improve the infant nutritional status. Many researchers have worked extensively on cereal-legume combinations in Nigeria. For example, Fashakin and Ogunsola (1982:94) formulated nut-ogi (a mixture of corn gruel and peanut), Akinrele and Edwards (1971:177) formulated soy-ogi (corn gruel and soybean), and the Collaborative Research Support Program (CRSP) cowpea linkage project at the University of Nigeria, formulated cerebabe (corn gruel and cowpea). Some of these combinations have been adopted by the food processing industries and are available on the Nigerian market. However, Fashakin (1989:116) observed that no single protein from the above sources was adequate to promote growth or enhance milk-based diets in children. To this end, a mixture of cowpea, soybean and corn gruel was found to be superior to any single protein source (Fashakin, 1989:118).

A low-cost, nutritious, well-balanced weaning food rich in protein and energy have been developed from locally available foods in Ghana. Weanmix is a blend of legume (groundnut and/or cowpea) and cereal (maize) in the ratio of 1:4 (Takyi *et al*., 1991:36). However, Takyi *et al*. (1991:37) suggested that alfalfa (legume) could be incorporated into the weaning diet of Ghanian infants. This legume was found to contain higher levels of protein, minerals and carotenes that could support child growth.

The WHO sometime ago convened a series of workshops to review the experience of complementary feeding programs in Africa, thereby facilitating the task of summarizing relevant activities in the region. Because industrially produced complementary foods have formerly been relatively unavailable or unaffordable in much of Sub-Saharan Africa,

governmental and non-governmental organizations have promoted centralized production of these foods. The national experiences found with manufactured complementary foods in various African countries are summarized in Table 2.4. Most of formulations were based on a cereal grain with added legumes (soya, lentils, cowpeas, or groundnuts), sugar and occasionally dried skimmed milk. Few of these preparations contained vitamin and mineral supplementation (see indications in Table 2.4), despite the fact that the mixtures were nutritionally incomplete and rich in anti-nutritional factors, such as phytates and tannins (WHO, 1998:159). With few exceptions, it was not known how many young children depended on these manufactured products and what proportion of the total diet they represented. Most of the presentations at the WHO workshops concluded that these products were not affordable by the neediest families. In some cases, however, these foods have been distributed through health systems or other outlets at subsidised prices. In the case of Botswana, for example, all children receive the vitamin and mineral-fortified complementary food, Tsabana, through a government program (WHO, 1998:159).

Table 2.4: Summary of national use of manufactured complementary foods in Africa (obtained form WHO, 1998:160)

Country	**Manufactured complementary food and ingredients**	**Targeting comments**
Algeria	Superamine: Wheat flour, crushed lentils, skimmed milk and vitamin and mineral mix.[a]	Widely bought at a subsidised price, which was no longer possible after cost of ingredients increased. Also similar imported products appeared on the market and attracted consumers.
Benin	Ouando flour: Maize, sorghum and sugar; beans and groundnut added for older children.	Marketed for children three months and older. Over 85% consumed in urban areas.
Botswana	Tsabana: Sorghum, soya and vitamins and minerals added. [a]	Received by all children four to 36 months.

Table 2.4 (Continued): Summary of national use of manufactured complementary foods in Africa (obtained form WHO, 1998:160)		
Country	**Manufactured complementary food and ingredients**	**Targeting comments**
Burundi	Musalac: Maize, sorghum and soya flours, skimmed milk and sugar.	Use has been considered widespread; also used in emergencies.
Cape Verdi	MICAF: Wheat, maize, beans and groundnut.	Industrial production tested.
Chad	Vitaford: Cereal, niebe, groundnut and sugar.	Mostly used in drought-stricken areas and health facilities.
Congo	Vitaford: Maize, cassava, soya, sugar and vitamins and minerals added. [a]	Limited consumption. Competes with and less enriched flours. Sold largely through health centres.
Ethopia	Faffa: Wheat, soy, pea flour and vitamins and minerals added. [a]	No information on targeting/coverage.
Ghana	Weanimix: Maize and groundnut/and or cowpeas.	Specifically for children.
Malawi	Likuni Phala: Maize and bean flours.	
Morocco	Actamine: Wheat and soy flour, skim milk, sugar and multivitamin mix. [a]	Greatest use in health centres for malnourished children. Has limited general consumption. Subsidised distribution in disadvantaged areas.
Niger	Bitamin: Millet, niebe and groundnut flours.	Consumption and production have remained small-scale.
Rwanda	Sosma: Sorghum, soya and maize flours.	Limited consumption. Production status not clear.
Tanzania	Lisha: Fermented porridge and use of germinated flour.	No information on targeting/coverage.
Togo	Nutrimix: Maize, sorghum, rice-flours and sugar for younger children; niebe and groundnut or soya for older	Product for younger children marketed for three to six months of age. Sale through pharmacies and health centres. Relatively limited

	children.	consumption.

[a] Regional complementary food formulations containing vitamin and mineral supplementation

The poor treatment success of severely malnourished children in Rwanda led the government of Rwanda to attempts to improve the food provided in a supplementary feeding program. Two cereal mixtures were compared. The one mixture being the original food used which was a fortified corn-soy-blend (CSB). For this dehulled soyabeans and oat flour were mixed with a mineral-vitamin mix. The other mixture product developed referred to as golden-briend-grellety (GBG) (Golden, 2010:672), where instead of soyabeans and oat flour, soyabeans and maize were mixed with the mineral-vitamin mix. All the ingredients used in CSB were roasted compared to the GBG ingredients which were cooked using the extrusion method. The GBG product was considered successful (see Table 2.5), with the rate of weight gain on 5.1 g per day for children on GBG compared to CSB which resulted in a 1.2 g per day of weight gain (Golden, 2010:672).

Table 2.5: Effect of changing from corn-soy-blend (CSB) supplementary feeding to golden-briend-grellety (GBG) formula porridge on the outcome of moderately malnourished children in Cyanika, Rwanda (obtained from Golden, 2010:673)

Supplementary feed	**Number of malnourished[a] children**	**Number of adequately nourished[b] children on supplementary feeding**	**Percentage success rate**
Corn-soy-blend (CSB)	825	423	51
Golden-briend-grellety (GBG mix)	126	102	81

[a] Malnourished = infants fed traditionally available foods at home e.g. CSB

[b] Adequately nourished = infants fed therapeutic nutrition products e.g. GBG

In the literature search two studies were identified that compared the efficacy of therapeutic nutrition products with traditionally available foods at home. Manary *et al*. (2004:559) compared ready-to-use therapeutic food (RUTF) with maize soy flour in Malawi, and observed higher weight gain and recovery, and lower morbidity in the RUTF group, in comparison to the group receiving home-based foods. The second study also in Malawi, investigated Misola (a local product made from millet, soyabeans, peanut kernel, sugar and

salt) that supplies energy almost equivalent to conventional RUTFs. The study found that Misola fortified with spirulina let to higher weight gain and lowered undernutrition in Malawian children, in comparison to the use of traditional foods (Simpore *et al*., 2006:3).

In a study carried out by Sanjay (2002:6) in Nepal, it nonetheless was concluded that a traditional porridge made by mothers was found to be very nutritious. The porridge is made from a finely ground flour of roasted cereal grains and pulses. The flour mixture is known as super flour or 'Sarbottam phito ko lito'. Some of the advantages of the super flour include its convenience, adaptability and storage. The flour can be used for making porridge and for baking bread and biscuits. Mashed vegetables and fruit can be added to the porridge to improve the nutritional value and the flavour. This product is highly recommended and successful in the reduction of malnutrition in children (Sanjay, 2002:6).

2.5.5 Household food security

Food insecurity can be defined as a situation in which people suffer from hunger or live in fear of starvation. According to the FAO (2003), worldwide around 852 million men, women and children are chronically hungry due to extreme poverty, while up to 2 billion people intermittently lack food security due to varying degrees of poverty. In some of the areas of the world people lack basic foods to provide them with sufficient energy and nutrients to lead fully productive lives (FAO, 2003).

Food security is an important measurement of household and personal wellbeing. Food insecurity and hunger are undesirable because they can lead to nutritional, health and developmental problems in children (Daniels *et al.*, 2007). Food security encompasses three dimensions: availability (a measure of food that is, and will be, physically available in the relevant vicinity of a population during a given period); access (a measure of the population's ability to acquire available food during a given period); and utilization (a measure of whether a population will be able to derive sufficient nutrition during a given period). Although it may not sum up all dimensions of poverty, the inability of households to obtain enough food for a productive healthy life is an important indication of their poverty (Hoddinott & Yohannes, 2002).

Malnutrition remains a major problem in the world, because each year 35 million women, children and the elderly are at risk of early death. The use of advanced technology that is meant to increase the production of food and its distribution has not been able to control the situation as the number of deaths caused by malnutrition and hunger is still increasing. The problem is also not only limited to underdeveloped countries. It also affects more developed and advanced countries such as Canada and the United States of America (USA). An estimated 2.5 million people in Canada depend on food banks, while 30 million people in the USA are unable to maintain good health because they cannot provide food for themselves (Mustafa *et al.*, 2007).

Kapunda (2006:69) investigated the patterns of food consumption, food security and poverty in Botswana. The results indicated that at the national level, household expenditure allocation on food consumption decreased from about 35% in 1993-1994 to about 33% in 2002-2003. The results also revealed that, though there is food security at national level, more households in rural areas experience food insecurity, despite the fact that households spend 88% of their income on food items and only 12% on non-food items.

Improvement of food security in Botswana is one of the main objectives of the government for the development of the agricultural sector. Both the number and the proportion of undernourished people have increased from 1990-1991 to 1999-2001 and food supply has decreased during the nineties. Statistics show that one out of four persons is undernourished. Furthermore, domestic production of cereals has never been sufficient to meet the national food requirements and a significant part of the annual cereal requirement is imported (Rural Development Coordination Division, 2006:10).

2.6 Summary

Undernutrition is an underlying factor in many diseases affecting children younger than five years of age. Undernutrition is most often prevalent in developing countries and considered a major health concern in such countries due to the high prevalence. The varied immediate factors that contribute to undernutrition are insufficient dietary consumption, psycho-social stress and trauma as well as diseases such as diarrhoea, acute respiratory infections, malaria, measles and HIV/AIDS. Underweight, stunting and wasting are the three types of undernourishment that result from these various causes with micronutrient deficiencies an accompanying consequence.

Micronutrients that are often deficient in the dietary intake of infants living in developing countries and which are essential to child growth and development are vitamin A, iron, zinc and folate with calcium and iodine also possibilities for deficiencies. The dietary intervention strategies available for curbing undernutrition, as well as micronutrient deficiencies, include adequate provision of complementary feeding, ensuring household dietary diversity and food security, provision of nutrition education especially to mothers and food fortification. Dietary diversity is an indicator of household food security. For a household to be nutritionally secure, a variety of foods must be consumed. Inability of households to obtain adequate food intakes as well as a diversity of food is often a sign of poverty which require intervention strategies to alleviate the often resulting undernutrition in infants and children.

Food fortification is the commonly used intervention strategy such as in Botswana where Tsabana is provided. Cereals as the fundamental staple food of most developing countries are used as the preferred vehicles for food fortification with Tsabana containing sorghum as the staple food. For food fortification to be effective in alleviating micronutrient deficiencies the forms of the micronutrients added need to be considered in addition to the amounts added.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Permission to conduct study

Upon approval of the research proposal ethical clearance to conduct this study was obtained from the Faculty of Applied Sciences Research Ethics Committee of the Cape Peninsula University of Technology (CPUT) (1 December 2011) (see Addendum A) and in addition by the Department of Health Research Unit at the Botswana Ministry of Health (17 January 2012) (see Addendum B). Letters of request to conduct the study were sent to the respective Senior District Medical Officers on receiving the above ethical approvals (see Addendum C).

The minimum/absolute essential elements taken into consideration within the written consent form (see Addendum D) addressed the aspects as put forward by the World Medical Association Declaration of Helsinki (South African Department of Health, 2006:70).

Analyzing the age-specific patterns of the adult literacy rates in Botswana, a 2003 survey suggested that with an increase in age, the literacy rate decreases to the lowest point of 18% for those at the age of 70 years. Women aged 15 to 44 years had somewhat higher literacy rates than men in the same age group. Literacy for these age groups ranged between 72.8% and 94.9% for women and 68.9% and 92.5% for men. For the age group between 45 and 70 years men had higher literacy rates than women. The literacy rates disaggregated by urban-rural and by districts show high literacy rates across towns for all age groups (between 92.5% and 98% for the 15 to 70 year age group) (Hanemann, 2006:10). The readability level of the study information and data tools should thus not be of great concern but was considered in the compilation of the questionnaire to assure that all participants understood the nature of the study. However, although written informed consent was obtained, the consent form information was verbally provided to the participants. The questionnaire was administered to the participants in their own native language (Setswana). The readability level of the simple questionnaire was nonetheless calculated as each participant would complete it himself/herself through the application of the SMOG Readibility Formula (Gaston & Daniels, 1988:19). The results of the SMOG readability formula application on the English version of

the questionnaire were as follows: the total polysyllabic word count (on exclusion of the word Tsabana) as 16 and the approximate grade level was grade 7 (primary school).

3.2 Type of study and study design

A quantitative inquiry methodology utilizing a survey as a data collecting tool was used for the study. Quantitative methods focus attention on amounts or measurements (more or less, larger and smaller, often or seldom, similar and difference) of the characteristics displayed by the people and events that the researcher studies. This research approach is useful to verify and test theories or explanations which are typically statistical procedures or produce numeric scores (Thomas, 2003:1; Creswell *et al*, 2003:18; Gravetter & Forzano, 2009:147). This study firstly entailed the nutritional appraisal of Tsabana aimed at verifying whether the energy, macro- and micronutrient composition of the nutrition intervention product met the nutrient composition guidelines (theoretical aspects) as set forward by the Codex Standard for Processed Cereal-based Foods for Infants and Young Children (Codex Standard 074, 2006:1-4) and the PNCFCF (2003:3011S-3020S). It further aimed at examining (testing) the acceptance and use of Tsabana to account for (explain) its realism in the field.

Survey methods involve gathering information about the current status of some target variable within a particular collectivity, then reporting a summary of the findings. A target variable is a specified characteristic of a group or collectivity with the collectivity a group of things of a specified kind that becomes the focus of the survey (Thomas, 2003:41-42). In this study the collectivity from which the information on the realism of Tsabana in the field was obtained consisted of individuals (caregivers), who received Tsabana as dietary intervention product for their infant/child, in government clinics in the Ngamiland, North East, Central and Kweneng districts of Botswana.

3.3 Data collection methods

When researchers speak of research methods, they often refer to processes and instruments used for gathering information (Thomas, 2003:57). In this study both primary and secondary sources (see Figure 3.1) were used as data collection methods. Primary sources (first hand data) were used to examine the acceptance and use of Tsabana as the information was directly obtained from the caregivers of the infants receiving Tsabana themselves. Secondary sources

(second hand data) were used for the nutritional appraisal of Tsabana as the nutrient content information was obtained from the product packaging label and compared to the guidelines as set forward by two publications namely the Codex Standard for Processed Cereal-based Foods for Infants and Young Children (Codex Standard 074, 2006:1-4) and the Proposed Nutrient Composition for Fortified Complementary Foods (2003:3011S-3020S). In addition, the World Health Organization recommended nutrient intakes (FAO/WHO, 2001) were used in comparison to the nutrients provided by Tsabana.

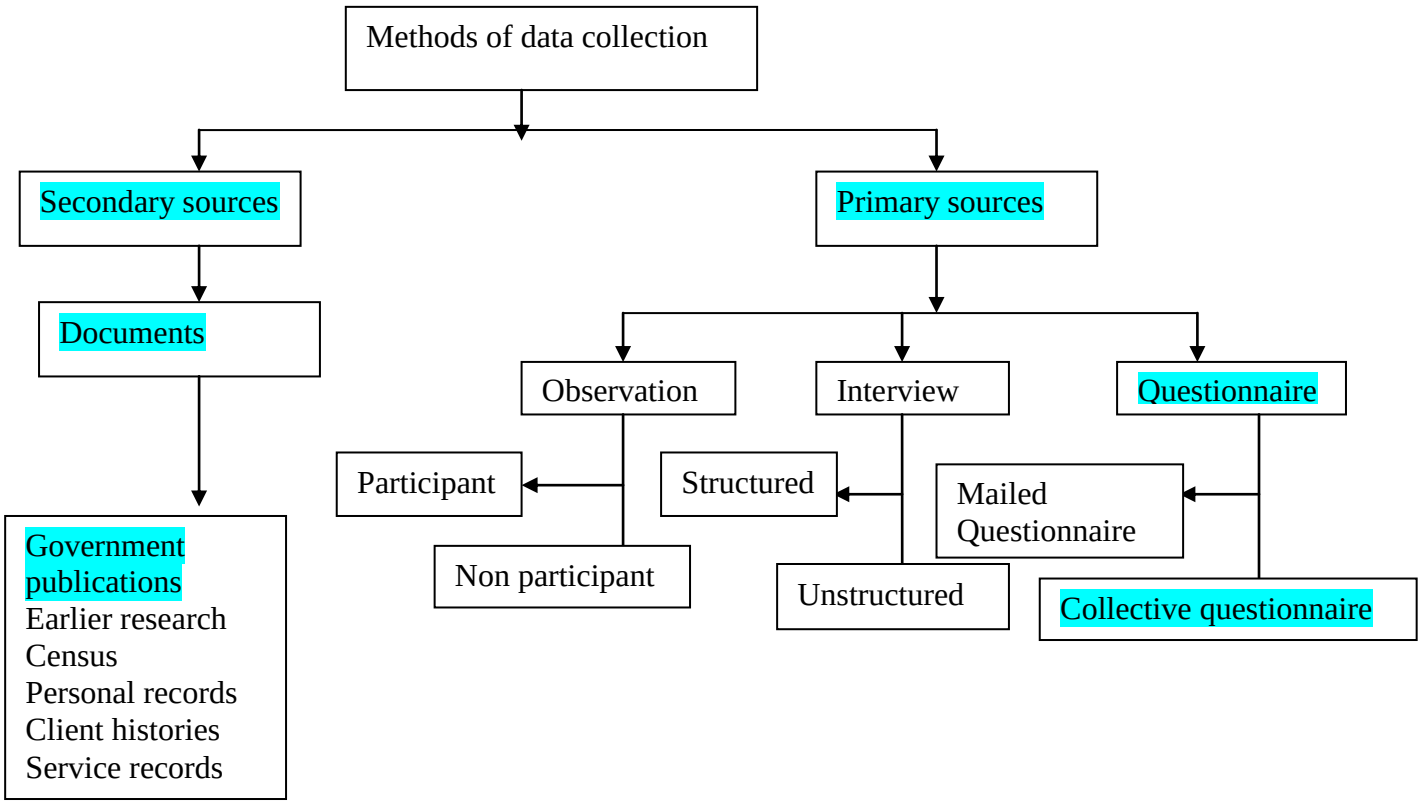


Figure 3.1: Methods of data collection (obtained from Kumar, 2005:118) with the shaded aspects related to this study

For the data gathered to examine the realism of Tsabana in the field (i.e. acceptance and use) a simple questionnaire was compiled and used (see Addendum E). All questions were written in the respondents' native language (Setswana) that was accompanied by a translation in English. Due to the high literacy rates across districts and towns in Botswana (Hanemann, 2006:10) the participants (i.e. caregivers of infants/children receiving Tsabana) were able to answer the self-administered simple questionnaire. In this study the questionnaire was answered in group sessions. To assist the answering of the questionnaire the researcher being

present in the group sessions read out the questions as suggested in the pre-testing of the questionnaire.

When the collective questionnaire was developed the major focus was on the acceptance and use of Tsabana in the households. Within the questionnaire three sub-sections were developed, with Section A on the acceptance and use of Tsabana, Section B on general clinic information and Section C on the participant and child demographic, biographic and lifestyle characteristics. Each section comprised its own set of questions. Section A consisted of 24 questions, section B 11 questions and section C 18 questions. The questions included were all closed-ended in the multiple-choice format for ease of the questionnaire completion. All the questionnaire questions and multiple-choice answers were coded for ease of the data analysis (see Addendum E).

3.4 Conducting the study

Conducting the study included execution of the nutritional appraisal of Tsabana followed by the acceptance and use of Tsabana through a field survey.

3.4.1 Nutritional appraisal

The guidelines of the Codex Standard for Processed Cereal-based Foods for Infants and Young Children (Codex Standard 074, 2006:1-4), the PNCFCF (2003:3011S-3020S) and the WHO recommended nutrient intakes (FAO/WHO, 2001) were used for the nutritional appraisal of Tsabana which is based only upon a theoretical determination. The nutrient content information obtained from the Tsabana product packaging was set out in tabular format and compared to the reference standards /specifications/ guidelines to determine if the nutrient contents of energy and the macro- and micronutrients fell within the specified nutrient ranges. In the nutritional appraisal of Tsabana against the Codex Standard (Codex Standard 074, 2006:1-4) and the PNCFCF (2003:3011S-3020S) adequate provision was considered when the included nutrients met, exceeded and fell short within 10% of the minimum specified ranges.

3.4.2 Acceptance and use

To fully appreciate the acceptance and use in households of the dietary intervention product, Tsabana, the following aspects were attended to as part of this phase of the study.

3.4.2.1 Study area, sample and size

Botswana is divided into 15 administrative districts: 9 rural districts and 6 urban districts. The study was conducted only in Botswana's rural districts. Four of these rural districts formed the study area as put forward by the Botswana Ministry of Health namely Ngamiland, North East, Central and Kweneng district (see Figure 3.2). These mentioned districts were additionally selected as they are not near the Food Resources Depots and might not be getting the same access of Tsabana than in urban districts where the depots are situated. Within these districts there are government clinics within the rural villages which were selected as the research sites. Cluster sampling was used to collect the data whereby the data was gathered from different clinics around the villages in the districts but situated in the closer proximity of each other. The information was collected from the caregivers who voluntarily participated, received Tsabana on behalf of the infant/child meeting the inclusion criteria of being six to 36 months old and attended the clinic on the day of the data gathering. Caregivers of six to 36 months old infants/children were selected for participation as this age group has high energy and protein needs for optimal growth and is the age group that is mostly brought to the clinics for growth monitoring and weighing.

Figure 3.2: Map of Botswana indicating the assigned districts

In each of the four rural districts, besides for the North East district, two villages with their respective clinics were sampled as cluster research sites considering the proximity from each other. Shorobe is a remote village situated in the Ngamiland district. It is about 50 kilometres (km) from Maun. Maun is the major village in Ngamiland. The Shorobe and Maun clinics were the research sites in the Ngamiland district (see Figure 3.3). Masunga, Nlapkhwane and Mapoka are rural villages in the North East district. They were selected as the research sites for this district and are approximately 15 to 20 km apart (see Figure 3.3).

Figure 3.3 Some of the clinics (research sites) in the selected rural districts

Mabeleapudi was one of the selected research sites in the Central district. It is about 40 km away from the Serowe village which is the major village in the Central district. Lencheng is another rural village in the Central district. It was the other selected research site. It is 20 km away from Palapye which is the second major village in the Central district (see Figure 3.3)**.** In the Kweneng district Lentsweletau and Letlhakeng were selected as the research sites. Lentsweletau is about 40 km from Molepolole which is the biggest village in the Kweneng district and Letlhakeng is about 65 km from Molepolole. It was further envisaged that at least ten caregivers would participate per village and clinic allowing for a minimum of 80 participants for this phase of the study.

3.4.2.2 Pilot study for pre-testing of questionnaire

The questionnaire was pre-tested for content and face validity. This was performed by academic staff members (n = 3) of the program Consumer Science: Food and Nutrition, CPUT and the Health Research Unit Division personnel (n = 3) of the Botswana Ministry of Health. Respondents in the field representing the study sample at a 10% level (n = 11) were invited to complete the questionnaire and commented on the ease of completion and the time required for its completion as further measure of its face validity. This pilot study was conducted at the clinic in Maun in the Ngamiland district.

All comments received on the content and face validity evaluation of the questionnaire were considered and the compiled questionnaire adapted accordingly. In the execution of the pilot study only one comment and concern was raised by the participants. They suggested that some of the participants read slower than others and could therefore not complete the questionnaire in the same time. It was proposed that the researcher should read the questionnaire question by question for the whole group. The researcher therefore read out the questions while the participants ticked their answer. It seemed to have worked well because the participants mentioned that with the researcher being the one reading out the questions for them they grasped the question easier and finished on time.

3.4.2.3 Questionnaire application

The questionnaire was used as the method of data collection on its pre-testing. Questionnaires were provided to groups of caregivers of infants and children aged six months to three years who received Tsabana at the selected clinics. The researcher was present as they completed the questionnaire to guide and answer any questions raised. It took an average of 30 minutes for the caregivers to complete the questionnaire. The field survey was conducted in a period of one month.

3.5 Data analysis

3.5.1 Tsabana nutritional appraisal

The data analysis was done considering the nutrient content of Tsabana against the guidelines from the Codex Standard for Processed Cereal-based Foods for Infants and Young Children (Codex Alimentarius Standard, 2006:1-4), the PNCFCF (2003:3011S-3020S) and WHO recommended nutrient intakes (FAO/WHO, 2001) as provision within the guideline range.

3.5.2 Tsabana acceptance and use as obtained from the questionnaire

Acceptance and use – Frequencies as descriptive statistics of the questionnaire question responses and associations between the responses (Pearson's chi-squared statistic) with a significance level of five percent ($p < 0.05$) were used for this data analysis. The Fisher's exact test was also used as a statistical analysis method on the response combinations to account for empty cells and low cell numbers on completion of the questionnaire (for question response combinations see Addendum F). The data entry and analysis was performed using the SPSS program version 20.

CHAPTER 4

RESULTS

The study results are presented in two parts that firstly comprises the nutritional appraisal of Tsabana (as 4.1) and secondly its acceptance and use (as 4.2).

4.1 Tsabana nutritional appraisal

4.1.1 Nutrient content adequacy

The guidelines of the Codex Alimentarius Standard for Processed Cereal-based Foods for Infants and Young Children (Codex Standard 074) (Codex Alimentarius Standard, 2006:1) and the PNCFCF (Lutter & Dewey, 2003:3015S) were used for the theoretical nutritional appraisal of Tsabana. The nutrient content information obtained from the Tsabana products packaging (see Table 4.1) were compared to the nutrient content indications in the guidelines to determine if the product energy, macro- and micronutrient content provisions fell within the specified nutrient ranges. The nutrient content guideline values are set at levels that meet the needs of all infants and children to prevent nutrient deficiencies. The levels set are therefore considered to be the amounts necessary to achieve and maintain optimum nutritional status and assist in the reduction of disease (Codex Alimentarius Standard, 2006:1).

Table 4.1: Nutritional composition of Tsabana per 100 gram powder as obtained from the product packaging

Energy and micronutrients	Nutrient content per 100 g[a] powder
Energy (kJ)[b]	1 470
Protein (g)	15
Vitamin A (ug)[c]	495
Vitamin D (ug)[c]	5
Vitamin E (mg)[d]	7.5
Vitamin C (mg)	80
Riboflavin (mg)	0.5
Niacin (mg)	8
Thiamin (ug)[e]	800
Pyridoxine (mg)	0.13
Vitamin B12 (ug)	2
Folacin (ug)[e]	200
Pantothenic acid (mg)	2.4
Calcium (mg)	630
Phosphorus (mg)	600
Zinc (mg)	1.65
Iodine (ug)[e]	50
Iron (mg)	6.5

[a] Obtained from the product packaging per 100 gram (g) powder

[b] kJ = kilojoules

[c] I.U. (International Units) indicated on packaging converted to micrograms (ug): Vitamin A: 1 650 I.U. = 495 ug; Vitamin D: 200 I.U. = 5 ug

[d] mg = milligrams

[e] Milligrams (mg) indicated on packaging converted to micrograms (ug): Thiamin: 0.8 mg = 800 ug; Folacin: 0.2 mg = 200 ug; Iodine: 0.05 mg = 50 ug

The two major ingredients of Tsabana are sorghum and soya which also contribute to its protein and energy contents. The energy level provided by Tsabana is more than the specified Codex Alimentarius Standard composition (see Table 4.2) but slightly less than the PNCFCF specified range (see Table 4.3), whereas the protein level provided is within the specified ranges as put forward by Codex composition (see Table 4.2) and the PNCFCF, respectively (see Table 4.3). As Tsabana does not contain any source of fat the lable does not state the EFA content (see Table 4.1). The vitamin A and D content meets the compositional guidelines of the Codex Alimentarius Standard, whereas the provision of thiamine and calcium exceed the specified and minimum specified compositional guidelines, respectively (see Table 4.2).

Table 4.2: Energy, macro- and micronutrient contents of Tsabana[a] in relation to the Codex Alimentarius Standard for Processed Cereal-based Foods for Infants and Young Children[b]

Energy and macronutrients	**Nutrient content of Tsabana**	**Codex Alimentarius Standard composition[b]**	**Tsabana content in comparison to the Codex Alimentarius Standard composition**
Energy (kJ[c] /g[d])	14.7 kJ/g	Not less than 3.3 kJ/g	↑
Protein (g/100kJ)	1.02 g/100kJ	Shall not exceed 1.3 g/100kJ or not be less than 0.48 g/100kJ	√
n-6 Polyunsaturated fatty acids (mg[e])	-	Not less than 70 mg/100kJ	–
n-3 Polyunsaturated fatty acids (g)	-	-	–
Micronutrients			
Vitamin A (ug[f]/100kJ)	33.7 ug/100kJ	Shall be within 14-43 ug/100kJ	√
Vitamin D (ug/100kJ)	0.34 ug/100kJ	Shall be within 0.25-0.75 ug/100kJ	√
Thiamin (ug/100kJ)	54.4 ug/100kJ	12.5 ug/100kJ	↑
Calcium (mg /100kJ))	42.9 mg/100kJ	Not less than 20 mg/100kJ	↑

[a] Obtained from the Tsabana product packaging

[b] Obtained from Codex Alimentarius Standard for Processed Cereal-based Foods for Infants and Young Children (Codex Alimentarius Standard, 2006:1)

[c] kJ = kilojoules

[d] g = grams

[e] mg = milligrams

[f] ug = micrograms

↑ Above minimum specified range

√ Within specified range

− Not provided

Table 4.3: Energy, protein and micronutrient contents of Tsabana[a] in relation to the Proposed Nutrient Composition for Fortified Complementary Foods [b]

Energy, protein and micronutrients	Nutrient content of Tsabana per 100 g[c] powder[a]	PNCFCF [b] per 100 g	Tsabana content in comparison to the PNCFCF
Energy (kJ)[d]	1 470	1 848	↓
Protein (g/100kJ)	1.02 g/100kJ	0.41 – 0.75 g/100kJ	↑
Vitamin A (ug)[e]	495	500	↓
Vitamin D (ug)	5	2-4	↑
Vitamin E (mg)	7.5	10	↓
Vitamin C (mg)[f]	80	140-280	↓
Riboflavin (mg)	0.5	0.36	↑
Niacin (mg)	8	6.1	↑
Thiamin (mg)	0.8	0.36	↑
Pyridoxine (mg)	0.13	0.44	↓
Vitamin B12 (ug)	2	0.52	↑
Folacin (ug)	200	83	↑
Pantothenic acid (mg)	2.4	0.70	↑
Calcium (mg)	630	200-400	↑
Phosphorus (mg)	600	150-200	↑
Zinc (mg)	1.65	8.3	↓
Iodine (ug)	50	180	↓
Iron (mg)	6.5	14	↓
Selenium (ug)	-	20	–
Copper (ug)	-	400-800	–

[a] Obtained from the Tsabana product packaging

[b] Proposed Nutrient Composition for Fortified Complementary Foods (Lutter & Dewey, 2003:3015S)

[c] g = grams

[d] kJ = kilojoules

[e] ug = micrograms

[f] mg = milligrams

↑ Above minimum specified range

↓ Less than specified range

− Not provided

In comparison to the PNCFCF (see Table 4.3), the content of vitamins A, E, C and pyridoxine are less than the specified ranges, while the content of the other vitamin (vitamin D, riboflavin, niacin, thiamine, vitamin B12, folacin and pantothenic acid) are above the specified ranges. The content of particularly pyridoxine at 29.5% and vitamin C at 57.1% are low compared to the content of vitamin A and E at 99% and 75%, respectively. While the content of the minerals calcium and phosphorus are above the specified ranges, the content of zinc, iodine and iron are lower compared to the compositional guidelines provided at only 19.9%, 27.8% and 46.4%, respectively. As with the absence of omega-3 and omega-6 fatty acids, the minerals selenium and copper are also not provided by Tsabana (see Table 4.1).

4.1.2 Micronutrient provision adequacy in relation to the World Health Organization recommended nutrient intakes

For seven- to 18-month-old infants Tsabana fed at the daily ration of 75g powder theoretically provides 92.8% of vitamin A in the vitamin A palmitate form and for one- to three-year-olds fed at the daily ration of 200g powder it provides 247.5%. Tsabana in these daily rations provides 75% of the vitamin D recommended intake for seven- to 18-month-old infants and at 200% for one- to three-year-olds in a cholecalciferol form. Vitamin E is provided in a vitamin E acetate form at these daily rations at 139% of the WHO recommended intake for seven- to 18-month-old and 200% for one- to three-year-old infants. The other vitamins incorporated are adequately provided except for pyridoxine which is inadequately provided for both 12- to 18-month-old (33.3%) and one- to three-year-old (52%) infants at the daily rations of 75g and 200g powder respectively (see Table 4.4).

Table 4.4: Adequacy of the Tsabana nutrient provision in relation to the WHO recommended nutrient intakes for 6- to-36-month old infants

Tsabana energy, protein and micronutrient provision		**Tsabana per daily ration [a]**		**WHO recommended nutrient intakes [d]**		**Tsabana % nutrient provision of the WHO recommended intakes**		
		6-18months	**19-36months**	**7-12 months**	**1-3years**	**7-12 months**	**12 – 18 months [e]**	**1½ - 3 years**
Composition	**Per 100 g powder**	**75 g powder [b]**	**200 g powder [c]**			**75 g powder**	**75 g powder**	**200 g powder**
Energy (kJ)[f]	1 470	1 102.5	2 205					
Protein (g)[g]	15	11.25	30					
Vitamin A (µg [h] Retinol) (Vitamin A palmitate)	495	371.25	990	400	400	99	92.8	247.5
Vitamin D (µg cholecalciferol)	5	3.75	10	5	5	75	75	200
Vitamin E (mg [i] α-Tocopherol) (Vitamin E acetate)	7.5	5.62	10	2.7	5	139	139	200
Vitamin C (mg)	80	60	160	30	30	240	200	533.3
Thiamine (mg) (mononitrate)	0.8	0.6	1.6	0.3	0.5	300	200	320
Riboflavin (mg)	0.5	0.38	1	0.4	0.5	125	95	200
Pyridoxin (mg)	0.13	0.1	0.26	0.3	0.5	100	33.3	52
Vitamin B12 (ug)	2	1.5	4	0.7	0.9	375	214.3	444.4
Folacin (ug)	200	150	400	80	150	188	188	266.7
Pantothenic Acid (mg)	2.4	1.8	4.8	1.8	2	106	100	240
Niacin (mg)	8	6	16	4	6	300	150	266.7
Calcium (mg) (Calcium pantothenate, carbonate and tri calcium phosphate ratio= 1:18:482)	630	472.5	1 260	400	500	158	118.1	252
Phosphorus (mg)	600	450						
Zinc (mg) (Zinc sulphate) [j]	1.65	1.24	3.2	8.4	8.3	19	14.8	38.6
Iodine (ug) (Potassium iodate)	50	37.5	100	90	90	42	42	111.1
Iron (mg)	6.5	4.88	13	18.6	11.6	26	26	112.1

[a] Information received from a representative on behalf of the Botswana Ministry of Health
[b] 37.5 g x 2 servings per day to 25 g x 3 servings per day equalling 75 g per daily ration
[c] 40 g x 5 servings per day to 33.3 g x 6 servings per day equalling 200 g per daily ration
[d] Vitamin and mineral requirements in human nutrition (WHO, 1998:338)
[e] Tsabana % nutrient provision of WHO (1-3 years) recommended intakes of 18- month-old infants who receive 75 g Tsabana as the daily ration
[f] Kilojoules
[g] Grams
[h] Micrograms
[I] Milligrams
[j] Low bioavailability consideration on WHO recommended nutrient intakes

In this daily ration of 75g and 200g powder respectively calcium is provided by Tsabana at 158% of the WHO recommended intake for seven- to 12-month-old infants, at 118% for 12- to 18-month-old infants and at 252% for one- to three-year-olds. The forms of calcium used in Tsabana are calcium pantothenate, carbonate and tri calcium phosphate at a ratio of 1:18:482. Tsabana provides iodine for the seven- to 18-month-old infants inadequately at a daily provision of 42% in a potassium iodate form. Twenty six percent of the WHO recommended intake of iron is provided by Tsabana for the seven- to 18-month-old infants. It is not stipulated on the Tsabana package in which form iron is provided. Zinc is only provided at less than 20% of the WHO recommended intake for the seven- to 18-month-old infants and at less than 40% for one- to three-year-olds. It is provided in a zinc sulphate form.

4.1.3 Micronutrient compounds used in fortification

The fortification compounds used in Tsabana for the mineral and vitamin additions are indicated in Table 4.4.

4.2 Tsabana acceptance and field use

4.2.1 Participant sample and sample profile

One hundred and ten caregivers of infants within the age group 6 to 36 months entered the study. These caregivers visited the selected clinicson the days the research was conducted and they were willing to participate in the study. The data of 105 of these caregivers were used for the study as five participants withdrew as they were not interested to complete the entire questionnaire. Two clinics were used as research sites per district, but three clinics were used in one of the districts (North East) to ensure that an adequate number of participants could be obtained within this district. The participant numbers were 23 (21.9%) for Ngamiland, 28 (26.7%) for North East, 20 (19%) for Central and Kweneng, being the largest district, 34 (32.4%) participants.

The caregivers' demographic, biographic and lifestyle characteristics are represented in Table 4.5. The majority (71.4%) of the caregivers were aged between 19 and 29 years (37.1%) and 30 to 44 years (34.3%). Most (46.7%) of them achieved the secondary educational level (Form 1 to Form 4). Most (69.5%) of the caregivers of the infants who were receiving Tsabana were also their own mothers. In most of the participating caregiver households there were at most two children (37.1%) followed closely by one child (29.5%) and three children (23.8%). Most (45.7%) of the households obtained their source of income from permanent work.

Table 4.5: Participant demographic, biographic and lifestyle information

Participant demographic, biographic and lifestyle information (n = 105)		**%**	**n**
Age (years)	18 and younger	15.2	16
	19-29	37.1	39
	30-44	34.3	36
	45-54	5.7	6
	54 and older	7.6	8
Education level	No schooling	8.6	9
	Standard 1-3	12.4	13
	Standard 4-7	20.0	21
	Form 1-4	46.7	49
	O'level and above	12.4	13
Caregiver relationship to infant receiving Tsabana	Mother	69.5	73
	Sister	5.7	6
	Aunt	9.5	10
	Grandmother	12.4	13
	Child minder	2.9	3
Infant's gender	Boy	49.5	52
	Girl	50.5	53

Table 4.5 (Continued): Participant demographic, biographic and lifestyle information			
Participant demographic, biographic and lifestyle information (n = 105)		**%**	**n**
Number of children in the household	1	29.5	31
	2	37.1	39
	3	23.8	25
	4 or more	9.5	10
Household income source	Permanent work	45.7	48
	Contract work	23.8	25
	Government grants	11.4	12
	Pension funds	1.0	1
	No fixed income	18.1	19

4.2.2 Participant infant meal and snack practices and dietary provision

4.2.2.1 Infant meal and snack practices

The infant meal and snack practices investigated in the study are presented in Table 4.6. Most (49.5%) of the infants ate a meal three times a day and received snacks once a day (56.2%). Most (60.9%) participants indicated that there were no times when the infant received less food because there was food shortage or no money in the household. A similar percentage (58.1%) of the participants also indicated that there were no times when the infant received no food because there was no food or money in the household. There were, however, households in which the infant either received less or no food due to household circumstances, for example no money in the household to buy food (39.1% and 41.9%, respectively).

Table 4.6: Participant infant daily meal and snack practices

Participant infant meal and snack practices (n = 105)		%	n
Meals per day	Once	11.4	12
	Twice	14.3	15
	Three times	49.5	52
	Four times and more	24.8	26
Daily snacks received	Once	56.2	59
	Twice	25.7	27
	Three times	10.5	11
	Four times and more	7.6	8
Less food received due to household circumstances	Yes, sometimes	26.7	28
	Yes, often	12.4	13
	No	60.9	64
No food received due to household circumstances	Yes, sometimes	30.5	32
	Yes, often	11.4	12
	No	58.1	61

4.2.2.2 Infant dietary provision

According to the caregivers the majority (74.3%) of the infants were not receiving breast milk which may relate to some of the infants being beyond 18 months of age. Besides from receiving Tsabana the majority was fed infant cereals (70.5%), but did not receive infant formula (75.2%). All the infants also received other cooked porridges besides Tsabana of which sorghum porridge was mostly provided (60.9%). Almost all (95.2%) of the participants indicated that they fed the infants other foodstuffs along with Tsabana. Infant cereal, cooked porridge and breakfast cereal were provided most (80.9%) on a daily basis. Bread was fed by most either weekly (41.9%) or daily (35.2%). Nearly half (49.5%) of the participants indicated that they fed the infants rice and/or pasta on a weekly basis. About a third of the participants fed the infants meat, chicken and /or fish either weekly (37.1%) or daily (33.3%). These dietary provision results are indicated in Table 4.7.

Table 4.7: Infant dietary provision

Infant dietary provision (n = 105)		**%**	**n**
Breast milk	Yes	25.7	27
	No	74.3	78
Infant cereal	Yes	70.5	74
	No	29.5	31
Infant formula	Yes	24.8	26
	No	75.2	79
Cooked porridge besides Tsabana	Yes	100	105
	No	0	0
Cooked porridge provided	Maize meal	22.9	24
	Sorghum	60.9	64
	Oats	16.2	17
Other food provided	Yes	95.2	100
	No	4.8	5
Food groups			
Cereals (infant cereal, cooked porridge and/or breakfast cereal)	Daily	80.9	85
	Weekly	10.5	11
	Seldom/never	3.8	4
Bread	Daily	35.2	37
	Weekly	41.9	44
	Seldom/never	18.1	19
Rice/Pasta	Daily	24.8	26
	Weekly	49.5	52
	Seldom/never	20.9	22
Meat/Chicken/Fish	Daily	33.3	35
	Weekly	37.1	39
	Seldom/never	24.8	26
Eggs	Daily	20.9	22
	Weekly	27.6	29
	Seldom/never	46.7	49
Milk	Daily	40	42
	Weekly	32.4	34
	Seldom/never	22.8	24
Yogurt/Cheese	Daily	23.8	25
	Weekly	27.6	29
	Seldom/never	43.8	46
Vegetables	Daily	36.2	38
	Weekly	40.9	43
	Seldom/never	18.1	19

Table 4.7 (Continued): Infant dietary provision			
Fruit	Daily	26.6	28
	Weekly	32.4	34
	Seldom/never	36.2	38
Fruit juice	Daily	24.8	26
	Weekly	37.1	39
	Seldom/never	33.3	35
Other beverages	Daily	37.1	39
	Weekly	25.7	27
	Seldom/never	32.4	34

Eggs were provided seldom and/or never to about half (46.7%) of the infants and milk was fed on a daily basis to less than half (40%) of the infants. Yogurt and cheese were also seldom and/or never fed to nearly half (43.8%) of the infants. A near equal percentage of the infants received vegetables (cooked and/or raw) weekly (40.9%) or daily (36.2%), while nearly a fifth (18.1%) of the infants seldom/never received vegetables. Fruit (fresh, canned or dried) was seldom/never fed or fed weekly to about a third (36.2% and 32.4%, respectively) of the infants, while only about a quarter (26.6%) received fruit daily. A similar finding was obtained for fruit juice with about a third receiving it weekly and seldom and/or never (37.1% and 33.3%, respectively). The participants also gave the infants other beverages to drink such as tea, coffee and/or cold drinks. About a third (37.1%) did so on a daily basis and a quarter (25.7%) on a weekly basis. About a third (32.4%) seldom/never provided these beverages to the infants (see Table 4.7).

4.2.3 Tsabana acceptance by participant sample

4.2.3.1 Infant acceptance of Tsabana as perceived by the caregivers

The majority of the participants indicated that the infants enjoyed Tsabana and liked it very much (50.5%) or moderately (29.5%) and indicated that it tasted ‘nice’ (43.8%) or ‘very nice’ (27.6%). Though most (52.4%) of the participants indicated that the colour of

Tsabana was acceptable, many also indicated that the colour was ‘nice’ (21.9%) and even ‘very nice’ (14.3%). The texture of Tsabana was also indicated acceptable (30.5%), ‘nice’ (35.2%) or even ‘very nice’ (21.9%) by most. The majority (78.1%) of participants believed that Tsabana had supported the infant’s wellbeing with most (65.9%) of these participants basing this on the infants’ improved growth. Only about half (51.4%) of the participants indicated that Tsabana was more nutritious as compared to other cooked porridges (see Table 4.8).

Table 4.8: Infant acceptance of Tsabana as perceived by the caregivers

Perceived product acceptance (n = 105)		**%**	**n**
Enjoyment	Likes very much	50.5	53
	Likes moderately	29.5	31
	Neither likes nor dislikes	11.4	12
	Dislikes moderately	1.9	2
	Dislikes much	6.7	7
Taste	Very nice	27.6	29
	Nice	43.8	46
	Acceptable	19.1	20
	Not nice	5.7	6
	Not nice at all	3.8	4
Colour	Very nice	14.3	15
	Nice	21.9	23
	Acceptable	52.4	55
	Not nice	3.8	4
	Not nice at all	7.6	8
Texture	Very nice	21.9	23
	Nice	35.2	37
	Acceptable	30.5	32
	Not nice	6.7	7
	Not nice at all	5.7	6
Improved wellbeing	Yes	78.1	82
	No	21.9	23
Wellbeing improvement (n = 82)	Baby's growth improved	65.9	54
	Appetite improved	30.5	25
	Health improved	3.6	3

Table 4.8 (Continued): Infant Tsabana acceptance as perceived by the caregivers			
Perceived product acceptance (n = 105)		**%**	**n**
Difference between Tsabana and other cooked porridges	Not different	13.3	14
	Tsabana more nutritious	51.4	54
	Tsabana gives more energy	15.2	16
	Tsabana tastes nicer	6.7	7
	Tsabana is easier to prepare	13.3	14

4.2.3.2 Factors related to the infant acceptance of Tsabana as perceived by the caregivers

a. Enjoyment acceptance

i. Associations/Differences between the enjoyment perception and factors related to the product use

Although numerous product use factors were investigated, the number of daily Tsabana feedings provided to the infant and the addition of sugar to the product were the only factors found to significantly ($p < 0.05$) impact the product enjoyment by the infants as perceived by their caregivers (see Table 4.9). A significant ($p < 0.05$) difference was found between the number of daily Tsabana feedings and the enjoyment of Tsabana by the infant as perceived by the caregivers. Most of the caregivers who perceived that the infant enjoyed Tsabana very much or moderately fed Tsabana to the infant once a day (66% and 61.3%, respectively). However, most (50%) of the caregivers who indicated that Tsabana is neither liked nor disliked by the infant indicated to not feed it daily (see Table 4.9).

Table 4.9: Associations/Differences between the enjoyment perception and factors related to the product use

Product use factors		Caregiver perceived infant enjoyment of Tsabana										
		Likes it very much		Likes it moderately		Neither likes it nor dislikes it		Dislikes it		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Number of daily feedings	Once a day	35	66	19	61.3	3	25	7	77.8	64	61	0.018[b]
	2 times a day	12	22.6	4	12.9	2	16.7	1	11.1	19	18.1	
	3 and more times a day	2	3.9	1	3.2	1	8.3	1	11.1	5	4.7	
	Not daily	4	7.5	7	22.6	6	50	0	0	17	16.2	
Amount fed at a time	1 cup [a] or 1½ cups	42	79.2	26	83.9	10	83.3	8	88.9	86	81.9	0.886
	2 and more cups	11	20.8	5	16.1	2	16.7	1	11.1	19	18.1	
Amount cooked at a time	For 1 feeding	35	66	21	67.7	9	75	9	100	74	70.5	0.212[b]
	For 2 and more feedings	18	34	10	32.3	3	25	0	0	31	29.5	
Cooking period of one feeding	Less than 10 minutes	13	24.5	6	19.4	3	25	1	11.1	23	21.9	0.167[b]
	10 to 15 minutes	26	49.1	20	64.5	9	75	8	88.9	63	60	
	20 minutes and longer	14	26.4	5	16.1	0	0	0	0	19	18.1	
Amount of powder used to cook one feeding	1 cup	30	56.6	23	74.2	10	83.3	7	77.8	70	66.7	0.308[b]
	2 cups	17	32.1	8	25.8	2	16.7	2	22	29	27.6	
	3 cups and more	6	11.3	0	0	0	0	0	0	6	5.7	
Amount of water used to cook one feeding	1 cup or 1½ cups	22	41.5	14	45.2	7	58.3	3	33.3	46	43.8	0.191[b]
	2 cups or 2½ cups	12	22.6	12	38.7	5	41.7	5	55.6	34	32.4	
	3 cups or 3½ cups	10	18.9	4	12.9	0	0	1	11.1	15	14.3	
	4 cups and more	9	17	1	3.2	0	0	0	0	10	9.5	
Temperature of infant feed	Hot	3	5.7	1	3.2	0	0	0	0	4	3.8	
	Warm	33	62.3	20	64.5	7	58.3	4	44.4	64	61	
	Cool / Cold	17	32.1	10	32.3	5	41.7	5	55.6	37	35.2	
Texture/Consistency of infant feed	Very soft and runny	7	13.2	3	9.7	2	16.7	0	0	12	11.4	0.582[b]
	Soft, but not runny	28	52.8	22	71	7	58.3	5	55.6	62	59	
	Stiff/ Very stiff	18	34	6	19.4	3	25	4	44.4	31	29.5	
Reading of instructions on package	Only once when first received	14	26.4	10	32.3	3	25	4	44.4	31	29.5	0.602
	Few times after first received	22	41.5	16	51.6	7	58.3	4	44.4	49	46.7	
	Did not pay much attention / Did not read it	17	32.1	5	16.1	2	16.7	1	11.1	25	23.8	

Table 4.9 (Continued): Associations/Differences between the enjoyment perception and factors related to the product use

Product use factors		Caregiver perceived infant enjoyment of Tsabana										
		Likes it very much				Likes it very much				Likes it very much		n
		n		n		n		n		n		
Add sugar to infant feed	Yes	43	81.1	22	71.1	11	91.7	6	66.7	82	78.1	0.031
	No	10	18.9	9	29	1	8.3	3	33.3	23	21.9	
Add cooking oil to infant feed	Yes	47	88.7	28	90.3	12	100	8	88.9	95	90.5	0.964
	No	6	11.3	3	9.7	0	0	1	11.1	10	9.5	
Add margarine to infant feed	Yes	6	11.3	4	12.9	2	16.7	1	11.1	13	12.4	0.964
	No	47	88.7	27	87.1	10	83.3	8	88.9	92	87.6	
Add salt to infant feed	Yes	26	49.1	13	41.9	7	58.3	6	66.7	52	49.5	0.542
	No	27	50.9	18	58.1	5	41.7	3	33.3	53	50.5	

a Cup = tea cup

b Fisher's exact test

The amount of Tsabana fed at a time, its preparation as the amount of Tsabana cooked at a time, the cooking time and the amount of powder or water used to cook one feeding, nor the attributes of the fed product, namely the serving temperature and texture/consistency, were significantly ($p > 0.05$) associated with its perceived infant enjoyment (see Table 4.9). Across the caregiver perceived infant enjoyment categories of Tsabana, whether it being perceived as liked very much or moderately, neither liked nor disliked or even disliked, the majority of the caregivers fed the infant one cup or one and a half cups of Tsabana at a time (79.2%, 83.9%, 83.3% and 88.9%, respectively) and cooked an amount providing one feeding at a time (66%, 67.7%, 75% and 100%, respectively). Most up to the majority of the caregivers, whether they indicated the perceived infant enjoyment as liking Tsabana very much or moderately, neither liking nor disliking it or even disliking it, also cooked one feeding for 10 to 15 minutes (49.1%, 64.5%, 75% and 88.9%, respectively) using mostly one cup powder (56.6%, 74.2%, 83.30% and 77.8%, respectively) with one to two and a half cups of water (64.1%, 83.9%, 100% and 88.9%, respectively) (see Table 4.9).

Most caregivers also served the cooked Tsabana at a warm temperature (62.3%, 64.5%, 58.3% and 44.4%, respectively) and of a soft, but not runny (52.8%, 71%, 58.3% and 55.6%, respectively) or stiff (34%, 19.4%, 25% and 44.4%) texture, whether they indicated the perceived infant enjoyment of Tsabana as liking it very much or moderately, neither liking nor disliking it or even disliking it (see Table 4.9). The perceived infant enjoyment of Tsabana was also not influenced by the caregiver reading of the instructions on the Tsabana package either attentively or not or not even reading the instructions at all ($p > 0.05$). Most up to the majority of the caregivers, whether they indicated the perceived infant enjoyment as liking Tsabana very much or moderately, neither liking nor disliking it or even disliking it, indicated reading the instructions of the Tsabana package once or a few times after it was received (67.9%, 83.9%, 83.3% and 88.8%, respectively) (also see Table 4.9).

As indicated, only the addition of sugar and no other ingredient addition were found to impact the infant enjoyment of Tsabana as perceived by their caregivers. While nearly three quarters and more of the caregivers who either perceived the infant enjoyment of Tsabana as liking it very much, moderately or neither liking nor disliking it indicated adding sugar to the cooked Tsabana (81.1%, 71.1% and 91.7%, respectively) only two thirds of the caregivers who perceived it to be disliked indicated adding sugar (66.7%) ($p < 0.05$) (see Table 4.9). Nearly all to all of the caregivers, whether they indicated the perceived infant enjoyment of Tsabana as liking it very much or moderately, neither liking nor disliking it or even disliking it, indicated adding cooking oil (88.7%, 90.3%, 100% and 88.9%), but not margarine (88.7%, 87.1%, 83.3% and 88.9%, respectively) ($p > 0.05\%$ for each) (see Table 4.9). Even though nearly half (49.5%) of the caregivers indicated adding salt to the cooked Tsabana its addition also did not impact their perceived infant enjoyment of Tsabana. In each of the perceived enjoyment categories, whether liking it very much or moderately, neither liking nor disliking it or even disliking it, about half of the caregivers in each enjoyment response category indicated to either add (49.1%, 41.9%, 58.3% and 66.7%, respectively) or not add (50.9%, 58.1%, 41.7% and 33.3%, respectively) salt to the cooked Tsabana ($p > 0.05$) (see Table 4.9).

ii. Associations/Differences between the enjoyment perception and clinic-related factors

Although no significant ($p > 0.05$) associations/differences were found between the caregiver's perceived infant enjoyment of Tsabana and their considered improvement in the infant wellbeing or not on receiving Tsabana and their considered attribute difference between Tsabana and other cooked porridges, a trend though did emerge. Among those caregivers who indicated a perceived infant enjoyment of Tsabana as liking it very much or moderately or neither liking nor disliking it, the majority indicated that it improved the infant wellbeing (84.9%, 74.2% and 83.3%, respectively) and most to the majority that it provides more nutrition to the infant than other porridges (47.2%, 54.8% and 83.3%, respectively). In contrast a larger percentage of those caregivers who indicated the perceived infant enjoyment of Tsabana as disliking it indicated that it did not improve the infant wellbeing (55.6%) compared to those that indicated it did (44.4%) and that it is not different from other cooked porridges (33.3%) than that it provides more nutrition to the infant than other porridges (22.2%) (see Table 4.10).

Table 4.10: Associations/Differences between the enjoyment perception and clinic-related factors

Clinic-related factors		Caregiver perceived infant enjoyment of Tsabana										
		Likes it very much		Likes it moderately		Neither likes it nor dislikes it		Dislikes it		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Infant wellbeing improvement by giving Tsabana	Yes	45	84.9	23	74.2	10	83.3	4	44.4	82	78.1	0.076
	No	8	15.1	8	25.8	2	16.7	5	55.6	23	21.9	
Difference between Tsabana and other cooked porridges	Not different from other cooked porridges	8	15.1	3	9.7	0	0	3	33.3	14	13.3	0.072[a]
	Gives more nutrition to the infant	25	47.2	17	54.8	10	83.3	2	22.2	54	51.4	
	Gives the infant more energy	13	24.5	2	6.5	0	0	1	11.1	16	15.2	
	Tastes nicer / Easier to prepare	7	13.2	9	29	2	16.7	3	33.3	21	20.1	

Table 4.10 (Continued): Associations/Differences between the enjoyment perception and clinic-related factors

Clinic-related factors		Caregiver perceived infant enjoyment of Tsabana										
		Likes it very much		Likes it moderately		Neither likes it nor dislikes it		Dislikes it		Total (n = 105)		p
		n	%	n	%	n	%	n	%	n	%	
Information received from clinic personnel about Tsabana	Yes	21	39.6	16	51.6	3	25	3	33.3	43	40.9	0.396
	No	32	60.4	15	48.4	9	75	6	66.7	62	59.1	
Not always receiving Tsabana from clinic	Yes	43	81.1	27	87.1	12	100	7	77.8	89	84.8	
	No	10	18.9	4	12.9	0	0	2	22.2	16	15.2	
Missing infant scheduled clinic visit	Yes	8	15.1	5	16.1	1	8.3	1	11.1	15	14.3	0.911
	No	45	84.9	26	83.9	11	91.7	8	88.9	90	85.7	

[a] Fisher's exact test

No significant ($p > 0.05$) association/difference was found between the caregiver perceived infant enjoyment of Tsabana and whether they received information regarding Tsabana from the clinic personnel or not. For instance, most of those caregivers who either indicated the infant enjoyment as liking it very much or disliking it indicated not to have received information regarding Tsabana from the clinic personnel (60.4% and 66.7%, respectively) (see Table 4.10). No significant ($p > 0.05$) associations/differences were found between the caregiver perceived infant enjoyment of Tsabana and them receiving Tsabana from the clinic or missing the infant clinic visits as whether indicating the perceived infant enjoyment of Tsabana as liking it very much or moderately, neither liking nor disliking it or even disliking it. The majority to everyone in the enjoyment response categories indicated not always receiving Tsabana from the clinic (81.1%, 87.1%, 100% and 77.8%, respectively) though not missing the scheduled infant clinic visits (84.9%, 83.9%, 91.7% and 88.9%, respectively) (see Table 4.10).

iii. Associations/Differences between the enjoyment perception and the caregiver and infant demographic factors

No significant ($p > 0.05$) associations/differences were found between the caregiver perceived infant enjoyment of Tsabana and their demographic factors and that of the infant (see Table 4.11). In the participant group most of the caregivers were aged 18 years and younger to 29 years or 30 to 44 years (52.4% and 34.3%, respectively equaling 86.7%) which were also reflected in each of the caregiver perceived infant enjoyment response categories as liking it very much (47.2% and 39.6%, respectively, equaling 86.8%) or moderately (64.5% and 22.6%, respectively equaling 87.3%), neither liking nor disliking it (50% and 33.3%, respectively equaling 83.3%) or even disliking it (44.4% and 44.4%, respectively equaling 88.8%) (see Table 4.11).

Table 4.11: Associations/Differences between the enjoyment perception and the caregiver and infant demographic factors

Demographic factors		Caregiver perceived infant enjoyment of Tsabana										
		Likes it very much		Likes it moderately		Neither likes it nor dislikes it		Dislikes it		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Caregiver age	18 years and younger to 29 years	25	47.2	20	64.5	6	50	4	44.4	55	52.4	0.763
	30 to 44 years	21	39.6	7	22.6	4	33.3	4	44.4	36	34.3	
	45 years and older	7	13.2	4	12.9	2	16.7	1	11.1	14	13.3	
Caregiver highest education level	No school education / Standard 1 to 7	22	41.5	13	41.9	5	41.7	3	33.3	43	40.9	0.971
	Secondary level and higher	31	58.5	18	58.1	7	58.3	6	66.7	62	59.1	
Caregiver relationship to infant receiving Tsabana	Mother	39	73.6	20	64.5	7	58.3	7	77.8	73	69.5	0.149
	Grand mother or child minder	10	18.9	2	6.5	3	25	1	11.1	16	15.2	
	Other family members	4	7.5	9	29	2	16.7	1	11.1	16	15.2	

Table 4.11 (Continued): Associations/Differences between the enjoyment perception and the caregiver and infant demographic factors

Demographic factors		Caregiver perceived infant enjoyment of Tsabana										
		Likes it very much		Likes it moderately		Neither likes it nor dislikes it		Dislikes it		Total (n = 105)		p
		n	%	n	%	n	%	n	%	n	%	
Gender of infant receiving Tsabana	Boy	25	47.2	14	45.2	8	66.7	5	55.6	52	40.5	0.594
	Girl	28	52.8	17	54.8	4	33.3	4	44.4	53	59.5	
Number of children receiving Tsabana in household	1 child	18	34	7	22.6	3	25	3	33.3	31	29.5	0.345
	2 children	14	26.4	14	45.2	6	50	5	55.60	39	37.1	
	3 and more children	21	39.6	10	32.3	3	25	1	11.1	35	33.3	
Household source of income	Permanent work / Contract work	36	67.9	20	64.5	11	91.7	6	66.7	73	69.5	0.659
	Government grants / Pension funds	6	11.3	4	12.9	0	0	2	22.2	12	11.4	
	No fixed income	11	20.8	7	22.6	1	8.3	1	11.1	20	19.1	

The results of the other demographic factors as the caregiver educational level, the relationship of the caregiver to the infant receiving Tsabana, the household income source and the number of children in the household receiving Tsabana of the participant group as a whole were also reflected within the caregiver perceived infant enjoyment response categories of Tsabana. Most of the caregivers attained a secondary educational level or higher (59.1%), were the infant's mother (69.5%), with the source of income mostly as permanent or contract work (69.5%) and having two or more children in the household receiving Tsabana (70.5%) which were also reflected in each of the Tsabana perceived infant enjoyment categories. In each of the perceived infant Tsabana enjoyment response categories, whether liking it very much or moderately, neither liking nor disliking it or even disliking it, most of the caregivers also attained a secondary education level or higher (58.5%, 58.1%, 58.3% and 66.7%, respectively), were the infant's mother (73.6%, 64.5%, 58.3% and 77.8%, respectively) with the source of the household income also mostly permanent or contract work (67.9%, 64.5%, 91.7% and 66.7%, respectively) and having one to two or more children in the household receiving Tsabana (66%, 77.4%, 75% and 66.7%, respectively) (see Table 4.11).

The infant enjoyment of Tsabana as perceived by their caregivers were also not associated ($p > 0.05$) with the gender of the infant as each of the perceived Tsabana enjoyment response categories were represented by a near equal percentage of boys and girls; for instance, the perceived enjoyment category of liking Tsabana very much was represented by 47.2% boys and 52.8% girls and the category of disliking Tsabana by 55.6% boys and 44.4% girls (see Table 4.11).

b. Taste acceptance

i. Associations/Differences between the taste perception and factors related to the product use

A significant ($p < 0.05$) association was found between the infant taste acceptance of Tsabana as perceived by the caregiver and the amount of water used to cook one feeding of Tsabana. Most of the caregivers who either perceived the infant taste acceptance of Tsabana as tasting very nice, nice or having an acceptable taste indicated using one up to two and a half cups of water to cook one feeding of Tsabana (72.4%, 82.6% and 70%, respectively). Most (70%) of the caregivers who indicated the perceived infant taste acceptance of Tsabana as not tasting nice also used one up to two and a half cups of water (see Table 4.12).

Table 4.12: Associations/Differences between the taste perception and factors related to the product use

Product use factors		Caregiver perceived infant taste acceptance of Tsabana										
		Tastes very nice		Tastes nice		Acceptable taste		Does not taste nice		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Number of daily feedings	Once a day	14	48.3	27	58.7	14	70	9	90	64	60.9	0.290[b]
	2 times a day	7	24.1	10	21.7	1	5	1	10	19	18.1	
	3 and more times a day	3	10.3	2	4.4	0	0	0	0	5	4.8	
	Not daily	5	17.3	7	15.2	5	25	0	0	17	16.2	
Amount fed at a time	1 cup[a] or 1½ cups	21	72.4	38	82.6	17	85	10	100	86	81.9	0.308[b]
	2 and more cups	8	27.6	8	17.4	3	15	0	0	19	18.1	
Amount cooked at a time	For 1 feeding	19	65.5	32	69.6	15	75	8	80	74	70.5	0.803
	For 2 or more feedings	10	34.5	14	30.4	5	25	2	20	31	29.5	
Cooking period of one feeding	Less than 10 minutes	8	27.6	9	19.6	1	5	5	50	23	21.9	0.298[b]
	10 to 15 minutes	16	55.2	29	63	13	65	5	50	63	60	
	20 minutes and longer	5	17.2	8	17.4	6	30	0	0	19	18.1	
Amount of powder used to cook one feeding	1 cup	17	58.6	36	78.3	10	50	7	70	70	66.7	0.128[b]
	2 cups	8	27.6	9	19.6	9	45	3	30	29	27.6	
	3 cups and more	4	13.8	1	2.1	1	5	0	0	6	5.7	
Amount of water used to cook one feeding	1 cup or 1½ cups	9	31	25	54.4	9	45	3	30	46	43.8	0.041
	2 cups or 2½ cups	12	41.4	13	28.2	5	25	4	40	34	32.4	
	3 cups or 3½ cups	3	10.4	6	13	5	33.3	1	10	15	14.3	
	4 cups and more	5	17.2	2	4.4	1	5	2	20	10	9.5	
Temperature of infant feed	Hot	1	3.4	3	6.5	0	0	0	0	4	3.8	0.262[b]
	Warm	14	48.3	29	63	16	80	5	50	64	61	
	Cool / Cold	14	48.3	14	30.5	4	20	5	50	37	35.2	
Texture/Consistency of infant feed	Very soft and runny	3	10.3	8	17.4	0	0	1	10	12	11.4	0.253[b]
	Soft, but not runny	16	55.2	28	60.9	14	70	4	40	62	59	
	Stiff / Very stiff	10	34.4	10	21.8	6	30	5	50	31	29.5	

Table 4.12 (Continued): Associations/Differences between the taste perception and factors related to the product use

Product use factors		Caregiver perceived infant taste acceptance of Tsabana										p
		Tastes very nice		Tastes nice		Acceptable taste		Does not taste nice		Total (n = 105)		
		n	%	n	%	n	%	n	%	n	%	
Reading of instructions on package	Only once when first received	11	37.9	11	23.9	5	25	4	40	31	29.5	0.722
	Few times after first received	10	34.5	24	52.2	11	55	4	40	49	46.7	
	Did not pay much attention / Did not read it	8	27.5	11	23.9	4	20	2	20	25	23.8	
Add sugar to infant feed	Yes	21	72.4	36	78.3	18	90	7	70	82	78.1	0.460
	No	8	27.6	10	21.7	2	10	3	30	23	21.9	
Add cooking oil to infant feed	Yes	26	89.7	41	89.1	19	95	9	90	95	90.5	0.897
	No	3	10.3	5	10.9	1	5	1	10	10	9.5	
Add margarine to infant feed	Yes	5	17.2	4	8.7	4	20	0	0	13	12.4	0.297
	No	24	82.8	42	91.3	16	80	10	100	92	87.6	
Add salt to infant feed	Yes	15	51.7	21	45.7	9	45	7	70	52	49.5	0.537
	No	14	48.3	25	54.3	11	55	3	30	53	50.5	

a Cup = tea cup

b Fisher's exact test

The number of daily Tsabana feedings, the amount of Tsabana fed at a time, the amount cooked at a time, the cooking time and the amount of powder used to cook one feeding of Tsabana, nor the attributes of the fed Tsabana, namely the serving temperature and texture/consistency were significantly ($p > 0.05$) associated with the infant taste acceptance of Tsabana as perceived by the caregivers. Concerning the caregiver perceived infant taste acceptance of Tsabana, whether being perceived as tasting very nice or nice, having an acceptable taste or not having a nice taste, most up to the majority of the caregivers fed the infant once a day (48.3%, 58.7%, 70% and 90%, respectively) and fed the infant one or one and a half cups of Tsabana at a time (72.4%, 82.6%, 85% and 100%, respectively). Most up to the majority of the caregivers, whether they indicated the perceived infant taste acceptance of Tsabana as tasting very nice, nice, having an acceptable taste or not tasting nice, also cooked one feeding (65.5%, 69.6%, 75% and 80%, respectively) for 10 to 15 minutes (55.2%, 63%,

65% and 50%, respectively) using mostly one cup powder (58.6%, 78.3%, 50% and 70%, respectively) or two cups (27.6%, 19.6%, 45% and 30%, respectively).

Most to the majority of the caregivers within each of the perceived Tsabana taste acceptance response categories as indicated above also served the cooked Tsabana at a warm temperature (48.3%, 63%, 80% and 50%, respectively) and at a soft but not runny texture/consistency (55.2%, 60.9%, 70% and 40%, respectively) or stiff texture (34.4%, 21.8%, 30% and 50%, respectively) (see Table 4.12). The perceived infant taste acceptance of Tsabana was not influenced by the caregiver reading of the cooking instructions on the Tsabana package either attentively or not or not even reading the cooking instructions at all ($p > 0.05$). The majority of the caregivers, whether they indicated the perceived infant taste acceptance of Tsabana as tasting very nice, nice, having an acceptable taste or not tasting nice, indicated reading the cooking instructions of Tsabana package once or a few times after it was received (72.4%, 76.1%, 80% and 80%, respectively) (see Table 4.12).

Almost all to all of the caregivers whether indicating the perceived infant Tsabana taste acceptance as very nice, nice, having an acceptable taste or not a nice taste indicated adding sugar (72.4%, 78.3%, 90% and 70%, respectively) and cooking oil (89.7%, 89.1%, 95% and 90%, respectively), but not margarine (82.8%, 91.3%, 80% and 100%, respectively). Although many caregivers indicated adding salt to the cooked Tsabana, whether they perceived the infant Tsabana taste acceptance as very nice, nice, having an acceptable taste or not tasting nice (51.7%, 45.7%, 45% and 70%, respectively), as many caregivers in each of the perceived infant Tsabana taste acceptance categories also indicated that they do not add salt to the cooked Tsabana (48.3%, 54.3%, 55% and 30%, respectively) ($p > 0.05$) (see Table 4.12).

ii. Associations/Differences between the taste perception and clinic-related factors

A significant ($p < 0.001$) difference was found between the caregivers' perceived infant taste acceptance of Tsabana and their considered improvement in the infant wellbeing by receiving Tsabana. Whereas the majority (86.2%, 84.8% and 80%, respectively), whether they indicated the perceived infant taste acceptance of Tsabana as very nice, nice or acceptable, indicated that

providing Tsabana to the infant improved the infant's wellbeing, the majority (80%) of the caregivers who perceived the infant taste acceptance of Tsabana as not tasting nice indicated that providing Tsabana to the infant had not improved the infant's wellbeing (see Table 4.13).

Table 4.13: Associations/Differences between the taste perception and clinic-related factors

Clinic-related factors		Caregiver perceived infant taste acceptance of Tsabana										p
		Tastes very nice		Tastes nice		Acceptable taste		Does not taste nice		Total (n = 105)		
		n	%	n	%	n	%	n	%	n	%	
Child wellbeing improvement by giving Tsabana	Yes	25	86.2	39	84.8	16	80	2	20	82	78.1	0.000
	No	4	13.8	7	15.2	4	20	8	80	23	21.9	
Difference between Tsabana and other cooked porridges	Not different from other cooked porridges	5	17.2	3	6.5	4	20	2	20	14	13.3	0.587
	Gives more nutrition to the infant	15	51.7	26	56.5	10	50	3	30	54	51.4	
	Gives the infant more energy	4	13.8	9	19.6	2	10	1	10	16	15.2	
	Tastes nicer / Easier to prepare	5	17.2	8	17.4	4	20	4	40	21	20.1	
Information received from clinic personnel about Tsabana	Yes	11	37.9	22	47.8	8	40	2	20	43	40.9	0.418
	No	18	62.1	24	52.2	12	60	8	80	62	59.1	
Not always receiving Tsabana from clinic	Yes	23	79.3	40	87	17	85	9	90	89	84.8	0.789
	No	6	20.7	6	13	3	15	1	10	16	15.2	
Missing infant scheduled clinic visit	Yes	3	10.3	5	10.9	5	25	2	20	15	14.3	0.400
	No	26	89.7	41	89.1	15	75	8	80	90	85.7	

Among the caregivers most (51.7%, 56.5%, 50% and 30%, respectively) in each of the perceived infant Tsabana taste acceptance response categories, whether they perceived the infant taste acceptance of Tsabana as very nice, nice, acceptable or not nice, indicated that Tsabana provided more nutrition to the infant than other cooked porridges ($p > 0.05$) (see Table 4.13).

No significant ($p > 0.05$) difference/association was also found between the caregiver perceived infant taste acceptance of Tsabana and whether receiving information regarding Tsabana from the clinic personnel or not. Most (62.1%, 52.2%, 60% and 80%, respectively) of the caregivers, whether they indicated the infant taste acceptance of Tsabana as very nice, nice,

acceptable or not tasting nice, indicated not to have received information regarding Tsabana from the clinic personnel (see Table 4.13). No significant ($p > 0.05$) differences/associations were also found between the caregiver perceived infant taste acceptance of Tsabana and them receiving Tsabana from the clinic or missing the infant clinic visits. Whether they indicated the perceived infant taste acceptance of Tsabana as very nice, nice, acceptable or not nice, the majority in each acceptance response category indicated not always receiving Tsabana from the clinic (79.3%, 87%, 85% and 90%, respectively) though not missing the scheduled infant clinic visits (89.7%, 89.1%, 75% and 80%, respectively) (see Table 4.13).

iii. Associations/Differences between the taste perception and the caregiver and infant demographic factors

No significant ($p > 0.05$) differences/associations were found between the caregiver perceived infant taste acceptance of Tsabana and their demographic factors and that of the infant (see Table 4.14). Most of the caregivers were aged 18 years and younger to 29 years and 30 to 44 years (52.4% and 34.3%, respectively equaling 86.7%) which were also reflected in each of the caregiver perceived infant taste acceptance response categories of Tsabana as tasting very nice (37.9% and 41.4%, respectively equaling 79.3%), nice (56.5% and 30.4%, respectively equaling 86.9%) having an acceptable taste (60% and 35%, respectively equaling 95%) or not tasting nice (60% and 30%, respectively equaling 90%) (see Table 4.14).

Table 4.14: Associations/Differences between the taste perception and the caregiver and infant demographic factors

Demographic factors		Caregiver perceived taste acceptance of Tsabana										
		Tastes very nice		Tastes nice		Acceptable taste		Does not taste nice		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Caregiver age	18 years and younger to 29 years	11	37.9	26	56.5	12	60	6	60	55	52.4	0.763
	30 to 44 years	12	41.4	14	30.4	7	35	3	30	36	34.3	
	45 years and older	6	20.7	6	13	1	5	1	10	14	13.3	
Highest education level of caregiver	No school education / Standard 1 to 7	14	48.3	17	37	9	45	3	30	43	40.9	0.664
	Secondary level and higher	15	51.7	29	63	11	55	7	70	62	59.1	
Caregiver relationship to infant receiving Tsabana	Mother	19	65.5	31	67.4	18	90	5	50	73	69.5	0.149
	Grand mother or child minder	8	27.6	6	13	1	5	1	10	16	15.2	
	Other family members	2	6.9	9	19.6	1	5	4	40	16	15.2	
Gender of infant receiving Tsabana	Boy	12	41.4	22	47.8	13	65	5	50	52	49.5	0.434
	Girl	17	58.6	24	52.2	7	35	5	50	53	50.5	
Number of children receiving Tsabana in household	1 child	11	37.9	14	30.4	3	15	3	30	31	29.5	0.574
	2 children	7	24.2	18	39.2	10	50	4	40	39	37.2	
	3 and more children	11	37.9	14	30.4	7	35	3	30	35	33.3	
Household source of income	Permanent work / Contract work	22	75.9	32	69.6	14	70	5	50	73	69.5	0.836
	Government grants / Pension funds	2	6.9	6	13	2	10	2	20	12	11.4	
	No fixed income	5	17.2	8	17.4	4	20	3	30	20	19.1	

The results of the other demographic factors for the participant group as a whole as the caregiver education level, the relationship of the caregiver to the infant receiving Tsabana, the household income source and the number of children in the household receiving Tsabana were also reflected within the caregiver perceived infant taste acceptance response categories of Tsabana. Most of the caregivers attained a secondary education level or higher (59.1%), were the infant's mother (69.5%), with the source of income mostly as permanent or contract work (69.5%) and having two or more infants in the household receiving Tsabana (70.5%). These results were reflected in each of the perceived infant Tsabana taste acceptance response

categories. In each of the perceived infant taste acceptance response categories of Tsabana, whether tasting very nice, nice, having an acceptable taste or not tasting nice, most of the caregivers attained a secondary education level or higher (51.7%, 63%, 55% and 70%, respectively) were the infant's mother (65.5%, 67.4%, 90% and 50%, respectively) with the source of the household income as mostly permanent or contract work (75.9%, 69.6%, 70% and 50%, respectively) and having two or more infants in the household receiving Tsabana (62.1%, 70.9%, 85% and 70%, respectively) (see Table 4.14).

No significant ($p > 0.05$) association/difference was also found between the infant taste acceptance of Tsabana as perceived by their caregivers and the infant gender. The gender of the infant in each of the perceived Tsabana taste acceptance response categories was represented by a near equal percentage of boys and girls as reflected in the perceived taste acceptance response categories very nice (41.4% boys and 58.6% girls), nice (47.8% boys and 52.2% girls) or not nice (50% boys and 50% girls) (see Table 4.14).

c. Colour acceptance

i. Associations/Differences between the colour perception and the factors related to the product use

A significant difference ($p < 0.05$) was found between the number of daily Tsabana feedings and its colour acceptance as perceived by the caregivers. Most of the caregivers who perceived the colour of Tsabana as very nice, nice, acceptable or not nice, fed Tsabana to the infant once a day (46.7%, 52.2%, 67.3% and 53.3%, respectively). However, this was followed by caregivers who indicated to not feed it daily among those who indicated that Tsabana has a very nice or not a nice colour (33.3% and 13.3%, respectively), and to feed it twice daily among those who indicated that Tsabana has a nice or an acceptable colour (21.7% and 20%, respectively). A significant ($p < 0.05$) difference was also found between the cooking period of one feeding of Tsabana and its colour as perceived by the caregivers. While most of the caregivers who either perceived the colour of Tsabana as very nice, nice or acceptable indicated cooking one feeding of

Tsabana for 10 to 15 minutes (60%, 47.8% and 67.3%, respectively), many of the caregivers who indicated Tsabana to not have a nice colour, indicated that they also cooked one feeding of Tsabana for 10 to 15 minutes (50%) and for less than 10 minutes (41.7%) (See Table 4.15)

Table 4.15: Associations/Differences between the colour perception and the factors related to the product use

Product use factors		Caregiver perceived infant colour acceptance of Tsabana										
		Very nice colour		Nice colour		Acceptable colour		Not a nice colour		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Number of daily feedings	Once a day	7	46.7	12	52.2	37	67.3	8	66.7	64	90.9	0.005
	2 times a day	2	13.3	5	21.7	11	20	1	8.3	19	18.1	
	3 and more times a day	1	6.7	2	8.7	1	1.8	1	8.3	5	4.8	
	Not daily	5	33.3	4	17.4	6	10.9	2	16.7	17	16.2	
Amount fed at a time	1 cup [a] or 1½ cups	12	80	17	73.9	47	85.5	10	83.3	86	81.9	0.680
	2 and more cups	3	20	6	26.1	8	15.5	2	16.7	19	18.1	
Amount cooked at a time	For 1 feeding	9	60	19	82.6	38	69.1	8	66.7	74	70.5	0.466
	For 2 and more feedings	6	40	4	17.4	17	30.9	4	33.3	31	29.5	
Cooking period of one feeding	Less than 10 minutes	1	6.7	4	17.4	13	23.6	5	41.7	23	21.9	0.032
	10 to 15 minutes	9	60	11	47.8	37	67.3	6	50	63	60	
	20 minutes and longer	5	33.3	8	34.8	5	9.1	1	8.3	19	18.1	
Amount of powder used to cook one feeding	1 cup	8	53.3	14	60.9	39	70.9	9	75	70	66.7	0.787
	2 cups	6	40	7	30.4	13	23.6	3	25	29	27.6	
	3 cups and more	1	6.7	2	8.7	3	5.5	0	0	6	5.7	
Amount of water used to cook one feeding	1 cup or 1½ cups	7	46.7	7	30.4	25	45.5	7	58.3	46	43.8	0.795
	2 cups or 2½ cups	2	13.3	8	34.8	20	36.4	4	33.3	34	32.4	
	3 cups or 3½ cups	4	26.7	3	13.0	8	14.6	0	0	15	14.3	
	4 cups and more	2	13.3	5	12.7	2	3.6	1	8.3	10	9.5	
Texture/Consistency of infant feed	Very soft and runny	0	0.	3	13	9	16.4	0	0	12	11.4	0.189[b]
	Soft, but not runny	11	73.3	11	47.8	34	61.8	6	50	62	59	
	Stiff / Very stiff	4	26.7	9	39.1	12	21.8	6	50	31	29.5	

Table 4.15 (Continued): Associations/Differences between the colour perception and the factors related to the product use												
Temperature of infant feed	Hot	1	6.7	0	0	3	5.5	0	0	4	3.8	
	Warm	8	53.3	15	65.2	34	61.8	7	58.3	64	61	
	Cool / Cold	6	40	8	34.8	18	32.7	5	41.7	37	35.2	
Reading of instructions on package	Only once when first received	6	40	5	21.7	16	29.1	4	33.3	31	29.5	0.592
	Few times after first received	7	46.7	10	43.5	25	45.5	7	58.3	49	46.7	
	Did not pay much attention / Did not read it	2	13.3	8	34.8	14	25.5	1	8.3	25	23.8	
Add sugar to infant feed	Yes	11	73.3	16	69.6	44	80	11	91.7	82	78.1	0.460
	No	4	26.7	7	30.4	11	20	1	8.3	23	21.9	
Add cooking oil to infant feed	Yes	15	100	20	87	48	87.3	12	100	95	90.5	0.281
	No	0	0	3	13	7	12.7	0	0	10	9.5	
Add margarine to infant feed	Yes	5	33.3	1	4.3	5	9.1	2	16.7	13	12.4	0.081
	No	10	66.7	22	95.7	50	90.9	10	83.7	92	87.6	
Add salt to infant feed	Yes	7	46.7	10	43.5	29	52.7	6	50	52	49.5	0.894
	No	8	53.3	13	56.5	26	47.3	6	50	53	50.5	

a Cup = tea cup

b Fisher's exact test

The amount of Tsabana fed at a time, its preparation as the amount of Tsabana cooked at a time, the amount of powder or water used to cook one feeding of Tsabana, nor the attributes of the fed product, namely the serving temperature and texture/consistency, were significantly ($p > 0.05$) associated with its colour acceptance as perceived by the caregivers (see Table 4.15). With regard to the caregiver perceived colour acceptance of Tsabana, whether being perceived as very nice, nice, acceptable or not nice, most of the caregivers indicated that they fed the infant one or one and a half cups of Tsabana at a time (80%, 73.9%, 85.5% and 83.3%, respectively) and cooked an amount enough for one feeding at a time (60%, 82.6%, 69.1% and 66.7%, respectively). Most to the majority of the caregivers, whether they indicated the perceived colour acceptance of Tsabana as very nice, nice, acceptable or not nice, also mostly indicated that they used one cup powder (53.3%, 60.9%, 70.9% and 75%, respectively) with either one up to two and a half cups of water (60%, 65.2%, 81.9% and 86.6%, respectively) in its preparation. Most

caregivers also indicated that they served the cooked Tsabana at a warm (53.3%, 65.2%, 61.8% and 58.3%, respectively) or cool or cold (40%, 34.8%, 32.7% and 41.7%, respectively) temperature and of a soft, but not runny (73.3%, 47.8%, 61.8% and 50%, respectively) or stiff (26.7%, 39.1%, 21% and 50%, respectively) texture/consistency, whether they indicated the perceived colour acceptance of Tsabana as very nice, nice, acceptable or not nice (see Table 4.15). The perceived colour acceptance of Tsabana was also not influenced by the caregiver reading the instructions of the Tsabana package either attentively or not or not even reading the instructions at all ($p > 0.05$). The majority of the caregivers, whether they indicated the colour of Tsabana as very nice, nice, acceptable or not nice, indicated reading the instructions of the Tsabana package once or a few times after it was received (86.7%, 65.2%, 74.6% and 91.6%, respectively) (see Table 4.15).

The majority to all of the caregivers, whether they indicated the perceived colour acceptance of Tsabana as very nice, nice, acceptable or not nice, indicated adding sugar (73.3%, 69.6%, 80% and 91.7%, respectively) and cooking oil (100%, 87%, 87.3% and 100%, respectively), but not margarine (66.7%, 95.7%, 90.9% and 83.7%, respectively) ($p > 0.05$) (see Table 4.15). Addition of salt to the cooked Tsabana also did not impact its perceived colour acceptance. In each of the colour acceptance categories, whether very nice, nice, acceptable or not nice, about half of the caregivers in each colour acceptance response category indicated to either add (46.7%, 43.5%, 52.7% and 50%, respectively) or not add (53.3%, 56.5%, 47.3% and 50%, respectively) salt to the cooked Tsabana ($p > 0.05$) (see Table 4.15).

ii. Associations/Differences between the colour perception and clinic-related factors

No significant ($p > 0.05$) associations/differences were found between the caregiver perceived colour acceptance of Tsabana and their considered improvement in the infant wellbeing, or not, on receiving Tsabana and their considered attribute differences between Tsabana and other cooked porridges. Most of the caregivers, whether they indicated the perceived colour acceptance of Tsabana as very nice, nice, acceptable or not

nice, indicated that it improved the infant wellbeing (86.7%, 69.6%, 81.8% and 66.7%, respectively) and about half of them indicated it to provide more nutrition to the infant than other porridges (40%, 56.5%, 52.7% and 50%, respectively) (see Table 4.16).

Table 4.16: Associations/Differences between the colour perception and clinic-related factors

Clinic-related factors		Caregiver perceived infant colour acceptance of Tsabana										
		Very nice colour		Nice colour		Acceptable colour		Not a nice colour		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Child wellbeing improvement by giving Tsabana	Yes	13	86.7	16	69.9	45	81.8	8	66.7	82	78.1	0.394
	No	2	13.3	7	30.4	10	18.2	4	33.3	23	21.9	
Difference between Tsabana and other cooked porridges	Not different from other cooked porridges	3	20	4	17.4	6	10.9	1	8.3	14	13.3	0.389[a]
	Gives more nutrition to the infant	6	40	13	56.5	29	52.7	6	50	54	51.4	
	Gives the infant more energy	4	26.7	4	17.4	8	14.5	0	0	16	15.2	
	Tastes nicer / Easier to prepare	2	13.3	2	8.7	12	21.8	5	41.7	21	20.1	
Information received from clinic personnel about Tsabana	Yes	10	66.7	9	39.1	21	38.2	3	25	43	40.9	0.134
	No	5	33.3	14	60.9	34	61.8	9	75	62	59.1	
Not always receiving Tsabana from clinic	Yes	12	80	21	91.3	46	83.6	10	83.3	89	84.8	0.777
	No	3	20	2	8.7	9	16.4	2	16.7	16	15.2	
Missing infant scheduled clinic visit	Yes	1	6.7	6	26.1	6	10.9	2	16.7	15	14.3	0.273
	No	14	93.3	17	73.9	49	89.1	10	83.3	90	85.7	

[a] Fisher's exact test

No significant ($p > 0.05$) association/difference was also found between the caregiver perceived colour acceptance of Tsabana and whether receiving information regarding Tsabana from the clinic personnel or not. Most of the caregivers, whether they indicated the colour acceptance of Tsabana as nice, acceptable or not nice, indicated not to have received information regarding Tsabana from the clinic personnel (60.9%, 61.8% and 75%, respectively). However, among those caregivers who perceived the colour acceptance of Tsabana as very nice most (66.7%) indicated to have received information regarding Tsabana from the clinic personnel. This difference though was not significant

($p > 0.05$) (see Table 4.16). No significant ($p > 0.05$) associations/differences were found between the caregiver perceived colour acceptance of Tsabana and them receiving Tsabana from the clinic or missing the infant clinic visits, whether they indicated the perceived colour acceptance of Tsabana as very nice, nice, acceptable or not nice. The majority in each colour acceptance response category indicated not always receiving Tsabana from the clinic (80%, 91.3%, 83.6% and 83.3%, respectively) even though not missing the scheduled infant visits (93.3%, 73.9%, 89.1% and 83.3%, respectively) (see Table 4.16).

iii. Associations/Differences between the colour perception and the caregiver and infant demographic factors

No significant ($p > 0.05$) differences/associations were found between the caregiver perceived colour acceptance of Tsabana and their demographic factors and that of the infant (see Table 4.17). Most of the caregivers as indicated were aged 18 years and younger to 29 years and 30 to 44 years (52.4% and 34.3%, respectively equalling 86.7%) which were also reflected in each of the caregiver perceived colour acceptance categories as having a very nice colour (66.6% and 26.7%, respectively equalling 93.3%), nice colour (52.2% and 34.8%, respectively equalling 87%), acceptable colour (49.1% and 36.4%, respectively equalling 85.5%) or even not having a nice colour (50% and 33.3%, respectively equalling 83.3%) (see Table 4.17).

Table 4.17: Associations/Differences between the colour perception and the caregiver and infant demographic factors

Demographic factors		Caregiver perceived colour acceptance of Tsabana										
		Very nice colour		Nice colour		Acceptable colour		Not a nice colour		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Caregiver age	18 years and younger to 29 years	10	66.6	12	52.2	27	49.1	6	50	55	52.4	0.945
	30 to 44 years	4	26.7	8	34.8	20	36.4	4	33.3	36	34.3	
	45 years and older	1	6.7	3	13	8	14.5	2	16.7	14	13.3	
Highest education level of caregiver	No school education / Standard 1 to 7	8	53.3	12	52.2	21	38.2	2	16.7	43	40.9	0.154
	Secondary level and higher	7	46.7	11	48.2	34	61.8	10	83.3	62	59.1	
Caregiver relationship to the infant receiving Tsabana	Mother	12	80	16	69.6	39	70.9	6	50	73	69.6	0.764
	Grand mother or child minder	1	6.7	4	17.4	8	14.5	3	25	16	15.2	
	Other family members	2	13.3	3	13	8	14.5	3	25	16	15.2	
Gender of the infant receiving Tsabana	Boy	7	46.7	11	47.8	26	47.3	8	66.7	52	49.5	0.660
	Girl	8	53.3	12	52.2	29	52.7	4	33.3	53	50.5	
Number of children receiving Tsabana in household	1 child	4	26.7	8	34.8	16	29.1	3	25	31	29.5	0.858
	2 children	5	33.3	6	26.1	22	40	6	50	39	37.1	
	3 and more children	6	40	9	39.1	17	30.9	3	25	35	33.4	
Household source of income	Permanent work / Contract work	11	73.3	15	65.2	38	69.1	9	75	73	69.5	0.519
	Government grants / Pension funds	3	20	4	17.4	4	7.3	1	8.3	12	11.4	
	No fixed income	1	6.7	4	17.4	13	23.6	2	16.7	20	19.1	

Most of the caregivers as indicated attained a secondary educational level or higher (59.1%), were the infant's mother (69.5%), with the source of income mostly as permanent or contract work (69.5%) and having two or more children in the household receiving Tsabana (70.5%) which were also reflected in each of the Tsabana perceived colour acceptance response categories. In each of the perceived Tsabana colour acceptance response categories, whether a very nice, nice, acceptable or not a nice colour,

most of the caregivers also attained a secondary educational level or higher (46.7%, 48.2%, 61.8% and 83.3%, respectively), were the infant's mother (80%, 69.6%, 70.9% and 50%, respectively) with the source of the household income mostly as permanent or contract work (73.3%, 65.2%, 69.1% and 75%, respectively) and having two or more children in the household receiving Tsabana (73.3%, 65.2%, 70.9% and 75%, respectively). With regard to the gender of the infant, the first three colour acceptance response categories were represented by a near equal percentage of boys (46.7%, 47.8% and 47.3%, respectively) and girls (53.3%, 52.2% and 52.7%, respectively) receiving Tsabana. In the last perceived Tsabana colour acceptance response category, mostly caregivers of boys (66.7%) receiving it indicated not to like it compared to caregivers of girls (33.3%) receiving it. This difference found though was not significant ($p > 0.05$) (see Table 4.17).

d. Texture acceptance

i. Associations/Differences between the texture perception and the factors related to the product use

A significant ($p < 0.05$) difference was found between the infant texture acceptance of Tsabana as perceived by the caregivers and the number of daily Tsabana feedings provided. Most of the caregivers, whether they indicated the perceived infant texture acceptance of Tsabana as very nice, nice, acceptable or not nice, indicated feeding the infant Tsabana once a day (60.9%, 64.9%, 59.4% and 53.8%, respectively). However, somewhat more caregivers who perceived the infant texture acceptance of Tsabana as not nice indicated that they did not feed it daily (23%) compared to those caregivers who perceived the infant texture acceptance of Tsabana as very nice, nice or of an acceptable texture (21.7%, 16.2% and 9.4%, respectively) (see Table 4.18).

Table 4.18: Associations/Differences between the texture perception and the factors related to the product use

Product use factors		Caregiver perceived infant texture acceptance of Tsabana										
		Very nice texture		Nice texture		Acceptable texture		Not a nice texture		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Number of daily feedings	Once a day	14	60.9	24	64.9	19	59.4	7	53.8	64	52.3	0.042 [b]
	2 times a day	2	8.7	7	18.9	8	25	2	15.4	19	34.3	
	3 and more times a day	2	8.7	0	0	2	6.2	1	7.8	5	13.3	
	Not daily	5	21.7	6	16.2	3	9.4	3	23	17	16.1	
Amount fed at a time	1 cup [a] or 1½ cups	16	69.6	29	78.4	29	90.7	12	92.2	86	81.9	0.153
	2 and more cups	7	30.4	8	21.6	3	9.3	1	7.7	19	18.1	
Amount cooked at a time	For 1 feeding	18	78.3	25	67.6	24	75	7	53.8	74	70.5	0.413
	For 2 and more feedings	5	21.7	12	32.4	8	25	6	46.2	31	29.5	
Cooking period of one feeding	Less than 10 minutes	5	21.7	7	18.9	6	18.8	5	38.5	23	21.9	0.232
	10 to 15 minutes	12	52.2	22	59.5	24	75	5	38.5	63	60	
	20 minutes and longer	6	26.1	8	21.6	2	6.2	3	23	19	18.1	
Amount of powder used to cook one feeding	1 cup	15	65.2	24	64.9	20	62.5	11	84.6	70	66.7	0.595[b]
	2 cups	5	21.7	11	29.7	11	34.4	2	15.4	29	27.6	
	3 cups and more	3	13	2	5.4	1	3.1	0	0	6	5.7	
Amount of water used to cook one feeding	1 cup or 1½ cups	10	43.5	17	45.9	13	40.6	6	46.2	46	43.8	0.452[b]
	2 cups or 2½ cups	6	26.1	13	35.1	10	31.2	5	38.5	34	32.4	
	3 cups or 3½ cups	3	13	4	10.8	8	25	0	0	15	14.3	
	4 cups and more	4	17.4	3	8.1	1	3.1	2	15.3	10	9.5	
Temperature of infant feed	Hot	3	13	0	0	1	3.1	0	0	4	3.8	0.295[b]
	Warm	11	47.8	23	62.2	22	68.8	8	61.5	64	61	
	Cool / Cold	9	39.1	14	37.8	9	28.1	5	38.5	37	35.2	
Texture/Consistency	Very soft and runny	0	0	5	13.5	4	12.5	3	23.1	12	11.4	0.157[b]
	Soft, but not runny	12	52.2	23	62.2	21	65.6	6	46.2	62	59	
	Stiff / Very stiff	11	47.8	9	24.3	7	21.9	4	30.8	31	29.5	
Reading of instructions on package	Only once when first received	8	34.8	12	32.4	8	25	3	23.1	31	29.5	0.300
	Few times after first received	7	30.4	15	40.5	20	62.5	7	53.8	49	46.7	
	Did not pay much attention / Did not read it	8	34.8	10	27	4	12.5	3	23.1	25	23.8	

Table 4.18 (Continued): Associations/Differences between the texture perception and the factors related to the product use

Add sugar to infant feed	Yes	20	87	30	81.1	23	71.9	9	69.2	82	78.1	0.384
	No	3	13	7	18.9	9	28.1	4	30.8	23	21.9	
Add cooking oil to infant feed	Yes	23	100	31	83.8	29	90.6	12	92.3	95	90.5	0.222 [b]
	No	0	0	6	16.2	3	9.4	1	7.7	10	9.5	
Add margarine to infant feed	Yes	4	17.4	6	16.2	2	6.2	1	7.7	13	12.4	0.492
	No	19	82.6	31	83.8	30	93.8	12	92.3	92	87.6	
Add salt to infant feed	Yes	11	47.8	19	51.4	16	50	6	46.2	52	49.5	0.987
	No	12	52.2	18	48.6	16	50	7	53.8	53	50.5	

a Cup = tea cup
b Fisher's exact test

None of the other numerous product use factors investigated, namely the amount of Tsabana fed at a time, the amount of Tsabana cooked at a time, the cooking time and the amount of powder or water used to cook one feeding, nor the feeding attributes of Tsabana, namely the serving temperature and texture/consistency, were significantly ($p > 0.05$) associated with the caregiver perceived infant texture acceptance of Tsabana (see Table 4.18). Among all the caregiver perceived infant texture acceptance response categories of Tsabana, whether it being perceived as very nice, nice, acceptable or not nice, most to the majority of the caregivers fed the infant one or one and a half cups of Tsabana at a time (69.6%, 78.4%, 90.7% and 92.2%, respectively), cooked an amount providing one feeding at a time (78.3%, 67.6%, 75% and 53.8%, respectively), cooked one feeding for 10 to 15 minutes (52.2%, 59.5%, 75% and 38.5%, respectively) and used mostly one cup powder (65.2%, 64.9%, 62.5% and 84.6%, respectively) with either one up to two and a half cups of water (69.6%, 81%, 71.8% and 84.7%, respectively) (see Table 4.18).

Most caregivers also indicated that they served the cooked Tsabana at a warm (47.8%, 62.2%, 68.8% and 61.5%, respectively) or cool or cold (39.1%, 37.8%, 28.1% and 38.5%, respectively) temperature and of a soft, but not runny (52.2%, 62.2%, 65.6% and 46.2%, respectively) or stiff (47.8%, 24.3%, 21.9% and 30.8%, respectively) texture, whether they indicated the perceived infant texture acceptance of Tsabana as very nice,

nice, acceptable or not nice (see Table 4.18). Reading the instructions on the Tsabana package either attentively or not or not even reading the instructions at all also did not influence the caregiver's perceived infant texture acceptance of Tsabana ($p > 0.05$). Most up to majority of the caregivers, whether they indicated the perceived infant texture acceptance as very nice, nice, acceptable or not nice, indicated that they read the instructions of the Tsabana package once or even a few times after it was received (65.2%, 72.9%, 87.5% and 76.9%, respectively) (see Table 4.18).

The majority of the caregivers, whether they perceived the infant texture acceptance of Tsabana as very nice, nice, acceptable or not nice, also indicated that they added sugar to the cooked Tsabana (87%, 81.1%, 71.9% and 69.2%, respectively) and in each of these texture acceptance response categories about half of the caregivers indicated to either add (47.8%, 51.4%, 50% and 46.2%, respectively) or not add (52.2%, 48.6%, 50% and 53.8%, respectively) salt to the cooked Tsabana ($p > 0.05$) (see Table 4.18). Nearly all to all of the caregivers, whether they indicated the perceived infant texture acceptance of Tsabana as very nice, nice, acceptable or not nice, indicated adding cooking oil (100%, 83.8%, 90.6% and 92.3%, respectively), but not margarine (82.6%, 83.8%, 93.8% and 92.3%, respectively) ($p > 0.05$) (see Table 4.18).

ii. Associations/Differences between the texture perception and clinic-related factors

Although a number of clinic-related factors were investigated, the caregiver perceived difference between Tsabana and other cooked porridges was the only factor found to significantly ($p < 0.05$) impact the infant texture acceptance of Tsabana as perceived by them. Most of the caregivers who perceived the infant texture acceptance of Tsabana as either nice, acceptable or not nice indicated that Tsabana provides more nutrition to the baby (56.8%, 59.4% and 46.2%, respectively), while somewhat more of the caregivers who perceived the infant texture of Tsabana as very nice indicated that Tsabana is not different from other cooked porridges (43.5%) compared to those who indicated that it provides more nutrition to the infant (34.8%). In addition more of the caregivers who perceived the infant texture of Tsabana as not nice indicated that Tsabana tastes nicer and is easier to prepare (38.4%) in comparison to those caregivers who indicated the

perceived infant texture acceptance of Tsabana as very nice, nice or of an acceptable texture (8.7%, 21.6% and 18.8%, respectively) (see Table 4.19).

Table 4.19: Associations/Differences between the texture perception and clinic-related factors

Clinic-related factors		Caregiver perceived infant texture acceptance of Tsabana										
		Very nice texture		Nice texture		Acceptable texture		Not a nice texture		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Child wellbeing improvement by giving Tsabana	Yes	20	87	30	81.1	25	78.1	7	53.8	82	78.1	0.126
	No	3	13	7	18.9	7	21.9	6	46.2	23	21.9	
Difference between Tsabana and other cooked porridge	Not different from other cooked porridges	10	43.5	3	8.1	1	3.1	0	0	14	13.3	0.008[a]
	Gives more nutrition to the infant	8	34.8	21	56.8	19	59.4	6	46.2	54	51.4	
	Gives the infant more energy	3	13	5	13.5	6	18.8	2	15.4	16	15.2	
	Tastes nicer / Easier to prepare	2	8.7	8	21.6	6	18.8	5	38.4	21	20	
Information received from clinic personnel about Tsabana	Yes	13	56.5	14	37.8	15	46.9	1	7.7	43	40.9	0.059
	No	10	43.5	23	62.2	17	53.1	12	92.3	62	59.1	
Not always receiving Tsabana from clinic	Yes	16	69.6	31	83.8	31	96.9	11	84.6	89	84.8	0.051
	No	7	30.4	6	16.2	1	3.1	2	15.4	16	15.2	
Missing infant scheduled clinic visit	Yes	3	13	4	10.8	5	15.6	3	23.1	15	14.3	0.738
	No	20	87	33	89.2	27	84.4	10	96.9	90	85.7	

[a] Fisher's exact test

No significant ($p > 0.05$) differences/associations were found between the caregiver perceived infant texture acceptance of Tsabana and their considered improvement in the infant wellbeing or not, whether they received information from the clinic personnel about Tsabana or not, receiving Tsabana from the clinic or not and missing the infant scheduled clinic visits or not. Among those caregivers who indicated the perceived infant texture acceptance of Tsabana as very nice, nice and acceptable, most of them indicated that it improved the infant wellbeing (87%, 81.1% and 78.1%, respectively), while among those caregivers who perceived the infant texture acceptance of Tsabana as not nice about half indicated that it did (56.8%) and did not (46.2%) improve the infant

wellbeing. This difference in the caregiver perceived infant wellbeing improvement in relation to the perceived infant texture acceptance of Tsabana though was not significant ($p > 0.05$) (see Table 4.19). Most to the majority of the caregivers who indicated the infant texture acceptance of Tsabana as nice, acceptable or not nice indicated not to have received information about Tsabana from the clinic personnel (62.2%, 53.1% and 92.3%, respectively), while most (56.5%) of those caregivers who perceived the infant texture of Tsabana as very nice indicated to have received information about Tsabana from the clinic personnel. This difference though was also not significant ($p > 0.05$). The majority of the caregivers whether they indicated the perceived infant texture acceptance of Tsabana as very nice, nice, acceptable or not nice indicated not always receiving Tsabana from the clinic (69.9%, 83.8%, 96.9% and 84.6%, respectively) though not missing the scheduled infant clinic visits (87%, 89.2%, 84.4% and 96.9%, respectively) (see Table 4.19).

iii. Associations/Differences between the texture perception and the caregiver and infant demographic factors

A significant ($p < 0.05$) difference was found between the caregiver perceived infant texture acceptance of Tsabana and the caregiver's highest education level. Most of the caregivers' perceived infant texture acceptance responses for each of the categories as nice, acceptable and not nice were provided by those caregivers who attained the secondary level and higher (70.3%, 68.7% and 61.5%, respectively). However, most of the caregivers who indicated the perceived infant texture acceptance response as very nice attained no school education or standard one to standard seven (73.9%) and not the secondary level and higher (26.1%) ($p < 0.05$) (see Table 4.20).

Table 4.20: Associations/Differences between the texture perception and the caregiver and infant demographic factors

Demographic factors		Caregiver perceived infant texture acceptance of Tsabana										
		Very nice texture		Nice texture		Acceptable texture		Not a nice texture		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Caregiver age	18 years and younger to 29 years	13	56.5	17	45.9	20	62.5	5	38.5	55	52.4	0.139
	30 to 44 years	4	17.4	15	40.5	10	31.2	7	53.8	36	34.3	
	45 years and older	6	26.1	5	13.5	2	6.3	1	7.7	14	13.3	
Caregiver highest education level	No school education / Standard 1 to 7	17	73.9	11	29.7	10	31.3	5	38.5	43	40.9	0.004
	Secondary level and higher	6	26.1	26	70.3	22	68.7	8	61.5	62	59.1	
Caregiver relationship to infant receiving Tsabana	Mother	17	74	22	59.4	25	78.1	9	69.2	73	69.5	0.088
	Grand mother or child minder	3	13	11	68.8	1	3.1	1	7.7	16	15.2	
	Other family members	3	13	4	10.8	6	18.8	3	23.1	16	15.2	
Gender of infant receiving Tsabana	Boy	8	34.8	18	48.6	20	62.5	6	46.2	52	40.5	0.238
	Girl	15	65.2	19	51.4	12	37.5	7	53.8	53	59.5	
Number of children receiving Tsabana in household	1 child	9	39.2	13	35.1	6	18.7	3	23.1	31	29.5	0.714
	2 children	7	30.4	13	35.1	14	43.8	5	38.5	39	37.1	
	3 and more children	7	30.4	11	29.8	12	37.5	5	38.5	35	33.3	
Household source of income	Permanent work / Contract work	13	56.5	27	73	24	75	9	69.2	73	69.5	0.359[a]
	Government grants / Pension funds	5	21.7	5	13.5	2	6.3	0	0	12	11.4	
	No fixed income	5	21.7	5	13.5	6	18.8	4	30.8	20	19.1	

[a] Fisher's exact test

No significant ($p > 0.05$) differences/associations were found between the caregiver perceived infant texture acceptance of Tsabana and their other demographic factors and that of the infant. Most to the majority of the caregivers were aged 18 years and younger to 29 years and 30 to 44 years (52.4% and 34.3%, respectively equalling 86.7%) which were also reflected in each of the caregiver perceived infant texture acceptance response categories as very nice (56.5% and 17.4%, respectively equalling 73.9%) nice (45.9% and 40.5%, respectively equalling 86.4%) acceptable (62.5% and 31.2%, respectively equalling 93.7%) or even not nice (38.5% and 53.8%, respectively equalling 92.3%) (see Table 4.19). The relationship of the caregiver to the infant receiving Tsabana, the

household income source and the number of children in the household receiving Tsabana also did not have an impact on the caregiver perceived infant texture acceptance of Tsabana. Most of the caregivers were the infant's mother (69.5%), with the source of income mostly as permanent or contract work (69.5%) and having two or more children in the household receiving Tsabana (70.5%) which were reflected in each of the Tsabana perceived infant texture acceptance categories as very nice, nice, acceptable or not nice. Most of the caregivers in each of these texture acceptance response categories were the infant's mother (74%, 59.5%, 78.1% and 69.2%, respectively) with the source of the household income mostly permanent or contract work (56.5%, 73%, 75% and 69.2%, respectively) and having two or more children in the household receiving Tsabana (60.8%, 64.9%, 81.3% and 77%, respectively) (see Table 4.20).

The infant texture acceptance of Tsabana as perceived by their caregivers were also not associated ($p > 0.05$) with the gender of the infant as each of the perceived infant texture acceptance response categories of Tsabana were represented by a near equal percentage or a third versus two thirds for the genders. The perceived infant texture acceptance category of Tsabana as nice was for instance represented by 48.6% boys and 51.4% girls and the category of not a nice texture by 46.2% boys and 53.8% girls, while the acceptance response categories as very nice was represented by 34.8% boys and 65.2% girls and the acceptable response category by 62.5% boys and 37.5% girls (see Table 4.20).

4.2.4 Tsabana use by participant sample

4.2.4.1 Feeding frequency, fed amount and attributes

Most (60.9%) of the participants fed Tsabana to the infant once a day and most (63.8%) fed the infant one cup at a time. Most (60.9%) of the participants also fed Tsabana to the infant at a warm temperature with a soft, but not runny, consistency (59.1%) (see Table 4.21).

Table 4.21: Tsabana feeding frequency, amount and attributes of the fed Tsabana as provided by the participants

Product feeding frequency, fed amount and attributes (n = 105)		%	n
Tsabana daily feeding frequency	Once a day	60.9	64
	2 times a day	18.1	19
	3 times a day	3.8	4
	4 times a day	1	1
	Not daily	16.2	17
Tsabana amount fed at a time	1 cup	63.8	67
	1½ cups	18.1	19
	2 cups	8.6	9
	2½ cups	2.8	3
	3 cups	1.9	2
	3½ cups	0	0
	4 cups	0	0
	4½ cups	4.8	5
Temperature of fed Tsabana	Hot	3.8	4
	Warm	60.9	64
	Cool	32.4	34
	Cold	2.9	3
Texture/Consistency of fed Tsabana	Very soft and runny	11.4	12
	Soft, but not runny	59.1	62
	Still	27.6	29
	Very stiff	1.9	2

4.2.4.2 Preparation

Most (70.5% and 60%, respectively) of the participants indicated that they cooked for one feeding of Tsabana at a time at a cooking time of 10 to 15 minutes. Most (66.7%) of the participants also used one teacup full of powder to cook one serving of Tsabana and used one and a half to two cups of water (23.8% and 27.6%, respectively) to cook one serving of Tsabana. The majority (78.1%) of the participants added sugar to the cooked Tsabana fed to the infant and most (54.9%) of them added one teaspoon to one serving of Tsabana. Nearly all the participants added cooking oil to the cooked Tsabana provided to the infant (90.5%) and most of them added one or two tablespoons (37.9% and 43.2%, respectively) to one serving of Tsabana. The majority (87.6%) of the participants,

however did not add margarine to the cooked Tsabana provided to the infant. Only about half (49.5%) of participants added salt to Tsabana when cooking it. Nearly all the participants indicated that they didn't add peanut butter (96.2%), jam (99%), syrup (97.1%), honey (97.1%) or meat sauce (96.2%) when serving the cooked Tsabana. About half (46.7%) of the participants indicated that they read the cooking instructions of Tsabana on the package a few times after it was received (see Table 4.22).

Table 4.22: Participant preparation of Tsabana

Product preparation (n = 105)		%	n
Tsabana feeding(s) cooked at a time	For 1 feeding	70.5	74
	For 2 feedings	21.9	23
	For 3 feedings	6.7	7
	For 4 or more feedings	0.9	1
Tsabana feeding(s) cooking time	Less than 10 minutes	21.9	23
	10 to 15 minutes	60	63
	20 to 25 minutes	6.7	7
	More than 30 minutes	11.4	12
Powder used for 1 Tsabana feeding	1 teacup full	66.7	70
	2 teacups full	27.6	29
	3 teacups full	0.9	1
	4 teacups full	4.8	5
Water used for 1 Tsabana feeding	1 cup	20	21
	1½ cups	23.8	25
	2 cups	27.6	29
	2½ cups	4.8	5
	3 cups	10.5	11
	3½ cups	3.8	4
	4 cups	3.8	4
	4½ cups	5.7	6
Sugar added to Tsabana	Yes	78.1	82
	No	21.9	23
Amount of sugar added to Tsabana (n = 82)	1 teaspoon	54.9	45
	2 teaspoons	37.8	31
	3 teaspoons	7.3	6
Cooking oil added to Tsabana	Yes	90.5	95
	No	9.5	10

Table 4.22 (Continued): Tsabana preparation			
Amount of cooking oil added to Tsabana (n = 95)	1 tablespoon	37.9	36
	2 tablespoons	43.2	41
	3 tablespoons	8.4	8
	4 tablespoons	10.5	10
Margarine added to Tsabana	Yes	12.4	13
	No	87.6	92
Salt added to Tsabana	Yes	49.5	52
	No	50.5	53
Peanut butter added to Tsabana	Yes	3.8	4
	No	96.2	101
Jam added to Tsabana	Yes	1	1
	No	99	104
Syrup added to Tsabana	Yes	2.9	3
	No	97.1	102
Honey added to Tsabana	Yes	2.9	3
	No	97.1	102
Meat sauce added to Tsabana	Yes	3.8	4
	No	96.2	101
Read cooking instructions of Tsabana on the package	Yes, but once	29.5	31
	Yes, a few times	46.7	49
	Yes, but did not pay attention	16.2	17
	No, did not read it	7.6	8

4.2.4.3 Use and management of leftovers

The majority (81%) of the participants did not feed the baby leftover Tsabana. For those who fed the baby leftovers (n = 20), most indicated that they stored leftover Tsabana covered in the kitchen or other room (70%) and fed it to the baby at a warm/heated temperature (65%). Most (60%) of the participants did not add water to the leftover Tsabana fed (see Table 4.23).

Table 4.23: Participant use and management of leftover prepared Tsabana

Use and management of product leftovers		%	n
Leftover Tsabana (n = 105)	Yes	19	20
	No	81	85
Storing leftover Tsabana (n = 20)	Cover, in the refrigerator	15	3
	Uncovered, in the refrigerator	15	3
	Cover, in the kitchen or other room	70	14
Temperature of leftover Tsabana fed (n = 20)	Warm/Heated	65	13
	At room temperature	30	6
	Cool/from refrigerator	5	1
Water addition to leftover Tsabana fed (n = 20)	Yes	40	8
	No	60	12

4.2.4.4 Clinic factors influencing use

Most (59%) of the participants indicated that the clinic personnel did not provide them with any information about Tsabana when they received it. Among those participants who received information (n = 41), the majority (88.4%) indicated that the clinic personnel informed them about the importance of feeding Tsabana to the infant and most (46.5%) also indicated that they were informed on how to prepare Tsabana. However, these participants also indicated that most were not informed on how to feed Tsabana to the infant (67.4%) and how to store Tsabana (69.8%). The majority (84.8%) of the participants also indicated that they sometimes did not receive Tsabana from the clinic. The main reason indicated by most (89.9%) of these participants for not receiving Tsabana was that its unavailability at the clinic. The majority (85.7%) of the participants did not miss the infant's clinic visit. The few (14.3%) that sometimes missed the infant's clinic visit mostly reported that Tsabana was not always available at the clinic (40%). Though most (54.3%) of the participants indicated that they walked a short distance to get to the clinic, many (40.9%) participants walked a long distance nonetheless (see Table 4.24).

Table 4.24: Clinic factors that may influence the participant use of Tsabana

Clinic factors influencing product use (n = 105)		%	n
Information on information received from clinic personnel	Yes	41	43
	No	59	62
Information on importance of feeding Tsabana (n = 43)	Yes	88.4	38
	No	11.6	5
Information on importance Tsabana preparation (n = 43)	Yes	46.5	20
	No	53.5	23
Information on importance feeding Tsabana (n = 43)	Yes	32.6	14
	No	67.4	29
Information on importance storing Tsabana (n = 43)	Yes	30.2	13
	No	69.8	30
Not receiving Tsabana from the clinic	Yes	84.8	89
	No	15.2	16
Reasons for not receiving Tsabana from the clinic (n = 89)	Tsabana not available	89.9	80
	Tsabana not enough	7.9	7
	Clinic personnel absent	1.1	1
	Missing clinic visits	1.1	1
Missing infant's clinic visits	Yes	14.3	15
	No	85.7	90
Reasons for missing infant's clinic visits (n = 15)	Clinic too far	26.6	4
	Tsabana not available	40	6
	Waiting long at the clinic	20	3
	Don’t have time	6.7	1
	Don’t feel like	6.7	1
Distance to get to the clinic	Walk short distance	54.3	57
	Walk long distance	40.9	43
	Use public transport	4.8	5

4.2.4.5 Factors related to the use of Tsabana by the caregivers

a. Daily feedings provided

i. Associations/Differences between number of daily feedings and the factors related to the product use

A significant ($p < 0.05$) association was found between the number of daily Tsabana feedings provided and the amount of Tsabana fed at a time to the infant. No matter how many times the infant was fed Tsabana a day, i.e., once, twice, three times or more, or even not daily, most of the caregivers fed one or one and a half cups of Tsabana (82.8%, 84.2%, 60% and 82.4%, respectively) followed by two cups and more (17.2%, 15.8%, 40% and 17.6%, respectively) at a time (see Table 4.25). A significant difference ($p < 0.05$) was though found between the number of daily Tsabana feedings provided and the amount of Tsabana cooked at a time. While most of the caregivers who fed Tsabana to the infant once daily, three or more times a day or not even daily cooked enough Tsabana for one feeding (81.3%, 60% and 64.7%, respectively), most of the caregivers who fed the infant Tsabana twice a day cooked enough Tsabana for two and more feedings at a time (57.9%) (see Table 4.25).

Table 4.25: Associations/Differences between number of daily feedings and the factors related to the product use

Product use factors		Number of daily Tsabana feedings										
		Once a day		Twice a day		Three or more times a day		Not daily		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Amount fed at a time	1 cup [a] or 1½ cups	53	82.8	16	84.2	3	60	14	82.4	86	81.9	0.004
	2 and more cups	11	17.2	3	15.8	2	40	3	17.6	19	18.1	
Amount cooked at a time	For 1 feeding	52	81.3	8	42.1	3	60	11	64.7	74	70.5	0.009
	For 2 and more feedings	12	18.7	11	57.9	2	40	6	35.3	31	29.5	

Table 4.25 (Continued): Associations/Differences between number of daily feedings and the factors related to the product use

Cooking period of one feeding	Less than 10 minutes	15	23.4	3	15.8	2	40	3	17.6	23	21.9	0.895
	10 to 15 minutes	39	60.9	12	63.1	2	40	10	58.8	63	60	
	20 minutes and longer	10	15.7	4	21.1	1	20	4	23.6	19	18.1	
Amount of powder used to cook one feeding	1 cup	41	64.1	13	68.4	3	60	13	76.5	70	66.7	0.938[b]
	2 cups	18	28.1	5	26.3	2	40	4	23.5	29	27.6	
	3 cups and more	5	7.8	1	5.3	0	0	0	0	6	5.7	
Amount of water used to cook one feeding	1 cup or 1½ cups	28	43.9	8	42.1	4	80	6	35.3	46	43.8	0.181[b]
	2 cups or 2½ cups	18	28.1	6	31.6	0	0	10	58.3	34	32.4	
	3 cups or 3½ cups	12	17.2	3	15.8	0	0	0	0	15	14.3	
	4 cups and more	6	9.4	2	10.5	1	10	1	5.9	10	9.5	
Texture /Consistency of infant feed	Very soft and runny	7	10.9	3	15.8	0	0	2	11.8	12	11.4	0.823[b]
	Soft, but not runny	38	59.4	12	63.2	2	40	10	58.8	62	59.1	
	Stiff / Very stiff	19	29.7	4	21	3	60	5	29.4	31	29.5	
Temperature of infant feed	Hot	2	3.1	1	5.3	0	0	1	5.8	4	3.8	0.731[b]
	Warm	42	65.6	11	57.9	3	60	8	47.1	64	70.0	
	Cool / Cold	20	54.1	7	18.9	2	40	8	47.1	37	35.2	

a Cup = tea cup

b Fisher's exact test

Most of the caregivers who indicated feeding the infant either once, twice, three or more times per day or not even daily indicated cooking one feeding of Tsabana for 10 to 15 minutes (60.9%, 63.1%, 40% and 58.8%, respectively) and using mostly one cup powder (64.1%, 68.4%, 60% and 76.5%, respectively) ($p > 0.05$) (see Table 4.25). Most to the majority of the caregivers, whether they indicated feeding the infant once, twice, three or more times per day or not even daily indicated using one to two and a half cups of water (72%, 73.7%, 80% and 93.6%, respectively) to cook one feeding of Tsabana, and served it at a warm (65.6%, 57.9%, 60% and 47.1%, respectively) followed by a cool/cold (54.1%, 18.9%, 40% and 47.1%, respectively) temperature and of a soft, but not runny (59.4%, 63.2%, 40% and 58.8%, respectively) or stiff (29.7%, 21%, 60% and 29.4%)

texture ($p > 0.05$) (see Table 4.25).

ii. Associations/Differences between the number of daily feedings and clinic-related factors

No significant ($p > 0.05$) differences/associations were found between the number of daily Tsabana feedings provided and the caregiver perceived improvement in the infant wellbeing or not on receiving Tsabana and their perceived attribute difference between Tsabana and other cooked porridges. Among the caregivers, whether they indicated feeding Tsabana once, twice, three or more times or even not daily, most to all of them indicated that it improved the infant wellbeing (75%, 89.5%, 100% and 70.6%, respectively) and indicated it to provide more nutrition to the infant than other porridges (54.7%, 47.1%, 60%, and 41.2%, respectively). Whether the caregiver received information regarding Tsabana from the clinic personnel or not, and missed the scheduled infant clinic visits or not also did not impact the number of daily Tsabana feedings provided ($p > 0.05$) (see Table 4.26). Most of the caregivers who indicated feeding Tsabana to the infant once, twice or not even daily indicated to not have received information about Tsabana from the clinic (54.7%, 63.2% and 76.5%, respectively). More (60%) of the caregivers who indicated that they fed Tsabana to the infant three times or more a day though indicated to have received information. The majority of the caregivers in each of the daily Tsabana feeding response categories indicated that they did not always receive Tsabana from the clinic (84.4%, 89.5%, 80% and 82.4%, respectively) though not missing the scheduled infant clinic visits (84.4%, 94.7%, 80% and 82.4%, respectively) (see Table 4.26).

Table 4.26: Associations/Differences between the number of daily feedings and clinic-related factors

Clinic-related factors		Number of daily Tsabana feedings										
		Once a day		2 times a day		3 or more times a day		Not daily		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Infant wellbeing improvement by giving Tsabana	Yes	48	75	17	89.5	5	100	12	70.6	82	78.1	0.346[a]
	No	16	25	2	10.5	0	0	5	29.4	23	21.9	
Difference between Tsabana and other cooked porridges	Not different from other cooked porridges	9	14.1	1	5.3	2	40	2	11.8	14	13.3	0.310[a]
	Gives more nutrition to the infant	35	54.7	9	47.4	3	60	7	41.2	54	51.4	
	Gives the infant more energy	8	12.5	6	31.6	0	0	2	11.8	16	15.2	
	Tastes nicer / Easier to prepare	12	18.8	3	15.8	0	0	6	35.2	21	20.1	
Information received from clinic personnel about Tsabana	Yes	29	45.3	7	36.8	3	60	4	23.5	43	40.9	0.318
	No	35	54.7	12	63.2	2	40	13	76.5	62	59.1	
Not always receiving Tsabana from clinic	Yes	54	84.4	17	89.5	4	80	14	82.4	89	84.8	0.919
	No	10	15.6	2	10.5	1	20	3	17.6	16	15.2	
Missing infant scheduled clinic visit	Yes	10	15.6	1	5.3	1	20	3	17.6	15	14.3	0.649
	No	54	84.4	18	94.7	4	80	14	82.4	90	85.7	

[a] Fisher's exact test

iii. Associations/Differences between the number of daily feedings and the caregiver and infant demographic factors

No significant ($p > 0.05$) associations/differences were found between the number of daily Tsabana feedings provided and the caregiver demographic factors and that of the infant (see Table 4.27). In the participant group most of the caregivers were aged 18 years and younger to 29 years or 30 to 44 years (52.4% and 34.3%, respectively equalling 88.7%) which were also reflected in each of the daily Tsabana feeding response categories as once (86%), twice a day (94.7%), three or more times a day (50%) or even not daily (90.2%).

Table 4.27: Associations/Differences between the number of daily feedings and the caregiver and infant demographic factors

Demographic factors		Number of daily Tsabana feedings										
		Once a day		2 times a day		3 or more times a day		Not daily		Total (n = 105)		P
		n	%	n	%	n	%	n	%	n	%	
Caregiver age	18 years and younger to 29 years	36	56.3	8	42.1	0	0	11	64.7	55	52.4	0.061[a]
	30 to 44 years	19	29.7	10	52.6	3	60	4	23.5	36	34.3	
	45 years and older	9	14.1	1	5.3	2	40	2	11.8	14	13.3	
Caregiver highest education level	No school education / Standard 1 to 7	27	42.2	6	31.6	2	40	8	47.1	43	40.9	0.803
	Secondary level and higher	37	57.8	13	68.4	3	60	9	52.9	62	59.1	
Caregiver relationship to infant receiving Tsabana	Mother	42	65.6	14	73.7	4	80	13	76.4	73	69.6	0.957[a]
	Grand mother or child minder	10	15.6	3	15.8	1	20	2	11.8	16	15.2	
	Other family members	12	18.8	2	10.5	0	0	2	11.8	16	15.2	
Household source of income	Permanent work / Contract work	42	65.6	15	78.9	3	60	13	75.4	73	69.5	0.448[a]
	Government grants / Pension funds	7	10.9	3	15.8	0	0	2	11.8	12	11.4	
	No fixed income	15	23.4	1	5.3	2	40	2	11.8	20	19.1	

[a] Fisher's exact test

The representation of the other demographic factors within the participant group as the caregiver education level, the relationship of the caregiver to the infant receiving Tsabana and the household income source were also reflected within the number of daily Tsabana feeding response categories. In each of the number of daily Tsabana feeding response categories, whether feeding it once, twice, three or more times per day or not daily, most of the caregivers attained a secondary level or higher (57.8%, 68.4%, 60% and 52.9%, respectively), were the infant's mother (65.6%, 73.7%, 80% and 76.4%, respectively) with the source of the household income mostly as permanent or contract work (65.1%, 78.9%, 60% and 75.4%, respectively) ($p > 0.05$) (see Table 4.27).

b. Amount cooked at a time

i. Associations/Differences between the amount cooked at a time and the factors related to the product use

A significant ($p < 0.05$) association was found between the amount of Tsabana cooked at a time and the amount of powder used to cook one feeding of Tsabana. Most of the caregivers, whether they indicated cooking an amount of Tsabana enough for one or two and more feedings indicated using one cup followed by about a quarter who indicated using two cups of powder to cook one feeding of Tsabana (67.6% and 28.4%, respectively and 64.5% and 25.8%, respectively) (see Table 4.28). The two other factors related to the product use which were significantly ($p < 0.05$ and $p < 0.001$, respectively) associated with the amount of Tsabana cooked at a time, were the amount of water used to cook one feeding of Tsabana and the temperature of the Tsabana fed to the infant. Most of the caregivers, whether they indicated cooking an amount of Tsabana enough for one or two and more feedings indicated using one or one and a half followed by two and a half cups of water (42.3% and 36.5%, respectively and 45.2% and 22.6%, respectively) to cook one feeding of Tsabana. Most of the caregivers, whether they indicated cooking an amount enough for one or two and more feedings also indicated to serve it at a warm temperature (62.2% and 58.1%, respectively) followed by about a third (33.7% and 38.7%, respectively) who indicated to serve it at a cool or cold temperature (see Table 4.28).

Table 4.28: Associations/Differences between the amount cooked at a time and the factors related to the product use

Product use factors		Amount of Tsabana cooked at a time						
		For 1 feeding		For 2 or more feedings		Total (n = 105)		P
		n	%	n	%	n	%	
Amount fed at a time	1 cup [a] or 1½ cups	65	87.8	21	67.7	86	81.9	0.061
	2 and more cups	9	12.2	10	32.3	19	18.1	
Cooking period of one feeding	Less than 10 minutes	17	23.1	6	19.4	23	21.9	0.052
	10 to 15 minutes	48	64.9	15	48.4	63	60	
	20 minutes and longer	9	12.2	10	32.2	19	18.1	
Amount of powder used to cook one feeding	1 cup	50	67.6	20	64.5	70	66.7	0.003
	2 cups	21	28.4	8	25.8	29	27.6	
	3 cups and more	3	4	3	9.7	6	5.7	
Amount of water used to cook one feeding	1 cup or 1½ cups	32	42.3	14	45.2	46	43.8	0.007
	2 cups or 2½ cups	27	36.5	7	22.6	34	32.4	
	3 cups or 3½ cups	11	14.9	4	12.9	15	14.3	
	4 cups and more	4	5.4	6	19.4	10	9.5	
Temperature of infant feed	Hot	3	4.10	1	3.2	4	3.8	0.000
	Warm	46	62.2	18	58.1	64	70	
	Cool / Cold	25	33.7	12	38.7	37	34.2	
Texture/Consistency of infant feed	Very soft and runny	8	10.8	4	12.9	12	11.4	0.849
	Soft, but not runny	45	60.8	17	54.8	62	59.1	
	Stiff / Very stiff	21	28.4	10	32.3	31	29.5	

[a] Cup = tea cup

No significant ($p > 0.05$) differences/associations were found between the amount of Tsabana cooked at a time and the amount fed at a time, the cooking period applied for one serving and the texture/consistency of the Tsabana fed to the infant, respectively. Most of the caregivers, whether they indicated cooking an amount of Tsabana enough for one or two and more feedings at a time indicated feeding one or one and a half cups of Tsabana at a time (87.8% and 67.7%, respectively) and feeding it at a soft, but not runny texture/consistency (60.8% and 54.8%, respectively) and mostly cooking it for 10 to 15 minutes (64.9% and 48.4%, respectively) (see Table 4.28).

ii. Associations/Differences between the amount cooked at a time and clinic-related factors

The amount of Tsabana cooked at a time was not influenced by the caregiver perceived improvement in the infant wellbeing or not on receiving Tsabana or their perceived attribute differences between Tsabana and other cooked porridges ($p > 0.05$). Among those caregivers who indicated cooking an amount of Tsabana enough for one or two and more feedings at a time, the majority indicated that it improved the infant wellbeing (74.3% and 87%, respectively). Most (47.3% and 61.3%, respectively) of the caregivers also indicated Tsabana to provide more nutrition to the infant than other cooked porridges, whether they indicated that they cooked an amount enough for one or two and more feedings at a time. Whether having received information regarding Tsabana from the clinic personnel or not, always receiving Tsabana from the clinic or not and the caregiver missing the scheduled infant clinic visits or not also did not impact the amount of Tsabana cooked at a time ($p > 0.05$) (see Table 4.29). Most of the caregivers, whether they indicated cooking an amount of Tsabana enough for one or two and more feedings indicated to have not received information about Tsabana from the clinic personnel (58.1% and 61.3%, respectively) and to not always receive Tsabana from the clinic (86.5% and 80.6%, respectively) though not missing the scheduled infant clinic visits (82.4% and 93.5%, respectively) (see Table 4.29).

Table 4.29: Associations/Differences between the amount cooked at a time and clinic-related factors

Clinic-related factors		Amount of Tsabana cooked at a time						
		For 1 feeding		For 2 or more feedings		Total (n = 105)		P
		n	%	n	%	n	%	
Child wellbeing improvement by giving Tsabana	Yes	55	74.3	27	87.1	82	78.1	0.149
	No	19	25.7	4	12.9	23	21.9	
Difference between Tsabana and other cooked porridges	Not different from other cooked porridges	13	17.6	1	3.2	14	13.3	0.070
	Gives more nutrition to the infant	35	47.3	19	61.3	54	51.4	
	Gives the infant more energy	9	12.2	7	22.6	16	15.2	
	Tastes nicer / Easier to prepare	17	23	4	12	21	20	
Information received from clinic personnel about Tsabana	Yes	31	41.9	12	38.7	43	41	0.762
	No	43	58.1	19	61.3	62	59	
Not always receiving Tsabana from clinic	Yes	64	86.5	25	80.6	89	84.8	0.447
	No	10	13.5	6	19.4	16	15.2	
Missing infant scheduled clinic visit	Yes	13	17.6	2	6.5	15	14.3	0.138
	No	61	82.4	29	93.5	90	85.7	

iii. Associations/differences between the amount cooked at a time and the caregiver demographic factors

No significant ($p > 0.05$) differences/associations were also found between the amount of Tsabana cooked at a time and the caregiver demographic factors. The two younger age groups of the caregiver sample were again greatly reflected in each of the response categories of the amount of Tsabana cooked as either for one feeding (56.8% and 29.7%, respectively equalling 80.5%) or for two and more feedings (41.9% and 45.2%, respectively equalling 87.1%) (see Table 4.30). In each of the response categories, whether cooking enough for one or two and more feedings at a time, most of the caregivers attained a secondary level or higher education (55.4% and 66.7%, respectively) were the infant's mother (68.9% and 71%, respectively) with the source of the household income mostly as permanent or contract work (66.2% and 77.4%, respectively) (see Table 4.30).

Table 4.30: Associations/differences between the amount cooked at a time and the caregiver demographic factors

Demographic factors		Amount of Tsabana cooked at a time						
		For 1 feeding		For 2 or more feedings		Total (n = 105)		P
		n	%	n	%	n	%	
Caregiver age	18 years and younger to 29 years	42	56.8	13	41.9	55	52.4	0.295
	30 to 44 years	22	29.7	14	45.2	36	34.3	
	45 years and older	10	13.5	4	12.9	14	13.3	
Caregiver highest education level	No school education / Standard 1 to 7	33	44.6	10	32.3	43	41	0.241
	Secondary level and higher	41	55.4	21	67.7	62	59	
Caregiver relationship to infant receiving Tsabana	Mother	51	68.9	22	71	73	69.5	0.498
	Grand mother or child minder	10	13.5	6	19.4	16	15.2	
	Other family members	13	17.6	3	9.7	16	15.2	
Household source of income	Permanent work / Contract work	49	66.2	24	77.4	73	69.5	0.225
	Government grants / Pension funds	11	14.9	1	3.2	12	11.4	
	No fixed income	14	18.9	6	19.4	20	19	

c. Reading package preparation instructions

i. Associations/Differences between the caregiver reading of the instructions and the factors related to the product use

No significant ($p > 0.05$) associations/differences were found between the caregiver reading of the instructions on the Tsabana package and the number of daily Tsabana feedings as well as the amount of Tsabana fed at a time. Most of the caregivers, whether they indicated that they read the instructions on the Tsabana package once or a few times after it was received or did not pay much attention to it or did not read it, indicated feeding Tsabana to the infant once a day (67.7%, 57.1% and 60%, respectively). Most of the caregivers, whether they indicated that they read the instructions on the Tsabana package once or a few times after it was received, or did not pay much attention to it or did not read it, indicated feeding one or one and a half cups of Tsabana to the infant at a time (80.6%, 85.7% and 76%, respectively) (see Table 4.31).

Table 4.31: Associations/Differences between the caregiver reading of the instructions and the factors related to the product use

Product use factors		Caregiver reading of instructions on the Tsabana package								
		Only once when first received		Few times after first received		Did not pay much attention / Did not read it		Total (n = 105)		P
		n	%	n	%	n	%	n	%	
Number of daily feedings	Once a day	21	67.7	28	57.1	15	60	64	60.9	0.231
	2 times a day	1	3.2	11	22.4	7	28	19	18.1	
	3 and more times a day	2	6.5	2	4.1	1	4	5	4.8	
	Not daily	7	22.6	8	16.3	2	8	17	16.2	
Amount fed at a time	1 cup [a] or 1½ cups	25	80.6	42	85.7	19	76	86	81.9	0.577
	2 and more cups	6	19.4	7	14.3	6	24	19	18.1	
Cooking period of one feeding	Less than 10 minutes	9	29	11	22.4	3	12	23	21.9	0.001
	10 to 15 minutes	16	51.6	36	73.5	11	44	63	60	
	20 minutes and longer	6	19.4	2	4.1	11	44	19	18.1	
Amount of powder used to cook one feeding	1 cup	18	58	36	73.5	16	64	70	66.7	0.329
	2 cups	11	35.5	12	24.5	6	24	29	27.6	
	3 cups and more	2	6.5	1	2	3	12	6	5.7	
Amount of water used to cook one feeding	1 cup or 1½ cups	15	48.4	22	44.9	9	36	46	43.8	0.162
	2 cups or 2½ cups	11	35.5	16	32.7	7	28	34	32.4	
	3 cups or 3½ cups	3	9.7	9	18.4	3	12	15	14.3	
	4 cups and more	2	6.5	2	4.1	6	24	10	9.5	
Add sugar to infant feed	Yes	24	77.4	41	83.7	17	68	82	78.1	
	No	7	22.6	8	16.3	8	32	23	21.9	
Add cooking oil to infant feed	Yes	29	93.5	45	91.8	21	84	95	90.5	0.436
	No	2	6.5	4	8.2	4	16	10	9.5	

[a] Cup = tea cup

A significant ($p < 0.05$) difference was found between the caregiver reading of the instructions on the Tsabana package and the cooking period of one feeding of Tsabana. The majority of the caregivers who indicated reading the instructions on the Tsabana package once or a few times after it was received indicated cooking one feeding of

Tsabana for 10 to 15 minutes (51.6% and 73.5%, respectively) or shorter than 10 minutes (29% and 22.4%, respectively) while the majority of the caregivers who indicated that they read the instructions but did not pay much attention to it or did not even read it either cooked one feeding of Tsabana for 10 to 15 minutes (44%) or for 20 minutes and longer (44%) (see Table 4.31).

The caregiver reading of the instructions on the Tsabana package did not impact ($p > 0.05$) the amount of powder or water they used to cook one feeding of Tsabana nor the addition of sugar or cooking oil to the cooked Tsabana. The majority of the caregivers, whether they indicated reading the instructions on the Tsabana package once or a few times after it was received, or did not pay much attention to it or not even reading it, indicated that they used one to two cups of powder (93.5%, 98% and 88%, respectively) with either one to two and a half cups of water (83.9%, 77.6% and 64%, respectively) to cook one feeding of Tsabana and added sugar (77.4%, 83.7% and 68%, respectively) and cooking oil (93.5%, 91.8% and 84%, respectively) to the cooked product ($p > 0.05$) (see Table 4.31).

ii. Associations/Differences between the caregiver reading of the instructions and clinic-related factors

No significant ($p > 0.05$) associations/differences were found between the caregiver reading of the instructions on the Tsabana package and the caregiver perceived improvement in the infant wellbeing and their considered attribute differences between Tsabana and other cooked porridges. The majority of the caregivers, whether they indicated reading the instructions on the Tsabana package once or a few times after it was received, or did not pay attention to it or not even reading it, indicated that it improved the infant wellbeing (80.6%, 75.5% and 80%, respectively), while most also indicated Tsabana to provide more nutrition to the infant than other cooked porridges (58.1%, 46.9% and 52%, respectively). Most of the caregivers who indicated reading the instructions on the Tsabana package once or a few times after it was received, or did not pay attention to it or not even reading it, indicated not to have received information about Tsabana from the clinic personnel (51.6%, 55.1% and 76%, respectively) (see Table

4.32).

Table 4.32: Associations/Differences between the caregiver reading of the instructions and clinic-related factors

Clinic-related factors		Reading of instructions on the Tsabana package								P
		Only once when first received		Few times after first received		Did not pay much attention / Did not read it		Total (n = 105)		
		n	%	n	%	n	%	n	%	
Child wellbeing improvement by giving Tsabana	Yes	25	80.6	37	75.5	20	80	82	78.1	0.834
	No	6	19.4	12	24.5	5	20	23	21.9	
Difference between Tsabana and other cooked porridges	It is not different from other cooked porridges	3	9.7	4	8.2	7	28	14	13.3	0.161
	It gives more nutrition to the infant	18	58.1	23	46.9	13	52	54	51.4	
	Gives the infant more energy	4	12.9	9	18.4	3	12	16	15.2	
	It tastes nicer / Easier to prepare	6	19.1	13	25.5	2	8	21	20.1	
Information received from clinic personnel about Tsabana	Yes	15	48.4	22	44.9	6	24	43	40.9	0.136
	No	16	51.6	27	55.1	19	76	62	59.1	

CHAPTER 5

DISCUSSION

5.1 Tsabana nutritional appraisal

5.1.1 Nutrient content adequacy

In the nutritional appraisal of Tsabana as manufactured complementary food, an adequate content was considered when the included nutrients met, exceeded and fell short within 10% of the minimum specified ranges of the Codex Alimentarius Standard for Processed Cereal-based Foods for Infants and Young Children (Codex Alimentarius Standard, 2006:1) and the PNCFCF (Lutter & Dewey, 2003:3015S) guidelines. When Tsabana was developed emphasis was placed on its adequate protein and energy provison. The energy provision of Tsabana is adequate compared to the Codex Alimentarius Standard guidelines, but the provision is about 20% lower (at 79.5%) than the PNCFCF guideline. Adequate energy is needed by infants for optimal growth and body development (Faber, 2004:375). Though falling short in energy in relation to the PNCFCF guideline over three-quarters of the caregivers in the study added sugar as a contributory energy source to the cooked Tsabana provided to the infants. The protein content of Tsabana is adequate according to both the considered guidelines and should provide in the infant's body needs for repair and maintenance of body cells and tissues (Lutter & Dewey, 2003:312S). This is an important finding as approximately half of the infants included in the study were not fed either meat, poultry, fish or eggs and milk or milk products on a daily basis.

The content of the majority of the included vitamins, i.e. vitamins A, D, B12, thiamine, riboflavin, niacin, folacin and pantothenic acid, is adequate according to the reference values across both the considered guidelines. All these micronutrients are essential in infants' diets for prevention of nutrient deficiencies and undernutrition-related clinical symptoms (IYCFC, 2006:3). Vitamin A is one of the globally most deficient and most needed nutrients that aid the immune system and preserving eyesight (Williams, 2005:60). Vitamin A is also needed for maintaining the gastrointestinal epithelium during

spouts of diarrhoea (Thaper & Sanderson, 2004:628). Vitamin D is needed to maintain normal blood levels of calcium and phosphate that are needed for mineralization of bone, muscle contraction and general cellular function in all cells of the body (FAO & WHO, 2001:109). The B vitamins help the body to use the energy that is generated by carbohydrate, fat and protein. Several B vitamins, namely thiamine, riboflavin, niacin and pantothenic acid, form part of the coenzymes that assist certain enzymes in the release of energy from carbohydrates, fat and protein. Without the B vitamins the body would lack energy. Folacin and vitamin B12 help cells to multiply (Whitney *et al.,* 2002:310).

The minerals calcium and phosphorus are also both adequately present based on both the considered guidelines. Calcium is vital for the infant's bone development and the body's metabolic processes. Low calcium provision in children may induce rickets and growth retardation. Phosphorus is a major structural component of bone and teeth formation (WHO, 1998:82).

The vitamins pyridoxine (29.5%), C (57.1%) and E (68%) are not adequately present in Tsabana based on the considered PNCFCF guidelines. Pyridoxine is a form of vitamin B6 and active in the amino acid metabolism (Whitney *et al.,* 2002:321). Vitamin C is mostly needed to enhance iron absorption (Lutter & Dewey, 2003:3016S) and vitamin E helps combat diarrhoea (Pryer, 2003:5798). In these roles vitamin C and vitamin E are particularly important to children as they are a vulnerable group for both iron deficiency and diarrhoea, especially undernourished children (Williams, 1994:110). Vitamin E is furthermore a major lipid-soluble antioxidant in the cell defence system protecting components of cell membranes from oxidation by free radicals (FAO & WHO, 2001:121).

The minerals zinc, iodine and iron are also not adequately present considering the PNCFCF guidelines. Zinc is needed to decrease the morbidity and mortality risk of young children/infants as prolonged diarrhoea is often the result of a zinc deficiency (IZZNCG, 2004:149S). Zinc is present in Tsabana at only about a fifth of the proposed amount. Meat, poultry, milk and milk products are the major providers of zinc, but these products

are mostly only provided weekly to the infants with some products such as eggs, yogurt and cheese mostly seldom/never provided. Nearly half of the infants seldom/never receive the latter products for consumption. Iodine deficiency in infants causes substantial linear growth retardation and leads to irreversible damage to the infant brain and central nervous system (FAO & WHO, 2001:109). Iodine is present at about a quarter of the reference value. About half of the caregivers though indicated that they added salt to the cooked Tsabana. Since iodized salt is used in Botswana, its addition would compensate for the lower amount of iodine provided by Tsabana. The iron content of Tsabana is below half of the reference value. Iron is needed by infants to prevent iron deficiency. Iron deficiency can result in cognitive and motor deficits, some which may not be reversible (Butte *et al*., 2004:446). Dietary iron sources, particularly that of haeme iron, are meat, fish and poultry (Whitney *et al.,* 2002:430). The study, however, found that only one-third of the infants were fed these products daily.

A few nutrients are not provided by Tsabana. These include omega-3 and omega-6 fatty acids, copper and selenium which are vital to an infant's health. During the development of Tsabana emphasis was not placed on fat as a source of energy, specifically the fatty acid provision of omega-3, as the Tsabana packaging recommends the caregivers to add cooking oil to it which is an omega-6 source. Unsaturated fatty acids should be included in infants' diets as they are vital for their health. For example, omega-3 is needed for the nervous tissue growth and functioning and also as an important component of the brain and retina of the eye. Inadequate intake of omega-3 decreases the DHA in the brain and decreased DHA in the developing brain leads to deficits in neurotransmitter metabolism and altered learning and visual functions (Innis, 2008:36). Dietary sources of omega-3 are specifically oily fish, certain plant oils (flaxseed, canola and walnut), nuts and seeds (butternuts and walnuts) (Whitney *et al.,* 2002:145). Approximately a quarter of the infants included in the study received fish seldom/never. The fish that is generally consumed in Botswana is tinned fish (pilchards) which is a source of oily fish. According to the guidelines for omega-3 consumption, infants are recommended to consume a variety of fish, preferable fatty/oily fish at least twice a week (Koletzko *et al*., 2008:9). Omega-6 is also an important component of the central nervous system (Ward & Singh,

2005:3628) which is provided through the addition of cooking oil to the Tsabana feedings that over three-quarters of the caregivers in the study indicated doing.

The trace elements not provided according to the PNCFCF guidelines are copper and selenium. Copper is vital for growth and development of infants as it is responsible for proper heart function as well as the immune system and the maintenance and development of bone (Stern, 2010:120). Dietary sources of copper are legumes, wholegrains, nuts, shellfish, organ meats and seeds (Whitney *et al.,* 2002:448). These foods are not usually consumed by infants. Selenium is mostly needed by infants for the modulation of growth and development, protection of the body tissues and maintenance of defences against infections (FAO & WHO, 2001:235). Dietary sources of selenium are meat, seafood and vegetables (Whitney *et al.,* 2002:447). The caregivers indicated that most infants were fed meat and/or fish, as well as vegetables, on a weekly basis which would not provide for an adequate intake as meat and/or fish and vegetables should be consumed daily.

As in Botswana, many infants in developing countries currently rely on various combinations of local cereals, legumes, pulses and oilseeds for their dietary provision that are also typically used for preparing complementary foods. Even where feeding practices are optimal, manufactured complementary foods are normally fortified with minerals and vitamins. However, even if they are fortified the nutrient levels are often too low and the provision of the EFAs often insufficient (Zlotkin *et al*., 2010:129S) as found in this study with particularly omega-3. The lipid content of many complementary food diets is low. In addition to providing EFAs, lipids are needed for the absorption of fat-soluble vitamins (Lutter & Rivera, 2003:2941S). These complementary foods may also contain forms of certain nutrients that have poor bioavailability (Zlotkin *et al*., 2010:129S) which for the Tsabana provision will be discussed as a separate consideration in this chapter.

5.1.2 Energy, macro- and micronutrient provision adequacy and dietary intake in relation to the World Health Organization recommended intakes

a. Macronutrients

i. Energy and carbohydrates

The majority of the caregivers indicated that the infants were fed infant cereals besides for receiving Tsabana. The caregivers also indicated that the infants were fed other starchy foodstuffs along with the above such as cooked porridges and breakfast cereals. These foods were provided to the majority of the infants on a daily basis of which sorghum porridge was the most provided. Foods such as bread, rice and/or pasta were mostly provided on a weekly basis. However, as good sources of carbohydrates they should be provided sufficiently on a daily basis to contribute additional carbohydrate sources to ensure dietary variety and adequate carbohydrate provision. Carbohydrates aid in the maintenance of the body and physiological processes as well as providing energy for physical growth and activity (Arimond & Ruel, 2004:20).

ii. Protein

Though the provision of protein through Tsabana as a manufactured complementary food is adequate the caregivers indicated that the majority of infants did not receive breast milk or infant formula, which they should still have received at this age. The composition of human breast milk contributes to the total protein and amino acid requirements during infancy (Dupont, 2003:1544S). Most of the caregivers indicated that they provided meat, chicken and/or fish weekly and seldom/never provided eggs, yogurt and cheese. These foods are good sources of protein. Protein is a major component of body cells, contributing in the formation, growth and repair of muscle. Between birth and weaning, complementary feedings are crucial for growth and development and long-term well-being. Dietary protein requirements are at the highest during this time period to support both maintenance and high rates of tissue formation. Protein deposition is highly efficient

with about 87% of protein intake used for maintenance and tissue synthesis (Dupont, 2003:1544S). An adequate intake from breast milk or infant formula along with that from complementary infant feeding is, however, still needed despite the high deposition efficiency.

b. Micronutrients

Approximately one third of the caregivers indicated that fruit (fresh, canned or dried) and fruit juice were seldom/never provided to the infants. Most of the caregivers indicated that vegetables (cooked and/or raw) were provided on a weekly basis. These foods are good sources of many vitamins and minerals that aid in the prevention of numerous nutritional deficiency diseases and are important for growth and development. Micronutrients contained in the diet of young children are often inadequate to meet their nutritional needs, resulting in micronutrient deficiencies (NRC, 2008:1761). Fruit and vegetables should be consumed on a daily basis to provide these essential nutrients. Eating a variety of foods is essential to achieve adequate coverage of macro- and micronutrient needs. Beyond this nutritional aspect, food variety also contributes to the psychological dimension of eating, since variety, both within and between meals, contributes to the pleasure of eating (Nicklaus, 2009:253). Even though the infant acceptance of Tsabana as perceived by the caregivers was positive (discussed in the next part of the this chapter), its nutrient provision of especially important minerals for growth and development such as iron, zinc and iodine are inadequate which makes adequate household provision of a variety of foods essential, especially of those foods which should be consumed on a daily basis.

i. Vitamin A

Vitamin A provision through Tsabana, if it is consumed in the recommended amounts, is adequate in relation to the WHO recommended intakes in particular for those 18 months to three years old. Vitamin A is provided at more than double the recommended intake for this age group. Even though vitamin A is adequately provided a vitamin A deficiency

is a problem often encountered in infant nutrition, especially in non-breastfed infants who do not receive adequate vitamin A from animal source foods (Lutter & Dewey, 2003:3016S). This may be relevant to the study infants being younger than 18 months of age as they represent a non-breastfed group (vitamin A though is provided at about 100% of the WHO recommended intake for this age group). Preformed vitamin A is found only in animal-derived food products which in this study most infants were not receiving daily, but weekly. Dietary carotenoids, as further contributory vitamin A source, are present in certain plant oils, fruit and vegetables (Lutter & Dewey, 2003:3017S). These foods were also not provided daily to most of the infants. Vegetables were only provided weekly and fruits seldom/never provided to the infants.

ii. Vitamin D

A Greek study on vitamin D status concluded that babies exclusively breastfed during the first six months are in need of vitamin D supplementation irrespective of the season, even in a sunny country where foods are usually not supplemented (Challa *et al.*, 2005:724). According to the WHO recommended intakes vitamin D is adequately provided by Tsabana. The food sources rich in vitamin D, e.g. eggs, fish and fruits (Armas *et al*., 2004:5388), though were not provided daily to most of the infants, but rather provided weekly or even seldom/never.

iii. Vitamin E

Infants receive vitamin E mostly from breast milk and infant formula (Landvik, 2004:785). About three quarters of the caregivers indicated that breast milk and / or infant formula were not provided to the infants. Moreover, foods that are rich sources of vitamin E such as green leafy vegetables and eggs were respectively provided to most of the infants on a weekly basis and seldom/never rather than on a daily basis. Despite the lack of vitamin E containing sources in the infant dietary provision it is adequately provided by Tsabana in relation to the WHO recommended intakes.

iv. Calcium

The majority of the infants were seldom/never or only weekly provided milk products rich in calcium, e.g. yogurt, cheese and milk which should be consumed on a daily basis to provide adequate dietary calcium intakes. Some components of the diet, such as phytates found in bran and most cereals and seeds, oxalates in spinach and tannins in tea, can also form insoluble complexes with calcium, thereby reducing its absorbability (Guéguen *et al*., 2000:122S). Although milk and milk products are naturally rich sources and major sources of highly bioavailable calcium in the diet, food fortification would significantly provide more dietary calcium (Lopez-Huertas *et al.*, 2006:314) which Tsabana accomplishes. Tsabana in relation to the WHO recommended intakes provide calcium adequately.

v. Zinc

Zinc is notable among the nutrients that have been designated 'problem' nutrients. An adequate intake of this nutrient from complementary foods is difficult without fortification (Hambidge & Krebs, 2007:1101). Complementary foods in less developed countries are almost entirely limited to plant foods. Zinc concentrations in widely consumed plant foods, especially staple foods like grains and legumes, are inadequate to meet dietary requirements as they have high concentrations of phytates which have inhibitory effects on its absorption (Gibson *et al*., 1998:764). In addition to zinc not being adequately provided by Tsabana in relation to the WHO recommended intakes, the majority of the infants were also provided grain foods such as various cooked porridges on a daily basis which might contribute a phytate consumption that inhibits zinc absorption. Animal source foods, especially meats, not only contain the highest concentrations of zinc but provide zinc in a bioavailable form (Gibson *et al*., 1998:764). The study found that the majority of the infants though did not consume animal source foods on a daily basis but generally on a weekly basis.

vi. Iodine

The major sources of iodine are grain products, especially bread, eggs, seafood and dairy products, especially milk (Zimmermann, 2009: 380). Bread, fish and milk were provided on a weekly basis to most of the infants whereas eggs were seldom/never provided to approximately half of the infants. This makes it difficult for infants to receive an adequate iodine provision since Tsabana is not providing it adequately according to the WHO recommended intake. Fortunately the salt used in Botswana is ionized and added by approximately half of the caregivers to Tsabana in its preparation.

vii. Iron

Iron is also not adequately provided by Tsabana and can be considered a concern considering the dietary sources provided to the infants. Good sources of iron are meat, eggs, milk and vegetables mainly the green leafy vegetables. Most of these foods were provided to most of the infants on a weekly basis instead of being provided daily with eggs seldom/never provided to most of the infants. This provides for the consumption of iron to be inadequate according to the WHO recommended intake.

5.1.3 Micronutrient compounds utilized in the fortification

Vitamins and minerals are added to foods to increase the nutritive value. The major factor to be considered in choosing the appropriate or suitable compound to be added to a particular food (the vehicle) is its bioavailability. Micronutrients are chemically reactive compounds and their bioavailability will be greatly affected by interactions with food components when added or during processing and storage (Rosado, 2003:2986S).

Although the vitamin A inclusion in Tsabana is provided adequately, it is provided as vitamin A palmitate which is not very well absorbed by the body making it less bioavailable (National Academies Press, 2001:86). The vitamin D incorporated in Tsabana is in the cholecalciferol form. Cholecalciferol is greatly bioavailable and as a

result readily absorbed and efficiently utilized by the human body (Armas *et al*., 2004:5388). Vitamin E is provided by Tsabana in a form of acetate which is inactive both biologically and as an antioxidant (Sen *et al*., 2006:3). Calcium must be ionized or must be in a solution to be absorbed (Bronner & Pansu, 1998:10). Calcium in the form of calcium phosphate, the predominant calcium form included in Tsabana, is well absorbed as is calcium in other inorganic salts, whether eaten with or without lactose (Guėguen *et al*., 2000:122S). Zinc is provided by Tsabana as zinc sulphate. As the second most used source of zinc, zinc sulphate is more soluble than other forms like zinc oxide though its stability depends on the food matrix to which it is added (Rosado, 2003:2987S). The iodine inclusion in Tsabana is provided as potassium iodate. Iodate is reduced in the gut and absorbed as iodide which is rapidly and completely absorbed in the stomach and duodenum (Marwaha & Gopalakrishnan, 2011:7). The Tsabana package does not stipulate in what form iron is provided.

5.2 Perceived infant acceptance of Tsabana

Approximately three quarters of the caregivers perceived Tsabana to be enjoyed by the infants, as well as to be accepted by them in terms of its taste. Almost two thirds of the caregivers also perceived the texture to either be very nice or nice to the infants. The perceived colour acceptance of Tsabana, compared to the acceptance of its other sensory attributes, was far lower with only slightly more than one third of the caregivers perceiving the colour to be very nice or nice to the infants in comparison to more than two-thirds who perceived it to be acceptable or not nice. The most important factor influencing product acceptance is the taste (Schwartz *et al*., 2009:1375) which was perceived to be either very nice or nice by almost three quarters of the caregivers compared to the colour which was not that well accepted. A sense of taste is very closely tied to a sense of smell, but also closely tied to a sense of sight. Humans expect their food to look appealing. If the food looks unappealing or has a dull unattractive colour, the brain is misled that it does not taste good. Though colour may not directly affect how food tastes, it affects how the taste of food is perceived. When the food tastes good it is accepted in terms of the enjoyment which then overshadows the colour. The colour of

food can, however, have a profound effect on the human appetite. A study by Poelman and Delahunty (2011:355) established that the food colour typically affect expected, but not actual preference of food. This may explain why despite the perceived colour acceptance of Tsabana indicated by only more than one third of the caregivers as very nice or nice, it was still well accepted by almost three-quarters of the caregivers in terms of the perceived taste and almost two thirds in terms of the perceived texture and as a result perceived to be much enjoyed by the infants.

The number of daily Tsabana feedings provided, addition of sugar to the cooked Tsabana, amount of water used to cook one feeding of Tsabana and the cooking period of one feeding were the only product use factors to be significantly ($p < 0.05$) linked to the perceived infant acceptance of Tsabana. The number of daily Tsabana feedings was linked to the perceived enjoyment of Tsabana and its perceived texture and colour acceptance, while the addition of sugar to the cooked Tsabana was linked to its perceived enjoyment, the amount of water used to its perceived taste acceptance and the cooking period of one feeding to its perceived colour acceptance.

More caregivers in relation to the Tsabana enjoyment and its colour and texture acceptance who perceived it not to be enjoyed and not having a nice colour or texture, indicated not to feed it daily in comparison to caregivers who perceived that Tsabana was enjoyed by the infants and that it had a nice colour and texture. When judging food by tasting, properties such as softness in biting, ease of disintegration into segments, connection of the fibres and softness sensation on the tongue are considered. An easy bite, a tender, firm but soft juicy texture seems to be the most acceptable to children as their food enjoyment is derived from these properties (Jellinek, 1985:156). In some foods, the perceived texture is the most important sensory attribute of the product. For these products a defect in the perceived texture would have an extremely negative impact on the consumers' hedonic responses to the product, e.g. soggy (not crispy) (for example potato crisps), tough (not tender) (for example steak) or stiff (not soft) (for example porridge) (Lawless & Heymann, 1998:380).

Humans are visually driven species. In many societies with culinary arts, the usual presentation of food is as important as its flavour and texture characteristics (Lawless & Heymann, 2010:49). In food processing and cooking, colour serves as an indication for the doneness of food and is correlated with changes in aroma and flavour. Scientific studies have also shown that the colour of the product affects the perception of other attributes, such as aroma, taste and flavour (Lawless & Heymann, 1998:406). A common finding is that when foods are more deeply coloured, they will obtain higher ratings for flavour intensity. Miscoloured foods and flavours are less effectively identified or enjoyed (Lawless & Heymann, 2010:49). It showed in the study that if the caregivers perceived Tsabana not to be enjoyed and not having a nice colour or texture that they would be more inclined to not feed it daily in comparison to those caregivers who perceived Tsabana as being enjoyed and having a nice colour and texture.

In the preparation guidelines it is stipulated that one teaspoon of sugar should be added to the cooked Tsabana (DLG & MoH, 2001). The application of this guideline seems to positively influence the caregiver perceived acceptance of Tsabana. More of the caregivers who either perceived the infants' enjoyment of Tsabana as liking it very much or moderately and neither liking nor disliking it added sugar to the cooked Tsabana than those who perceived it to be disliked. In the first year of infant development, sweet and salty tastes are the preferred tastes compared to sour and bitter tastes (Schwartz *et al*., 2009:1375). A study by Harris (2008:315) investigating the development of taste and food preferences in children, found that flavour-conditioning (addition of sugar or salt) may contribute positively to food acceptance in children. A study by Schwartz *et al*. (2011:650) highlighted that a higher preference for sweet taste enhanced the acceptance of new foods.

There is considerable supporting evidence that the sensory characteristics of food, in particular the taste and flavour, have a very specific effect on the consumers' choice. From an early age, the behaviour towards food seems to be strongly influenced by the effects of taste and flavour. An example can be found in the facial expression of young babies when fed. When these babies are fed sweet food, the sweetness elicits a facial

acceptance response, i.e. large eyes and retraction of mouth, resembling a smile. However, tasteless, bitter and sour tastes of food makes the baby respond and react in a different way, with tight closed eyes, gaping mouth and sudden turn of the head, showing instant rejection (Clark, 1998:639).

The majority of the caregivers who either perceived the infant taste acceptance of Tsabana as very nice, nice or having an acceptable taste used one to two and a half cups of water to cook one feeding of Tsabana. The majority of the caregivers who perceived the infant taste acceptance of Tsabana as not nice though also used one to two and a half cups of water. However, according to the Tsabana preparation guidelines, three cups of water should be used for infants aged 18 months and four cups for infants aged 19 to 36 months to prepare one feeding of Tsabana (DLG & MoH, 2001) which was not applied by the caregivers and as a result influenced the overall caregiver perceived infant taste acceptance of Tsabana. Using less water for the preparation of Tsabana than advised will impact the consistency of the prepared product which in this case is assumed to have influenced the caregiver perceived infant taste acceptance of Tsabana. Individuals make choices based on a number of physiological, nutritional, environmental and socio-cultural factors. However, the sensory qualities of food are critical to dietary preferences, and taste in particular seems the most important determinant of food choices (Garcia-Bailo *et al*., 2009:69).

About half to two thirds of the caregivers who perceived the colour acceptance of Tsabana as very nice, nice or acceptable indicated cooking one feeding of Tsabana for 10 to 15 minutes. Among those caregivers caregivers who perceived it to not have a nice colour, half indicated that they cooked one feeding for 10 to 15 minutes and nearly as many that they cooked one feeding for less than 10 minutes. Tsabana's preparation guideline stipulates that it should be cooked for 10 to 15 minutes (DLG & MoH, 2001). The shorter cooking time applied by these caregivers influenced the perceived colour acceptance though the colour of Tsabana (being yellowish cream) does not change much on longer cooking. This result must be considered in the context of the study where the colour acceptance of Tsabana was indicated by the caregivers based on their perception

and not by the infants themselves. Children prefer white or tan-colored foods like pasta, rice, bread and potatoes. They rarely like green foods such as broccoli and green beans. It is unknown whether this is solely peer-influenced or whether the white and tan colors of breast milk, formula and baby cereals, which are all the first foods they are exposed to, make an important imprint on the minds of children as reference to what they feel comfortable accepting (Davis, 2009:4).

The amount of Tsabana fed at a time, the amount cooked at a time, the amount of powder used to cook one feeding of Tsabana, the temperature of Tsabana as fed to the infant and the texture/consistency of Tsabana fed to the infant, along with the reading of the instructions on the Tsabana package or not and adding cooking oil, margarine and salt to the cooked Tsabana or not as further product use factors had no significant impact on the caregivers' perceived infant acceptance of Tsabana.

The caregiver perceived infant wellbeing improvement through the provision Tsabana and the perceived difference between Tsabana and other cooked porridges were the only clinic-related factors which significantly influenced the infant acceptance of Tsabana as perceived by the caregivers. While the majority of the caregivers who perceived the infant taste acceptance of Tsabana as very nice, nice or acceptable indicated that providing Tsabana to the infant improved the infant's wellbeing, the majority who perceived it as not tasting nice indicated that providing Tsabana to the infant had not improved the infant's wellbeing. More than half of the caregivers who perceived the infant texture acceptance of Tsabana as acceptable or nice indicated that Tsabana provides more nutrition to the infant. However, less than half of the caregivers who perceived the texture of Tsabana as not nice indicated that it provides more nutrition to the infant. The Botswana Ministry of Health provided Tsabana to Batswana infants to improve their wellbeing as Tsabana provides more nutrients and more energy to infants as compared to other traditionally prepared porridges like sorghum and maize meal (DLG & MoH, 2001). The information received from the clinic personnel about Tsabana, not always receiving Tsabana from the clinic and missing the scheduled infant clinic visits

though are clinic-related factors that did not influence the perceived infant acceptance of Tsabana.

The caregiver education level was the only demographic factor to significantly influence the acceptance of Tsabana. The majority of the caregivers who perceived the infant texture acceptance of Tsabana as nice, acceptable and not nice attained the secondary level schooling. In contrast the majority who perceived the texture acceptance as very nice attained no schooling/standard one to seven and not a secondary level or higher. It could be speculated that caregivers who attained a higher education level may be more critical of such attributes as the texture acceptance of Tsabana. The caregiver age and relationship to the infant receiving Tsabana, the gender of the infant receiving Tsabana, the number of infants in the household and the household source of income did not influence the acceptance of Tsabana.

5.3 Tsabana field use

About three quarters of the caregivers indicated that they read the preparation guidelines of Tsabana on the package when it was first received or even a few times after receiving it for the first time. However, despite the majority of the caregivers having read the preparation guidelines most of the caregivers did not follow all the field use guidelines for Tsabana. For example, more than two thirds of the caregivers fed Tsabana to the infants once a day and fed them one cup at a time. This usage is not according to the guidelines provided. Tsabana should be fed two to three times a day to infants aged six to 18 months (DLG & MoH, 2001). Two thirds of the caregivers used one cup of powder to prepare one Tsabana feeding, which was not a correct usage according to the Tsabana preparation guidelines. When preparing Tsabana for infants six to 18 months old, one and a half cups of powder should be used (DLG & MoH, 2001). More than half of the caregivers usually used one to two and a half cups of water to cook one feeding of Tsabana. According to the Tsabana preparation guidelines, three cups of water should be used for infants aged 18 months and less and four cups for those 19 to 36 months old; hence a further incorrect usage (DLG & MoH, 2001). Two thirds of the caregivers though

fed Tsabana to the infant at a warm temperature with a soft but not runny consistency which is according to the Tsabana preparation guidelines. More than two thirds of the caregivers cooked one feeding of Tsabana at a time, for 10 to 15 minutes, of which the preparation is also according to the guidelines.

More than three quarters of the caregivers added sugar to the cooked Tsabana and about half of them added one teaspoon which is used according to the Tsabana preparation guidelines. Almost all the caregivers added cooking oil to Tsabana of which just over half added two tablespoons which is the correct usage. More than three quarters of the caregivers did not add margarine to the cooked Tsabana. More than three quarters of the caregivers also did not feed the infants leftover Tsabana. More than two thirds of the caregivers who fed leftovers indicated that they stored it covered in the kitchen or another room and fed it at a warm temperature. It is stipulated on the Tsabana package that Tsabana should be cooked in such a way that it is enough for one feeding to avoid using leftovers. This is advised as a food safety measure, as leftovers can be a source of infections and can impact the infants' health (DLG & MoH, 2001). Two thirds of the caregivers who fed leftover Tsabana to the infants also did not add water to it. Not adding water to the leftover Tsabana by these caregivers will in particular impact the texture acceptance because the leftover Tsabana will stiffen and not be of a soft consistency. Water addition might be needed to soften it before feeding it to the infant.

More than half of the caregivers indicated that they did not receive any information about Tsabana from the clinic personnel. Of those caregivers who indicated that they received information from the clinic personnel, more than three quarters indicated that they were taught the importance of feeding Tsabana to the infant. More than half of these caregivers though indicated that they were not taught how to prepare Tsabana and about three quarters that they were not taught the importance of storing Tsabana properly. According to the usage guidelines stipulated on the package, Tsabana expires after four months of manufacture and should be stored under cool, dry and covered storage conditions (DLG & MoH, 2001).

More than three quarters of the caregivers indicated that they did not always receive Tsabana from the clinic. Among those who did not always receive it, more than three-quarters indicated the main reason as Tsabana not being available at the clinic. More than three-quarters of the caregivers also did not miss the infants' scheduled clinic visits. Among those who did miss it, one-third indicated that the main reason was the unavailability of Tsabana at the clinic. More than half of the caregivers walked a short distance to the clinic whereas more than one third walked a long distance.

The amount of Tsabana fed at a time and the amount of Tsabana cooked at a time were the only product use factors to significantly influence the number of daily feedings of Tsabana provided by the caregivers with a significant association found in the amount fed and a significant difference found in the amount cooked at a time. Even if the infants were fed once, twice or three times a day and more or not even daily most of the caregivers fed the infants one or one and a half cups of Tsabana at a time. Most of the caregivers who fed Tsabana to the infant once, three and more times a day or not even daily cooked enough Tsabana for one feeding compared to most of the caregivers who fed the infant twice a day who cooked enough for two feedings at a time.

The amount of powder and water used to cook one feeding of Tsabana were respectively significantly associated with the amount of Tsabana cooked at a time. Most of the caregivers who cooked an amount enough for one or for two and more feedings used one cup of powder to cook one feeding of Tsabana. Almost half of the caregivers, even though cooking an amount of Tsabana enough for one or two and more feedings, used one or one and a half cups of water to cook one feeding of Tsabana. The temperature of the Tsabana fed to the infant was highly significantly linked to the amount of Tsabana cooked at a time. About two thirds of the caregivers whether they cooked an amount enough for one or two and more feedings served Tsabana at a warm temperature, while nearly one third whether they cooked an amount enough for one or two and more feedings served it cool/cold.

The reading of the preparation guidelines on the Tsabana package significantly influenced the cooking period of one feeding of Tsabana. Most of those caregivers who indicated reading the package instructions once or a few times after receiving it cooked one feeding for 10 to 15 minutes which is according to the Tsabana preparation guidelines. Only a few caregivers cooked it for longer. In contrast nearly half of the caregivers who read the instructions, but did not pay much attention to it/did not read it, cooked one feeding of Tsabana for 20 minutes and longer which is not according to the Tsabana preparation guidelines.

All the clinic-related factors, that is the child wellbeing improvement or not by providing Tsabana, knowing the difference between Tsabana and other cooked porridges or not, having received information from the clinic personnel about Tsabana or not, always and not always receiving Tsabana from the clinic and missing the scheduled infant clinic visits or not, did not significantly influence either the number of daily feedings of Tsabana provided, the amount of Tsabana cooked at a time or reading of the preparation instructions on the Tsabana package by the caregivers. In addition none of the caregiver demographic factors such as their age, highest attained education level, relationship to the child receiving Tsabana and household source of income significantly influenced the number of daily feedings of Tsabana provided, the amount of Tsabana cooked at a time and reading of the preparation instructions on the Tsabana package by the caregivers.

5.4 Research strengths and limitations

The strengths of the study involve the following:

- The major strength relates to the information obtained on the Tsabana nutritional appraisal and the acceptance and use in the field which was not previously available and will be provided to the Ministry of Health and the Ministry of Local Government to assist in possible modification of the product for future benefit of infants receiving Tsabana and to improve its field use.

- During the field visits the researcher was able to share information with the clinic personnel as well as the caregivers on completion of the questionnaire. They asked various questions about Tsabana, particularly regarding its field use and in relation to its preparation, more especially the importance of cooking Tsabana for the stipulated period. Here the impact of extended heating on the micronutrient provision was in particular discussed.

The limitations of the study involve the following:

- Tsabana's nutritional appraisal was theoretically undertaken based on the product label information and not on an actual nutrient content analysis.

- Due to financial and time constraints only four out of the nine rural districts with two clinics in each were selected for the study.

- The participant representation within the sample was hampered across the districts and clinics. In some clinics, especially those in the Ngamiland and North East districts, there were a few caregivers (n=8), especially those who were not the mothers of the infants, who were reluctant or even refused to sign the consent forms. They therefore could not be included as participants. In a number of cases (n=5) the caregivers were not willing to wait to take part in the study by completing the questionnaire. These were caregivers who had already received Tsabana from the clinic at the time of the questionnaire completion or occurred when Tsabana was not available from the clinic on the study day. Most of the caregivers from Letlhakeng in the Kweneng district do not speak or understand Setswana or English. They mostly speak Sekgalagadi which is a language that the researcher doesn't know and the clinic personnel were not willing to interpret as they said the questionnaire was too long. These caregivers ended up not participating in the study. These occurences lowered the target number of caregivers for the particular clinics.

- The use of a small, but feasible sample size. A few (n=5) caregivers withdrew from the study as they were not interested to complete the entire questionnaire. Hence only 105 participants were used instead of the initial envisaged 110.

- In the questionnaire there is a question which reads “number of children in the household receiving Tsabana”. This question provided the realization that there are a few infants involved per household who are receiving Tsabana feedings, not only one infant/child. As the questionnaire related to a “child” the caregivers were asked to complete the questionnaire in general for those infants in the household which met the age criteria of the study.

- In the data analysis, questionnaire responses had to be combined as there were several cells with low cell counts and zeros which resulted in the use of the Fisher’s exact test to accommodate these low counts instead of using the Chi-square test only as initially planned. This led to the combination of some question responses which did not allow for providing the results of the individual question responses in these cases. Consideration was though given to the response combinations for each involved question in making them relevant and practical.

CHAPTER 6

CONCLUSIONS

Vitamins and minerals (micronutrients) are important components for optimal nutrition and human health, supporting physical and intellectual development in many ways. A number of vitamins and minerals are particularly important because a large number of people around the world are deficient in them, in particular infants and children (NRC, 2008:1761). These are vitamin A, iodine, iron, zinc and folate. For instance, approximately one third of the developing world's children under the age of five are vitamin A-deficient (WHO, 2009).

Based on the macro- and micronutrient contents of Tsabana in relation to the Codex Alimentarius Standard, the PNCFCF and the WHO recommended intakes it is evident that most of the vitamins and minerals included are adequately present. Although most of them are adequately present, there is a serious concern about micronutrients which are needed by infants and children for proper growth and development of which the provision are less than the specified compositions in all the guidelines. These micronutrients include the minerals zinc, iron and iodine. As with the absence of omega-3 and omega-6 fatty acids, the minerals selenium and copper are also not provided by Tsabana.

Tsabana is a fortified complementary food product. The fortification compounds used for the vitamin and mineral additions are stipulated on the Tsabana packaging besides for the iron used. The cholecalciferol, zinc sulphate, potassium iodate and calcium micronutrient fortificants used in Tsabana are readily bioavailable. However, vitamin A palmitate and vitamin E acetate used as fortification compounds have low bioavailability which results in less effective utilization by the body.

Based on the perceptions of the caregivers Tsabana was enjoyed and sensorically accepted by the infants. The enjoyment, taste and texture of Tsabana were the attributes

that contibuted to the perceived acceptance. The attribute that greatly supported the perceived acceptance was the enjoyment with the Tsabana colour the attribute that least supported the acceptance. Despite this high perceived acceptance of Tsabana its preparation for use as a complementary feed was not satisfactory as most of the caregivers in terms of the preparation guidelines provided did not apply them correctly.

It was evident that most of the factors that influenced the acceptance of Tsabana were the product use factors which influenced its enjoyment, taste, colour and texture acceptance as well as its field use in terms of the daily feedings provided, the amount cooked at a time and reading of the preparation guidelines. It is thus greatly important that the preparation guidelines be applied correctly as the product use had an influence on its perceived infant acceptance.

A few guidelines were correctly adhered to by nearly all the caregivers in terms of the Tsabana field use. These include addition of cooking oil and sugar to Tsabana, its cooking time and not feeding infants leftover Tsabana. The addition of sugar influenced the enjoyment of Tsabana as perceived by the caregivers as of those who indicated a dislike perception some did not add sugar, while those who added sugar mostly indicated a liking perception. One teaspoon of sugar is recommended to be added to Tsabana not only to increase the energy provision but also to improve the taste so that the infants can enjoy it better (DLG & MoH, 2001). Continued correct application of these field use guidelines should be strived for.

Though as much as two thirds of the caregivers adhered to the cooking time guideline, more than one third did not. Tsabana should be cooked for 10 to 15 minutes as the preparation guideline stipulates (DLG & MoH, 2001). The study found that those caregivers who cooked it for 10 to 15 minutes indicated a perceived colour acceptance of Tsabana, while those who cooked it for less than 10 minutes did not. This further indicates the importance of adherence to the preparation guidelines as it might impact the colour acceptance. The colour acceptance was found to be the least supported perceived product acceptance attribute and it was also found to be linked to the number of daily Tsabana feedings provided.

However, as indicated a number of guidelines were not adhered to by the caregivers in terms of the Tsabana field use. These incorrect aspects were, the number of daily Tsabana feedings provided, the amount of Tsabana fed at a time, the amount of Tsabana cooked at a time, the amount of powder and the amount of water used to cook one feeding of Tsabana and reading of the preparation guidelines on the Tsabana package.

The number of daily Tsabana feedings provided was found to be important. It was linked to the caregiver perception of the infant enjoyment, colour and texture acceptance of Tsabana. The number of daily Tsabana feedings provided should be two to three times a day for infants six- to 18 months old to provide them with an adequate nutrient provision (DLG & MoH, 2001). Three quarters of the caregivers did not provide Tsabana to the infants two to three times a day as recommended. Instead they provided Tsabana to the infant once per day. A negative perception of the infant enjoyment, colour and texture acceptance of Tsabana provided for it not to be fed daily. A negative acceptance perception relates to those disliking it or disliking it very much in case of the perceived Tsabana enjoyment, colour and texture.

The amount of water used to cook one feeding of Tsabana influenced its taste acceptance. Although the majority of the caregivers used one to two and a half cups of water to cook one feeding it is stipulated on the Tsabana package that three and a half cups of water be used to cook one and one-half cups of Tsabana powder (DLG & MoH, 2001). In the Tsabana field use most of the caregivers indicated that they did not receive any information from the clinic personnel, and even though the caregivers indicated that they read the preparation guidelines on the Tsabana package they did not apply them. The incorrect field use of Tsabana implied that these infants aged six to 18 months were not receiving their full Tsabana nutritional provision as it was fed at lower amounts per time per day. If the caregivers use less powder and less water infants will receive a smaller amount than what they should because the volume will be less. The texture of the fed Tsabana may also be compromised as the volume of water and powder used to cook one feeding is less than the required amounts. Providing information to the caregivers by the clinic personnel on the importance of the provision of Tsabana to undernourished infants

and its use becomes an important consideration, particularly the preparation of Tsabana which seems to be the more neglected aspect in the Tsabana information provision by the clinic personnel.

In addition to the information considered on the provision of Tsabana, information on the types of foods provided was also addressed in considering the infant dietary provision. The study found that foods that should be included in the daily dietary provision were not provided daily but weekly to the majority of the infants such as meat, poultry and fish as well as fruit and vegetables or even seldom/never provided such as eggs, yogurt and cheese.

In many disadvantaged countries, nutritionally adequate complementary foods that can easily be introduced after six months of age are not widely available or reasonable in cost, especially for mothers living in resource-poor households (FAO/WHO, 2003). Instead, complementary foods in these countries are frequently based almost exclusively on cereal, despite the evidence that such foods are often accompanied by major deficits in iron, zinc, calcium and vitamin A (Gibson *et al*, 1997:764; Anderson *et al*., 2008:146). For example, in Mongolia complementary feeding is compromised by deficits in several micronutrients as the foods mostly consumed are predominantly cereal-based (wheat flour and rice). The diet rarely contains meat, poultry, fish or eggs that should be consumed daily or as often as possible. Hence it is likely that deficits in the problem micronutrients exist in complementary diets in Mongolia and may be responsible for micronutrient deficiencies which persist throughout early childhood (Lander *et al*., 2009:1304). This is also likely for Botswana as the study found that protein foods in addition to fruit and vegetables were not as a rule provided daily to the infants

CHAPTER 7

RECOMMENDATIONS

This study indicated the need to pay attention to the vitamins and minerals that are not adequately provided by Tsabana as it directly influences the nutritional adequacy of the product as complementary food and as intervention dietary source to undernourished infants. By noting the following, the findings of the study could assist the Botswana Ministry of Health in the fortification of Tsabana through:

- Increasing the micronutrient addition amounts for those found lacking to provide an adequate provision. The two micronutrients of particular importance here are zinc and iron.

- Modifying the product by including omega-3 and omega-6 fatty acids as well as the trace elements selenium and copper needed by the body for growth and development. By adding red palm oil to Tsabana it can act as a vitamin A and vitamin E fortificant as well as an antioxidant to prevent the oxidation of polyunsaturated fats which may need to be considered on fat modification of the product. Red palm oil is a source of vitamin A (contains β-carotene which is a precursor to vitamin A) to fortify Tsabana and also contains vitamin E in the form of α-tocopherol as well as four types of tocotrienols namely α-, β-, γ- and δ-tocotrienols (Seppanen *et al*., 2010:478). Tocotrienols are characterized by higher anti-oxidant activities compared to tocopherols and are therefore ideal to prevent rancidity in polyunsaturated oils (Seppanen *et al*., 2010:479).

- Changing the forms in which certain fortificant compounds are added to Tsabana. It is important and advisable that manufacturers use forms of nutrient fortificant compounds which are more readily absorbable and make them more bioavailable to the body. Vitamin E can be added in a form of non-synthetic α-tocopherol instead of tocopherol acetate. Zinc amino acid complexes or chelates are the

forms of dietary zinc which are highly bioavailable. Zinc sulphate when added to food may affect the bioavailability of other minerals more especially iron. Some of the micronutrient component forms as added, such as that of iron, were not indicated on the Tsabana package. The component form added should be obtained from the manufacturer.

- On the possible modification of the nutritional content of Tsabana, the addition of higher amounts of the nutrients inadequately provided or the addition of other nutrients found lacking should not influence the perceived acceptance of Tsabana, particularly its enjoyment and taste as these are the two attributes highly supportive of the perceived acceptance. As the colour is the attribute that least supports the Tsabana acceptance, consideration could be given to improve its colour. Any nutrient incorporation changes should not unnecessarily darken the product. However, considered in the context of the study, the colour perception was indicated by the caregivers and not the infants themselves.

- A survey utilizing dietary intake methodology undertaken to determine if the dietary intake of infants receiving Tsabana in some way provide in the provision of the nutrients that are not provided or not adequately provided by Tsabana.

In improving the perceived acceptance of Tsabana as well as its field use the clinic personnel require comprehensive training about the nutritional importance of Tsabana and its correct usage so that they can provide caregivers with the needed essential information.

Caregivers need education regarding nutrition and child care especially on the following aspects:

i. Tsabana use

- The nutritional importance of feeding Tsabana to the infants.

- The difference between Tsabana and other cooked porridges.

- How much and how frequently Tsabana should be fed to the infant, at what temperature and texture/consistency.

ii. Tsabana preparation guidelines

- It is important that the caregivers be encouraged to read the preparation guidelines. However they may not fully comprehend the information on their own. If adequately explained to them in an educational format it could be of great assistance. Trained clinic personnel could also do cooking demonstrations which will show the caregivers the correct way of preparing Tsabana because if it is not correctly prepared it can impact the sensory attributes, such as possibly the colour, and as a result the field use.

- Educating the caregivers on the importance of adding sugar and cooking oil to Tsabana as well as cooking it for the correct time of 10 to 15 minutes could help improve the perceived infant acceptance of Tsabana and rectify its field use pertaining to these aspects which is of particular importance to the nutritional contribution Tsabana is envisaged to make.

iii. Other

- Healthy eating in support of the Tsabana provision, such as emphasizing the importance of providing a variety of foods and which foods should be consumed daily and in what amounts.

CHAPTER 8

REFERENCES

Aaby, P. 1991. Determinants of measles mortality. In De la Maza, L.M. & Peterson, E.M. (eds). *Medical Virology*. 10th edition. New York: Plenium Press.

Adu-Afarwuah, S., Lartey, A., Brown, K.H., Zlotkin, S., Briend, A. & Dewey, K.G. 2008. Home fortification of complementary foods with micronutrient supplements is well accepted and has positive effects on infant iron status in Ghana. *American Journal of Clinical Nutrition,* 87:929–938.

Agbon, C.A., Onabanjo, O.O. & Akinyemi, C.O. 2011. Micronutrient adequacy of homemade complementary foods. *Nutrition and Food Science*, 41(1):12-19.

Agostoni, C., Decsi, T., Fewtrell, M., Goulet, O., Kolacek, S., Koletzko, B., Michaelsen, K.F., Moreno, L., Puntis, J., Rigo, J., Shamir, R., Szajewska, H., Turck, D. & van Goudoever, J. 2008. ESPGHAN Committee on Nutrition: Complementary feeding. *Nutrition Journal of Pediatrics & Gastroenterology of Nutrition*, 46:99–110.

Akaninwor, J.O. & Okechukwu, P.N. 2004. Nutritional value of 'ogi', a Nigerian infant food. *Biokemistri*, 16:15-21.

Akinrele, I.A. & Edward, C.C.A. 1971. An assessment of the nutritive value of a maize-soya mixture soy-ogi, as a weaning food in Nigeria. *British Journal of Nutrition*, 26:177-185.

Allen, L. & Gillespie, S. 2001. What works? A review of the efficacy and effectiveness of nutrition interventions. *ACC/SCN Nutrition Policy Paper*, 19:27-28.

Anderson, V.P., Cornwall, J. & Jack, S. 2008. Intakes from non-breast milk foods for stunted toddlers living in poor urban villages of Phnom Penh, Cambodia are inadequate. *Maternal & Child Nutrition,* 4:146–159.

Arimond, M. & Ruel, M.T. 2004. Dietary diversity is associated with child nutritional status: Evidence from 11 demographic and health surveys. Washington, D.C: International Food Policy Research Institute.

Armas, L.A., Hollis, B.W. & Heaney, R.P. 2004. Vitamin D_2 is less effective than vitamin D_3 in humans. *Journal of Endocrinology and Metabolism,* 89(11):5387-5391.

Ayaya, S.O., Esamai, F.O., Rotich, J. & Olwambula, A.R. 2004. Socio-economic factors predisposing under five-year-old children to severe protein energy malnutrition at the Moi Teaching and Referral Hospital, Eldoret, Kenya. *Eastern African Medical Journal*, 81(8): 415-421.

Azais-Braesco, V. & Pascal, G. 2000. Vitamin A in pregnancy: requirements and safety limits. *American Journal of Clinical Nutrition,* 71(5):1325S-1333S.

Bailes, J.E. & Mills, J.D. 2010. Omega-3 fatty acids for treatment of traumatic brain injury. *Journal of Neurotrauma,* 10:1617-1624.

Barners, L.A. 1989. Nutrition and nutritional disorders. In Vaughan, V.C., Mckay, R.J. & Berhrman, R.E (eds). *Nelson's textbook of pediatrics*. Philadephia: Saunders Co.

Beck, E.J., Mays, N. & Whiteside, A. 2008. *The HIV pandemic: Local and global implications*. Oxford: Oxford University Press.

Bolling, K., Grant, C., Hamlyn, B. & Thornton, A. 2005. BT infant feeding survey. London: The Information Centre, Department of Health, Social Services and Public Safety.

Botswana Central Statistics Office (BCSO). 2000. Botswana multiple indicator survey. Gaborone: Government Printers.

Botswana Central Statistics Office (BCSO). 2009. Botswana family health survey IV, 2007. Gaborone: Government Printers.

Botswana Department of Local Government (DLG) & Ministry of Health (MoH). 2001. Specifications for Tsabana (sorghum/soya weaning food). Annexure III-IV. Gaborone: Government Printers.

Botswana Ministry of Health. 2010. Botswana national nutrition surveillance system trend report. Gaborone: Department of Public Health, Ministry of Health.

Bronner, F. & Pansu, D. 1999. Nutritional aspects of calcium absorption. *Journal of Nutrition*, 129:9-12.

Brown, K.H., Wessells, K.R. & Hess, S.Y. 2007. Zinc bioavailability for zinc fortified foods. *Journal of Vitamin and Nutrition Research*, 77(3):174-181.

Butte, N.F., Cobb, K., Graney, L., Heird, W.C. & Rickard, K.A. 2004. The start healthy feeding guidelines for infants and toddlers. *Journal of the American Dietetic Association*, 104:442-454.

Cabrera-Vigue, C. & Navarro-Alarcon, M. 2008. Selenium in food and human body. A review. *Science of the Total Environment*, 400:115-141.

Caulfield, L.E., De Onis, M., Blössner, M. & Black, R.E. 2004. Undernutrition as an underlying cause of child deaths associated with diarrhea, pneumonia, malaria and measles. *American Journal of Clinical Nutrition*, 80:193-198.

Caulfield, L.E., Huffman, S.L. & Piwoz, E.G. 1999. Interventions to improve intake of complementary foods by infants 6-12 months of age in developing countries: impact on growth and on the prevalence of malnutrition and potential contribution to survival. *Food and Nutrition Bulletin*, 20:183-200.

Challa, A., Ntourntoufi, A. & Cholevas, V. 2005. Breastfeeding and vitamin D status in Greece during the first 6 months of life. *European Journal of Pediatrics*, 164:724-729.

Christiaensen, L. & Alderman, H. 2001. Child malnutrition in Ethopia: Can maternal knowledge augment the role of income? Available from: http://www.worldbank.org.za [Accessed: 10/04/2011].

Chung, M., Balk, E.M., Ethan M., Brendel, M., Ip, S., Lau, J., Lee, J., Lichtenstein, A., Patel, K., Raman, G., Tatsioni, A., Terasawa, T. & Trikalinos, T.A. 2009. Vitamin D and calcium: A systematic review of health outcomes. Rockville, MD: Agency for Healthcare Research and Quality (AHRQ).

Clark, J.E. 1998. Taste and flavour: their importance in food choice and acceptance. *Proceedings of the Nutrition Society*, 57:639-643.

Clausen, T., Charlton, K.M., Gobotswamang, K.S.M. & Holombe-Ottesen, G. 2005. Predictors of food variety and dietary diversity among older persons in Botswana. *Nutrition*, 21:86-95.

Clover, J. 2003. Food security in Sub-Saharan Africa. *African Security Review*, 2:1-3.

Codex Alimentarius Standard. 2006. Codex Standard for Processed Cereal-based Foods for Infants and Young Children. Rome: Codex Alimentarius Commission, 1:1-9.

Collins, S. & Sadler, K. 2002. Outpatient care for severely malnourished children in emergency relief programs: a retrospective cohort study. *Lancet*, 360:1824–1830.

Communication for Development Group. 2003. Knowledge and information for food security in Africa. Available from: http://www.fao.org/sd/Cddirect/Cdan0017.html [Accessed: 29/04/ 2011].

Creswell, J.W., Plano Clark, V., Gutmann, M. & Hanson, W. 2003. Advances in mixed methods design. In: Tashakkori, A. & Teddlie, C. (eds). Hand book of mixed methods in the Social and Behavioural Sciences. California: Thousand Oaks.

Crowther, P. 2008. The association between household food security and mortality in children under 5 years of age in Agincourt, Limpopo Province. University of the Witwatersrand. Available from: http://www.hdl.handle.net/123456789/5816. [Accessed: 24/07/ 2011].

Daniels, M.C., Adair, L.S., Popkin, B.M. & Truong, Y.K. 2007. *Dietary diversity scores can be improved through the use of portion requirements: an analysis in young Filipino children*. New York: Nature Publishing Group.

Davis, S. 2009. Sensory preferences and food intake in children. Available from: http://www.liivestrong.com/article/49353-sensory-preferences-intake-children/ [Accessed 19/09/2012].

Dettwyler, K.A. 1987. Infant feeding in Mali, West Africa: variations in belief and practice. *Social Science & Medicine*, 23: 651–64.

Dewey, K. & Brown, K. 2003. Update on technical issues concerning complementary feeding of young children in developing countries and implications for intervention programs. *Food and Nutrition Bulletin*, 4:24-85.

Dewey, K.G., Yang, Z. & Boy, E. 2009. Systematic review and meta-analysis of home fortification of complementary foods. *Maternal & Child Nutrition*, 5(4):283–321.

Dhanamitta, S. 1998. Community based nutrition projects. Bangkok: Institute of Nutrition, Mahidol University.

Doudu, K.G., Taylor, J.R., Belton, P.S. & Hamaker, B.R. 2003. Factors affecting sorghum protein digestibility. *Journal of Cereal Science,* 38:117-131.

Duggan, M. & Golden, B. 2006. *Deficiency diseases in human nutrition*. 11th edition. London: Elsevier Churchill Livingstone.

Dupont, C. 2003. Protein requirements during the first year of life 1–4 years. *American Journal of Clinical Nutrition.* 77:1544S–15449S.

Edward, H. 2009. 7 common typyes of zinc explained. Available from: http://www.globalhealingcenter.com/natural-health/types-of-zinc [Accessed: 08/02/2013].

Faber, M. & Benadé, A.J.S. 2002. A household food production program to address vitamin A deficiency: A South African experience. Tygerberg: Medical Research Council.

Faber, M. 2004. Complementary foods consumed by 6-12 months old rural infants in South Africa are inadequate in micronutrients. *Public Health Nutrition*, 8(4):373-381.

Faber, M., Schwabe, C. & Drimie, S. 2008. Dietary diversity in relation to other household food security indicators. *International Journal of Food Safety, Nutrition and Public Health*, 2:157-171.

Fashakin, J.B. & Ogunsola, F. 1982. The utilization of local foods in the formulation of weaning foods. *Journal of Tropical Pediatrics,* 28(2):93-96.

Fashakin, J.B. 1989. Nutritional evaluation of weaning foods. In: Fashakin J.B. (eds). Proceedings of the workshop on present knowledge on weaning foods in Nigeria. Oshodi-Lagos: Federal Institute for Industrial Research.

Food Agricultural Organisation (FAO). 2003. The state of food insecurity in the world. Available from: http://www.fao.org-docrep-006-J0083e-j0083e00.html [Accessed: 04/03/2011].

Food and Agricultural Oganization (FAO). 1997. Agriculture food and nutrition for Africa, a resource book for teachers of agriculture. Available from: http://www.fao.org/docrep/woo78e.html. [Accessed: 06/05/2011].

Food and Agricultural Organization (FAO) / World Health Organization (WHO). 2001. Human vitamin and mineral requirements. Report of a joint FAO/WHO expert consultation in Bangkok, Thailand. Rome: Food and Agriculture Organization.

Food and Agriculture Organization (FAO) / World Health Organization (WHO). 1998. Preparation and use of food dietary guidelines. Report of joint FAO/WHO consultation technical report series 880. Geneva: FAO/WHO.

Food and Agriculture Organization of the United Nations (FAO). 1996. Food technology-Technology and quality control. *Food and Nutrition Paper*, 60:1-10.

Friis, M. & Michaelsen, K.F. 1998. Micronutrients and HIV infection: A review. *European Journal of Clinical Nutrition*, 52:157-163.

Gagnė, A., Qin Wei, S., Frazer, W.D. & Julien, P. 2008. Absorption, transport and bioavailability of Vitamin E and its role in pregnant women. *Obstetrics*, 31(3):210-217.

Garcia-Bailo, B., Toguri, C., Eny, K.M. & El-Sohemy, A. 2009. Genetic variation in taste and its influence on food selection. *Journal of Integrated Biology*, 13:69–80.

Gaston, N. & Daniels, P. 1988. Guidelines: Writing for adults with limited reading skills. Alexandria, Viginia: Department of Agriculture.

Gibson, R.S., Ferguson, E.L. & Lehrfeld, J. 1998. Complementary foods for infant feeding in developing countries: their nutrient adequacy and improvement. *European Journal of Clinical Nutrition,* 52, 764–770.

Giovannini, M., Riva, E. & Banderali, G. 2004. Feeding practices of infants through the first year of life in Italy. *Acta Pediatrics*, 93:492-497.

Giovannini, M., Sala, D. & Usuelli M. 2006. Double-blind, placebo controlled trial comparing effects of supplementation with two different combinations of micronutrients delivered as sprinkles on growth, anemia, and iron deficiency in Cambodian infants. *Journal of Pediatrics and Gastroenterological Nutrition,* 42: 306–12.

Golden, M. 2010. Evolution of nutritional management of acute malnutrition. *Indian Pediatrics*, 47:667-678.

Golden, M.H.N. & Golden, B.E. 2000. Severe malnutrition. In Garrow, J.J., Ralph, A. & James, W.P.T. (eds). *Human nutrition and dietetics*. 10th edition: London: Churchill Livingstone.

Gravetter, F.J. & Forzano, L.B. 2009. *Research methods for the behavioural sciences.* 3rd edition. Wadsworth: New York.

Gropper, G. 2000. *Biochemistry of human nutrition*. 2nd edition. Bedford: Brooks.

Gross, R. 1999. Micronutrient supplementation throughout the life cycle. Report of a workshop held by the Ministry of Health Brazil and UNICEF. Rio de Janeiro, November 17–19. Rio de Janeiro: UNICEF.

Grueger, B. 2013. Weaning from the breast. *Paediatric Child Health*, 18(4):1-5

Guéguen, L. & Pointillart, A. 2000. The biloavailability of dietary calcium. *Journal of the American College of Nutrition*, 19(2):119S-136S.

Guiro, A.T., Sail, M.G., Kane, O. & Diarra, D. 1987. Protein-caloric malnutrition in Senegalese children. Effects of rehabilitation with a pearl weaning food. *Nutrition Reports International*, 36:1071-1079.

Gunnarsson, B.S., Thorsdottir, I. & Palsson, G. 2004. Iron status in 2 year-old Icelandic children and associations with dietary intake and growth. *European Journal of Clinical Nutrition*, 58:901-906.

Haas, E.M. 2006. *Staying healthy with nutrition*. 21st edition. California: Ten Speed Press.

Hacherl, E.L., Kosson, D. S., Young, L.Y. & Cowan, R.M. 2001. Measurement of iron(III) bioavailability in pure iron oxide minerals and soils using anthraquinone-2,6-disulfonate oxidation. *Environmental Science and Technology*, 35(24):4886–4893.

Hambidge, K.M. & Krebs, N.F. 2007. Zinc deficiency: A special challenge. *Journal of Nutrition*, 137(4):1101-1105.

Hanemann, U. 2006. Literacy in Botswana. Education for all global monitoring report. Gaborone: UNESCO.

Harris, G.G. 2008. Development of taste and food preference in children. *Current Opinion in Clinical Nutrition and Metabolic Care*, 11(3):315-319.

Herman, S., Griffin, I.J., Suwarti, S., Ernawati, F., Permaesih, D., Pambudi, D. & Abrams, S. 2002. Cofortification of iron-fortified flour with zinc sulphate, but not zinc oxide, decreases iron absorption in Indonesian children. *American Journal of Clinical Nutrition*, 76:813-817.

Herzberg, M., Foldes, J. & Menczel, J. 1990. Zinc excretion in osteoporotic women. *Journal of Bone Mineral Research*, 5:251-257.

Hoddinott, J. & Yohannes,Y. 2002. Dietary diversity as a food security indicator. Food and Nutrition Technical Assistance (FANTA) Project. Washington D.C: Academy for Educational Development.

Hortz, C. & Gibson, R.S. 2007. Traditional food processing and preparation practices to enhance the bioavailability of micro-nutrients in plant-based diets. *Journal of Nutrition*, 137:1097-1100.

Hurrell, R. & Egli, I. 2010. Iron bioavailability and dietary reference values. *American Journal of Clinical Nutrition*, 91(5):1461S-1467S.

Infant and Young Child Feeding (IYCFC). 2006. An integrated course. Geneva Department of Nutrition for Health and Development, World Health Organization.

Innis, S.M. 2008. Dietary omega 3 fatty acids and the developing brain. *Brain Research*, 1237:35-43.

International Zinc Nutrition Consultative Group (IZNCG). 2004. Assessment of the risk of zinc deficiency in populations and options for its control. *Food and Nutrition Bulletin*, 25(4):94S-204S.

Istituto Nazionale della Nutrizione (INN). 1999. Strategies to fight anemia and growth retardation in Saharawi children. Rome: Comitato Internazionale per lo Sviluppo dei Popoli.

Jackson, A.A., Ashworth, A. & Khanum, S. 2006. Improving child survival: Malnutrition Task Force and the paediatrician's responsibility. *Archives of Disease in Childhood*, 91(8):706-710.

Jellinek, G. 1985. *Sensory evaluation of food – Theory and practice.* Chichester: International Publishers in Science and Technology.

Jones, J.S. 1998. Malnutrition a silent emergency. *South African Journal of Clinical Nutrition*, 88(5):634.

Kalanda, B.F., Verhoeff, F.N. & Brabin, B.J. 2006. Breast and complementary feeding practices in relation to morbidity and growth in Malawian infants. *European Journal of Clinical Nutrition*, 60:401-407.

Kapunda, S.M. 2006. Food Security and consumption patterns in Botswana: analysis based on recent national household budget survey. *The ICFAI Journal of Agricultural Economics*, 3(3):69-76.

Kar, B.R., Rao, S.L., & Chandramouli, B.A. 2008. Cognitive development in children with chronic protein energy malnutrition. *Behavioral and Brain Functions* 4:1-31.

Katz, K.A., Mahlberg, M.H., Honig, P.J. & Yan, A.C. 2005. Rice nightmare: Kwashiorkor in 2 Philadelphia-area infants fed Rice Dream beverage. *Journal of the American Academy of Dermatology*, 52:S69-S72.

Kebakile, M.M., Mpotokwane, S.M., Motswagole, B.S., Lima De Faria, M., Domingues, M. & Saraiva, C. 2003. Consumer attitudes to sorghum foods in Botswana. Kanye: National Food Technology Centre. Available from www.afripro.org.uk/papers/paper12Kebakile.pdf [Assessed: 12/05/2011].

Kennedy, G., Nantel, G. & Shetty, P. 2003. The scourge of "hidden hunger": global dimensions of micronutrient deficiencies. *Food, Nutrition & Agriculture,* 32: 8–16.

Kilic, M., Taskin, E., Ustundag, B. & Aygun, A.D. 2004. The evaluation of serum leptin level and other hormonal parameters in children with severe malnutrition. *Clinical Biochemistry*, 37: 382-387.

King, K.W., Dominique, G., Uriodain, G., Fourgere, W. & Beghin, I.D. 1972. Food patterns form dietary surveys in developing countries. *Journal of the American Dietetic Association*, 53:114-118.

Kleinman, R.E. 2004. Complementary feeding. In Kleinman, R.E. (eds). *Pediatric nutrition hand book*. 5th edition. Elk Grove Village: APP.

Koletzko, B., Dokoupil, K. & Reitmayr, S. 2000. Dietary fat intakes in infants and primary school children in Germany. *American Journal of Clinical Nutrition*, 72:1392-1398.

Koletzko, B., Lien, E., Agostoni, C., Böhles, H., Campoy, C., Cetin, I., Decsi, T., Dudenhausen, J.W., Dupont, C., Forsyth, S., Hoesli, I., Holzgreve, W., Lapillonne, A., Putet G., Secher, N.J., Symonds, M., Szajewska, H., Willatts, P. & Uauy, R. 2008. The roles of long-chain polyunsaturated fatty acids in pregnancy, lactation and infancy: review of current knowledge and consensus recommendations. *Journal of Perinatal Medicine,* 36(1):5-14. doi: 10.1515/JPM.2008.001.

Kramer, M.S. & Kakuma, R. 2004. The optimal duration of exclusive breastfeeding. A systematic review. *Advances in Experimental Medicines and Biology*, 554:63-77.

Kramer, M.S., Guo, T. & Platt, R.W. 2003. Infant growth and health outcomes associated with 3 compared to 6 months of exclusive breastfeeding. *American Journal of Clinical Nutrition*, 78:291-295.

Krige, M.U. & Senekal, M. 1997. Factors influencing the nutritional status of pre-school children of farmworkers in the Stellenbosch district. *South African Journal of Food & Nutrition*, 1(9):14-23.

Kris-Etherton, P.M. & Innis, I. 2007. Position of the American Dietetic Association and Dietitians of Canada: Dietary fatty acids. *Journal of the American Dietetic Association*, 107:1599-1611.

Kumar, R. 2005. *Research methodology: a step by step guide for beginners*. 2nd edition. London: Sage.

Kuusipalo, H, Maleta, K, Briend, A, Manary, M. & Ashorn, P. 2006. Growth and change in blood haemoglobin concentration among underweight Malawian infants receiving fortified spreads for 12 weeks: a preliminary trial. *Journal of Pediatrics and Gastroenterological Nutrition*, 43:525–32.

Lander, R., Enkhjargal, T.S., Batjargal, J., Bolormaa, N., Enkhmyagmar, D., Tserendolgor, U., Tungalag, S., Bailey, K. & Gibson, R.S. 2009. Poor dietary quality of complementary foods is associated with multiple micronutrient deficiencies during early childhood in Mongolia. *Public Health Nutrition*, 13(9):1304–1313.

Landvik, S. 2004. Vitamin E from supplements has good bioavailability. *American Journal of Clinical Nutrition*, 80(3):784-785.

Lawless, H.T. & Heymann, H. 1998. *Sensory evaluation of food: Principles and practices*. Chapman and Hall: Springer.

Lawless, H.T. & Heymann, H. 2010. *Sensory evaluation of food: Principles and practices*. 2nd edition. New Yolk: Springer.

Leedy, P.D. & Ormrod, J.E. 2005. *Practical research: Planning and design*. New Jersey: Merrill Prentice Hall.

López-Huertas, E., Teucher, B., Boza, J.J., Martínez-Férez, A., Majsak-Newman., Baró, L., Carrero, J.J., González-Santiago, M., Fonollá, J. & Fairweather-Tait. 2006. Absorption of calcium from milks enriched with fructo-oligosaccharides, caseinophosphopeptides, tricalcium phosphate and milk solids. *American Journal of Clinical Nutrition*, 83:310-316.

Lozoff, B., Beard, J., Connor, J., Barbara, F., Georgieff, M. & Schallert, T. 2006. Long-lasting neural and behavioral effects of iron deficiency in infancy. *Nutrition Reviews*, 64:S34–S91.

Lutter, C.K. & Dewey, K.G. 2003. Proposed nutrient composition for fortified complementary foods. *Journal of Nutrition*, 133:3011S-3020S.

Lutter, C.K. & Rivera, J.A. 2003. Nutritional status of infants and young children and characteristics of their diets. *Journal of Nutrition*, 133(9) 2941S-2949S.

Lutter, C.K. 2000. Processed and complementary foods: summary of nutritional characteristics, methods of production and distribution and cost. *Food and Nutrition Bulletin*, 21(1):61-83.

Mabilia, M. 1996. Beliefs and practices in infant feeding among the Wagogo of Chigongwe (Dodoma rural district), Tanzania: breastfeeding. *Ecological Food and Nutrition*, 35:195–207.

Malekafzali, H. 2000. Community-based nutritional intervention for reducing malnutrition among children under 5 years of age in the Islamic Republic of Iran. *Eastern Mediterranean Health Journal*, 6(2/3):238-245.

Manary, M.J., Ndkeha, M.J., Ashorn, P., Maleta, K. & Briend, A. 2004. Home based therapy for severe malnutrition with ready-to-use food. *Archives of Disease in Childhood*, 89:557–561.

Maruapula, S., 1993. Children Nutritional status in Botswana: Results of the 1993 Nutrition Survey of children under five years. Gaborone: Lentswe la Lesedi.

Marwaha, R.K. & Gopalakrishnan, S. 2011. Facts of iodine supplementation. *Journal of the Association of Physicians of India*, 59:7-10.

McArthur, K.E., Walsh, J.H. & Richardson, C.T. 1988. Soy protein meal stimulates less gastric acid secretion and gastric release than beef. *Scandinavian Journal of Gastroenterology*, 95:920-926.

Monckeberg, F. 1991. Protein energy malnutrition: Marasmus. In Bissonnette, B. & Dalens, B.J. (eds). *Clinical nutrition of the young child*. New York: Raven Press.

Morris, D.H. 2004. Flax reduces inflammation leading to atherosclerosis. New flax facts. Winnipeg: Flax Council of Canada.

Mother and Child Nutrition. 2007. Worlds popular highlights: Malnutrition. Available from: http://motherchildnutrition.org [Accessed: 06/05/2011].

Mugabe, M., Gobotswang, K. & Holmboe-Ottessen. 1998. From food security to nutrition security in Botswana. Botswana: Lentswe la Lesedi.

Müller, O. & Krawinkel, M. 2005. Malnutrition and health in developing countries. *Canadian Medical Association Journal*, 173(3):279-286.

Mustafa, K., Rod, M. & Luc, J.A., 2007. Food Security is a global concern: International development research. Available from: http://www.idrc.ca/en/ev-30581-201-1-DO-TOPIC.html [Accessed: 25/08/2011].

National Academies Press. 2001. Dietary reference intakes for vitamin A, vitamin K, arsenic, boron, chromium, copper, iodine, iron, manganese, molybdenum, nickel, silicon, vanadium and zinc**.** Washington, D.C: The National Academies Press.

National Academies Press. 2006. Dietary reference intakes: The essential guide to nutrient requirements. Washington, D.C: The National Academies Press.

National AIDS Coordinating Agency (NACA). 2008. The government of Botswana's progress report of the national response to the United Nations General Assembly Special Session (UNGASS) declaration of commitment on HIV/AIDS. Gaborone: Government Printers.

National Research Council (NRC). 2008. Nutrient requirements for infants and young children. *American Public Health Association,* 56(10):1756-1784.

Nemer, L., Gelband, H. & Jha, P. 2001. The evidence base for intervention to reduce malnutrition in children under five and school-aged children in low and middle-income countries. CMH Working Paper Series, No. WG5:11. Geneva: WHO.

Nesamvuni, A.E., Vorster, H.H., Margetts, B.M. & Kruger, A. 2005. Fortification of maize meal improved the nutritional status of 1-3-year-old African children. *Public Health Nutrition,* 8(5):461-467.

Nestel, P., Briend, A., de Benoist, B., Decker, E., Ferguson, E., Fontaine, O., Micardi, A. & Nalubola, R. 2003. Complementary food supplements to achieve micronutrient adequacy for infants and young children. *Journal of Pediatric Gastroenterology and Nutrition,* 36:316–328.

New, Y.Y. 1995. Synthesis of thematic evaluations in West and Central Africa: lessons learnt from water, sanitation and guinea worm interventions. New York: United Nations Children's Fund.

Nicklaus, S. 2009. Development of food variety in children. *Appetite*, 52(1):253-255.

Nnanyelugo, D.O., Ngoddy, P.O., Uwaegbute, A.C., Okeke, E.C., Ene-Obong, H.N., Ngwu, E.K., McWalters, K. & Phillips, D. 1990. Impact of village mill technology in Nigeria. In Barnes McConnell, P. (eds). *Proceedings of the international seminar on beans/cowpea CRSP*. East Lansing, Michigan: Desktop Publishing & Design Co.

Nnyepi, M.S. 2004. Linking child survival program with malnutrition alleviation strategies. PhD Dissertation, Michigan States University, Michigan.

Ohiokpehai, O., Jagow, J., Jagwer, J. & Maruapula, S. 1994. Tsabana-towards locally produced weaning food in Botswana. *Proceedings of the presentation at the Nutrition Security Workshop*, Gaborone, 28-30 November 1994.

Ojofeitimi E.O, Owolabi O.O., Aderonmu A., Esimai A.O. & Olasanmi S.O., 2003. A study on under nutritional status and its determinants in a semi-rural community of Ile-Ife, Ogun State, Nigeria. *Nutrition Health*, 17(1):21-27.

Ologhobo, A.D. & Fetuga, B.L. 1984. The effect of processing on the trypsin inhibitor, haemagglutini, tannin acid, and phytic acid contents of seeds of ten cowpeas varieties. *Journal of Food Processing and Preservation*, 8:31-41.

Oyelami, O.A. & Ogunlesi, T.A. 2007. Kwashiorkor – is it a dying disease? *South African Medical Journal*, 97:65-68.

Pavlovski, C. 2009. Screening for essential fatty acids deficiency in at risk infants. *Medical Hypotheses*, 73:910-916.

Pereira, S.M. 1991. Protein energy malnutrition: kwashiorkor and marasmic kwashiorkor, part 2. In Bissonnette, B. & Dalens, B.J. (eds). *Clinical nutrition of the young child*. New York: Raven Press.

Piercecchi-Marti, M.D., Louis-Borrione, C., Bartoli, C., Sanvoisin, A., Panuel, M., Pelissier-Alicot, A.L. & Leonetti, G. 2006. Malnutrition, a rare form of child abuse: diagnostic criteria. *Journal of Forensic Science,* 51(3):670-673.

Piwoz, E.G. & Preble, E.A. 2000. HIV/AIDS and nutrition: A review of the literature and recommendation for nutrition support and care in sub-Saharan Africa. Washington, D.C: Support for Analysis and Research in Africa.

Rah, J.H., de Pee, S., Kraemer, K., Steiger, G., Bloem, M.W., Spiegel, P., Wilkinson, C. & Bilukha, O. 2012. Program experience with micronutrient powders and current evidence. *Journal of Nutrition*, 142(1):191S-196S.

Ralph, A. & McArdle, H.J. 2001. *Copper metabolism and requirements in the pregnant mother, fetus, and children*. New York: International Copper Association.

Rayman, M.P. 2000. The importance of selenium to human health. A review. *Lancet*, 356:233-241.

Rollnick, R. 2002. "Botswana's high-stakes assault on AIDS". Africa Recovery Volume 16. Available from: http://www.un.org/ecosocdev/geninfo/afrec/vol16no2/162aids2/html [Accessed: 06/07/2011].

Rosado, J.L. 2003. Zinc and copper: Proposed fortification levels and recommended zinc compounds. *Journal of Nutrition*, 133:2985S-2989S.

Ruel, M.T., Garrett, J. & Haddad, L. 2008. Rapid urbanization and the challenges of obtaining food and nutrition security. In: Semba, R.D. & Bloem, M.W. (eds). *Nutrition and health series: Nutrition and health in developing countries*. 2nd edition. Totowa: Humana Press.

Ruel, M.T., Levin, C.E., Armar-Klemesu, M., Maxwell, D. & Morris, S.S. 1999. Good care practices can mitifate the negative effects on poverty and low maternal schooling on children's nutritional status. Washington, D.C: International Food Policy Research Institute.

Rural Development Coordination Division. 2006. Annual poverty monitoring report. Gaborone: Impression House.

Sadhra, S.S., Wheatley, A.D. & Cross, H.J. 2007. dietary exposure to copper in the European Union and its assessment for EU regulatory risk assessment. *Science Total Environment*, 374:223-234.

Sanjay, K.N. 2002. Weaning practices in Nepal: food steps 52. *Nutrition*, 25:6.

Schroeder, D.G., Martorell, R., Rivera, J.A. & Ruel, M.T. 1995. Age differences in the impact of nutritional supplementation on growth. *Journal of Nutrition*, 125(4):1051S-1059S.

Schwartz, C., Chabanet, C., Lange, C., Issanchou, S. & Nicklaus, S. 2011. The role of taste in food acceptance at the beginning of complementary feeding. *Physiology and Behaviour*, 104(1):646-652.

Schwartz, C., Issanchou, S. & Nicklaus, S. 2009. Developmental changes in the acceptance of the five basic tastes in the first year of life. *British Journal of Nutrition*, 102(9):1375-1385.

Sen, C.K., Khanna, S. & Roy, S. 2006. Tocopherols: Vitamin E beyond tocopherols. *Life Sciences*, 78(18):2088-2098.

Sharifzadeh, G., Mehrjoofard, H. & Raghebi, S. 2010. Prevalence of malnutrition in under 6-year olds in South Khorasa, Iran. *Iranian Journal of Pediatrics*, 20(4):435-441.

Sharma, S. & Nagar, S. 2006. Impact of educational intervention on knowledge of mothers regarding childcare and nutrition in Himachal Pradesh. *Journal of Social Sciences*, 12(2):139-142.

Sheikholeslam, R. 1999. Evaluation of IDD plan in the Islamic Republic of Iran. Tehran: School of Public Health, Medical University of Tehran.

Sheikholeslam, R., Abdollahi, Z. & Haghighi, F. N. 2004. Managing nutritional programs in developing countries. *Eastern Mediterranean Health Journal*, 10:737-746.

Shetty, P. 2002. *Food and nutrition*: *the global challenge*. London: Blackwell Publishing.

Simpore, J., Kabore, F., Dansou, D., Bere, A. & Pignatelli, S. 2006. Nutrition rehabilitation of undernourished children utilizing Spirulina and Misola. *Nutrition Journal*, 23(5):3.

Sipos, E.S. 2002. Edible uses of soy protein. *American Soybean Association*, 1-14.

Smuts, C.M., Dhansay, M.A. & Faber, M. 2005. Efficacy of multiple micronutrient supplementation for improving anemia, micronutrient status, and growth in South African infants. *Journal of Nutrition*, 135:653S–659S.

South Africa. Department of Health. 2006. Guidelines for good practice in the conduct of clinical trials with human participants in South Africa. Pretoria: Department of Health.

Stern, B.R. 2010. Essentiality and toxicity in copper health risk assessment. *Journal of Toxicology and Environmental Health*, 73:144-127.

Steyn, N.P., Labadarios, D., Maunder, E., Nel, J. & Lombaard, C. 2005. Secondary anthropometric data analysis of the National Food Consumption Survey in South Africa: the double burden. *Nutrition*, 21(1):4-13.

Stoltzfus, R.J., Mullany, L. & Black, R.E. 2005. Iron deficiency anemia. Comparative qualification of health risks: global and regional burden of disease attributable to selected major risk factors. Geneva: WHO.

Summit on the food security in Africa. 2006. Towards a prioritized outcome–based approach to implementing Africa's food security commitments. Available from: http://www.africa union.org/root/AU/Conferences/Past/2006/December/rea/Summit/. [Accessed 29/04/2011].

Swindale, A. 2007. Months of adequate household food provisioning for measurement of household food access: Indicator guide. Food and nutrition technical assistance project (FANTA). Washington, D.C: Academy for Educational Development.

Swindale, A. & Bilinsky, P. 2006. Household dietary diversity score for measurement of household food access: Indicator guide. Food and nutrition technical assistance (FANTA) project. Washington, D.C: Academy for Educational Development.

Swindale, A. & Ohri-Vachaspati, P. 2005. Measuring household food consumption: A technical guide. Food and nutrition technical assistance (FANTA) project. Washington, D.C: Academy for Educational Development.

Takyi, E.E.K., Kido, Y., Rikimaru, T. & Kennedy, D.O. 1991. The use of alfalfa as a supplement in infant feeding. *Bulletin of Noguchi Memorial Institute for Medical Research*, 4:35-47.

Temesgen, M. 2013. Nutrition status of Ethiopian weaning and complementary foods: A review. *Open Access Scientific Reports*, 2(2):1-9.

Thacher, T.D., Fischer, P.R., Strand, M.A. & Pettifor, J.M. 2006. Nutritional rickets around the world: causes and future directions. *Annals of Tropical Paediatrics*, 26:1-16.

Thapar, N. & Sanderson, I.R. 2004. Diarrhoea in children: an interface between developing and developed countries. *Lancet*, 363:641-653.

Tharakan, C.T. & Suchindran, C.M. 1999. Determinants of child malnutrition – an intervention model for Botswana. *Nutrition Research*, 19(6):843-860.

Thomas, R.M. 2003. *Blending qualitative & quantitative research methods in theses and dissertations.* California: Sage.

Thorsdottir, I., Gunnarsson, B.S. & Atladottir, H. 2003. Iron status at 12 months of age: effects of body size, growth and diet in a population with high birth weight. *European Journal of Clinical Nutrition*, 57:505-513.

Torún, B. 2006. *Protein-energy malnutrition in modern nutrition in health and disease.* 10th ed. Belmont CA: Lipponcott Williams & Wilkins.

Torún, B. & Chew, F. 1994. *Protein-energy malnutrition in, modern nutrition in health and disease*. 8th ed. Belmont CA: Lea & Febiger.

Uauy, R. & Dangour, A.D. 2009. Fat and fatty acid requirements and recommendations for infants of 0-2 years and children of 2-18 years. *Annals of Nutrition Metabolism*, 55:76-96.

UNAIDS (Joint United Nations Program on HIV/AIDS). 2010. 'UNAIDS report on the global AIDS epidemic'. Available from: http://www.unaids.org/globalreport/html. [Accessed: 06/08/2011].

United Nations Children's Emergency Fund (UNICEF). 2004. Strategy for improved nutrition of children and women in developing countries. A UNICEF policy review. New York: UNICEF.

United Nations Children's Emergency Fund (UNICEF). 2007. Revised country program document: South Africa. Available from: http://www.unicef.org.za [Accessed: 01/07/2011].

United Nations Children's Emergency Fund (UNICEF). 2009a. Tracking progress on the child and maternal nutrition. A survival and development priority. New York: UNICEF.

United Nations Children's Emergency Fund (UNICEF). 2009b. Child malnutrition and household food insecurity remain major concerns for Bangladesh. Press Centre. Available from: http://www.unicef.org/media/media_48981 [Accessed: 11/05/2011].

United Nations Children's Emergency Fund (UNICEF). 2009c. A matter of magnitude: the impact of the economic crisis on women and children in South Asia. Available from: http://www.unicef.org.za [Accessed: 06/05/2011].

United States Agency for International Development (USAID). 2002. Commodities reference guide-part II, module I: Material child health and nutrition. New York: USAID.

Vorster, H.H. & Hautvast, J. 2002. *A global perspective on food and nutrition in, the nutrition society textbook series, introduction to human nutrition*. London: Blackwell Publishing.

Ward, O.P. & Singh, A. 2005. Omega-3/6 fatty acids: Alternative sources of production. *Process Biochemistry*, 40:3627–3652.

Wardlaw, G.M. & Insel, P.M. 1996. *Perspective in nutrition* 3rd edition. St. Louis: Mosby-Year Book Inc.

Wardlaw, G.M. & Insel, P.M. 2000. *Contemporary nutrition*. 3rd edition. California: Mcgraw-Hill Companies.

Whitney, E.N., Cataldo, C.B. & Rolfes, S.R. 2002. *Understanding normal and clinical nutrition.* 6th edition. Belmont. CA: Wordsworth/Thompson Learning.

WHO/CDC. 2011. Logic model for micronutrient interventions in public health. Vitamin and Mineral Nutrition Information System. Geneva: (WHO/NMH/NHD/MNM/11.5) [Accessed 07/2011]. Available from: http://www.who.int/vmnis/toolkit/WHO-CDC_Logic_Model_en.pdf.

Williams, A.F. 2005. Pediatric nutrition. In Gibney, M.J., Elia, M., Ljungqvist, O. & Dowsett, J. (eds). *Nutrition society textbook series.* London: Blackwell Publishing.

Williams, S.R, 1993. *Nutrition and diet therapy*. 7th edition. St. Louis: Mosby-Year Book.

Williams, S.R. 1994. *Essentials of nutrition and diet therapy*. 6th edition. St. Louis, Missouri: Mosby-Year Book, Inc.

Wittenberg, D.F. 2004. Nutritional and metabolic disorders. In Rollins, N. & Willumsen, J. (eds). *Paediatrics and child health*. Cape Town: Oxford University Press.

World Health Organization (WHO). 1998. Preparation and use of food dietary guidelines. Report of joint FAO/WHO consultation technical report series 880. Geneva: FAO/WHO.

World Health Organization (WHO). 2001a. The optimal duration of exclusive breast-feeding. Geneva: WHO.

World Health Organization (WHO). 2001b. Complementary feeding and summary of guiding principles. Geneva: WHO.

World Health Organization (WHO). 2009. Global prevalence of vitamin A deficiency in populations at risk 1995-2005. Geneva: WHO.

World Health Organization, Food and Agricultural Organization of the United Nations. 1998. Vitamin and mineral requirements in human nutrition: report of a joint FAO/WHO expert consultation, Bangkok.

Young, V.R. & Pellett, P.L. 1994. Plant proteins in relation to human protein and amino acid nutrition. *American Journal of Clinical Nutriton*, 59(5):1203S-1212S.

Zimmermann, M.B. 2009. Iodine deficiency. *Endocrine Review*, 30(4):376-408.

Zlotkin, S, Arthur, P, Antwi, K.Y & Yeung, G. 2001. Randomized prospective controlled trial of ferrous sulfate drops versus microencapsulated ferrous fumarate "sprinkles" for treatment of anemia in Ghanaian infants and young children. *FASEB. Journal*, 15:A635.

Zlotkin, S., Siekmann, J., Lartey, A. & Yang, Z. 2010. The role of the Codex Alimentarius process in support of new products to enhance the nutritional health of infants and young children. *Food Nutrition Bulletin*, S128-S133.

Addendum A: Ethics approval by the Faculty of Applied Sciences Research Ethics Committee, Cape Peninsula University of Technology

Cape Peninsula
University of Technology

Faculty of Applied Sciences
Keizersgracht and Tennant Street
Zonnebloem
P O Box 652
Cape Town
8000
Tel : +27 21 460 3911
www.cput.ac.za

01 December 2011

Ms B Kopong
Consumer Science: Food and Nutrition
Cape Peninsula University of Technology

Dear Ms Kopong

Nutritional appraisal of Tsabana, a dietary intervention product for those aged four months to five years, and its acceptance and use in rural districts of Botswana - Ref 08/2011

The Ethics Committee has considered your application for Ethics approval for the above project and would like to comment as follows:

1. There is concern about the difficulty of the language used in the consent form. Questions will have to be explained to participants to ensure that questions are understood properly.
2. Budget – Please specify "other"

Provisional approval for the project is hereby granted on condition that the above issues are addressed and feed-back given to the Chairperson.

We wish you the best with your study.

Kind regards

Prof AJS Benade
Chairperson
Ethics Committee
Faculty of Applied Sciences

Addendum B: Ethical approval by the Health Research and Development Division, Ministry of Health, Republic of Botswana

Telephone: (267) 363200
FAX (267) 353100
TELEGRAMS: RABONGAKA
TELEX: 2818 CARE BD

MINISTRY OF HEALTH
PRIVATE BAG 0038
GABORONE

REPUBLIC OF BOTSWANA

REFERENCE NO: PPME 13/18/1 PS V (207) 17 January 2012

Health Research and Development Division

Notification of IRB Review: New application

Ms Bogadi Kopong
The Six 534
1 Sydney street Cape Town
South Africa

Protocol Title:	NUTRITIONAL APPRAISAL OF TSABANA, A DIETARY INTERVENTION PRODUCT FOR THE FOUR MONTH TO FIVE YEARS OLD AGE GROUP, AND ASSESSMENT OF ITS ACCEPTANCE AND USE IN RURAL DISTRICTS OF BOTSWANA
HRU Approval Date:	16 January 2012
HRU Expiration Date:	15 January 2013
HRU Review Type:	HRU reviewed
HRU Review Determination:	Approved
Risk Determination:	Minimal risk

Dear Ms Kopong

Thank you for submitting new application for the above referenced protocol.
This approval includes the following:-

1. Application form
2. Protocol
3. Data collection tools

This permit does not however give you authority to collect data from the selected sites without prior approval from the management. Consent from the identified individuals should be obtained at all times.

The research should be conducted as outlined in the approved proposal. Any changes to the approved proposal must be submitted to the Health Research and Development Division in the Ministry of Health for consideration and approval.

Furthermore, you are requested to submit at least one hardcopy and an electronic copy of the report to the Health Research, Ministry of Health within 3 months of completion of the study. Approval is for academic fulfillment only. Copies should also be submitted to all other relevant authorities.

If you have any questions please do not hesitate to contact Mr. P. Khulumani at pkhulumani@gov.bw, Tel +267-3914467 or Lemphi Moremi at or Tel: +267-3632464

Continuing Review
In order to continue work on this study (including data analysis) beyond the expiry date, submit a Continuing Review Form for Approval at least three (3) months prior to the protocol's expiration date. The Continuing Review Form can be obtained from the Health Research Division Office (HRDD), Office No. 9A 11 or Ministry of Health website: www.moh.gov.bw or can be requested via e-mail from Mr. Kgomotso Motlhanka, e-mail address: kgmmotlhanka@gov.bw As a courtesy, the HRDD will send you a reminder email about eight (8) weeks before the lapse date, but failure to receive it does not affect your responsibility to submit a timely Continuing Report form

Amendments
During the approval period, if you propose any change to the protocol such as its funding source, recruiting materials, or consent documents, you must seek HRDC approval before implementing it. Please summarize the proposed change and the rationale for it in the amendment form available from the Health Research Division Office (HRDD), Office No. 9A 11 or Ministry of Health website: www.moh.gov.bw or can be requested via e- mail from Mr. Kgomotso Motlhanka, e-mail address: kmotlhanka@gov.bw . In addition submit three copies of an updated version of your original protocol application showing all proposed changes in bold or "track changes".

Reporting
Other events which must be reported promptly in writing to the HRDC include:
- Suspension or termination of the protocol by you or the grantor
- Unexpected problems involving risk to subjects or others
- Adverse events, including unanticipated or anticipated but severe physical harm to subjects.

Do not hesitate to contact us if you have any questions. Thank you for your cooperation and your commitment to the protection of human subjects in research.

Yours sincerely

P. Khulumani
For Permanent Secretary

Addendum C: Letter of request to Senior District Medical Officers

P.O. BOX 20043
Mochudi

6 February 2012

Primary Health
Ministry of Health
Private Bag 0038 Gaborone

Dear Sir/Madam

REQUEST TO USE CLINIC FACILTIES

This letter serves to inform you than the Health Research and Development Division have permitted me to conduct the study of Nutritional Appraisal of TSABANA, a Dietary Intervention product for the four months to five years old age group, and assessment of its acceptance and use in Rural Districts of Botswana.

This study requires me to use your clinic facilities.

Your assistance will be highly appreciated.

Yours Faithfully

Ms Bogadi Kopong

Addendum D: Participant information and consent form (English version)

Cape Peninsula
University of Technology

PARTICIPATION INFORMATION AND CONSENT FORM

Title of the study: Nutritional appraisal of Tsabana, a dietary intervention product for the four months to five years old age group, and assessment of its acceptance and use in rural districts of Botswana

Principal investigator: Ms Bogadi Kopong

Contact number and e-mail: +27 723880524, byekops@yahoo.com

Address: Programme: Consumer Science: Food and Nutrition, Department of Agricultural and Food Sciences, Cape Peninsula University of Technology (CPUT), Cape Town, South Africa

Introduction

This serves as invitation to you to take part in this study. Please read the information provided here as it will explain the study to you. You are welcome to ask questions about any part of this study that you do not fully understand. Your participation is entirely voluntary and you are free to decline to participate.

Purpose of the study

The study is firstly planned to compare the nutrient provision of Tsabana with the nutrient guidelines put forward that such products should contain. You will not be involved in this part of the study. In addition to the above the study also plans to find out more about the acceptance and use of Tsabana by those who receive it. You are asked to

take part in this part of the study as you are taking care of a baby/child who is receiving Tsabana. The information gathered in this study will help the Botswana Ministry of Health to make sure that Tsabana supports the nutritional well-being of those babies/children who receive it.

Participation criteria

Caregivers of babies/children in the age group of 18 months to three years receiving Tsabana in the rural districts of Nhabe, Central, Kweneng and North East will be used during the study visit.

Study procedure

No experimental procedures are involved in this study. If you take part in the study you will only be asked to honestly complete a questionnaire once on the acceptance and use of Tsabana along with basic demographic, biographic and lifestyle information about yourself and the baby/child receiving Tsabana. Completion of the questionnaire will take approximately 30 minutes of your time.

Alternative procedures

As this study is only gathering information on the acceptance and use of Tsabana you have the option to participate or not. No other procedures are involved.

Blood tests and storage of specimens obtained

No blood or other samples will be collected from any participant in this study.

Risks and /or discomfort and handling of research related injury

No risk or harm is involved in taking part in this study. No injury is also expected to occur as a result of your participation in the study as you will only complete the questionnaire.

Benefits

There will be no direct benefit to the study participants but the information obtained from them may improve their knowledge on the use of Tsabana.

Costs to participant and compensation

You will not be paid to take part in this study and also not be compensated any transport fees should you use paid transportation to get to the clinic as you will complete the questionnaire while you are at the clinic.

Voluntary participation and right to withdraw

Participation in the study is voluntary and any invited participant can withdraw from the study at anytime.

Privacy, anonymity and confidentiality

The information you provide in this study will be kept confidential by the research staff. You will also remain anonymous in the study as you will receive a number that will be filled in on your questionnaire. The information provided by all participants will be summarised and reported for the group and not for an individual participant.

Use of gathered information

The information gathered in the questionnaires and summarised will be used only for the purpose of this study which forms part of an academic qualification at the Cape Peninsula University of Technology and by the Botswana Ministry of Health to improve the provision of Tsabana.

Who to contact

You can contact Ms Bogadi Kopong at +27 723880524 (South Africa) or +267 71850023 (Botswana) and byekops@yahoo.com if you have any further questions about the research study.

Statement of the consent

Declaration by participant

I (*name*)……..agree to take part in the study entitled *Nutritional appraisal of Tsabana, a dietary intervention product for the four months to five years old age group, and assessment of its acceptance and use in rural districts of Botswana.*

I declare that:

- I have read and understood the above participation information and consent form as it is written in a language I understand.
- I understand that taking part in this study is voluntary and that I can withdraw anytime.
- I understand that there will be no costs involved in taking part in the study and I will not be paid to take part.

Signed at (*place*)…… (*date*)…….2012

……..

Signature of participant

Declaration by investigator

I (*name*)……..declare that:

- I fully explained the information in the document to the participant.
- I will administer a questionnaire to the participant in English or her/his native language (Setswana) as requested by the participant.

Signed at (*place*)…… (*date*)…….2012

…….

Signature of investigator

Addendum D: Participant information and consent form (Setswana version)

Cape Peninsula University of Technology

TLHALOSO KA GO TSAYA KAROLO MO PATLISISONG LE FOMO YA TUMALANO

Setlhogo sa patlisiso: Tshekatsheko ka bodikotla jwa Tsabana, sejo sa bana ba dikgwedi tse nne go ya go dingwaga tse tlhano, le tshekatsheko ka kamogelesego ya Tsabana le tiriso ya yone mo dikgaolong mo Botswana

Mmatlisisi - mogolo: Ms Bogadi Kopong

Mogala le e-mail: +27 723880524, byekops@yahoo.com

Aterese: Programme: Consumer Science: Food and Nutrition, Department of Agricultural and Food Sciences, Cape Peninsula University of Technology (CPUT), Cape Town, South Africa

Matseno

O lalediwa go tsenelela patlisiso e. Tswee tswee bala se se kwadilweng mo pampering e ka se tlaa go tlhalosetsa ka ga patlisiso. Phuthologa go ka botsa dipotso ka ga sepe fela se o ka tswang o sa se tlhaloganye. Go tsenelela patlisiso go mo maruding a gago, mme ka jalo o phuthologile go itlhophela go sa e tsenelela.

Maikaelelo a patlisiso

Lwa ntlha, patlisiso e ikaelela go tshwantshanya dikotla tse di mo go Tsabana le dilekanyo tse di beetsweng dijo tsa mohuta oo. Foo ga re tle go tlhoka ditshwaelo tsa gago. Mo godimo ga tshwantshanyo eo ya dikotla, patlisiso e eletsa go itse ka ga

kamogelo le tiriso ya Tsabana mo go ba ba e fiwang. Fa ke gone re go kopang go tsaya karolo teng ka go araba dipotso, ka go bo o tlhokomela ngwana yoo o fiwang Tsabana. Ditshwaelo tse di phuthiwang ka go dira patlisiso e, di tlaa dithusa Lephata la Botsogo mo Botswana go tlhomamisa gore Tsabana e dira se e tshwanetseng go se dira, e leng go tlhabolola seemo sa dikotla mo baneng ba ba e fiwang.

Ba ba tlhokwang mo patlisisong e

Batlhokomedi ba bana ba ba dikgwedi di le lesome le boferabobedi go ya go dingwaga tse tharo, ba ba fiwang Tsabana mo dikgaolong tsa Nhabe, Central, Kweneng le North East, ba tlaa kopiwa go araba dipotso tsa patlisiso.

Mokgwa o patlisiso e tlaa dirwang ka one

Patlisiso ga e tle go tlhoka sepe se se amanang le go meta kgotsa go lekanya sepe mo mmeleng wa moarabi wa dipotso. Moarabi o tlaa kopiwa fela go araba dipotso (pampiri e le nngwe fela) ka ga kamogelesego le tiriso ya Tsabana, ga mmogo le dipotso mabapi le ka fa o tshelang ka teng, wena le ngwana yo o fiwang Tsabana. Go araba dipotso tse, go araba dipotso tse go tlaa tlhoka metsotso a ka nna masome a mararo.

Mekgwa e mengwe ya go dira patlisiso

Ka gobo patlisiso e e batla fela go utlwa ka seemo sa kamogelesego le tiriso ya Tsabana, o ka itlhophela go tsaya karolo mo go yone kana nnyaa. Ga go mekgwa epe ya patlo-kitso e e tlaa bong e dirisiwa.

Go tsewa ga madi le go bewa ga dipe gape tse di tsewang mo mmeleng

Ga gona madi ape, kgotsa dipe gape, tse di tlaa tsewang mo mmeleng wa mothusa-patlisiso.

Borai kgotsa diphatsa le go sa tseega sentle mabapi le patlisiso

Patlisiso e ga e na dipe diphatsa. Ga go dikgobalo dipe tse di solofetsweng mo go tseeng karolo ga gago, ka patlisiso e tlhoka fela gore o arabe dipotso.

Meputso kana maduo a go tsaya karolo

Ga go maduo ape a a tlaa bong a lebagane le motsaa-karolo, mme tsholofelo ke gore kitso ee tlaa kokoanngwang ka patlisiso e, e ka thusa motsaa-karolo go tokafatsa kitso ya gagwe ka ga tiriso ya Tsabana.

Dituelo tsa go tsaya karolo

Ga go dituelo dipe kgotsa madi a dipalamo a a tlaa fiwang batsaa-karolo ba patlisiso e, ka go bo dpampiri tsa dipotso di tlaa bo di arabelwa kwa dikokelwaneng, kwa ba tlaa bong ba setse ba le teng gale.

Botsaa-karolo le tshwanelo ya motsaa-karolo ya go intsha mo patlisisong

Botsaa-karolo mo patlisisong e, ga bo patelediwe, ka jalo motsaa-karolo o ka itlhophela go tswa nako nngwe le nngwe.

Sephiri

Se o se abelanang le rona mo patlisisong e, ke sephiri. Le leina la gago ga le tle go dirisiwa ka go tlaa bo go tlhokega fela nomore e o tlaa bong o e neetswe. Dikarabo tsa batsaa-karolo botlhe di tlaa kokoanngwa, mme di begiwe ka kakaretso, e le tsa botsaa-karolo botlhe ba patlisiso, e seng ka bongwe ka bongwe.

Tiriso ya maduo a patlisiso

Dikitso tse di tlaa kokoanngwang ka patlisiso e, di tlaa dirisediwa fela maikemisetso a patlisiso, e leng go thusa mmatlisisi-mogolo go bona maduo kgotsa go falola mo dithutong kwa Cape Peninsula University of Technology, le go thusa lephata la Botswana la botsogo mo tokafatsong ya go abiwa le tiriso ya Tsabana.

Go ka itshwaraganngwa le mang?

O ka itshwaraganya le Mme Bogadi Kopong mo megaleng ee latelang, +27 723880524 (South Africa) kgotsa +267 71850023 (Botswana) le mo email ya byekops@yahoo.com fa o na le dipe dipotso ka ga patlisiso e.

Tumalano

Maikaelelo a motsaa-karolo

Ke le (*leina*)……..ke ikemisetsa go tsaya karolo mo patlisisong ya 'Tshekatsheko ka bodikotla jwa Tsabana, sejo sa bana ba dikgwedi tse nne go ya go dingwaga tse tlhano, le tshekatsheko ka kamogelesego ya Tsabana le tiriso ya yone mo dikgaolong mo Botswana'

Ke tlhomamisa gore:

- Ke badile ebile ke tlhalogantse tlhaloso ee fa godimo, le fomo ya tumalano, ka e kwadilwe ka teme/puo e ke e tlhaloganyang.
- Ke tlhaloganya gore go tsaya karolo mo patlisisong e, ga go patike, mme ka jalo ke ka ikgogela morago ka nako nngwe le nngwe.
- Ke tlhaloganya gore go tsaya karolo ga go amane le dituelo dipe.

E saennwe/tlantswe kwa (*lefelo*)…… (*ka*)…….2012

……..

Setlanyo/monwana wa motsaa-karolo

Maikano a mmatlisisi

Ke le (*leina*)……..ke tlhomamisa gore:

- Ke tlhaloseditse motsaa-karolo ka botlalo se se kwadilweng mo pampiring e.
- Ke tlaa botsa dipotso ka sekgoa kgotsa Setswana, go ya ka gore motsaa-karolo o itlhophela efe puo mo bobeding joo.

E saennwe/tlantswe kwa (*lefelo*)…… (*ka*)…….2012

Setlanyo/monwana wa mmatlisisi ……..

Addendum E: Collective questionnaire (English version)

Cape Peninsula
University of Technology

QUESTIONNAIRE: Acceptance and use of Tsabana

Instructions for completion of the questionnaire:

Only indicate one answer for each question asked. Indicate your answer with a cross (x) in the block opposite your answer. The questionnaire will take about 30minutes of your time to answer. You need not write your name on the questionnaire.

Programme: Consumer Science: Food and Nutrition, Department of Agricultural and Food Sciences, Faculty of Applied Sciences, Cape Peninsula University of Technology in collaboration with the Health Research Unit of the Botswana Ministry of Health

Respondent number

Date:

February 2012

For office use only

Section A: Information on the acceptance and use of Tsabana

1. Indicate how much you think the baby enjoys Tsabana.

Likes it very much	1
Likes it moderately	2
Neither likes it nor dislikes it	3
Dislikes it moderately	4
Dislikes it very much	5

1

2. Indicate how you would describe the taste of Tsabana.

Tastes very nice	1
Tastes nice	2
Acceptable taste	3
Does not taste nice	4
Does not taste nice at all	5

2

3. Indicate how you would describe the colour of Tsabana.

Very nice colour	1
Nice colour	2
Acceptable colour	3
Not a nice colour	4
Not a nice colour at all	5

3

4. Indicate how you would describe the texture of Tsabana.

Very nice texture	1
Nice texture	2
Acceptable texture	3
Not a nice texture	4
Not a nice texture at all	5

4

5. How often do you feed the baby Tsabana?

Once a day	1
2 times a day	2
3 times a day	3
4 times a day	4
Not daily	5

5

6. How much Tsabana do you feed the baby at a time? (1 full tea cup = 250ml)

1 cup	1
1½ tea cups	2
2 cups	3
2½ cups	4
3 cups	5
3½cups	6
4 cups	7
4½cups	8

6

7. Do you serve the baby leftover Tsabana?

Yes	1
No	2

7

(If yes, continue with question 8)
(If no, do not answer questions 8, 9 and 10. Continue with question11)

8. Where do you store the leftover Tsabana?

Covered, in the refrigerator	1
Uncovered, in the refrigerator	2
Covered, in the kitchen or other room	3
Not covered, in the kitchen or other room	4

8

9. At what temperature do you feed the leftover Tsabana to the baby?

Warm/Heated	1
At room temperature	2
Cool/From refrigerator	3

9

10. Do you add water to the leftover Tsabana when feeding it to the baby?

Yes	1
No	2

10

11. How much Tsabana do you cook at a time?

For 1 feeding	1
For 2 feedings	2
For 3 feedings	3
For 4 or more feedings	4

11

12. For how long do you cook one serving of Tsabana?

Less than 10 minutes	1
10 to 15 minutes	2
20 to 25 minutes	3
More than 30 minutes	4

12

13. How much powder do you use to cook one serving of Tsabana? (1 full teacup = 250ml)

1 teacup full	1
2 teacups full	2
3 teacups full	3
4 teacups full	4

13

14. How much water do you use to cook one serving of Tsabana? (1 full teacup = 250ml)

1 cup	1
1½tea cups	2
2 cups	3
2½cups	4
3 cups	5
3½cups	6
4 cups	7
4½cups	8

14

15. Do you add sugar to the cooked Tsabana provided to the baby?

Yes	1
No	2

15

(If yes, continue with question 16)
(If no, do not answer question 16. Continue with question 17)

16. How much sugar do you add to one serving of Tsabana?

1 teaspoon	1
2 teaspoons	2
3 teaspoons	3
4 teaspoons	4

16

17. Do you add cooking oil to the cooked Tsabana provided to the baby?

Yes	1
No	2

17

(If yes, continue with question 18)
(If no, do not answer question 18. Continue with question 19)

18. How much oil do you add to one serving of Tsabana?

1 tablespoon	1
2 tablespoons	2
3 tablespoons	3
4 tablespoons	4

18

19. Do you add margarine to the cooked Tsabana provided to the baby?

19

Yes	1
No	2

(If yes, continue with question 20)
(If no, do not answer question 20. Continue with question 21)

20. How much margarine do you add to one serving of Tsabana?

1 tablespoon	1
2 tablespoons	2
3 tablespoons	3
4 tablespoons	4

20

21. Do you add any of the following products to Tsabana in cooking it or feeding it to the baby? **(Answer for each added product listed)**

	Added product	Yes	No	
21.1	Salt	1	2	21
21.2	Peanut butter	1	2	22
21.3	Jam	1	2	23
21.4	Syrup	1	2	24
21.5	Honey	1	2	25
21.6	Meat sauce	1	2	26

22. At what temperature do you feed Tsabana to the baby?

Hot	1	27
Warm	2	
Cool	3	
Cold	4	

23. At what texture/consistency do you feed Tsabana to the baby?

Very soft and runny	1	28
Soft, but not runny	2	
Stiff	3	
Very stiff	4	

24. Did you read the cooking instructions of Tsabana on the package?

Yes, but only once when it was first received.	1	29
Yes, a few times after it was received.	2	
Yes, but did not pay much attention to it.	3	
No, did not read it.	4	

Section B. General Clinic information

1. Do you think giving Tsabana to the baby has helped the baby's wellbeing?

Yes	1	30
No	2	

(If yes, continue with question 2 but do not answer question 3)
(If no, do not answer question 2. Continue with question 3)

2. Indicate how you think Tsabana has helped the baby most.

The baby's growth has improved as the baby has picked up weight.	1
The baby's appetite has improved as the baby is eating better.	2
The baby's health has improved as the baby is not sick that often.	3

31

3. Indicate why you think Tsabana has not helped the baby.

The baby has not picked up weight.	1
The baby is not eating better.	2
The baby is still getting sick.	3
The baby does not eat up all the Tsabana given.	4
The baby did not regularly get Tsabana.	5
The baby gets sick often and then does not eat.	6

32

4. In what way do you think Tsabana differs most from other cooked porridges?

It is not different from other cooked porridges.	1
It gives more nutrition to the baby.	2
It gives the baby more energy.	3
It tastes nicer.	4
It is easier to prepare.	5

33

5. Did you get any information about Tsabana from the clinic personnel when you received it?

Yes	1
No	2

34

(If yes, continue with question 6)
(If no, do not answer question 6. Continue with question 7)

6. What information did you get about Tsabana from the clinic personnel?
(Answer for each information topic listed)

	Information topic.	Yes	No
6.1	Importance of feeding Tsabana to the baby.	1	2
6.2	How to prepare Tsabana.	1	2
6.3	How to feed Tsabana to the baby.	1	2
6.4	How to store Tsabana.	1	2

35
36
37
38

7. Do you sometimes not receive Tsabana from the clinic?

Yes	1
No	2

39

(If yes, continue with question 8)
(If no, do not answer question 8. Continue with question 9)

8. What would the main reason be that you sometimes do not receive Tsabana?

Tsabana not available at the clinic.	1
Tsabana not enough for all caregivers on that day.	2
Clinic personnel not available to dispatch Tsabana.	3
Missing the baby's clinic visits.	4

40

9. Do you sometimes miss the baby's clinic visit?

Yes	1
No	2

41

(If yes continue with question 10)

(If no, do not answer question 10. Continue with question 11)

10. Why do you mostly miss the baby's clinic visit?

Clinic far from home.	1
Tsabana is not always available.	2
Have to wait too long at the clinic.	3
Do not have enough time to go to the clinic.	4
Don't always feel like going to the clinic.	5

42

11. How do you get to the clinic?

Walk a short distance	1
Walk a long distance	2
Use public transport	3

43

Section C. Demographic, biographic and lifestyle information

1. How old are you?

18 years and younger	1
19 to 29 years	2
30 to 44 years	3
45 to 54 years	4
55 years and older	5

44

2. What is your highest education level?

No school education	1
Standard 1 to 3	2
Standard 4 to 7	3
Secondary level (Form 1 to Form 4)	4
O' level and above	5

45

3. How are you related to the baby who is receiving Tsabana?

Mother	1
Sister	2
Aunty	3
Grand mother	4
Child minder	5

46

4. How old is the baby who is receiving Tsabana?

18 to 24 months (1½to 2 years)	1
24 to 36 months (2 to 3 years)	2

47

5. Is the baby receiving Tsabana a boy or a girl?

A boy	1
A girl	2

48

6. How many children are there in the baby's house counting this baby?

1 child	1
2 children	2
3 children	3
4 or more children	4

49

7. What is the income source of this house/family?

Permanent work	1
Contract work	2
Government grants	3
Pension funds	4
No fixed income	5

50

8. Is the baby still receiving breast milk?

Yes	1
No	2

51

9. Does the baby get any infant cereals besides for Tsabana?

Yes	1
No	2

52

10. Does the baby get any infant formulas besides for Tsabana?

Yes	1
No	2

53

11. Does the baby eat any porridge besides for Tsabana?

Yes	1
No	2

54

(If yes, continue with question 12)

(If no, do not answer question 12. Continue with question 13)

12. Which other porridge does the baby eat most?

Maize meal porridge	1
Sorghum porridge	2
Oats porridge	3

55

13. Do you feed the child any other food along with Tsabana?

Yes	1
No	2

56

(If yes, continue with question 14,
(If no, do not answer question 14. Continue with question 15)

14. Which food do you feed the child along with Tsabana?

(Answer for each food group / food listed)

	Food groups / Foods	**Eats/ Drinks daily**	**Eats/ Drinks weekly**	**Eats/Drinks seldom or never**	
14.1	Instant cereal, cooked porridge and/or breakfast cereal	1	2	3	57
14.2	Bread	1	2	3	58
14.3	Rice and/or pasta	1	2	3	59
14.4	Meat, chicken and/or fish	1	2	3	60
14.5	Eggs	1	2	3	61
14.6	Milk	1	2	3	62
14.7	Yogurt and/or cheese	1	2	3	63
14.8	Vegetables (cooked and/or raw)	1	2	3	64
14.9	Fruit (fresh, canned and/or dried)	1	2	3	65
14.10	Fruit juice	1	2	3	66
14.11	Other beverages such as tea, coffee and/or cold drink	1	2	3	67

15. How many times does the child eat a meal (a small plate of food) per day?

Once	1
Twice	2
Three times	3
Four times and more	4

68

15. How many times during the day does the child receive snacks (a snack is a small portion of food that is generally eaten between meals)?

Once	1
Twice	2
Three times	3
Four times and more	4

69

17. Are there times when the baby receives less food because there is less food / less money in the house?

Yes, sometimes	1
Yes, often	2
No	3

70

18. Are there times when the baby receives no food because there is no food / no money in the house?

Yes, sometimes	1
Yes, often	2
No	3

71

Thank you for answering the questionnaire.

Addendum E: Collective questionnaire (Setswana version)

Cape Peninsula
University of Technology

DIPOTSO: Kamogelesego le tiriso ya Tsabana

Ditaelo:

Faa karabo e le nngwe fela mo potsong nngwe le nngwe, ka go baa (X) mo lebokosong le le lebaganeng le karabo ya gago. Dipotso tse di tlaa go tsaya metsotso e ka nna masome a mararo go di araba. Ga go tlhokege gore o ikwale leina.

Thulaganyo ya: Consumer Science: Food and Nutrition, Department of Agricultural and Food Sciences, Faculty of Applied Sciences, Cape Peninsula University of Technology ba golagane le ba lephata la dipatlisiso tsa botsogo, mo lephateng la Botsogo la Botswana

Nomore ya

Motsaa-karolo

Date:

Tlhakole 2012

Tiriso ya ofisi fela

Karolo ya ntlha: Patlisiso ka kamogelesego le tiriso ya Tsabana

1. Ka fa ponong ya gago, ngwana wa gago o rata Tsabana go le kae?

O e rata thata	1
O e rata go se kae	2
Maikutlo a gagwe a fag are ka yone	3
O na le go sa e ratenyana	4
Ga a e rate gotlhelele	5

1

2. O ka tlhalosa tatso ya Tsabana o reng?

E Monate thata	1
E Monate	2
E a amogelesega	3
Ga e monate	4
Ga e monate gotlhelele	5

2

3. O ka tlhalosa o reng mmala wa Tsabana yo o apeilweng?

E mmala o o kgatlhisang thata	1
E mmala montle	2
O siame fela	3
Ga o montle	4
Ga o kgatlhe gotlhelele	5

3

4. O ka tlhalosa go tshwara ga Tsabana e le mo go ntseng jang? (seemo sa boleta kgotsa mase
a a mo go ene).

E kgatlhisa thata	1
E a kgatlhisa	2
E a amogelesega	3
Ga e kgatlhise	4
Ga e kgatlhise gotlhelele	5

4

5. O fa ngwana Tsabana ga kae?

Gangwe ka letsatsi	1
Gabedi ka letsatsi	2
Gararo ka letsatsi	3
Gane ka letsatsi	4
Malatsi a magwe	5

5

6. Fa o jesa ngwana, o mo fa selekanyo se se kae sa Tsabana? (1 full tea cup = 250ml)

Kopi ya tee	1
Kopi ya tee le sephatlo	2
Dikopi tse pedi	3
Dikopi tse pedi le sephatlo	4
Dikopi tse tharo	5
Dikopi tse tharo le sephatlo	6
Dikopi tse nne	7
Dikopi tse nne le sephatlo	8

6

7. A o a tle o fe ngwana tsabana e e a bong ene e setse?

Ee	1
Nnyaa	2

7

(Fa o araba 'Ee' tswelela le potso 8)
(Fa o araba 'Nnyaa', se arabe potso 8, 9 le 10. Tswelela le potso 11)

8. Tsabana ya masalela ee apeilweng o e baya kae?

A khurumetswe, mo setsidifatsing	1
A sa khurumelwa, mo setsidifatsing	2
A khurumetswe mo phaposing ya boapeelo kgotsa ntlo e nngwe	3
A sa khurumetswe mo phaposing ya boapeelo kgotsa ntlo e nngwe	4

8

9. O jesa ngwana Tsabana yo o bothitho/botsididi bo bo ntseng jang?

Yo o bothitho/thuthufaditsweng	1
Bothitho jo bo lekanang fela le jwa ntlo	2
A le tsididi kgotsa a tswa mo setsidifatsing	3

9

10. Fa o jesa ngwana Tsabana yo o ipeetsweng kgotsa yo o neng a sa kgona go mo ja otlhe, o tshela metsinyana go o repisa?

Ee	1
Nnyaa	2

10

11. O apaya Tsabana a le bontsi bo kae ka gangwe?

Selekanyo se ngwana a ka se jang gangwe fela	1
Selekanyo se a ka se jang gabedi	2
Selakanyo se a ka se jang gararo	3
Selekanyo se a ka se jang gane kgotsa go feta	4

11

12. Tsabana yo o lekanyeng gore ngwana a mo je gangwe fela, o mo apaya lebaka le le kae?

Metsotso e e sa feteng lesome	1
Metsotso e le lesome go fitlha go e le lesome le botlhano	2
Metsotso e le masome a mabedi go fitlha go ele masome a mabedi le botlhano	3
Metsotso e feta masome a mararo	4

12

13. O dirisa bopi jwa Tsabana bo le kae go apaya selekanyo se ngwana a ka se jang gangwe fela? (Kopi ya tee ee tletseng = 250ml)

Kopi ya tee e tletse	1
Kopi ya tee gabedi, e tletse	2
Kopi ya tee gararo, e tletse	3
Kopi ya tee gane, e tletse	4

13

14. How much water do you use to cook one serving of Tsabana? (Kopi ya tee ee tletseng = 250ml)

Kopi ya tee	1
Kopi ya tee le sephatlo	2
Dikopi tse pedi	3
Dikopi tse pedi le sephatlo	4
Dikopi tse tharo	5
Dikopi tse tharo le sephatlo	6
Dikopi tse nne	7
Dikopi tse nne le sephatlo	8

14

15. A o tsenyetsa ngwana sukiri pele ga o mo jesa Tsabana?

Ee	1
Nnyaa	2

(Fa karabo e le 'Ee', tswelela le potso 16)

(Fa karabo e le 'Nnyaa', se arabe potso 16, tswelela le potso 17)

15

16. O tsenya sukiri e le kae mo selekanyong sa Tsabana se ngwana a ka se jang gangwe fela?

Leswana la tee	1
Ditshwana tsa tee di le pedi	2
Dintshwana tsa tee di le tharo	3
Dintshwana tsa tee di le nne	4

16

17. A o tsenyetsa ngwana cooking oil mo Tsabaneng yo o apeilweng?

Ee	1
Nnyaa	2

(Fa karabo ele 'Ee' tswelela le potso 18)

(Fa karabo e le 'Nnyaa' se arabe potso 18. Tswelela le potso 19)

17

18. O tsenya cooking oil e le kae mo selekanyong sa Tsabana se ngwana a ka se jang gangwe fela?

Leswana le le jang, gangwe fela	1
Leswana le le jang, gabedi	2
Leswana le le jang, gararo	3
Leswana le le jang, gane	4

18

19. A o tsenyetsa ngwana margarine/majarini mo Tsabaneng yo o apeilweng?

Ee	1
Nnyaa	2

19

(Fa karabo e le 'Ee' tswelela le potso 20)
(Fa karabo e le 'Nnyaa' se arabe potso 20. Tswelela le potso 21

20. O tsenya margarine/majarini e le kae mo selekanyong sa Tsabana se ngwana a ka se jang gangwe fela?

Leswana le le jang, gangwe fela	1
Leswana le le jang, gabedi	2
Leswana le le jang, gararo	3
Leswana le le jang, gane	4

20

21. A o atle o tsenye sepe sa rse di latelang mo Tsabaneng fa o mo apaya kgotsa o mo jesa
ngwana? **(Arabela dijo tsotlhe tse di latelang)**

	Added product	Ee	Nnyaa
21.1	Letswai	1	2
21.2	Peanut butter	1	2
21.3	Jeme	1	2
21.4	Surapa	1	2
21.5	Tswina ya dinotshe	1	2
21.6	Moro wa nama	1	2

21
22
23
24
25
26

22. O jesa ngwana Tsabana wa bothitho jo bo kae?

Yo o molelo	1
Yo o bothitho	2
Yo o mololo	3
Yo o tsididi	4

23. O jesa ngwana Tsabana yo o tshwereng/tshume mo go ntseng jang?

Yo o boleta ebile a le metsi	1
Yo o boleta mme a se metsi	2
Yo o tshume mo go lekanetseng	3
Yo o tshume/tshwereng thata	4

27

28

24. A o ne wa bala ditaelo tsa kapei tse di kwadilweng mo sephuthelwaneng sa Tsabana?

Ee, ke sale ke dib ala gangwe fela.	1
Ee, ke di badile ga mmalwanyana morago gag a go amogela Tsabana.	2
Ee, ke di badile mme ka seka ka di sala morago thata.	3
Nnyaa, ga kea di bala.	4

29

Karolo ya bobedi. General clinic information

2. A o dumela fa go jesa ngwana Tsabana go thusitse mo botsogong le go gola ga gagwe?

Ee	1
Nnyaa	2

30

(Fa karabo e le 'Ee', tswelela le potso 2, mme o seka wa araba potso 3)
(Fa karabo e le 'Nnyaa', se arabe potso 2, tswelela potso 3)

2. Tlhalosa ka fa Tsabana a thusitseng ngwana thata ka teng.

Go gola ga ngwana go tokafetse, ka o okeditse mmele.	1
Keletso ya ngwana ya dijo e tokafetse thata, ka o tlhaga le go ja.	2
Botsogo jwa ngwana bo tokafetse, ka ga a sa tlhole a tshabellwa ke go lwala.	3

31

12. Faa mabaka a gore ke eng o re Tsabana ga e a thusa ngwana.

Ngwana ga a oketsega mo mmele.	1
Ngwana ga a je botoka.	2
Ngwana o santse a tshabelelwa ke go lwala.	3
Ngwana ga a je Tsabana otlhe yo a mo fiwang.	4
Ngwana o ne a kgona go tlhoka kgotsa go sa fiwe Tsabana.	5
Ngwana o tshabelelwa ke go lwala, a bo a sa je.	6

32

13. O bona Tsabana bogolo thata a farologana jang le magobe a mangwe aa apeilweng?

Ga a farologane nao.	1
Tsabana o dikotla go gaisa magobe a mangwe.	2
Tsabana o fa ngwana maatla a a fetang a magobe a mangwe.	3
Tsabana o monate go feta magobe a mangwe.	4
Tsabana o motlhofo go apewa go gaisa magobe a mangwe.	5

33

14. A o ne wa fiwang dingwe ditsiboso ka ga Tsabana ke badiri ba kokelwana fa ba go mo neela?

Ee	1
Nnyaa	2

34

(Fa karabo e le 'Ee', tswelela le potso 6)
(Fa karabo e le 'Nnyaa", se arabe potso 6. Tswelela le potso 7)

15. Badiri ba kokelwana ba go file ditsiboso dife ka ga Tsabana?
(Araba tsiboso nngwe le nngwe ka ee kana nnyaa)

	Tsiboso.	Ee	Nnyaa
6.1	Botlhokwa jwa go jesa ngwana Tsabana.	1	2
6.2	Mokgwa wa go apaya le go tshwara Tsabana.	1	2
6.3	Mokgwa wa go jesa ngwana Tsabana.	1	2
6.4	Mokgwa wa go baa Tsabana sentle.	1	2

35
36
37
38

16. A o kgona go tlhoka go fiwa Tsabana kwa kokelong?

Ee	1
Nnyaa	2

39

(Fa karabo e le 'Ee', tswelela le potso 8)
(Fa karabo ele 'Nnyaa', se arabe potso 8. Tswelela le potso 9)

17. Thatathata mabaka a go tlhoka go fiwa Tsabana ko kokelwaneng e a bo e le afe?

Tsabana e a bo e seyo.	1
Tsabana e a bo e tlhaela tsatsi leo.	2
Badiri ba kokelwana ba a bob a seyo.	3
Ngwana o a bo a tlhaetse go isiwa kokelwaneng.	4

40

18. A o a tle o tlhoke go isa ngwana sekaleng kgotsa mokentong kwa kokelwaneng?

Ee	1
Nnyaa	2

41

(Fa karabo e le 'Ee', tswelela le potso 10)
(Fa karabo ele 'Nnyaa', se arabe potso 10. Tswelela le potso 11)

19. Go tlhoka go isa ngwana sekaleng kana mokentong gag ago e a bo e le ka mabaka afe?

Kokelwana e kgakala le kwa re nnang teng.	1
Fa gongwe Tsabana ga a nne teng kwa kokelwaneng.	2
Re leta lebaka le le leela thata kwa kokelwaneng.	3
Ke tlhoka nako ya go ya kokelwaneng.	4
Fa gongwe ke itsapa go ya kokelwaneng.	5

42

20. Lo ya jang kwa kokelwaneng?

Re tsamaya sekgelenyana se se khutshwane	1
Re tsamaya sekgelenyana se se leele	2
Re dirisa dipalamo tsa sechaba	3

43

Karolo ya boraro. Demographic, biographic and lifestyle information

11. O dingwaga di kae?

18 go ya kwa tlase	1
19 go ya go 29 years	2
30 go ya go 44 years	3
45 go ya go 54 years	4
55 go ya kwa godimo	5

44

12. O ema fa kae kwa sekolong?

Ga ke a tsena sekolo	1
Standard 1 go ya go 3	2
Standard 4 go ya go 7	3
Sekolo se se golwane kwa tlase ga form 5	4
Form 5 le go feta	5

45

13. O eng le ngwana yo o fiwing Tsabana yo?

Mmagwe	1
Mogolowe	2
Mmgwane kana rakgadi	3
Nkokoaagwe	4
Motlhokomedi	5

46

14. ngwana yo o fiwng Tsabana yo, dingwaga tsa gagwe di wela fa kae?

Dikgwedi tse 18 go ya go 24 (ngwaga le sephatlo go ya go ngwaga tse pedi)	1
Dikgwedi tse 24 to 36 (ngwaga tse pedi go ya go tse tharo)	2

47

15. Ngwana yo o fiwang Tsabana yo, ke mosimane kgotsa mosetsana?

Mosimane	1
Mosetsana	2

48

16. Bana ba kae ka palo mo lapeng le, o balela le ene yo?

O mongwe fela	1
Ba babedi	2
Ba bararo	3
Ba bane kgotsa go feta	4

49

17. Lelwapa le, le itshetsa ka eng?

Mongwe/bangwe ba a dira kgotsa ba thapilwe ga sennela ruri	1
Mongwe/bangwe ba a ipereka	2
Dithuso tsa ga goromente	3
Pension/dipenshene	4
Ga gona madi aa tsenang mo lwapeng re thusiwa key ole le yole	5

50

18. Aa ngwana o santse a anya?

Ee	1
Nnyaa	2

51

19. Aa lo fa ngwana dingwe gape dijo kana magobenyana aa diletsweng bana, kwa ga Tsabana?

Ee	1
Nnyaa	2

52

20. Aa lo siela ngwana mashi a dithini, kwa ntle ga Tsabana?

Ee	1
Nnyaa	2

53

11. Aa ngwana o ja bogobe, mo godimo ga go ja Tsabana?

Ee	1
Nnyaa	2

54

(Fa karabo e le 'Ee', tswelela le potso 12)
(Fa karabo e le 'Nnnyaa', se arabe potso 12. Tswelela le potso 13)

12. Ke bogobe bofe jo ngwana a bo jang gantsi?

Phaletshe	1
Bogobe	2
Oats	3

55

13. Aa go na le dijo dingwe gape tse o di fang ngwana kwa ntle ga Tsabana?

Ee	1
Nnyaa	2

56

(Fa karabo e le 'Ee', tswelela le potso 14,
(Fa karabo e le 'Nnyaa', se arabe potso 14. Tswelela le potso 15)

14. O jesa ngwana dijo dife kwa ntle ga Tsabana?

(Arabela mo go tse di latelang)

	Mehuta ya dijo	**Ngwana o ja/nwa malatsi otlhe**	**Ngwana o ja/nwa mo bekeng**	**Ngwana o ja/nwa nako nngwe kgotsa gotlhelele**	
14.1	Mehuta yotlhe ya magobe le tse di hutswelwang jalo jalo	1	2	3	57
14.2	Borotho/senkgwe	1	2	3	58
14.3	Raese/reisi le pasta (lesika la bo macaroni	1	2	3	59
14.4	Dinama, go balelwa ya koko le tlhapi	1	2	3	60
14.5	Mae	1	2	3	61
14.6	Mashi	1	2	3	62
14.7	Yogurt le/kgotsa cheese/chisi	1	2	3	63
14.8	Merogo (e e apeilweng kgotsa e sa apewa				64
14.9	Maungo (a a foreshe, a a mo dithining/mabotleleng kgotsa a a omisitsweng)	1	2	3	65
14.10	Juice ya maungo	1	2	3	66
14.11	Dino tse dingwe jaaka tee, kofi le dino-tsididi	1	2	3	67

15. Ngwana wa gago o ja mogopo wa dijo ga kae mo letsatsing?

Gangwe	1
Gabedi	2
Gararo	3
Gane kgotsa go feta	4

68

16. Ngwana o fiwa dijonyana tse di motlhofonyana (seneke) ga kae mo letsatsing?

Gangwe	1
Gabedi	2
Gararo	3
Gane kgotsa go feta	4

69

17. Aa ngwana o a tle a fokolediwe selekanyo sa dijo ka go bo di tlhaela mo lwapeng, kgotsa go tlhaela one madi a go di reka?

Ee, fa gongwe	1
Ee, gantsinyana	2
Nnyaa	3

70

18. Aa go a tle go diragale gore ngwana a tlhoke go ja ka ntlha ya letlhoko la dijo kgotsa la madi mo lwapeng?

Ee, fa gongwe	1
Ee, gantsinyana	2
Nnyaa	3

71

Re lebogetse thata nako le matsapa a gago go araba dipotso tse.

Addendum F: Question responses combined in the data analysis

Question responses where cells had a low count were combined in the data analysis. The combined responses are indicated in the table below.

Question responses combined in the data analysis

Product use factors	**Questionnaire responses**	**Data analysis categories**
Perceived enjoyment	1 Likes it very much 2 Likes it moderately 3 Neither likes it nor dislikes it 4 Dislikes it moderately 5 Dislikes it very much	1, 2, 3 and 4 (4 and 5 combined) [a]
Perceived taste acceptance	1 Tastes very nice 2 Tastes nice 3 Acceptable taste 4 Does not taste nice 5 Does not taste nice at all	1, 2, 3 and 4 (4 and 5 combined) [a]
Perceived colour acceptance	1 Very nice colour 2 Nice colour 3 Acceptable colour 4 Not a nice colour 5 Not a nice colour at all	1, 2, 3 and 4 (4 and 5 combined) [a]
Perceived texture acceptance	1 Very nice texture 2 Nice texture 3 Acceptable texture 4 Not a nice texture 5 Not a nice texture at all	1, 2, 3 and 4 (4 and 5 combined) [a]
Number of daily feedings	1. Once a day 2. 2 times a day 3. 3 times a day 4. 4 times a day 5. Not daily	1, 2, 3 and 4 (3 and 4 combined) [a]

Amount fed at a time	1. 1 cup 2. 1½ tea cups 3. 2 cups 4. 2½ cups 5. 3 cups 6. 3½cups 7. 4 cups 8. 4½cups	1 and 2 (1 & 2 combined and 3 to 8 combined) [a]
Amount cooked at a time	1. For 1 feeding 2. For 2 feedings 3. For 3 feedings 4. For 4 or more feedings	1 and 2 (2 to 4 combined) [a]
Cooking period of one serving	1. Less than 10 minutes 2. 10 to 15 minutes 3. 20 to 25 minutes 4. More than 30 minutes	1, 2 and 3 (3 and 4 combined) [a]
Amount of powder used to cook one feeding	1 cup 2 cup 3 cup 4 cup	1, 2 and 3 (3 and 4 combined) [a]
Amount of water used to cook one feeding	1. 1 cup 2. 1½tea cups 3. 2 cups 4. 2½cups 5. 3 cups 6. 3½cups 7. 4 cups 8. 4½cups	1, 2, 3 and 4 (1 & 2, 3 & 4, 5 & 6 and 7 & 8 combined) [a]
Temperature of infant feed	1. Hot 2. Warm 3. Cool 4. Cold	1, 2 and 3 (3 and 4 combined) [a]
Texture/consistency infant feed	1. Very soft and runny 2. Soft, but not runny 3. Stiff 4. Very stiff	1, 2 and 3 (3 and 4 combined) [a]

Reading of instructions on package	1. Yes, but only once when it was first received. 2. Yes, a few times after it was received. 3. Yes, but did not pay much attention to it. 4. No, did not read it.	1, 2 and 3 (3 and 4 combined) [a]
Clinic-related factors	**Questionnaire responses**	**Data analysis categories**
Difference between Tsabana and other cooked porridges	1. It is not different from other cooked porridges. 2. It gives more nutrition to the baby. 3. It gives the baby more energy. 4. It tastes nicer. 5. It is easier to prepare.	1, 2, 3 and 4 (4 and 5 combined) [a]
Demographic factors	**Questionnaire responses**	**Data analysis categories**
Caregiver age (years)	1. 18 years and younger 2. 19 to 29 years 3. 30 to 44 years 4. 45 to 54 years 5. 55 years and older	1, 2 and 3 (1 & 2 combined and 4 & 5 combined) [a]
Caregiver highest education level	1. No school education 2. Standard 1 to 3 3. Standard 4 to 7 4. Secondary level (Form 1 to Form 4) 5. O' level and above	1 and 2 (1, 2 & 3 combined and 4 & 5 combined) [a]
Caregiver relationship to infant receiving Tsabana	1. Mother 2. Sister 3. Aunty 4. Grand mother 5. Child minder	1, 2 and 3 (2 & 3 combined and 4 & 5 combined) [a]
Number of children receiving Tsabana in household	1. 1 child 2. 2 children 3. 3 children 4. 4 or more children	1, 2 and 3 (3 and 4 combined) [a]

Household source of income	1. Permanent work 2. Contract work 3. Government grants 4. Pension funds 5. No fixed income	1, 2 and 3 (1 & 2 combined and 3 & 4 combined with 5 as 3)[a]

[a] Numbers referring to questionnaire responses