CONSUMER ACCEPTABILITY AND PERCEPTIONS OF MAIZE MEAL IN GIYANI, SOUTH AFRICA

by Khumalo, Teclah P *(neé Ncube)*

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ABSTRACT

Consumer acceptability and perceptions of maize meal in Giyani, South Africa

by Teclah P Khumalo (neé Ncube)

Supervisor: Prof. HC Schönfeldt (University of Pretoria)

Department of Consumer Science

University of Pretoria
for the degree M. Consumer Science

This study was concerned with the level of acceptability and perceptions of three types of commercially produced roller-milled white maize meal namely: sifted unfortified, sifted fortified and super fortified versus hammer-mill produced white and yellow maize meal (with and without fibre) among Shangaan consumers in Giyani in the Limpopo Province, South Africa (SA). The local households produce maize grain on a small scale or buy it from small scale farmers and take it to the local small scale millers for milling for a fee. The 48 participants for this project were female consumers (eighteen years old or older). The study was divided into two phases. The aim of the first phase was to determine the difference if any in acceptability of the sensory attributes of the various maize meal types. It employed a sensory evaluation technique which is a quantitative scientific method in which numerical data was collected and analysed in order to determine and compare consumer acceptability. The aim of the second phase was to discuss the perceptions of these consumers in relation to the products and employed focus-group interviews.

During phase one maize meal porridge was prepared by local community volunteers under careful supervision in a standardized manner. The porridge was served warm: two samples at a time, marked with 3-digit random codes. None of the participants had any prior information pertaining to the samples they were tasting at any time. The identity of the samples were only revealed during the focus-group interviews (phase two).

Consumers preferred (liked) white sifted fortified maize meal porridge on a double blind basis more than the white sifted unfortified maize meal porridge. Hammer-mill white and hammer-mill yellow maize porridge with fibre were equally disliked by participants. There was no significant difference in the acceptability of hammer-mill white compared to yellow maize meal without fibre. No significant difference was found in preference for aroma, colour, consistency and taste between white sifted unfortified and super fortified maize meal compared to white hammer-mill maize meal without fibre.

The difference in taste preference can only be attributed to the fortificant that is added commercially to the maize meal. This is quite a significant finding and different to that measured prior to the implementation of the SA National Fortification Scheme, where no impact on taste was measured. Furthermore, consumers' preference for fortified maize meal on a double blind bias is in contrast to previous findings of research indicating a degree of dislike among consumers regarding fortified maize meal, according to maize millers' opinion.

During phase two focus-group interviews were conducted immediately following phase one. The participants sat in a cluster for these interviews. The qualitative data was transcribed verbatim into text for analysis and discussion of results. At least 40 out of 48 consumers stated that they liked the hammer-mill yellow maize meal porridge in terms of aroma, colour, texture, taste and for its nutritional value. Those in Homu 14 village stated that if the price of roller-mill maize meal was similar to that of yellow maize meal they would buy both maize types as they liked them equally but those in Mahlathi would buy yellow maize meal for nutritional reasons.

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My gratitude also goes to the "Small Scale Millers in South Africa" National Research Foundation which provided the finances for this study (the study is part of a larger target project funded by the aforesaid).

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Above all I am grateful to my Creator and Lord for giving me the opportunity to study and make a contribution to society.

I declare that the script, which I hereby submit for the degree M Consumer Science at the University of Pretoria, is my own work and has not been previously submitted by me for a degree at this or any other tertiary institution.

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Teclah P Khumalo Date

CHAPTER 1

BACKGROUND AND MOTIVATION FOR STUDY

1.1 Introduction

This study was concerned with the level of acceptability and perceptions of traditionally prepared porridge cooked from commercial roller-mill white maize meal (sifted unfortified and sifted fortified; as well as super fortified maize meal); and hammer-mill white and yellow maize meal (with and without fibre) among Shangaan households in Giyani in the Limpopo Province, South Africa (SA). For this study it was important to look at the history of maize consumption in Southern Africa in order to gain knowledge on the origins of maize consumption.

Maize is the worlds' most widely grown cereal, cultivated across a range of latitudes, moisture regimes, slopes and soil types (Smale & Jayne, 2003:7; Iken & Amusa, 2004:302). Historically millet and sorghum were the foods consumed by Africans. Maize cultivation in Africa dates back to the 16th century when the Americans imported it to Africa 'along the western and eastern coasts and gradually moving inland as the slave trade expanded'. Maize growing was a success due to the fact that it (firstly) 'needed less capital investments and technical skill unlike other crops like tobacco and cotton and (secondly) gave higher returns to land than other indigenous cereals' such as millet and sorghum in the same climatic and agro–conditions (Smale & Jayne, 2003:9). According to Saunders (1930:14) maize was introduced by the Portuguese to South Africa in 1655 as recorded in Van Riebeck's diary. During World War 1 millet and sorghum crops were destroyed by disease. Whatever seed was left was eaten instead of being planted. That was when Southern African territories now known as Zambia, Zimbabwe, Malawi and Kenya made a transition to maize as a crop in the 1900s (Smale & Jayne, 2003:9). These authors reiterate that the driving factors that propelled the rise of maize production in the Eastern and Southern African countries included the following: the agronomic suitability of maize; the British starch market; milling technology; the integration of Africans into the settler wage economy and trade policies promoted by settler farm lobbies. The preferences of today's African consumer for white maize meal as

opposed to yellow maize meal began with the influence of the British starch market in the 1920s as well as the establishment of roller mills on a large scale in 1955 (Smale & Jayne, 2003:10, 14; Mukumbu & Jayne, 1995:3). These authors state that the British starch market favoured the soft dent-type maize because it was easier to process and was less injurious to industrial roller mills. The British starch market took exception to the yellow maize imported from the United States of America (U.S.) and required a white only product from its colonies. This was encouraged by the fact that export volumes from Kenya and Zimbabwe to the British starch market exceeded human consumption. The demand for maize in particular increased due to the fact that employers (white settlers from Britain) used maize rations as in kind-payments to the colonial workers in the mines, plantations and cattle farms. This may explain the development of the preference for white maize. People get used to what they eat regularly. Furthermore, consumers prefer white polished grains because they cook quicker, their taste and texture is 'more desirable and consequently are associated with higher cultural status' that matches their income bracket (Messer, 2002:10). In fact as early as 1930 Saunders (1930:230) stated that white maize meal was preferred for human consumption because it was believed that yellow maize meal was less digestible.

In the 1920s hammer mills were introduced (Shopo, 1985 as quoted by Smale & Jayne) which gave a cost processing advantage to maize in comparison to smaller grains namely: sorghum and millet that needed de-hulling first. According to Smale and Jayne (2003:15) the removal of the germ and pericarp makes the maize meal whiter, last longer and taste sweeter than the hammer mill whole maize meal (maize meal with fibre). State marketing boards birthed the development of large–scale concentrated grain milling industries in the 1950s. They used roller mills to produce the refined and relatively expensive maize meal.

In 1996 the SA Maize Board appointed agents such as farm co-operatives to buy maize from farmers and farm corporate millers on their behalf (Traub & Jayne, 2004:6). Overtime these co-operatives grew and consolidated. By the 1980s six of them controlled virtually the entire handling and storage facilities of the main commercial maize growing areas. There are three basic kinds of commercial roller-mill maize meal in SA: 'super' which is highly refined and the highest priced, 'special' or medium refined and 'sifted' which is the least refined and least expensive (Department

of Agriculture, Regulation 1738: 1993; Traub & Jayne, 2004:6). The aforesaid milling companies produce mainly super and special maize meal.

According to the Department of Agriculture, Regulation 1739 (1993) maize meal is classified as ***super*** (with a low extraction rate, very high starch content and high price), ***special*** (with an intermediate extraction rate and intermediate price) and ***sifted*** (with a very high extraction rate, lower starch content and low price). The white sifted fortified Eagle maize meal (produced by Progress Millers of Polokwane, Limpopo Province) used for the study had the following micro-nutrients (due to the fortification process): vitamin A, thiamine, riboflavin, niacin, pyridoxine, folic acid, iron and zinc as stipulated by the Department of Agriculture (Regulation 1739: 1993). Refer to Figure 1.1 for the classification of maize meal. Preference for white maize meal still exists in Southern Africa dating from colonial days (Mukumbu & Jayne, 1995:9).

Maize meal	Extraction rate:	Fat content:	Fibre content:	Texture:
Super	Lower ↓	Lower ↓	Lower ↓	Finer ↓
Special				
Sifted				
Unsifted	Higher	Higher	Higher	Coarser

FIGURE 1.1 CLASSIFICATION OF MAIZE MEAL (Department of Agriculture, Regulation 1739 : 1993)

Maize meal is regarded as the dominant staple food in SA (Traub & Jayne, 2004:4; Saunders, 1930:15; Mqadi, 2005:7). A staple food is defined as the 'traditional food consumed by ethnic groups in a particular country' (Agbola & Saini, 2001:3). Maize production in SA is heavily influenced by rainfall in the growing season between October and April (Traub & Jayne, 2004:14; Mqadi, 2005:24). The former authors state that many individual consumers procure maize meal by

purchasing small quantities of grain in local markets and taking it to a nearby hammer-mill to process it into maize meal for a fee. Not much research has been reported in SA on where hammer-millers are located. If more information can be gathered regarding the factors that affect acceptability of hammer-mill maize meal, for example, this could be used to empower hammer millers to produce nutritionally acceptable maize meal. This can boost the economic status of local hammer millers as well as the nutrition of consumers.

The area of study was Giyani Local Municipality in the Greater Giyani District Municipality, in the Limpopo Province, SA. The Limpopo Province is bordered by: the Northwest, Gauteng and Mpumalanga Provinces to the south; Mozambique to the east; Zimbabwe to the north and Botswana to the east. Refer to the map in Figure 1.2. Giyani was chosen as it is representative of a rural area with indigenous knowledge. A rural area is characterized by poverty, lack of safe water and sanitation, in-adequate health facilities and road systems (Fuchs, Victoria and Martines, 1996: 392). People living in rural areas rely on local knowledge and wisdom passed from one generation to another by word of mouth for self-reliance (Babbie & Mouton, 2001:322).

Hammer-mill yellow maize meal from small-scale millers was investigated in terms of acceptability among Giyani consumers. Traditionally white maize is used only for human consumption and yellow maize meal only if a shortage exists such as during drought. The target population for the study was the female Shangaan consumers in Giyani, in the Limpopo Province, SA. The target population may be defined as that segment of the population that uses or is expected to use the product (Resurrection, 1998:71; Lawless& Heymann, 1998:656).

This script forms part of a larger research project funded by the "Small Scale Millers in South Africa" National Research Foundation to ascertain if hammer-mill yellow maize meal produced by small-scale farmers in Giyani, in the Limpopo Province, SA has a higher nutrient content and acceptability than the commercial roller-mill white maize meal. Yellow maize produced in sub-Saharan Africa has been found to be of higher nutritional value than white maize in terms of vitamin A (Batán, 2003:2). This is an important consideration in terms of nutrition for SA as

micronutrient deficiencies are prevalent throughout the country. In fact according to Marshall (1995:83) vitamin A deficiency levels are at unacceptable high levels in South Africa.

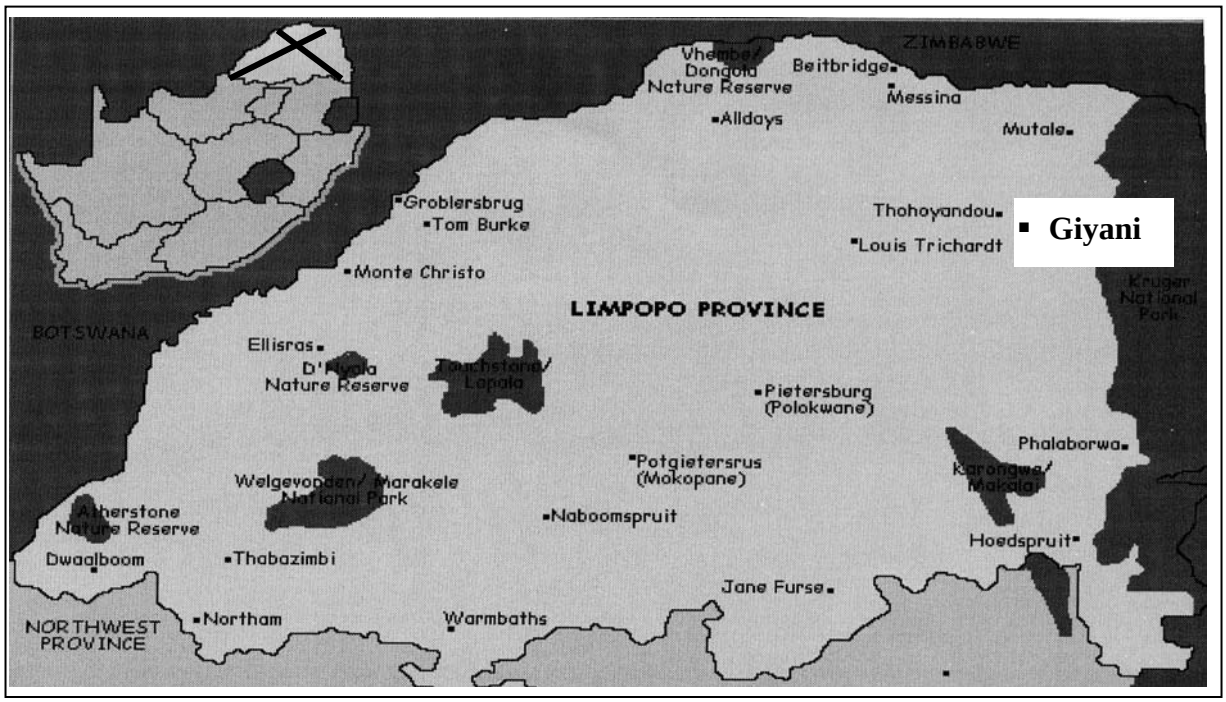

FIGURE 1.2 THE MAP OF THE LIMPOPO PROVINCE, SA

1.2 Structure and presentation of the study

Based on the preceding historical background and motivation, the structure and the presentation of the study will be discussed in the form of the following chapters and headings:

Chapter 2**:** Theoretical Background for the Study

Chapter 3**:** Research Design

Chapter 4: Research Results and Discussion

Chapter 5: Conclusion and Recommendations

CHAPTER 2

THEORETICAL BACKGROUND FOR THE STUDY

2.1 Introduction

A theoretical and conceptual framework was chosen to research the problems and questions arising from the historical background and motivation for this study. The theoretical background and concepts relating to the chosen framework will be discussed in this chapter.

The theoretical and conceptual framework (Figure 2.1) was adapted from Cardello (1994:254); Shepherd and Sparks (1994:204) and Conner and Armitage (2002:6). This forms the basis for the discussion of the study in terms of the sensory attributes and perceptions consumers have that may influence their acceptance or rejection behaviour towards the maize meal. The theoretical and conceptual framework was adapted by omitting the physiological variables (from the three references) that affect food acceptance since they were beyond the scope of this project and furthermore, it was decided that the rural participants for this study were not going to be laboured with a lot of theoretical questions in order to maintain their interest and concentration in the study.

Food is one commodity that consumers buy regularly since they need it on a continual basis in order to *fulfil biological needs and sustenance*. In other words food is consumed for nutrition, pleasure, expressing social relationships and values (Rozin, Pelchat & Fallon, 1986:85). A consumer is an individual who purchases and eats a food item (Meiselman, Hursch & Popper, 1988:78; Nordtest, 2002:3). On the other hand consumption itself may be regarded as the actual utilization (purchase, eating) of a food item as well as the actual amount utilized (Meiselman *et al.* 1988:78). The provision of food whether from a producer's or a consumer's point may be viewed as a cyclical process: food is acquired, prepared and cooked, eaten and then the remains are disposed of and the cycle begins again. Consumers acquire food products which are available, affordable and safe to eat (Ritson & Hutchins, 1995:22). The acquisition of a food product is of primary concern to those involved in producing and manufacturing food products since their major interest is in selling food products (Shepherd & Sparks 1994:202). Manufacturers such as hammer-

mill farmers and millers are interested in understanding consumer reasoning behind the acquisition of food products. The maize meal products that are available may either be acceptable or non acceptable to consumers in order to satisfy their different needs for food.

Factors that have an influence on food acceptability may be divided into those related to the food, to the individual and to the environment (Cardello, 1994:254; Shepherd & Sparks, 1994:204; Conner & Armitage, 2002:6). According to Conner and Armitage (2002:5) external factors linked to the food and environment are assumed to influence sensory and psychological factors within the individual thus impacting on food acceptance or rejection behaviour as illustrated in Figure 2.1.

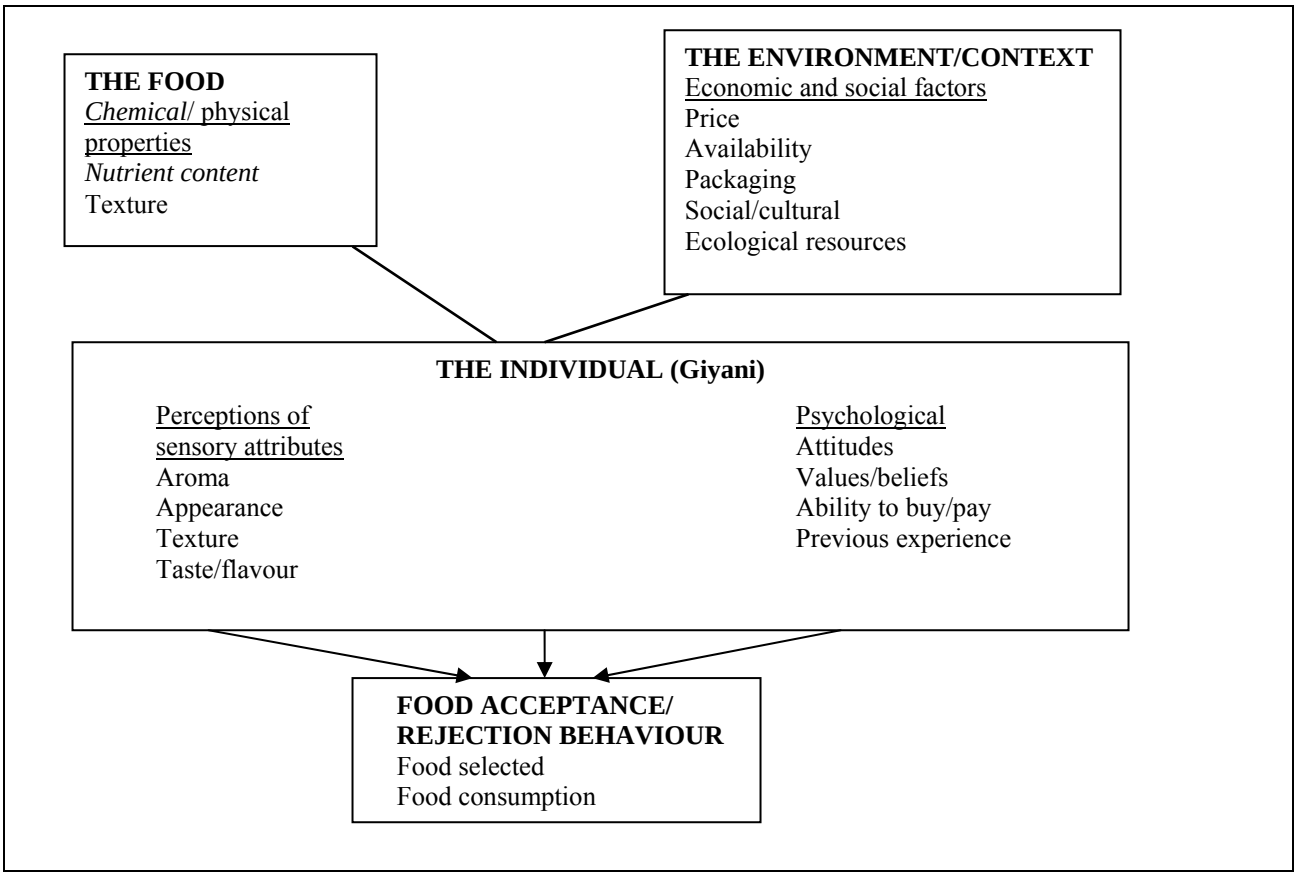

FIGURE 2.1 THEORETICAL AND CONCEPTUAL FRAMEWORK OF FACTORS INFLUENCING FOOD ACCEPTABILITY (adapted from Cardello, 1994:254; Shepherd & Sparks, 1994:204; Conner & Armitage, 2002:6)

2.2 Factors that affect acceptability of food

Food acceptability may be affected by the food product itself in relation to its chemical and physical properties, perception of sensory attributes as well as the psychological effect that the food product has on the individual making the decision to accept or reject the food product.

2.2.1 The Food

The physical aspect of food has an effect on food acceptability through the sensory attributes of the product and psychological factors**.** The chemical and physical composition of food is perceived by an individual as sensory attributes such as aroma, appearance, texture and taste/flavour (Clark, 1998:639; Cardello, 1994:254; Shepherd, 1988:254). Consumers are able to identify food as acceptable by using the sense of smell and hand-feel when they consume the food. Traditionally rural consumers break the maize meal porridge off from a lump in the plate (it must be the right consistency in the hand) using their fingers, moisten it in their relish (isitshebo) before consuming the maize meal porridge. "Subconsciously, consumers often evaluate foods using a checklist that begins with appearance and ends with mouth feel" says Berry (2005:1). According to Conner and Armitage (2002:6) it is not the sensory attributes per se that are important, but the preferences for particular combinations of characteristics in different eating contexts.

Rural consumers rely on experience in combining the ingredients to cook the porridge. Although the recipes are not written down the female consumers know how much water and maize meal to use for the porridge and even how long it must cook from the aroma coming from the cooking porridge and its cooked appearance and hand feel when beating the maize porridge during the cooking process. This was established from the cooks that prepared the porridge for the study as well as from personal experience of rural cooking of porridge that has no written recipes. From the standardized recipes the porridge took 15 minutes to boil and a further 15 minutes to cook over medium heat.

Chemical properties: nutrient content

All food is a mixture of nutrients such as carbohydrates, protein, fat, vitamins, other anti-oxidants, mineral salts and emulsifiers (Bareham, 1995:24; Conner & Armitage, 2002:7). The chemical compounds in the food such as the amount of protein or carbohydrates a food contains may affect a consumer's acceptance of the product (Shepherd, 1988:254). Maize is mainly composed of carbohydrates with lesser amounts of the other chemical components.

Physical properties: texture

In terms of this study the texture of the maize meal is visual texture and mouth feel which may be divided into sight and feel. The properties that appeal to sight and feel include coarse, medium-coarse and fine textures (Lawless & Heymann, 1998:386). If these properties meet consumer needs or expectations this may lead to consumer acceptance of the product.

2.2.2 The Environment/Context

The environment and context in which the food is consumed is representative of external influences on food acceptability in terms of economic and social factors. The environment an individual is brought up in may have an impact on food acceptance. In this study the environment and context refers to economic and social factors that may impact on food acceptability. These include ability to pay for the maize meal, price, availability, social/cultural and ecological resources (Cardello 1994:254; Shepherd & Sparks, 1994:204).

Price

Price in a modern economy is expressed in money terms rather than in kind (Tangermann, 1986: 61). Price is the monetary value manufacturers place on food products on the basis that consumers are willing to pay that much to acquire the food product to get their money's worth in terms of quality or usefulness to meet food requirements. Maize meal in SA is a staple food product. The price of maize meal is not regulated and is mainly determined by the large millers in South Africa, based on supply, demand, input costs (especially the highly fluctuating maize grain price) and transportation costs. Certain food items may be bought due to a reduction in price. Bulk buying of maize meal is usually associated with price discounts. Consumers may then acquire the products to

save money for future purchases (Ritson & Hutchins, 1995:45; Bell & Meiselman 1995:299). A decrease in price on products may also increase consumption levels. In such a scenario consumers may buy more of the same product or spend the extra money on other consumables.

Availability

Availability includes physical and economic access to food products (Mela, 1999:514; Krondl & Coleman, 1988:61; Southgate, 1996:379). In most cases fluctuations in the food supply in a country or region coupled with seasonal availability has an impact on what people are likely to consume. The supply of agricultural products may be affected by drought at times when there is not enough rain for crops to grow adequately. At such a time food chosen may not necessarily be that which would be preferred or even liked (Mela, 1999:514; Souter & Keller, 2002:9). In general, white maize meal is readily available in SA throughout the year. However, an example of an exception is, for instance, during drought. SA then imports yellow maize from the United States of America (USA) for human consumption, but due to lack of choice, locals will consume it even if at lower levels, rather than switching completely to an alternative such as bread. The yellow maize is not readily accepted by local consumers.

Packaging

The mere presence of a packet, tin, sachet or bag shows that the food product has been manufactured and packed conveniently for the consumer (Lannon, 1986:241; Lawless & Heymann, 1998:17). Packaging may have an influence on how consumers perceive and react to food products. Packaging has a tendency to enhance the perception of food products through the sense of sight. However Bricas, Cheyns, Dury and Essomba, (2001:22) are of the opinion that packaging is generally accepted as an efficient sign of hygienic quality although it deprives the consumer from inspecting the quality of the product through the sensory perceptions of smell, taste and sight. In the case of maize meal packaging makes it convenient for the South African consumer to purchase maize meal in quantities suited to the family needs (5 kg, 12.5 kg, 50 kg and so on) and provides consumers with additional information such as the brand name, nutritional information and manufacturer's details.

Social/ cultural factors

Social and cultural factors are influences that are translated into an individual's behaviour towards food products (Rozin *et al.* 1986:93). The environment an individual is brought up in may have an impact on food acceptance. The individual's region of origin and the size of the village he lived in until sixteen is a very influential environmental characteristic in terms of food acceptance (Randall, 1982:16**;** Whitney & Rolfes, 1999:3)). What can be eaten is learnt from early childhood. With time acceptance of certain foods is established. Culture dictates what is acceptable. A person learns from the culture he or she is born in about the local cuisine, healthy and acceptable means of acquiring food. Culture is shared and is social, for example, cultural rules of cuisine and appropriateness exert tremendous influences on what may appear on the plate, when and how (Mela, 1999:514**;** Bareham, 1995:66). Traditionally maize meal porridge is prepared by adding maize meal paste to boiling water (see Addendum B). The porridge is left to boil until it smells cooked over medium heat (about 15 minutes). The porridge may either be thickened with a second maize meal paste or with dry maize meal depending on the local acceptable way of preparation for that particular village. The porridge is left to cook over medium heat for a further 15 minutes. Every five minutes the porridge is beaten with a wooden spoon to ensure even cooking and the prevention of lumping.

Ecological resources

According to Krondl and Lau (1978:39) ecological resources (climatic conditions, agriculture and industrialization) not only influence scarcity or abundance of food but also influence an individual's personal taste and emphasis on the food products which the culture of his or her day consider desirable.

2.2.3 The Individual

Influences of food acceptance may be found within the individual in terms of perceptions of sensory attributes and psychological factors that are likely to interact with the aspects of food and the environment to produce food acceptability (Conner & Armitage, 2002:8).

Perceptions of sensory attributes

Consumers learn to accept or reject food based on the perception of its sensory attributes. The perceptions of sensory attributes may be defined as the evaluated adequacy of the product in terms of its set of desirable eating quality characteristics like appearance, taste, aroma and texture (Nordtest, 2002:4; Land, 1988:478). The sensory characteristics of a food play a significant role in the acceptance of a food product. Consumers seem to be born with a liking for sweet food flavours although a liking for bitter or hot spicy foods is often acquired through repeated exposure (Clark, 1998:639; Birch, 1998:617). Perceptions of sensory attributes may be determined by using sensory evaluation methods which will be discussed later in this study.

Aroma

Aroma is defined as the fragrance or odour of a food product as perceived by the nose from sniffing the food product (Lawless & Heymann, 1998:804). A pleasant or unpleasant odour from a food product may induce acceptance or rejection of the product respectively.

Appearance

Appearance is the visual properties of food in terms of among other things texture, gloss and colour (MacDougall, 1988:104; Lawless & Heymann, 1998:804). Human beings are visually driven species (Hetherington & MacDougall, 1992:165). The initial quality of a food product may be evaluated in terms of appearance as related to colour. As such colour may be regarded as the most important appearance characteristic for some food products. This was a very important factor considered in the case of commercial roller-mill white maize meal (white sifted unfortified and white sifted fortified; white super and hammer-mill white and yellow maize meal (with and without fibre) in this study. According to Messer (2002:10) consumers prefer polished white grains because they cook faster, taste sweeter and their texture is more desirable than whole grain products. In these terms white super fortified maize meal porridge would be more acceptable to consumers due to its super white colour, hand and mouth feel than the other maize meal products tasted in the study.

Texture

Texture describes the physical properties of food products such as fine, medium and coarse (Lawless & Heymann, 1998:388). Texture as well as the other sensory attributes of a food product are determined by the senses of sight, touch and sound. As in the case of maize products for this study a combination of the senses was used to evaluate food products. For example, the viscosity of soft porridge can be evaluated by sight, by stirring it with a wooden spoon as well as by tactile sensation in the mouth when the porridge is consumed.

Traditionally the porridge is broken off from a large mould of porridge in the plate, moulded into a smooth boll in the hand before being dipped in the isitshebo (relish) and then ingested. Isitshebo is made from meat and combined with tomatoes and onion for gravy or it can be made from vegetables such as pumpkin leaves which enhances the palatability and acceptability of maize meal porridge. The acceptability of the texture of the maize meal porridge is evaluated in three stages: firstly when it is broken off from the mould, secondly when it is moulded in the hand before dipping it in the isitshebo and thirdly when it is chewed in the mouth.

Taste/flavour

Taste and flavour are the main sensory attributes used by consumers to either accept or reject food products. A person instinctively responds to different tastes found in food products. For instance, sweet tastes elicit a facial acceptance response like large eyes and retraction of the mouth, resembling a smile, while a bitter taste is shown by tight closing of the eyes, gaping of the mouth and sudden turn of the head indicative of like or dislike of a food product respectively (Clark, 1998:639). Brennan and Kuri (2002:65) contend that it is widely accepted that consumers' acceptance of food is mainly determined by their sensory perception, whereas choice is strongly influenced by the perceived value for money. Clark (1998:639) singles out taste and flavour as key to consumer acceptance of food. In the case of maize meal porridge taste/flavour combined with other sensory attributes considered in the study had an effect on the acceptability of the porridge. Taste/flavour that meets consumers' expectations would lead to acceptability.

Psychological factors

Characteristics of an individual may include psychological factors like gender, attitudes, values/beliefs, ability to pay and previous experience (Cardello 1994:254; Shepherd & Sparks, 1994:204). Gender was not a factor in this study as the participants were all females.

Attitudes

Attitudes may be defined as an expression of inner feelings that reflect a consumer's liking or disliking of an attribute of a food product which may induce acceptance or rejection of a product (Parraga, 1990:663; Shepherd & Raats, 1996:349). Attitudes may also be regarded as an individual's evaluation of food products. Consumer attitudes towards food products being presented may either be favourable or unfavourable (that is, positive or negative). Attitudes are learnt or acquired from direct personal experiences, from information from other people and exposure to mass media rather than being inborn (Johns & Kuhnlein, 1990:23). It is important to note that attitudes vary from one situation to another, for example coarse maize meal may be suitable for soft maize meal porridge but may not be appropriate for making stiff pap (thick porridge). Attitudes can change from negative to positive 'through elaboration' such as being informed of the goodness of the product to meet dietary needs. Attitudes that are formed as a result of elaboration are more likely to guide behavioural intentions than attitudes that are formed as a result of non-thoughtful persuasion (Bagozzi, Gürhan-Canli & Priester, 2002:125).

Values/Beliefs

Values determine what is desirable and undesirable as food and which foods are held in high esteem whereas beliefs about food represent an interpretation of food values (Parraga, 1990:661). Values and beliefs are mental images that serve as a guide for cultural appropriate behaviour regarding food choice and acceptability. Values and beliefs endure and they are difficult to change. For example, traditionally rural males do not feel that they have had a meal if it did not include maize meal porridge. Values contain an affective element and guide an individual's behaviour towards the acceptance of food, that is, accept or reject the food. On the other hand beliefs have a cognitive element in relation to the knowledge about the product and as such an individual may or may not be guided by the beliefs she or he holds (Whitney & Rolfes, 1999:4; Bareham, 1995:169).

This implies that an individual may act contrary to the beliefs (knowledge) such that even if he or she knows that a particular food product is nutritionally good he or she may go ahead and choose something else. Values and beliefs are learnt from the environment an individual is brought up in.

Ability to purchase

The ability to buy or pay for food products is dependent on the proportion of the family income that is set aside for the purchase of food. According to Bareham (1995:42) consumers switch to higher valued and more expensive food items as their incomes grow. They may purchase certain food products in order to enhance their personal image, that is, refined and expensive products are usually associated with social prestige or status (Bareham, 1995:88; Foxall & Goldsmith, 1994: 50). Further more, consumers prefer white polished grains (that is, super maize meal) because they cook quicker, their taste and texture is 'more desirable and consequently are associated with higher cultural status' that matches their income bracket (Messer, 2002:10). However, this is despite the fact that super maize meal is the most expensive type of maize meal followed by the special and then by the sifted maize meal. As such the prevailing economy around the individual, locally, regionally and nationally may dictate the quality and quantity of food items acquired by the consumer. "Economic and cultural studies have shown how income and food costs determine food selections, and often override considerations of healthfulness, social desirability and even taste" (Messer, 2002:4; Souter & Keller, 2002:4).

Sometimes people may have adequate nutrition knowledge but may lack the economic means to acquire enough food for optimal or adequate nutrition. This signifies a 'lack of food-purchasing power'. For low income earners food products perceived to be too expensive for the budget will be eliminated and the food products selected will be strictly those needed to meet fulfilment of hunger and maintenance of life (Krondl & Lau, 1986:143). Limited cash income and lack of knowledge in connection with the nutritional content of food items may have a negative impact on the acceptability of foods that may otherwise be suitable for optimal or adequate nutrition. For instance, there may not be adequate income set aside for isitshebo which is necessary to enhance the acceptability of the maize porridge.

Previous experience

People acquire a preference for foods they have been exposed to in their culture or environment. Mela (1999**:**516) suggests that habitually consumed foods tend to be preferred over new or unfamiliar products. Some degree of exposure or experience with the food may lead to the formation of likes and dislikes toward a food product. Consumers in the area of study are exposed to yellow maize meal during drought when it is supplied by the government to improve food availability countrywide.

2.3 Factors affecting an individual's perception of food products

Perception is a process whereby an individual recognizes, selects, organizes and interprets any input (stimuli) to any of/or a combination of the five senses (sight, smell, taste, touch and hearing) into a meaningful and coherent picture of the situation (Bagozzi *et al.* 2002:132; Foxall & Goldsmith, 1994:50; Schiffman & Kanuk, 1991:146). Physical stimuli comes from the outside environment whereas the other is provided by the individual himself or herself in the form of predispositions like expectations, motives and learning based on previous experience. The three aspects of perception which will be briefly discussed include selection, organization and interpretation of stimuli. The mental picture and expectations built around maize meal by consumers for example, may lead to the acceptance and rejection of the food product.

Perceptual selection

Subconsciously an individual recognizes and selects which stimuli to respond to, for example, an individual is exposed to hundreds of food products, but she or he selects only those that satisfy her dietary needs. A consumer's previous experience with the product and his or her motives are combined to make the selection (Krondl & Coleman, 1988:59)**.** Consumers tend to perceive things they want or need, that is, the stronger the need for the food product the greater the tendency to pay more attention to the stimuli that meets the consumer's wants, needs or expectations. With a large variety of maize meal available in the South African market consumers will choose those that meet their expectations and need for food.

Perceptual organization

Consumers organize stimuli from the environment into groups or unified wholes to form an impression about a food product (Krondl & Coleman, 1988:59)**.** Grouping stimuli facilitates memory and recall which may be useful in future. If incomplete information about the food product is given consumers have a tendency to fill in the missing information to complete the picture of the food product and arrive at a conclusion about the food product being presented (Schiffman & Kanuk 1991: 165).

Perceptual interpretation

According to Bell and Meiselman (1995:295) previous experience and social associations may help individuals to form certain expectations around a food product being presented. Perception of a food product may also be affected by its appearance such as colour, for example. Colour is a visual attribute that helps consumers to rank and label food products. According to Messer (2002: 9) white maize is preferred for Mexican tortillas since it is regarded as cleaner, softer in texture and tastier than tortillas made from yellow maize. As such *higher-nutrient maize varieties* have been rejected because of the undesirable yellow colour. This scenario could be the same in SA regarding the yellow maize meal as there is an assumption that some consumers in SA regard yellow maize as suitable only for animal feed. The three aspects of perception discussed above assist consumers to define food quality perception.

Food quality perception

Consumers judge the quality of food products based on cues namely: it's intrinsic (inherent) and extrinsic value. Intrinsic cues are the natural characteristics found in food products such as appearance, colour, flavour and aroma. The sensory attributes of a food product interacts with consumer psychological, behavioural and cognitive factors within his/her experience to exert influence on consumer perception (Imran, 1999:225; Krondl & Coleman, 1988:73)**.** The environment and context in which the consumer encounters the food product will impact on the individual's feeling of like and dislike of a food product. Before the food is ingested it is 'first eaten with the eyes' (visual sensation). As such, human perception of food quality relies on the visual image of the food product (Hetherington & MacDougall, 1992:165). The anticipatory characteristics or visual cues (appearance in terms of colour, visual structure, visual texture and

perceived flavour) play a significant role in assisting consumers to select and buy food products prior to consumption. Imran (1999:227) contends that visual sensory properties are of critical importance especially in situations where products are sold through appearance rather than through packaging.

Individuals often assess the quality of food products using extrinsic cues (external factors) like price. Consumers may rely on price as an indicator of product quality such that highly priced food products may be perceived as of better quality. Consumers often judge product quality by price (Foxall & Goldsmith, 1994:64; Schiffman and Kanuk, 1991:176). For example, if consumers are offered two similar versions of the same food product that are priced differently, consumers have a tendency of choosing the version with a higher price as quality choice rather than make an economic choice. Price perceptions are complex as illustrated in a study on behavioural intentions by Alba (1994) cited by Bagozzi *et al.* (2002:134) which showed that 'consumers perceive prices at a store with frequent shallow discounts more attractive than one with infrequent deep discounts'. In retail settings consumers rely on visual cues to form judgements about food products. Store choices among other factors may depend on the assortment of products based on product presentation and size of packaging (Bagozzi *et al.* 2002:134). Consumers notice these cues especially when they affect the products they want or need.

2.4 Food acceptance and rejection behaviour

The factors discussed above are interrelated such that they may lead an individual to accept or reject the food (see Figure 2.1). Food acceptance is the act of a given individual or population of finding that a food product answers satisfactorily to his/her/its expectations (Nordtest, 2002:4). Acceptance of a food product implies that the product induces a positive response from a consumer. Rejection of a food product on the other hand produces a negative response from a consumer. According to Whitney and Rolfes (1999:4) people may sometimes attach intense and strong unalterable dislikes to food products that they were forced to eat when they were either sick or not hungry when they were children.

Food acceptance should be viewed within the context of values, that is, an individual's acceptance of food co-exists within a set of other values such as the importance of health, social status and culture. Food acceptability comprises of three components:

- *The cognitive component* which is shown when an individual *characterizes food in terms of food; foods as members of a food group and other possible divisions.* This is measured by statements of belief
- *The affective component* depicts the emotions elicited from the food and is measurable using physiological indicators (facial expression when food is being tasted) and or verbal statements of feeling
- *The behavioural component* is exhibited by an individual's particular act toward the food.

This can be measured directly for example, in sensory evaluation and implied in statements as in focus-group interviews (Sanjur, 1982:138; Cardello, 1994:254; Meiselman, 1988:78; Shepherd, 1988:254).

'It is widely accepted that consumer acceptance of food is mainly determined by their sensory perception' in terms of appearance, taste, aroma and texture whereas 'choice is strongly influenced by the perceived value for money' (Brennan & Kuri, 2002:65; Messer, 2002:5). The degree of 'acceptance of these characteristics' differs among individuals as well as 'within cultural populations'. Messer (2002:8) states that in Africa where the basic staple is porridge with texture (in terms of consistency) ranging from thick to watery, different groups distinguish themselves by what they prefer in their staple food. For instance, some consumers accept a crumble texture of maize porridge while others take the soft smooth texture as ideal. New or unfamiliar food items are generally accepted if they can be served in forms *that are familiar in texture and presentation*.

Food selected

Researchers like Conner and Armitage (2002:27) as well as Krondl and Coleman (1988:62) believe that food selection is based on mental information processing. The most profound and significant determinants of food selection are undoubtedly cultural and traditional. However the presentation of food products via packaging and other promotional practices under the control of food manufacturers play an important role (Rozin *et* al. 1986:85; Lannon, 1986:241). Food selection is

determined by how the consumer thinks and evaluates the information about the product either gathered from: others in the community he or she lives in, mass media or previous experience with the product. Colour provides the first line of judgement which in the end impacts on food product selection (Imran, 1999:227; Bagozzi *et al.* 2002:134).

Food consumption

Food consumption is about what an individual will or will not allow to enter his or her body and how often the food is consumed (Vermeir & Verbeke, 2004:3). Staple food products are consumed on a daily basis to supply the basic dietary needs of people in a particular country (Agbola & Saini, 2001:3)**.** In summary the most important factors influencing consumer acceptance are perception of sensory attributes, ability to pay for the product, product presentation, eating quality, desire and social attitudes based on the basis of the expectations of consumers in terms of value for their money (Ritson & Hutchins, 1995:45; Regmi, Deepak, Seale & Bernstein, 2001:8).

CHAPTER 3

MATERIALS AND METHODS

3.1 Introduction

The research design and methodology dictates to some extent and are indicative of the materials, techniques and procedures that were used. These were based on a plan which is an essential component for any research. The research design and methodology that were used to execute the research aim and objectives for this study will be discussed in this chapter.

3.2 Research aim and objectives

The research aim for this study was to determine the level of acceptability and perception of traditionally prepared maize meal porridge made from commercial roller-mill white maize meal (sifted unfortified and sifted fortified, as well as super fortified) versus informal hammer-mill white and yellow maize meal (with and without fibre-produced by small-scale millers) among Giyani consumers in the Limpopo Province, SA. Refer to Table 3.1.

TABLE 3.1 MAIZE MEAL PORRIDGE SAMPLES COMPARED

Traditionally prepared maize meal porridge samples compared							
Option 1			**Option 2**				
Maize meal type	**Brand**		**Maize meal type**	**Brand**			
White sifted unfortified	Big "**L"**		White sifted fortified	Eagle (brand of Progress milling			
Hammer-mill white (with fibre)	No brand- produced by local miller in the Giyani area		Hammer-mill yellow (with fibre)	No brand- produced by local miller in the Giyani area		**Option 3**	
Hammer-mill white (without fibre)	No brand- produced by local miller in the Giyani area		Hammer-mill yellow (without fibre)	No brand- produced by local miller in the Giyani area		**Maize meal type**	**Brand**
White sifted unfortified	Big "**L"**		White super fortified	White super (brand of Brenner milling)		Hammer-mill white (without fibre)	No brand- produced by local miller in the Giyani area

As can be observed from Figure 2.1 in Chapter 2 various factors influence the acceptability and perceptions of food products, thus indicating the complexity of the food acceptance and perception process. The food acceptance process is based on conscious, automatic, habitual and subconscious

decisions made by an individual at the point of purchase, point of consumption or any point in between (Furst, Connors, Bisogni, Sobal and Falk, 1996:263; Hamilton, McIlveen & Strugnell, 2000:113).

The focus of this study was two fold and was performed in two phases. In phase one a quantitative research approach was employed through the use of sensory evaluation tests to measure the hedonic (like/dislike) response of Giyani consumers towards various maize meal types as tabulated (Table 3.1). A qualitative research approach was employed during phase two in which focus-group interviews were conducted in order to obtain supportive information to interpret and explain the data obtained during phase one of this study.

The following objectives were formulated for each of the phases for the study. Objectives for phase one were as follows:

- To estimate the level of acceptance of traditionally prepared porridge made from commercial roller-mill white maize meal (sifted unfortified and sifted fortified as well as hammer-mill white and yellow maize meal (with and without fibre-produced by small-scale millers) in terms of sensory attributes of aroma, appearance, texture and taste/ flavour.
- To determine the overall acceptability of traditionally prepared maize meal porridge prepared from commercial roller-mill white maize meal (sifted unfortified and sifted fortified as well as super fortified); hammer-mill white and yellow maize meal (with and without fibre-produced by small-scale millers).

For phase two the following objective was formulated:

- To form a basis of understanding consumer acceptability and perception of traditionally prepared maize meal porridge cooked with commercial roller-mill white maize meal (sifted unfortified and sifted fortified as well as super fortified) as well as hammer-mill white and yellow maize meal with and without fibre-produced by small-scale millers) to substantiate the results obtained in phase one.

3.3 Research design

The participants for this project were Shangaan female consumers. They were eighteen years old or older, willing as well as having the time available to participate in the study. These were limited to the geographical area of Giyani in the Limpopo Province, SA. They were recruited by the local pastor of The Assemblies of God. He knows the local language and customs of Giyani. The participants from Homu 14A village numbered twenty-one and those from Mahlathi village numbered twenty-seven. The total number of participants for the study was forty-eight who all first completed the consent form (Addendum A). According to the local pastor's records there were 1400 consumers in the area of study, thus the size of the sample of forty-eight represented 3 % of the study population. The size of the sample for this study was not designed to be representative (Furst *et al.* 1996:262), thus the results could not be generalized.

The research process

The first phase employed a sensory evaluation technique which is a quantitative scientific method (Lawless & Heymann, 1998:2; Meiselman, 1988:302) in which numerical data was collected and analysed in order to determine consumer acceptability of commercial-mill white maize meal and hammer-mill white and yellow maize meal (with and without fibre).

The main objective in the second phase was to gain an understanding of the perceptions consumers have for commercial roller-mill white maize meal and hammer-mill white and yellow maize meal (with and without fibre) that is produced by small-scale millers in Giyani, in the Limpopo Province, SA. In this second phase qualitative techniques in sampling (purposeful sampling)**,** data collection and data analysis were employed. Purposeful sampling for this study was directed at current and would be users of commercial roller-mill white maize meal and hammer-mill white and yellow maize meal respectively. Focus-group interviews were conducted to investigate various aspects of Giyani female consumers' perceptions and reactions to porridge made from commercial roller-mill maize meal and hammer-mill maize meal presented to them. Qualitative research methods (descriptive in nature) were used to get detailed information about consumer attitudes, perceptions, behaviours and practices on the consumption (Resurrection, 1998:93) of maize porridge. The

researcher remained in the field until no further evidence emerged (saturation) as suggested by the latter researcher.

3.4 Conceptual framework for the study

The conceptual framework for this study is presented in Figure 3.1 and is based on an adapted model of Cardello (1994:254); Shepherd and Sparks (1994:204); and Conner and Armitage (2002:6). It illustrates some of the factors (relevant for this study) that influence food acceptability and perception in terms of commercial roller-mill white maize meal (white sifted unfortified and white sifted fortified; white super) and hammer-mill white and yellow maize meal (with and without fibre-produced by small scale farmers in Giyani, Limpopo Province, SA).

3.5 Conceptualization

The concepts derived from the research aim and conceptual framework were defined in order to be clear of what was to be measured in the study.

The **unit of analysis** for the purposes of this study was the Shangaan female consumers (due to their role in purchasing and cooking of food for the family) geographically located in the Giyani Local Municipality in the Greater Giyani District municipality, in the Limpopo Province, SA. A consumer is an individual who purchases and consumes a food item (Nordtest, 2002:3; Meiselman *et al*, 1988:78).

Physical properties

The physical properties of the food such as texture (coarse, medium-coarse and fine) and colour are the characteristics of food products as perceived by the senses of sight, touch and sound (Lawless & Heymann, 1998: 379). In the case of maize meal the commercial roller mill white super the porridge is whiter than porridge cooked from the rest of the maize meal types used in the study. As such white super maize is readily accepted by consumers as it looks ‘cleaner’ than porridge cooked with the other maize meal types used in the study.

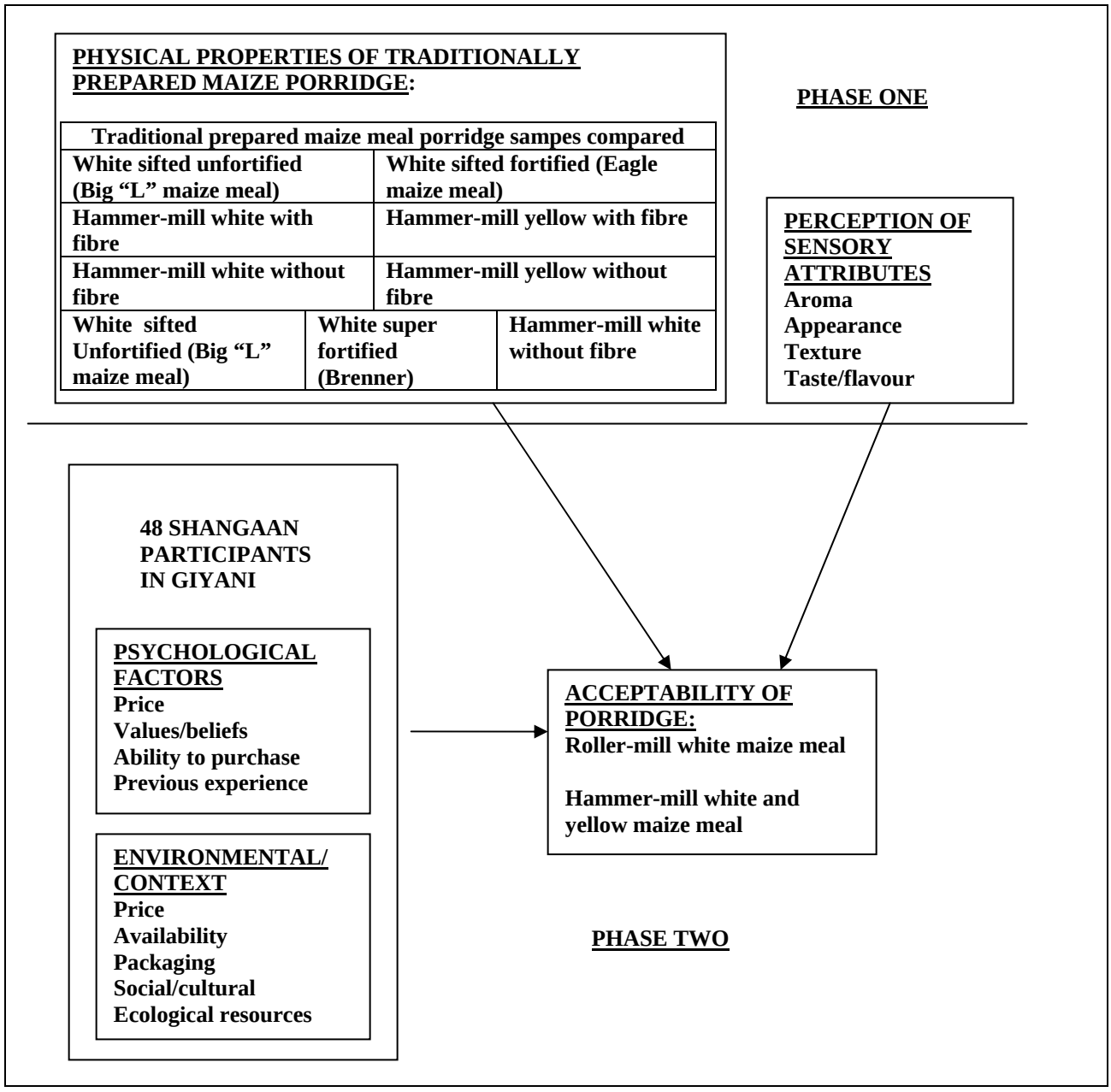

FIGURE 3:1 CONCEPTUAL FRAMEWORK FOR THE STUDY (adapted from Cardello, 1994:254; Shepherd & Sparks, 1994:204; Conner & Armitage, 2002:6)

Aroma

Aroma is defined as the fragrance or odour of a food product as perceived by the nose from sniffing the food product (Lawless & Heymann, 1998:804). The researcher is of the opinion that

participants have a tendency of identifying aroma of food products as nice without specifying why they feel that the aroma is nice.

Appearance

Appearance is the visual properties of food in terms of texture, gloss and colour (MacDougall, 1988:104; Lawless & Heymann, 1998:804). Colour is an important trait that may induce acceptance or rejection behaviour of participants of maize meal in terms of this study. According to Messer (2002:10) the taste, texture and colour of white polished grains are more desirable than whole grains.

Texture

Texture describes the physical properties of food products such as fine, medium and coarse (Lawless & Heymann, 1998:388). Coarse maize products may not be well accepted as the porridge may not look that attractive since food 'is eaten with the eyes' before it is actually consumed. The feeling of the texture in the hand as well as in the mouth contributes to the acceptability and rejection of the food product.

Taste/flavour

For the purposes of this study taste and flavour are considered as the main sensory attributes used by consumers to either accept or reject food products based on the perceptions of bland, sweet, sour, bitter or salty sensations (Clark, 1998:639; Brennan and Kuri, 2002:65). For this study chewing the maize product properly was an important factor so that the taste and flavour could be identified as pleasant or unpleasant. Salt was not added to the porridge, as is custom when traditionally prepared. The porridge was cooked using local water, as the consumers are used to the taste of local water. Any other source of water could have had an effect on the porridge by altering the taste/flavour of the cooked porridge.

Perceptions on food products

Perception is a process whereby an individual recognizes, selects, organizes and interprets any input (stimuli) to any of or a combination of the five senses (sight, smell, taste, touch and hearing) into a meaningful and coherent picture of the situation (Bagozzi *et al.* 2002:132).

The variables that follow now were not measured in the study, but formed part of the general background for the qualitative part of the research. The information thus obtained was useful to support the quantitative research in phase one.

Attitudes

Attitudes may be defined as an expression of inner feelings that reflect a consumer's liking or disliking of an attribute of a food product which may induce acceptance or rejection of a product (Parraga, 1990:663; Shepherd & Raats, 1996:349)**.**

Values/Beliefs

Values and beliefs are mental images that serve as a guide for cultural appropriate behaviour regarding food choice and acceptability (Krondl, 1990:8; Parraga, 1990:661)**.**

Ability to purchase

Availability of money for food signifies the presence or the absence of the ability to pay for food products (Vermier & Verbeke, 2004:7; Furst *et al*, 1996:254**).** Researchers often use either amount or source of income to measure social class in order to estimate the affordability or purchase of food products based on family income.

Previous experience

Previous experience implies that an individual has been exposed to the food product before or is familiar with it from habitual consumption (Mela, 1999:516). Giyani consumers have been exposed to white and yellow hammer-mill maize meal before. During drought periods the residents have been exposed to imported yellow maize meal from USA.

Price

Price in a modern economy is expressed in money terms rather than in kind (Tangermann, 1986: 61). Price is the monetary value placed on food products ear-marked for sale to consumers.

Availability

Availability aspects of food products include physical and economic access to food products (Mela, 1999:514; Krondl & Coleman, 1988:61; Southgate, 1996:379). SA supermarkets and rural food shops sell a wide variety of commercial roller-mill maize meal at affordable prices.

Packaging

The mere presence of a packet, tin, sachet or bag shows that the food product has been manufactured and has a tendency of enhancing the perception of food products through the sense of sight (Lannon, 1986:241; Lawless & Heymann, 1998:17). In the South African context packaging of maize meal makes it convenient for consumers to purchase maize meal in amounts suited for the size and needs of the family

Social/ cultural factors

Social and cultural factors are influences that are learnt from the environment an individual is brought up in or lives in. These are often translated into an individual's behaviour towards food products (Rozin *et al.* 1986:93). For instance, if in a particular rural area hammer-mill maize meal is regarded as low class, consumers living there will not buy it for fear of being looked down upon even though the hammer-mill maize meal is of high nutritional value as a whole grain product.

Ecological resources

For the purposes of this study ecological resources refer to the availability of food resources that may be affected by scarcity or plenty of food (influenced by climatic conditions) and cooking facilities (Krondl & Lau 1978:39).

Food selected

Food selection is an act of a given individual or population of finding that a food product answers satisfactorily to his/her/its expectations (Nordtest, 2002:4). For the purposes of this study food selection was determined by how the consumer thought and evaluated the information about maize meal either gathered from others in the community she lives in, or from previous experience with roller-meal white maize meal and hammer-mill maize meal. Colour provides the first line of

judgement which in the end impacts on food product selection (Imran, 1999:227; Bagozzi *et al.* 2002:134).

Food consumption

Food consumption is about what an individual will or will not allow to enter his or her body (Vermeir & Verbeke, 2004:3). Frequency of consumption can be determined by the amount of the food product consumed by individuals.

3.6 Data collection and combating error

This study was conducted between November 30, 2005 and February 10, 2006. The researcher visited Giyani, Limpopo Province, SA twice for data collection during the duration of the study. Each data collection visit lasted two days. Data collection was a process whereby the concepts indicated in the conceptual framework (see Figure 3.1) for this study were measured. During data collection measures (as discussed in the following section) were taken to combat error.

3.6.1 Data collection and combating error for phase one

For phase one the **physical properties** and **perceptions of sensory attributes** of commercial roller-mill white maize meal, as well as hammer-mill white and yellow maize meal (with and without fibre) were measured for acceptability. Sensory evaluation tests were used for data collection. Sensory evaluation tests are usually conducted to measure consumer acceptability using such techniques as the hedonic scales (Stone & Sidel, 1992:87; Lawless & Heymann, 1998:256; Nordtest, 2002:6). Hedonic refers to the likes, dislikes or preferences for food by a consumer. Hedonic scales (a form of rating scales) may be used to estimate the degree of food acceptance among consumers. *Sensory evaluation* is a quantitative scientific method in which numerical data are collected to establish lawful and specific relationships between product characteristics and human perception (Lawless& Heymann, 1998:2; Meiselman, 1988:302). According to these authors sensory evaluation is used to *evoke, measure, analyze and interpret* consumer responses through the senses of taste, touch, smell, sight and hearing. In Homu 14A village twenty-one

participants took part in the sensory evaluation tests whereas in Mahlathi village there were twenty-seven.

According to Babbie and Mouton (2001:244) no matter how carefully a scale has been constructed as an instrument for data collection there is certainty of error and the surest protection against error was to pre-test the sensory evaluation in part. For this study the hedonic tests (face scales with an equivalent scale of 1=dislike very much, 2= dislike moderately, 3= like moderately, 4=like very much) for sensory evaluation tests were pre-tested during a pilot study visit on a small sample of 6 participants prior to its use, in order to determine the functionality of the measuring instrument as suggested by Resurrection (1998:30). A 4-point scale was used due to the limited literacy level of participants. Figure 3.2 shows part of the research team correcting the questionnaires to suit the participants for the study.

FIGURE 3.2 PART OF THE RESEARCH TEAM RECTIFIES THE TECHNICAL PROBLEMS ON THE QUESTIONNAIRE

The pilot study was helpful in that several technical problems on the questionnaire (the spacing of the sections of the questionnaire to demarcate the sensory attributes questions was not clear; the tests were randomized as well) were detected and rectified to suit the participants before the actual study could take place. During the pilot study the maize porridge recipes were standardized in order to enhance accurate data collection. The recipes used for the dishes for the sensory evaluation were standardized. The amount of ingredients used, methods employed and duration of cooking the porridge for evaluation remained the same for the duration of the study. According to Reed and Schuster (2002:2) standardization ensures food product control. Thus the quality and yield of the finished product can be predicted. One of the research team members recorded the standardized recipes from the volunteer-cooks for future reference and compilation of the final report (Addendum B). In both villages the volunteer-cooks were strictly supervised by one research team student for the project in order to make sure that the standardized recipes were adhered to for the duration of the study as a precaution against distortion of the results in the study. Porridge for the study was prepared in the traditional manner particular to the area of study using the commercial roller-mill white maize meal and hammer-mill yellow maize meal selected for the consumer sensory evaluation tests. The commercial roller-mill white maize meal types included the following: white sifted unfortified (Big "**L**" sifted maize meal, white sifted fortified (Eagle fortified maize meal) and white super fortified (Brenner) maize meal whereas hammer-mill maize meal consisted of hammer-mill white with fibre, hammer-mill white without fibre, hammer-mill yellow with fibre and hammer-mill yellow without fibre maize meal. For this study it is important to know about the **procurement** of the commercial roller-mill maize meal versus hammer-mill white and yellow maize meal used for the study.

White sifted unfortified, sifted fortified, as well as super fortified maize meal are commercial products produced with roller-mills. These were purchased at the Giyani Maize depot (see Figure 3.3).

According to the Department of Agriculture, Regulation 1739 (1993) maize meal is classified as ***super*** (with a low extraction rate, very high starch content and high price), ***special*** (with an intermediate extraction rate and intermediate price) and ***sifted*** (with a very high extraction rate, lower starch content and low price) [see Figure 1.1 in Chapter 1]. The fortified Eagle maize meal

(produced by Progress Millers of Polokwane, Limpopo Province) and used for the study had the following micro-nutrients due to the fortification process: vitamin A, thiamine, riboflavin, niacin, pyridoxine, folic acid, iron and zinc as stipulated by the Department of Agriculture (Regulation 1739: 1993). Refer to Figure 3.4 for the classification of maize meal.

FIGURE 3.3 GIYANI MAIZE MEAL DEPOT

A special process is followed to produce hammer-mill maize meal. The maize grain is mostly bought from small-scale farmers. After rinsing the grain with tape water it is either stamped into maize meal at home (in a mortar which is made from a scooped out thick tree trunk, pounding is performed with a thick rod) or it is sent to a hammer-meal for a fee (see Figure 3.4).

Local ladies in each village familiar with the local cookery techniques of Giyani volunteered to cook the commercial roller-mill white maize meal and hammer-mill yellow maize meal porridge for the duration of the study (see Figure 3.5).

Maize grain

Maize grain rinsed in tape water

Hulling maize grain

Hulled maize grain

Hammer-milling of maize grain

Local ladies sifting stamped maize grain into fine maize meal

Sun-drying hammer-mill maize meal

Cooked maize meal porridge

FIGURE 3.4 HAMMER- MILLING PROCESS

FIGURE 3.5 PAIR OF LOCAL LADIES COOKING PORRIDGE AT HOMU 14A VILLAGE

The research team comprising of two doctoral students, four masters' students, study leader of the project and another professor from the Consumer Science Department at the University of Pretoria took part in the research proceedings at Homu 14A village, but only the researcher and one masters' student oversaw the proceedings of the research at Mahlathi village. In both villages earmarked for the study the saucepans/pots and lids were clearly marked with random numbers matching the maize meal random numbers being used to prevent bias. This was important in order to enhance accurate data collection. The cooks used traditional methods of cooking the porridge peculiar to their village. This was important for this study because regions use different techniques and procedures to prepare maize meal porridge as is shown by the recipes (see Addendum B). For instance, the cooks in Homu 14A village added a maize meal paste to thicken the porridge whereas the cooks at Mahlathi village added dry maize meal to thicken the porridge. These villages are only 50 kilometres apart. The cooking method used may have a profound effect on the acceptability of the cooked porridge. In fact Whiney and Rolfes (1999:56) state that every region of a country has its own typical foods and ways of combining them into dishes. Cooking porridge by the same local

team for all data collection procedures was useful in making sure the porridge was prepared in a familiar manner to the area in order to enhance acceptability and consistency, as well as reduce error during data collection.

Three-legged pots were used to cook porridge at Mahlathi village as there is no electricity in that area. Villagers use firewood as fuel for cooking. The kitchen was too dark to take photographs of the cooking process. The locals clean their pots well and dry them in the sun (Figure 3.6). In Mahlathi village the original hammer-mill yellow maize meal without fibre was not included because it had gone stale during storage in the cool room at the University of Pretoria. Upon failing to get a fresh supply of hammer-mill yellow maize meal (without fibre) required, the researcher sifted the available hammer-mill yellow maize meal with fibre to get hammer-mill yellow maize without fibre.

At the commencement of the evaluation process the researcher explained the purpose of the study to the participants as an exercise to ascertain their likeness of maize meal porridges for the study. Before the participants could take part in the study they were required to fill in a consent form (see Addendum A). The researcher gave a comprehensive explanation of both the consent form as well as the evaluation form. The consent form is quite brief due to the limited literacy of the participants. For this study it was important to verbally explain the procedure and limit written documentation in order to meet the literacy level of the participants. As a result the researcher had to read the evaluation form step by step assisted by the translator in order to make sure that the evaluation form was properly and accurately marked for each sample being tasted. After all the participants were clear about their role in the exercise they were required to wash their hands before commencing with the taste test. Since there was no running water participants washed their hands under a water-jug so that the running water from the water-jug watered the plants that were growing in the church hall. The participants then filled in the consent forms as requested by the researcher. Some participants needed assistance with writing their names and age range on the form. The same procedure was followed in Mahlathi village.

FIGURE 3.6 THREE-LEGGED POTS CLEANED AND SUN DRIED READY FOR COOKING PORRIDGE AT MAHLATHI VILLAGE

The cooked porridge samples were dished out into small clear plastic take-away dishes and immediately covered with foil to prevent loss of aroma to the atmosphere before the participants tasted the porridge (see Figure 3.7). The foil covers for the taste samples were marked with 3-digit random numbers matching the cooked porridge. The 3-digit numbers were used to eliminate biases since 1 or 2-digit numbers have meanings to some people that may be negative or positive (Resurrection, 1998:66; Lawless & Heymann, 1998:97). The tasting sets were as follows:

(1) white sifted unfortified maize meal vs. white sifted fortified maize meal;

(2) hammer-mill white maize meal with fibre vs. hammer-mill yellow maize meal with fibre;

(3) hammer-mill white maize meal without fibre vs. hammer-mill yellow maize meal without fibre;

(4) white sifted unfortified maize meal vs. hammer-mill white maize meal without fibre vs. white super fortified maize meal.

Participants were provided with damp disposable kitchen towels with which to wipe their hands between the tasting of samples since they had to press the porridge between their fingers in order to evaluate the texture of the cooked porridge. Traditionally porridge is eaten using hands as opposed to the use of cutlery in the western culture.

A modified four point hedonic scale (face scales) was used to give an estimate of the acceptability of white and yellow maize meal products by the female consumers involved in the study based on sensory attributes (see Addendum C). The researcher explained what the faces on the evaluation form meant. Responses to each attribute were filled in by all the participants at the same time step by step, while both the researcher and the interpreter walked around making sure that every participant was following the process accurately. In both villages some of the more literate participants were asked to be leaders at the tables were they were seated in order to help other participants that needed extra assistance in marking their responses on the evaluation form. This made the participants appreciate their role in the study. Refer to Figure 3.8 for the sensory evaluation process.

Sets of cooked porridge were tasted during the four sessions. The samples in each tasting set were randomly tasted so that each sample in the set of cooked porridge had an equal chance of being tasted first. This was done to make sure that no sample in the set of cooked porridge was disadvantaged by always being tasted last, that is at a point when the participants may be tired of tasting the cooked porridge. The participants were asked to indicate their responses with a cross next to the smiley-face matching their response on the evaluation form (see Addendum C). According to Stone and Sidel (1992:87) face scales are suitable for those with limited reading and/or comprehension skills. Most of the participants in this study were illiterate or semi-illiterate as was observed while filling in consent forms thus confirming the assumption the researcher had made at the beginning of this study.

FIGURE 3.7 PORRIDGE SAMPLES DISHED OUT FOR PARTICIPANTS

FIGURE 3.8 SENSORY EVALUATION PROCESS

Individual porridge samples were served directly in front of them to ensure transparency. The cooks for the study formed part of the participants in the study as a form of allaying any superstition about the cooked porridge. Coetzee (1997:4) states that traditional sensory evaluation methods should be modified to suit the level of education and cultural fears of the respondents. The participants ate slices of carrots and rinsed their mouths with cold water at room temperature between the tasting of each individual cooked porridge sample in the set to neutralize their taste buds. Each set of porridge samples were served at the same time to avoid differences in temperature which can affect the taste and texture if the porridge is left standing for different periods of time. In Homu 14A village the research team members dished out and distributed the porridge to the participants whereas in Mahlathi village the researcher dished out the samples while the younger participants in the study distributed the samples to fellow participants making sure the porridge number matched the randomized evaluation form for the participants.

To safeguard mixing up of samples in the set enough porridge samples for the randomized test were dished out from one pot and immediately covered with numbered foil covers matching the porridge and then the same procedure was followed for next porridge in the set before distributing the porridges in the set. The lids of the pots were replaced immediately to prevent the porridge cooling before the completion of sensory evaluation of the taste set. The tasted samples were cleared away before a new set of randomized samples were given to the participants.

The 'simple observation' technique was used since most of the participants were illiterate or semi-illiterate (Babbie & Mouton, 2001:293; Hamilton *et al*. 2000:115). This was achieved by taking video and photographs of the sensory evaluation exercise. The researcher recorded expressive movements of the participants, such as: facial expressions or eye movements indicating acceptance or rejection of the product being sample tasted. Some of the facial expressions were captured on video camera.

It must be noted that the evaluation area used for the sensory evaluation was the church hall which was clean, professional looking and isolated from the cooking area of the food to be evaluated to

prevent diffusion of the smells of cooked products to the participants (Lawless & Heymann, 1998:86). The smell of burnt or well cooked starch from the maize meal could negatively or positively influence the participants. Thus a true reflection of the participants' responses could have been compromised at the expense of the study if the cooking area was too close to the evaluation area.

3.6.2 Data collection and combating error for phase two

Based on Figure 3.1 phase two: the qualitative interviews for this study were flexible, iterative and continuous (Babbie & Mouton, 2001:289). More than enough participants (21 in Homu 14A and 27 in Mahlathi villages respectively) were chosen in case some of the participants choose to be silent during focus-group interviews on sensory evaluation (Resurrection, 1998:94; Babbie and Mouton 2001:292 suggest 12). The participants sat in a group clustered quite close to each other in front of the researcher and interpreter to discuss perceptions in connection with maize meal porridge based on the environmental/contextual factors, perceptions of sensory attributes as well as psychological factors. The researcher and interpreter conducted group interviews while standing so that there were able to see the participants' facial expressions to questions and were able to control the order of the interviews. All the participants were encouraged to speak their views without any fear of intimidation. The researcher exhausted all means to encourage participation of all participants to ensure that all opinions about an issue were brought up during the interviews as suggested by Resurrection (1998:110).

Participants discussed, contrasted opinions and even related information about their experiences with the two maize types. Participants that held negative views against hammer-mill yellow maize meal were encouraged to elaborate why they did not like it. In Homu 14A village four out of the twenty-one participants expressed a strong dislike for the hammer-mill yellow maize meal whereas in Mahlathi village the participants stated that they like yellow maize meal and that they wished that it could be available all the time. The researcher endeavoured to probe attitudes as well as uncover underlying feelings (Lawless & Heymann, 1998:553; Resurrection, 1998:110) towards the maize porridge by encouraging the participants to give an honest opinion about the yellow maize

porridge in particular. One participant's remark 'may bring an issue to mind in another person who might not have thought about in a one to one interview' (Babbie & Mouton, 2001:292). The focus-group interviews were both video and tape recorded as well as transcribed by the researcher for verification at the end the phase two proceedings at each village. The multi- method approach to data collection was employed as depicted by Babbie and Mouton (2001:280). The researcher directed the interviews to a meaningful direction with a purpose to collect plausible data for the study by asking questions related to all the aspects outlined in Figure 3.1.

In Homu 14A village the local pastor of The Assemblies of God church translated the proceedings. The use of an interpreter can distort the answers from participants if the interpreter wants to give the answers he thinks the researcher wants to hear (Green, Botha, & Schönfeldt, 2004:55)**.** However in Mahlathi village a female student who is currently following a Masters' programme in the Department of Consumer Science at the University of Pretoria translated the proceedings. She knew the local language very well and understood the terminology of the study, as well as the requirements of a research study of this kind.

For phase two the researcher transcribed the focus-group interviews. The tape recorded focus-group interviews were put into text-form to be cleaned, coded and analysed later to complete the findings of the study. Actual facial expressions of participants were captured on video. Resurrection (1998: 29) states that if actual behaviours of participants are observed and recorded such errors of recall and distortion are eliminated. Using different data collecting techniques (triangulation) minimizes error in data collection. Triangulation allows the researcher to come as close as possible to the 'truth'.

Participants were given a token of thanks as suggested by Resurrection (1998:69), as well as by Sobal, Bisogni and Connors (1999:87) for participating in the study. The token (incentive) was in the form of a 5 kg commercially packed maize meal each (see Figure 3.9). The local pastor was paid a small fee in monetary terms for expenses incurred in driving from place to place recruiting participants, organizing the yellow maize from local small scale farmers, overhead expenses for using the pastor's kitchen, as well as for sending the maize to one of the local millers. In Mahlathi

village, the niece to the pastors was also compensated for overhead expenses incurred using the kitchen facilities to prepare the porridge for the study.

FIGURE 3.9 PARTICIPANTS LEAVING WITH THEIR INCENTIVES OF 5 KG MAIZE MEAL

3.7 Measuring instruments of food acceptance and perceptions

Measuring instruments of food acceptance for phase one were sensory evaluation tests. These were used to measure perceptions of sensory attributes of cooked porridge.

The measuring instruments of perceptions on food for phase two were focus-group interviews. These are useful in identifying and exploring factors that are strongly influential on consumer acceptance and perception of food products (Resurrection, 1998:11, Lawless & Heymann,

1998:527). Participants were encouraged and guided by the researcher to state, describe and determine what factors influenced them to choose commercial roller-mill white maize meal over the hammer-mill yellow maize meal. The researcher used open ended questions based on the various aspects outlined in Figure 3.1 in which the participants were allowed to elaborate their responses to the why and how questions regarding the selection and frequency consumption of commercial roller-mill white maize meal and hammer-mill yellow maize meal.

3.8 Data analysis for phase one

The data obtained from the sensory evaluation forms was entered into a spreadsheet, cleaned and coded for analysis using SPSS version 12 for the one-way between groups ANOVA with post-hoc tests (Pallant, 2005: 214-215). The same author suggests that one-way between-groups analysis of variance is used when one has one independent (grouping) with three or more groups and one continuous variable as was the case was for this study. For this study the 'between groups' refers to the participants in each session of the sensory evaluation process whereas the 'one-way' indicates the only one independent grouping.

3.8.1 Quality of the study for phase one

The quality of this study depended on validity, reliability and objectivity which were major considerations for the first phase of the study. Any research study may only be valuable to the scientific community on the basis of the validity and reliability of the data collection techniques employed. Validity refers to the extent to which data collected by a researcher adequately reflects the true meaning of the concepts being investigated (Mouton, 1996:109; Bless & Higson-Smith, 2000:157; Babbie & Mouton, 2001:122). Validity is the degree to which a study actually measures what it purports to measure. In the case of this study the acceptability of porridge cooked using commercial roller-mill white maize meal and hammer-mill yellow maize meal was adequately estimated**.** On the other hand reliability implies the extent to which a given measuring technique will yield the same results if repeated on the same object or other objects of similar nature elsewhere or some time later (Mouton, 1996:126; Babbie & Mouton, 2001:119,122). Visits to the two villages earmarked for the study for multiple collections of data were an attempt to enhance the

reliability of the instrument of this study. The researcher has detailed the research methodology for this study so that a similar study in the same or any other village in the same or similar context can be carried out to produce equivalent results for the study to be considered reliable.

Theoretical validity

According to Bailey (1994:67) validity is in two parts. Firstly the measuring instrument should measure the concept in question; secondly the concept should be measured accurately. Therefore the concepts to be measured should be clearly defined. The researcher in this study defined concepts that were to be measured after thoroughly reviewing literature relevant to the study (see the theoretical and conceptual framework modified from such researchers like Cardello (1989: 254). Defining the concepts to be measured helped the researcher to be clear about what is being investigated and why the study was being carried out.

Measurement of validity

While collecting data the researcher was friendly, established good rapport with participants as well as refrained from expressing surprise or disgust at participants' responses. The researcher created an atmosphere of trust in order to win co-operation of the participants throughout the study. Obtaining informed consent from participants taking part in this study indirectly enhanced the validity of the study and also conformed to the *Ethical code of Professional Conduct* of South Africa 18/5/B 26/03/2000 (Babbie & Mouton, 2001:529).

- ❖ Reliability was enhanced by conducting several sensory evaluation tests using different sets of cooked porridge as indicated in Addendum C for the four (4) sessions of the study in Homu 14A and Mahlathi villages.
- ❖ Reliability was also enhanced by transcribing, video and tape-recording all the activities of data collection.
- ❖ Data was cleaned and analysed later as suggested by Babbie & Mouton (2001:417).

Findings may also be affected by the mood of either the participants or the researcher. The latter tried as much as possible not be affected by any negative responses from participants. She

endeavoured to be calm and took charge of the situation in a professional manner. For example, the participants in both villages wanted the porridge to be tasted together with 'meat relish: isitshebo'. The researcher explained comprehensively the importance of tasting the porridge according to the requirements of the study to the satisfaction of the participants such that the latter had no problem taking part in the study. The situation was handled in a calm attitude by the researcher as an attempt to enhance the reliability of the findings as well.

3.9 Data analysis for phase two

Data from tape-recorded focus-group interviews was typed into text form for narrative data analysis.

3.9.1 Quality of the study for phase two

Credibility, transferability, dependability and confirmability were major components that were combined in order to enhance the trustworthiness of phase two of this study. This study cannot be transferable unless it is credible and cannot be credible unless it is dependable (Babbie & Mouton, 2001:277).

Credibility for this study was achieved through the following techniques:

- The researcher stayed in the field until no more data could be obtained from the focus-group interviews (until data saturation occurred).
- Multi-data collection techniques (triangulation) that is, data was collected via focus-group interviews, via capturing some of the participants' responses on video camera as well as transcribing the participants' facial expressions/gestures of like and dislike and verbal expressions regarding the porridge that was being tasted.
- Video and audio tapes were used to get accurate records of all the research activities.
- Members of the research team met at the end of each interview session for briefings and analysis of the proceedings and data collected in order to evaluate data collection techniques and necessary adjustments were made.

Transferability refers to the extent to which the findings of a study can be applied in other contexts or with other participants (Babbie & Mouton, 2001:277). The following techniques were used to enhance transferability:

- The researcher collected sufficiently detailed data as accurately as possible in order to allow for informed judgements about the transferability to be made by other researchers.
- Participants for the study were purposively sampled, that is, they were recruited and transported to a church-hall by the local pastor of The Assemblies of God for the convenience of the study to be carried out systematically.

Dependability refers to the fact that similar evidence from a study will be obtained if it were repeated with the same or similar participants elsewhere in the same or similar context. Interview notes, audio and video recording were useful in this study to enhance dependability (Babbie & Mouton, 2001:278).

Confirmability is the degree to which the findings are the product of the study and not the biases of the researcher (Babbie & Mouton, 2001:278). In this study the researcher has left 'an audit trail to determine if the conclusions, interpretations and recommendations' were based on and supported by a number of classes of data listed below as suggested by Babbie & Mouton (2001:278):

- Raw data in the form of recorded video and audiotapes, and written field notes.
- Data reduction and analysis of field notes, audio and videotape data for reference by interested researchers.
- Data reconstruction and synthesis products such as the aims and objectives developed for the study.
- Research methodology notes and trustworthiness notes.
- Research proposal spelling out intentions to carryout such a study.
- Instrumentation information such as pilot study forms and data collected during the pilot study as well as observations made during the rest of the study.

3.10 Limitations of the study

Limitations of this study were noted as follows:

- The participants were not studied in their natural environment. For the convenience of the study they were transported to one location where it was easier to conduct sensory tests and focus-group interviews. Sometimes difficulties faced during the trip to the venue may affect the participants' response during the study.
- The use of an interpreter can distort the answers from participants if the interpreter wants to give answers she thinks the research team wants to hear (Green *et al.* 2004:55).
- The nutrient content of the maize meal is outside the scope of this study as it will be determined by another member of the research team.
- All influencing factors (psychological and environmental/context) were not measured directly, but were only discussed in phase two of the study.

3.11 Research ethics

The script proposal for this study was presented to the research panel and fellow research students for scrutiny under the supervision of the study leader. Such a procedure ensured objectivity and quality control in the study. Quality control can be achieved through peer review of proposals, blind referring of articles in accredited scientific journals and regular reviews of research outputs (Babbie & Mouton, 2001:10). Presenting the proposal for approval to the **Ethics committee** of the University of Pretoria was an attempt to make sure the rights and interest of the participants were protected and respected (Babbie & Mouton, 2001:528). As a postgraduate student in the Department of Consumer Science the researcher is qualified to do the above study. Carrying out the above study enabled the researcher to exercise and practice investigative research.

No harm was caused to the participants since the maize meal porridge was cooked under hygienic conditions. The volunteer-cooks in both villages earmarked for the study were also participants in this study in order to win the confidence of the rest of the participants that the porridge was safe.

The findings of the study will be made available at the library of the University of Pretoria so that other researchers may scrutinize them. The researcher has an "obligation to the free and open dissemination of research results to the scientific community" (Babbie & Mouton 2001:527). An

article will also be published in a peer-reviewed journal. The scientific community will therefore have the opportunity to reproduce a similar study and ascertain the reliability of the findings of this study.

The politics of research is of concern to every researcher. Babbie & Mouton (2001:528) suggest that a researcher should be honest about his/her qualifications, capabilities and aims of the study to the sponsors. Research findings were not biased towards the "Small Scale Millers" in SA National Research Foundation who sponsored the project. The findings of this study were reported as accurately as possible without showing bias in favour of sponsors and in so doing the ethics of the scientific community were left in tact.

CHAPTER 4

DISCUSSION OF RESULTS

4.1 Introduction

The results are presented and discussed in this chapter. As mentioned earlier the research process was conducted in two phases. Phase one employed a quantitative approach in which numerical data was collected using sensory evaluation tests. The sensory evaluation process was divided into four sessions during which the participants tasted different sets of porridge cooked with commercial roller-mill white maize meal and hammer-mill white and yellow maize meal (with and without fibre) as defined in the research process. For phase two a qualitative approach in the form of focus-group interviews was utilized. The objective was to get supportive information to explain and interpret the data obtained in phase one of the study.

4.2 Presentation of the results

The results obtained in both phase one and two will be presented first and then discussed. Since the cooking methods in the two villages varied (electric stove vs. fire, modern pots vs. three-legged pots) it did not make sense to compare the results of the two villages directly.

4.2.1 Sensory evaluation tests

Attributes tested in each of the taste tests were aroma, appearance (colour and consistency), texture (hand-feel and mouth-feel) and taste. The scores used for the taste test were as follows: 1= “Dislike very much”; 2= “Dislike moderately”; 3= “Like moderately” and 4= “Like very much”. Any score <2.5 signifies some level of dislike for an attribute and a score of >2.5 signifies some level of liking for an attribute.

White sifted unfortified versus White sifted fortified maize meal

The data for unfortified versus white sifted fortified maize meal produced commercially with a roller-mill is presented in Table 4.1.

TABLE 4.1 ACCEPTABILITY OF WHITE SIFTED UNFORTIFIED MAIZE MEAL VS WHITE SIFTED FORTIFIED MAIZE MEAL

Session 1: one way ANOVA (n=48)					
Attribute	**F**	**df**	**Significant Difference**	**Mean Values [1]**	
				White Sifted Unfortified Sample code 239	**White Sifted Fortified Sample code 348**
Aroma	7.420	1	0.008***	2.77	3.35
Appearance : Colour	11.336	1	0.001***	2.94	3.63
Appearance: Consistency	7.562	1	0.007***	2.90	3.46
Texture: feel (hand)	4.863	1	0.030**	2.90	3.35
Texture: grittiness (mouth)	6.456	1	0.013**	2.81	3.38
Taste	6.001	1	0.016**	2.81	3.33
Total score	14.548	1	0.000***	16.96	20.67

[1] 1= Dislike very much to 4= Like very much
*** Significant difference at the 1% probability level
** Significant difference at the 5% probability level
* Significant difference at the 10% probability level
◊ No significant difference
n Number of participants

Aroma

On the hedonic scales (face scales) the commercial roller-mill white sifted unfortified maize meal porridge in terms of aroma had a mean score of 2.77 whereas the white fortified maize meal porridge had a mean score of 3.35. According to the ANOVA this was a significant difference of $p \leq 0.01$.

Appearance: colour

On the hedonic scales the commercial roller-mill white sifted unfortified maize meal porridge had a mean score of 2.94 whereas the white fortified maize meal porridge had a mean score of 3.63. According to the ANOVA this was a significant difference of $p \leq 0.01$.

Appearance: consistency

In terms of consistency the commercial roller-mill white sifted unfortified maize meal porridge had a mean score of 2.90 whereas the white fortified maize meal porridge had a mean score of 3.46. According to the ANOVA this was a significant difference of $p \leq 0.01$.

Texture: feel (hand)

On the hedonic scales the commercial roller-mill white sifted unfortified maize meal porridge had a mean score of 2.90 whereas the white fortified maize meal porridge had a mean score of 3.35. According to the ANOVA this was a significant difference of $p \leq 0.05$.

Texture: grittiness (mouth)

On the hedonic scales the commercial roller-mill white sifted unfortified maize meal porridge had a total mean score of 2.81 whereas the white fortified maize meal porridge had a mean score of 3.38. According to the ANOVA this was a significant difference of $p \leq 0.05$.

Taste/flavour

On the hedonic scales the commercial roller-mill white sifted unfortified maize meal porridge had a mean score of 2.81 whereas the white fortified maize meal porridge had a mean score of 3.33 on the hedonic scales. According to the ANOVA this was a significant difference of $p \leq 0.05$.

Total score

On the hedonic scales the commercial roller-mill white sifted unfortified maize meal porridge had a total mean score of 16.96 whereas the white sifted unfortified maize meal porridge had a total mean score of 20.67. According to the ANOVA this was a significant difference of $p \leq 0.01$.

Hammer-mill white with fibre versus Hammer-mill yellow maize meal with fibre

The data for hammer-mill white vs. hammer-mill yellow maize meal with fibre is presented in Table 4.2.

Aroma

On the hedonic scales the hammer-mill white maize meal (with fibre) porridge in terms of aroma had a mean score of 2.43 whereas the hammer-mill yellow maize meal (with fibre) porridge had a mean score of 2.21. According to the ANOVA there was no significant difference between the two samples.

TABLE 4.2 ACCEPTABILITY OF HAMMER-MILL WHITE MAIZE MEAL WITH FIBRE VS HAMMER-MILL YELLOW MAIZE MEAL WITH FIBRE

Session 2: one way ANOVA (n=48)					
Attribute	**F**	**df**	**Significant Difference**	**Mean Values [1]**	
				Hammer White with Fibre Sample code 216	**Hammer yellow with Fibre Sample code 924**
Aroma	0.744	1	0.391 ◊	2.43	2.21
Appearance: colour	0.719	1	0.399 ◊	2.06	2.29
Appearance: Consistency	0.007	1	0.935 ◊	2.15	2.17
Texture: feel (hand)	0.620	1	0.433 ◊	2.00	2.21
Texture: grittiness (mouth)	0.579	1	0.448 ◊	1.79	1.98
Taste	0.410	1	0.524 ◊	1.85	2.02
Total Score	0.331	1	0.566 ◊	12.08	12.83

[1] 1= Dislike very much to 4= Like very much
*** Significant difference at the 1% probability level
** Significant difference at the 5% probability level
* Significant difference at the 10% probability level
◊ No Significant difference
n Number of participants

Appearance: colour

On the hedonic scales the hammer-mill white maize meal (with fibre) porridge had a mean score of 2.06 whereas the hammer-mill yellow maize meal (with fibre) porridge had a mean score of 2.29. According to the ANOVA there was no significant difference between the two samples.

Appearance: consistency

On the hedonic scales the hammer-mill white maize meal (with fibre) porridge had a mean score of 2.15 whereas the hammer-mill yellow maize meal (with fibre) porridge had a mean score of 2.17. According to the ANOVA there was no significant difference between the two samples.

Texture: feel (hand)

On the hedonic scales the hammer-mill white maize meal (with fibre) porridge had a mean score of 2.00 whereas the hammer-mill yellow maize meal (with fibre) porridge had a mean score of 2.21. According to the ANOVA there was no significant difference between the two samples.

Texture: grittiness (mouth)

On the hedonic scales the hammer-mill white maize meal (with fibre) porridge had a mean score of 1.79 whereas the hammer-mill yellow maize meal (with fibre) porridge had a mean score of 1.98. According to the ANOVA there was no significant difference between the two samples.

Taste/flavour

On the hedonic scales the hammer-mill white maize meal (with fibre) porridge had a mean score of 1.85 whereas the hammer-mill yellow maize meal (with fibre) porridge had a mean score of 2.02. According to the ANOVA there was no significant difference between the two samples.

Total score

On the hedonic scales the hammer-mill white (with fibre) had a total mean score of 12.08 whereas the hammer-mill yellow maize (with fibre) had a total mean score of 12.83. According to the ANOVA there was no significant difference between the two samples.

Hammer-mill white without fibre versus Hammer- mill yellow maize meal without fibre

The data for the hammer-mill white without fibre vs. hammer-mill yellow maize meal without fibre is presented in Table 4.3.

Aroma

On the hedonic scales the hammer-mill white (without fibre) porridge had a mean score of 3.13 whereas the hammer-mill yellow maize meal (without fibre) porridge had a mean score of 3.00. According to the ANOVA there was no significant difference between the two samples.

Appearance: colour

On the hedonic scales the hammer-mill white (without fibre) porridge had a mean score of 3.33 whereas the hammer-mill yellow maize meal (without fibre) porridge had a mean score of 3.25. According to the ANOVA there was no significant difference between the two samples.

TABLE 4.3 ACCEPTABILITY OF HAMMER-MILL WHITE MAIZE MEAL WITHOUT FIBRE VS HAMMER-MILL YELLOW MAIZE MEAL WITHOUT FIBRE

Session 3: one way ANOVA (n=48)					
Attribute	**F**	**df**	**Significant Difference**	**Mean Values [1]**	
				Hammer White No-Fibre Sample code 284	**Hammer yellow No-Fibre Sample code 693**
Aroma	0.312	1	0.578 ◊	3.13	3.00
Appearance: colour	0.143	1	0.706 ◊	3.33	3.25
Appearance: Consistency	5.884	1	0.017**	3.31	2.75
Texture: feel (hand)	3.726	1	0.057*	3.29	2.85
Texture: grittiness (mouth)	0.445	1	0.506 ◊	3.00	2.83
Taste	0.107	1	0.744 ◊	3.06	2.98
Total Score	1.396	1	0.240 ◊	19.08	17.67

[1] 1= Dislike very much to 4= Like very much
*** Significant difference at the 1% probability level
** Significant difference at the 5% probability level
* Significant difference at the 10% probability level
◊ No significant difference
n Number of participants

Appearance: consistency

On the hedonic scales the hammer-mill white (without fibre) porridge had a mean score of 3.31 whereas the hammer-mill yellow maize meal (without fibre) porridge had a mean score of 2.75. According to the ANOVA this was a significant difference of $p \leq 0.05$.

Texture: feel (hand)

On the hedonic scales the hammer-mill white (without fibre) porridge had a mean score of 3.29 whereas the hammer-mill yellow maize meal (without fibre) porridge had a mean score of 2.85. According to the ANOVA this was a significant difference of $p \leq 0.10$.

Texture: grittiness (mouth)

On the hedonic scales the hammer-mill white maize meal (without fibre) porridge had a mean score of 3.00 whereas the hammer-mill yellow maize meal (without fibre) porridge had a mean score of 2.83. According to the ANOVA there was no significant difference between the two samples.

Taste/flavour

On the hedonic scales the hammer-mill white maize meal (without fibre) porridge had a mean score of 3.06 whereas the hammer-mill yellow maize meal (without fibre) porridge had a mean score of 2.98. According to the ANOVA there was no significant difference between the two samples.

Total score

On the hedonic scales the hammer-mill white had a total mean score of 19.08 whereas the hammer-mill yellow (without fibre) had a total mean score of 17.67. According to the ANOVA there was no significant difference between the two samples.

White sifted unfortified versus White super fortified versus Hammer-mill white maize meal without fibre

The data for the commercial roller-mill white sifted unfortified vs. white super fortified vs. hammer-mill white (without fibre) is presented in Table 4.4 (post-hoc tests of one way ANOVA).

TABLE 4.4 ACCEPTABILITY OF WHITE SIFTED UNFORTIFIED VS WHITE SUPER FORTIFIED VS HAMMER-MILL WHITE MAIZE MEAL WITHOUT FIBRE

Session 4: one way ANOVA (n=48)						
Attribute	**F**	**df**	**Significant Difference?**	**Mean values[1]**		
				White Sifted unfortified Sample code 657 (239)	**White super fortified Sample code 471**	**Hammer White No-fibre Sample code 563 (284)**
Aroma	9.345	2	0.000***	3.00 a	3.56 b	2.67 a
Appearance: colour	9.267	2	0.000***	3.02 a	3.75 b	3.04 a
Appearance: consistency	4.639	2	0.011**	2.88 a	3.50 b	3.06 a
Texture: feel (hand)	5.041	2	0.008***	2.83 a	3.46 b	3.19 b
Texture: grittiness (mouth)	4.999	2	0.008***	2.75 a	3.40 c	3.17 b
Taste	7.261	2	0.001***	2.71 a	3.50 b	2.98 a
Total Score	8.693	2	0.000***	17.19 a	21.17 b	18.11 a
Total Score for individual taste-tests		1		16.96 a	*20.67 b*	19.08 a

[1] 1= Dislike very much to 4= Like very much
[2] LSD Post-hoc tests
*** Significant difference at the 1% probability level
** Significant difference at the 5% probability level
* Significant difference at the 10% probability level

Aroma

On the hedonic scales (face scales) the commercial white sifted unfortified maize meal porridge in terms of aroma had a mean score of 3.00; white super fortified had a mean score of 3.56 whereas the hammer-mill white (without fibre) maize meal porridge had a mean score of 2.67. According to the ANOVA this was a significant difference of $p \leq 0.01$ among the three samples of porridge. There was no significant difference between white sifted unfortified and hammer-mill white (without fibre). According to the ANOVA a significant difference was found in aroma between white sifted unfortified and hammer-mill white (without fibre) maize meal porridge when compared to white super fortified ($p \leq 0.01$) maize meal porridge.

Appearance: colour

On the hedonic scales the commercial white sifted unfortified maize meal porridge in terms of appearance: colour had a mean score of 3.02; white super fortified had a mean score of 3.75 whereas the hammer-mill white (without fibre) maize meal porridge had a mean score of 3.04. According to the ANOVA there was a significant difference of $p \leq 0.01$ among the three samples of the porridge. According to the ANOVA there was no significant difference between the commercial roller-mill white sifted unfortified and hammer-mill white (without fibre). According to the ANOVA a significant difference was found in appearance (colour) between commercial white sifted unfortified and hammer white (without fibre) maize meal porridge versus white super fortified ($p \leq 0.01$) maize meal porridge.

Appearance: consistency

On the hedonic scales the commercial white sifted unfortified maize meal porridge in terms of appearance: consistency had a mean score of 2.88; white super fortified had a mean score of 3.50 whereas the hammer-mill white (without fibre) maize meal porridge had a mean score of 3.06. According to the ANOVA this was a significant difference of $p \leq 0.05$ among the three samples of porridge. According to the ANOVA there was no significant difference between white sifted unfortified and hammer-mill white (without fibre). According to the ANOVA a significant difference was found between white sifted unfortified and hammer-mill white (without fibre: $p \leq 0.05$) versus white super fortified ($p \leq 0.01$) maize meal porridge.

Texture: feel (hand)

On the hedonic scales the commercial white sifted unfortified maize meal porridge in terms of texture (feel-hand) had a mean score of 2.83; white super fortified had a mean of 3.56 whereas the hammer-mill white (without fibre) maize meal porridge had a mean score of 3.19. According to the ANOVA this was a significant difference of $p \leq 0.01$ among three samples of porridge. According to ANOVA in terms of texture: feel (hand), a significant difference was found between commercial white sifted unfortified and white super fortified ($p \leq 0.01$) versus hammer white (without fibre: $p \leq 0.10$) maize meal porridge. According to ANOVA there was no significant difference between hammer white (without fibre) and white super fortified maize meal porridge.

Texture: grittiness (mouth)

On the hedonic scales the commercial white sifted unfortified maize meal porridge in terms of texture: grittiness had a mean score of 2.75; white super fortified had a mean score of 3.40 whereas the hammer-mill white (without fibre) maize meal porridge had a mean score of 3.17. According to the ANOVA this was a significant difference of $p \leq 0.01$ among the three samples of porridge. According to the ANOVA a significant difference was found in terms of texture: grittiness (mouth), for white sifted unfortified and white super fortified ($p \leq 0.01$) versus hammer white fibre ($p \leq 0.05$) maize meal porridge.

Taste/flavour

On the hedonic scales the commercial white sifted unfortified maize meal porridge in terms of taste had a mean score of 2.71; white super fortified had a mean score of 3.50 whereas the hammer-mill white (without fibre) maize meal porridge had a mean score of 2.98. According to the ANOVA there was a significant difference of $p \leq 0.01$ among the three samples of porridge. According to the ANOVA was no significant difference between commercial white sifted unfortified vs. hammer white. According to the ANOVA a significant difference was found in taste/flavour between commercial white sifted unfortified and hammer white (without fibre: $p \leq 0.05$) versus white super fortified ($p \leq 0.01$) maize meal porridge.

Total score

According to the ANOVA there was no significant difference between white sifted unfortified and hammer white (without fibre) maize meal porridge. According to the ANOVA a significant difference was found in terms of the total mean score for white sifted unfortified and hammer white (without fibre) versus white super fortified ($p \leq 0.01$) maize meal porridge. The total mean scores showed that the female consumers in Giyani were able to significantly identify the differences in the traditionally prepared porridge cooked with different maize meal types as indicated in Table 4.4.

4.2.2 Focus-group interview results

The focus-group interview results are tabulated in Table 4.5 outlining the responses to the open-ended questions posed in Homu 14A and Mahlathi villages involved in the study.

TABLE 4.5 RESULTS OF THE FOCUS-GROUP INTERVIEWS

Open-ended questions:	***Homu 14A (n=21)***01/12/20(	***Mahlathi (n=27)*** 09/02/2006
Suppose this yellow maize is packed like Iwisa would you buy it?	Yes.	Yes.
You tasted the yellow maize here-how did you like it?	4 did not like the taste, colou 17 liked it	Yellow maize is bitter=4. Rest=yellow maize is nice
What did you like about the yellow maize?	It contains Vit. A.	Yellow maize is rich with things that make our bodies healthy.
What else did you like about the yellow maize?	Like the aroma	
Let's look at the texture: we tasted the texture twice. You know when we eat our food we use our hands. How did the yellow maize feel to you as you pressed it between your fingers?	It's okay	Fine yellow maize meal is okay. We don't like the rough maize meal.
What about when you were chewing it?	Felt good about it	It is fine
If you are given a choice between Iwisa/Ace and yellow maize meal: which one would you choose?	Yellow	We like the fine yellow maize Meal. We would buy it.
We want to know exactly what the people in the Limpopo Province say about the yellow maize meal. We want to know your honest truth.	People say that they don't like the smell and colour. We get it during drought.	We like the yellow maize-we usually get it during drought. We wish we could get a continuous supply.

Open-ended questions:	***Homu 14A (n=21)***01/12/2005	***Mahlathi (n=27)*** 09/02/2006
If this yellow maize is sold in shops would you buy it?	Yes	Yes
Suppose the price of yellow maize meal is up and for white maize meal the price is low-which one would you buy?	Only a few would buy white maize meal. 4 out 21 (17 for yellow)	White maize meal.
So price can affect your choice?	Yes	Yes the price can affect our choice
Tell me, today we just looked at pap, but what I want to see is: if there are any other occasions you can use this yellow maize because I have established that you are fine with fine yellow maize meal	Not sure other than using it for pap.	Any occasions as long as the price is right-these include weddings and cultural feasts. The choice is determined by the owner of the feast who has a greater say in what can be cooked.
Is there anything else you can tell me –in what conditions do you normally get the yellow maize meal?	During drought. It is supplied to the area.	During drought that's when we usually get it.
So there has been drought before in this area-so you have been exposed to it before?	Yes. During good rains yellow maize can't be found anywhere in this area	In times of drought and after the drought we wish we could continue getting the yellow maize meal.
In other words the failure is in the area of manufacturers' thinking that if they produce it people would not buy it/eat it-may be that's why they are not producing it.	N.B. question not asked at Homu 14 A	People would buy it as long as the price is right.
Do any of you grow the yellow maize in your gardens?	Yes (only 6)	Some of us have grown it and we like it on the cob.
What do you use for cooking it (equipment/fuel)	Firewood and three-legged Pots	Firewood and three-legged pots

4.3 Discussion of the results

The results of the sensory evaluation tests carried out for the project will be discussed first and then the focus-group interviews second. It must be noted that salt was not added to the porridge samples as it is not traditionally used for cooking maize meal porridge.

4.3.1 White sifted unfortified versus white sifted fortified maize meal

The results for the commercial white sifted unfortified versus commercial white sifted fortified maize meal porridge are discussed below. Refer to Table 4.1.

Aroma

In terms of aroma porridge cooked with commercial white sifted fortified maize meal was more acceptable than that prepared with white sifted unfortified maize meal. After sniffing the porridge the Shangaan female consumers gave the white sifted unfortified and white sifted fortified maize meal porridge mean scores of 2.77 and 3.35 ($n=48$; $p \leq 0.01$) respectively on the hedonic scales used. The aroma from the cooked porridge of fortified maize meal was rated as more pleasant than that of the white sifted unfortified maize meal due to fortification. The researcher was unable to establish the fortificant used due to the fact that the Progress millers in Polokwane, Limpopo Province, SA refused to state what was used for fortification of the maize meal nor would they divulge the suppliers of the fortification mix.

Appearance: colour

Colour provides the first line of evaluation which in the end impacts on food product acceptability (Imran, 1999:227; Bagozzi *et al.* 2002:134). The mean scores for the commercial white sifted unfortified and white sifted fortified porridge on the hedonic scales were 2.94 and 3.63 ($n=48$; $p \leq 0.01$) respectively thus indicating that the latter porridge was liked more than the former one. According to Messer (1984:220) visual attributes such as colour or overall appearance often affect food acceptability. Colour is often considered as of utmost importance to the perceived quality and acceptability of foods. The researcher concurs with Messer (2002:10) that colour together with taste and texture of whiter maize meal is more desirable. Fortification of the sifted maize meal improved the acceptability level over the unfortified variety. Figure 4.1 depicts the colour of the porridge made from white sifted unfortified maize meal. The maize meal is classified as medium hence the presence of roughage which gives the porridge the yellow speckles.

Appearance: consistency

In terms of consistency commercial white sifted unfortified and white sifted fortified maize meal porridge had mean scores of 2.90 and 3.46 ($n=48$; $p \leq 0.01$) respectively. Appeal to the eye in terms of consistency favoured porridge cooked with commercial white sifted fortified maize over the porridge cooked with commercial white sifted unfortified maize meal. Humans use the sense of sight as well as other senses to judge the acceptability of food products (MacDougall, 1988:104;

Lawless & Heymann, 1988:804). Refer to Figure 4.1 for the expected consistency of the maize porridge as seen through the sense of sight.

Texture: feel (hand)

Culturally maize meal porridge is consumed with hands. How the porridge feels in the hand of the eater is important. It contributes to the acceptability or rejection of the cooked porridge. For this project a smooth soft porridge (not crumbly like putu porridge) was the acceptable texture. The participants pressed the porridge between the fingers to judge whether or not it was lumpy, or too thick to the hand feel which would amount to unacceptability.

FIGURE 4.1 PORRIDGE COOKED WITH WHITE SIFTED UNFORTIFIED MAIZE MEAL

The commercial white sifted unfortified and white sifted fortified maize meal porridge had mean scores of 2.90 and 3.35 ($n=48$, $p \leq 0.05$) showing a higher level of acceptable texture (hand feel) for the porridge cooked with commercial white sifted fortified maize meal. The two maize meal types used to prepare the porridge is classified as medium sifted (same classification in terms of the physical appearance of maize meal).

Texture: grittiness (mouth)

The participants after chewing the maize meal porridge of both commercial white sifted unfortified and white sifted fortified gave mean scores of 2.81 and 3.38 (n=48, $p \leq 0.05$) respectively. The texture experienced by the participants while chewing determined whether or not they liked the porridge. Acceptable porridge should neither disintegrate nor be watery or lumpy. The porridge prepared from commercial white sifted fortified maize meal held better between the teeth than that of the white sifted unfortified maize meal. The porridge was evaluated by tactile sensation in the mouth when consumed.

Taste/flavour

The mean scores for commercial white sifted unfortified and white sifted fortified maize meal porridge in terms of taste/flavour were 2.81 and 3.33(n=48, $p \leq 0.05$) respectively. The participants rated the taste of the latter porridge as more pleasant than the former. Clark (1998:639) singles out taste and flavour as key to the acceptability of food products. A person instinctively responds to different tastes found in food products. For instance, the researcher captured on video facial expressions of participants as they tasted the porridge. Participants in Homu 14A and Mahlathi villages showed a liking for the porridge with a smile and lighted up large eyes.

Total score

Overall commercial white sifted fortified was more acceptable than commercial white sifted unfortified with total mean scores of 16.96 and 20.67 (n=48; $p \leq 0.01$). A total mean score >15.00 for this project indicates some degree of "like" for the cooked porridge as was the case for both porridge samples cooked with white sifted unfortified and fortified maize meal.

It is evident from the results that in terms overall liking, as well as for the separate attributes, the consumers preferred the Eagle sifted fortified to the Big "L" sifted unfortified. The difference in the acceptability could be attributed to a combination of the sources of the maize meal (mill, origin and quality of the grain used for manufacturing) as well as, the fortification mix added to the fortified maize meal. The consumers' preference for the fortified sifted maize meal on a double blind basis is quite surprising and unexpected, compared to previous literature. According to the results of a study conducted prior to the implementation of the fortification legislation in SA

(Department of Health, 2004:1) no impact was detected on taste due to the addition of the fortification mix. Furthermore, consumers' preference for fortified maize meal on a double blind basis is in contrast to previous findings of research indicating a dislike among consumers regarding fortified maize meal, according to maize millers' opinions (Vermeulen, 2006:10)

4.3.2 Hammer-mill white maize meal (with fibre) versus hammer-mill yellow maize meal (with fibre)

The results of the hammer-mill white maize meal (with fibre) versus hammer-mill yellow maize meal (with fibre) porridge are discussed in this section as presented in Table 4.2.

Aroma

Sniffing by participants of porridge made from hammer-mill white and hammer mill yellow with fibre yielded mean scores of 2.43 and 2.21 (n=48; no significant difference) respectively. Both mean scores for the porridge in terms of aroma are below 2.50 which are indicative of a dislike for the aroma. Participants showed no preference for either of the porridge made from hammer-mill white or hammer-mill yellow with fibre. Aroma from the cooked porridge did not elicit acceptability among participants. Locals learn with experience what is acceptable aroma for maize meal porridge. The individual's region of origin is very influential in terms of food product acceptability (Randall, 1982:16, Whitney & Rolfes, 1999:3). Cultural rules of cuisine and appropriateness exert tremendous influence on what and how acceptable the food product is (Mela, 1999:514; Bareham, 1995:66).

Appearance: colour

The mean scores on the hedonic scales for hammer-mill white and hammer-mill yellow (with fibre) were 2.06 and 2.29 (n=48; no significant difference between the cooked porridges) respectively. A mean score of less than 2.5 for an attribute indicates unacceptability. Colour is one of the most important visual properties of food products that can negatively or positively affect acceptance (MacDougall, 1988:104; Lawless & Heymann, 1988:804). The researcher observed that the colour of both cooked products looked dark and did not appeal to the participants.

Appearance: consistency

The mean scores in terms of consistency for both hammer-mill white and hammer-mill yellow with fibre were 2.15 and 2.17 (n=48; no significant difference) respectively, indicates no significant difference in acceptability between the cooked maize meal products. Consistency for this project signifies the thickness and smoothness of the cooked product and should be smooth, soft and free of lumps. The granules hold together as visualized through the eyes. Refer to Figure 4.1 for reference of consistency as observed by a participant.

Texture-feel (hand)

Porridge cooked with hammer-mill white and hammer-mill yellow maize meal was equally disliked by participants with mean scores of 2.00 and 2.21 (n=48, no significant difference) respectively. The retention of water during the cooking process was due to the high fibre content that contributed the texture of the cooked product. It was noted during the cooking of porridge samples that more water was required to cook the hammer-mill varieties than for commercial maize meal varieties. Texture can also be evaluated while beating/stirring the porridge while cooking. The cooks in both villages of study mentioned that if the porridge feels good in the hand while beating/stirring, it will feel right too in the hand while consuming it.

Texture: grittiness (mouth)

The mean scores awarded to texture: grittiness (mouth) for the porridge made from hammer-mill white and hammer-mill yellow maize meal with fibre by participants were 1.79 and 1.89 (n=48; no significant difference) respectively. Participants disliked very much the texture of both porridges alike as experienced while chewing the cooked products. For the porridge to be acceptable it was supposed to be smooth, soft, not feel lumpy or granular in the mouth while being chewed. Tactile sensation experienced during chewing has an effect on the acceptability of the cooked porridge. The porridge was slightly sticky to the hands and some of the participants felt that the porridge was slightly sticky to the upper part of the mouth. This could explain the low mean score for both maize meal varieties in terms of texture: grittiness (mouth).

Taste/flavour

The mean scores for taste/flavour for the porridge prepared with hammer-mill white and hammer-mill yellow maize meal with fibre were 1.85 and 2.02 (n=48; no significant difference) respectively. The mean scores are indicative of the fact that the taste/flavour of the porridge did not meet the expectations of the participants (Nordtest, 2002:4).

Total score

The total scores for acceptability for hammer-mill white and hammer-mill yellow maize meal were 12.68 and 12.83 (n=48; no significant difference in dislike) respectively. For this project any total mean score below 15.0 is indicative of some degree of dislike for the porridge. A total mean score of ±12 implies that the cooked porridge is disliked very much. This was the case with the porridge made from hammer-mill white and hammer-mill yellow maize meal.

4.3.3 Hammer-mill white maize meal without fibre versus hammer-mill yellow maize meal without fibre

The results (see Table 4.3) of the hammer-mill white maize meal without fibre versus hammer-mill yellow maize meal without fibre are discussed in this section.

Aroma

The mean scores for aroma for the porridge prepared with hammer-mill white and hammer-mill yellow maize meal (without fibre) were 3.13 and 3.00 (n=48; no significant difference) respectively, thus indicating acceptability to the same degree. For this project a mean score of 2.50 or more for an attribute signifies some degree of acceptability (like moderately).

Appearance: colour

The mean scores for appearance (colour) for the porridge prepared with hammer-mill white and hammer-mill yellow maize meal (without fibre) were 3.33 and 3.25 (n=48; no significant difference) respectively and were indicative of acceptability of the same degree for the two porridge samples. This finding was different to that of Messer (2002:9) who reported that white maize meal products are preferred to yellow maize meal products since the former are regarded as

cleaner, tastier and softer than the latter. In this project preference for hammer-mill white and hammer-mill yellow (without fibre) was 'equal'. Colour for both samples was accepted to the same degree.

Appearance: consistency

The mean scores for appearance (consistency) for the porridge prepared with hammer-mill white and hammer-mill yellow maize meal (without fibre) were 3.31 and 2.75 (n=48; $p \leq 0.05$) respectively. Based on these results, participants had some degree of "like" for the consistency of hammer-mill yellow maize meal porridge. Participants liked the porridge made from hammer-mill white maize meal more than the yellow variety due to the fact it looked cleaner and smoother than the yellow variety (Messer, 2002:9). The cohesion of the cooked starch granules of the porridge met the expectations of the participants in the study.

Texture: feel (hand)

The mean scores of hammer-mill white and hammer-mill yellow without fibre were 3.29 and 2.85 (n=48; $p \leq 0.10$) respectively. The participants liked the hand-feel of the porridge. The mean scores of like moderately based on the hedonic scale indicated that the porridge held well in the hand, was smooth and lump free.

Texture: grittiness (mouth)

The mean scores for texture (grittiness-mouth) for the porridge prepared with hammer-mill white and hammer-mill yellow maize meal (without fibre) were 3.00 and 2.83 (n=48; no significant difference) respectively were indicative of acceptability of the hammer-mill maize meal samples to the same degree. Chewing the porridge evoked the tactile sensation in the mouth resulting in an insignificant degree of acceptability of white porridge over the yellow variety.

Taste/flavour

A mean score in terms of taste at 3.06 and 2.98 (n=48; no insignificant difference) respectively, implied an insignificant degree/level of acceptability. Although from the perspective of the mean score it would seem that the porridge made from hammer-mill white maize meal was more

acceptable than that made from hammer-mill maize meal (without fibre), the degree of acceptability between both samples was insignificant.

Total score

The total overall mean scores for hammer-mill white and hammer-mill yellow maize meal (without fibre) were 19.08 and 17.67 respectively. According to the ANOVA this was insignificant in terms of acceptability between the cooked samples. From observation all the attributes evaluated for hammer-mill white and yellow maize meal (without fibre) were acceptable.

4.3.4 Acceptability of white sifted unfortified versus white super fortified versus hammer-mill white maize meal without fibre

The results of the acceptability of white sifted unfortified versus white super versus hammer-mill white (without fibre) maize meal are discussed in this section (see Table 4.4).

Aroma

The mean scores comparing acceptability of white sifted unfortified, white super and hammer white without fibre were 3.00, 3.56 and 2.67 ($n=48$; $p \leq 0.01$) respectively. The response from the participants after sniffing the three porridge samples showed that the participants liked the aroma of the white super fortified porridge the most. The degree of acceptability between hammer-mill white (without fibre) and white sifted unfortified for aroma was insignificant.

Appearance: colour

The mean scores for white sifted unfortified vs. white super vs. hammer-mill white (without fibre) in terms of colour were 3.02, 3.75, 3.04 ($n=48$; $p \leq 0.01$) respectively. Among the porridge samples acceptability of the porridge samples in terms of colour was at the probability level of 1%. The white super fortified porridge sample was liked the most due to the fact that it looked cleanest and most attractive to the participants. Messer (2002:10) confirms this, that is, polished white grains are more desirable than dark grain products. The acceptability level between white sifted unfortified and hammer-mill white maize meal (without fibre) was insignificant. The hulling process of the maize grain for the hammer-mill maize meal made the colour as close as possible to

that of the white sifted unfortified hence the insignificant difference in the acceptability of the colour. The difference between white super fortified and white sifted unfortified at p≤ 0.01 was due to the processing that makes white super fortified whiter and more attractive to participants. De-hulling of the grain for the hammer mill maize meal does not make it as white as the white super fortified maize meal porridge.

Appearance: consistency

The mean scores for white sifted unfortified vs. white super vs. hammer-mill white (without fibre) in terms of appearance: consistency were 2.88, 3.50 and 3.06 (n=48, p≤ 0.05)) respectively. White super fortified porridge sample was regarded by the participants as more cohesive than the other two due to its clear viscosity. However, they perceived the consistency of white sifted unfortified and hammer-mill maize meal porridge samples visually to be of the same degree.

Texture: feel (hand)

The mean scores for white sifted unfortified vs. white super vs. hammer-mill white (without fibre) in terms of texture: feel (hand) were 2.83, 3.46 and 3.19 (n=48, p≤ 0.01) respectively. There was an insignificant difference in acceptability between the white super fortified vs. hammer-mill white (without fibre) due to de-hulling of the maize grain that improves the hand feel of cooked product to compete favourably with white super fortified maize meal.

Texture: grittiness (mouth)

The mean scores for porridge cooked with white sifted unfortified vs. white super fortified vs. hammer-mill white (without fibre) in terms of texture: grittiness (mouth) were 2.75, 3.40 and 3.17 (n=48, p≤0.01) respectively. Hammer-mill white (without fibre) compared with white sifted unfortified maize meal porridge sample had a p value≤ 0.10. The hulling process improved the acceptability level of the former porridge sample in terms of texture: grittiness (mouth).

Taste/flavour

The mean scores for porridge samples cooked with white sifted unfortified vs. white super fortified vs. hammer-mill white (without fibre) in terms of taste/flavour were: 2.71, 3.50 and 2.98 (n=48; p≤ 0.01) respectively. Evaluation for the white sifted unfortified and hammer-mill yield had an

insignificant acceptability level whereas the acceptability level for white sifted unfortified vs. white super fortified and hammer-mill white (without fibre) was at $p \leq 0.01$. The p-value of the hammer-mill white vs. super fortified maize meal porridge sample confirms the opinion of Messer (2002: 10) that white polished grain products are sweeter and tastier than less white grain products.

Total score

Overall the participants in this study preferred white super fortified maize meal to white sifted unfortified and hammer-mill white maize meal (without fibre) for aroma, appearance (colour and consistency), texture (feel-hand and grittiness-mouth) as well as taste. The total mean score was 17.19, 21.17 and 18.11 ($n=48$; $p \leq 0.01$) respectively. Colour had the highest mean value of 3.75 for white super fortified maize meal. Participants had a similar liking for white sifted unfortified maize meal and hammer-mill maize meal in terms of aroma, appearance (colour and consistency) and taste. However hammer-mill maize meal was more liked in terms of texture (feel-hand and grittiness-mouth).

The two maize meal porridge samples most preferred by the Shangaan consumers in Giyani were the white sifted fortified and white super fortified maize meal with total scores of 20.67 and 21.17 respectively. It would seem as if fortification improved/ enhanced the acceptability levels of the maize meal types investigated in this study. Food acceptability and the related capacity to purchase the food are major determinants of food choice and acceptability although these are usually modified by cultural factors defining what is seen as appropriate or acceptable food products (Krondl & Coleman, 1988:61; Southgate, 1996:379). Messer (1984:220) on the other hand states that visual characteristics of food such as colour or overall appearance often affects food acceptability.

4.3.5 Focus-group interviews

The qualitative approach employed for phase two of the study is discussed in this section. Narrative analysis similar to reading and interpreting a poem or novel (Lieblich, Tuval-Mushiach & Zilber, 1998:170) was used to analyse the qualitative data of phase two. The direction of the questions for phase two of the study was mainly directed at the hammer-mill yellow maize meal.

This was purposely done for this study in order to avoid tedious questioning of rural participants (simple and short questions to suit their level of limited education) that could lead to diminished interest in the focus-group interview.

Sensory attributes such as aroma, appearance, texture and taste play a major role in the acceptance of food products (Land, 1988:478). According to the results of the focus-group interview displayed in Table 4.5 a number of participants in Homu 14A and Mahlathi villages liked the hammer-mill yellow maize porridge sample (17 out 21 and 23 out of 27 respectively). In the former village they said that they liked the **taste and colour** whereas in the latter village they simply said that the yellow maize porridge was nice. Those who did not like the product cited colour and taste whilst those in Mahlathi described the porridge as bitter. This translates to 16.7% of the participants in both villages disliking hammer-mill yellow maize meal porridge.

Those participants in Homu 14A that liked it mentioned that **aroma** as well as **texture** influenced the acceptability of the porridge sample. The participants in Mahlathi stated that they did not like the coarse (zakhomi) hammer-mill yellow maize meal but that they liked hammer-mill yellow maize meal (without fibre) because it had a finer texture. Focus-group interviews revealed that the texture of the cooked porridge in the hand and mouth affected acceptability in that the participants stated that they liked the feel of the yellow maize meal porridge both in the hand and mouth. The physical properties that appealed to the sight and feel (Lawless & Heymann, 1998:386) of participants was the fineness of the maize meal and its cooked consistency. The researcher agrees with Conner and Amitage (2002:6) who stated that it is not the sensory attributes per se that are important, but the preferences for particular combinations of characteristics in different eating contexts. Participants in Homu 14A specifically mentioned the presence of vitamin A in the yellow maize whereas the Mahlathi participants said that it is rich in 'things that make their bodies healthy'. The awareness of consumers in Homu 14A regarding yellow maize meal and vitamin A was due to the previous research which dealt with vitamin A rich maize (Golden maize) in the same community in 2004 that involved consumer education regarding the presence of vitamin A in certain yellow /orange coloured food types, as well as, the advantages of adequate vitamin A intake. In this case the acceptability of the hammer-mill yellow maize meal porridge sample was based not only on sensory attributes but on nutritional grounds as well.

According to the participants in both villages **packaging** (placing it into convenient quantities like 12.50 kg/ 25.00 kg/50 kg) of the yellow maize meal by the familiar commercial roller-mill manufactures (Iwisa/Ace) would lead to yellow maize meal being purchased. However, **price** and **availability** were mentioned as factors that affect procurement of maize meal products. Participants in Homu 14A stated that if the price of commercial roller-mill and hammer-mill yellow maize meal was the same they would purchase both whereas those at Mahlathi village said they would buy yellow maize meal for nutritional reasons. The latter however stated that if white maize meal was sold at lower price than the yellow maize meal they would purchase the white variety. Ritson and Hutchins (1995:22) confirm such consumer behaviour, that is, consumers acquire food products which are available and affordable. Nestle, Wing, Birch, Disogra, Drewnowski, Middleton, Sigman-Grant, Sobal, Winston and Economos (1998:S56) state that by changing the availability of foods it is possible to change the overall acceptability of a food product.

From the focus-group interview it was clear that the participants were familiar with hammer-mill yellow maize meal. As such consumers acquire a preference for food products they have been exposed to in their culture or environment (Mela, 1999:516). Participants from both villages confirmed that yellow maize meal is available in Giyani during periods of drought and is supplied to the area by the government. The supply of agricultural products like maize may be affected by drought at times when there is not enough rain for crops to grow adequately. Under such circumstances consumers procure maize meal products that are not general preferred or liked due to non-availability of the preferred variety (Mela, 1999:514; Souter & Keller, 2002:9).

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

Important conclusions based on the results from the quantitative and qualitative data analysis are presented and discussed in this chapter. The results are also synergized with the theoretical background. At the end of this chapter the value of the study is discussed and recommendations are given.

5.2 Conclusion

The theoretical framework (model) adapted from Cardello (1994:254), Shepherd and Sparks (1994:204), and Conner and Armitage (2002:6) was used to carry out the research aim for this study. This model depicts a number of factors that can influence the acceptability and perceptions of porridge prepared with commercial roller-mill white sifted unfortified vs. white sifted fortified maize meal (as well as hammer-mill white and yellow maize meal with fibre; hammer-mill white and yellow maize meal without fibre produced by small scale farmers in Giyani, Limpopo Province, SA). These factors may be grouped into those related to the food, environment/context and the individual. They are related although researchers conveniently discuss them separately (individually).

A summary of the results and interpretation of the results, in terms of the comparison between "White sifted unfortified" and "White sifted fortified" maize meal is shown in Table 5.1. Thus, even though both maize meal porridge samples elicited some degree of positive liking from the participants, overall and in terms of all the attributes the white sifted fortified maize meal was preferred significantly above the white sifted unfortified maize meal.

TABLE 5.1 A SUMMARY OF THE RESULTS AND INTERPRETATION OF THE RESULTS, IN TERMS OF THE COMPARISON BETWEEN "WHITE SIFTED UNFORTIFIED" AND "WHITE SIFTED FORTIFIED" MAIZE MEAL

Attribute	**Mean scores[1]**		**Significant Difference?**	**Most preferred Sample**
	White sifted Unfortified (n=48)	**White sifted Fortified (n=48)**		
Aroma [2]	2.77* (Between "Neutral" & "Like moderately")	3.35* (Between "Like moderately" & "Like very much"	Yes, p≤0.01	White sifted Fortified
Appearance: colour [2]	2.94* (Between "Neutral" & "Like moderately")	3.63* (Between "Like moderately" & "Like very much"	Yes, p≤0.01	White sifted Fortified
Appearance: Consistency [2]	2.90* (Between "Neutral" & "Like moderately")	3.46* (Between "Like moderately" & "Like very much"	Yes, p≤0.01	White sifted Fortified
Texture: feel (hand) [2]	2.90* (Between "Neutral" & "Like moderately")	3.35* (Between "Like moderately" & "Like very much"	Yes, p≤0.05	White sifted Fortified
Texture: Grittiness (mouth) [2]	2.81* (Between "Neutral" & "Like moderately")	3.38* (Between "Like moderately" & "Like very much"	Yes, p≤0.01	White sifted Fortified
Taste [2]	2.81* (Between "Neutral" & "Like moderately")	3.38* (Between "Like moderately" & "Like very much"	Yes, p≤0.01	White sifted Fortified
Total score [3]	16.96*	20.67*	Yes, p≤0.01	White sifted Fortified

[1]1=Dislike very much; 2=Dislike moderately; 2.5=Neutral; 3=Like moderately; 4=Like very much

[2] A mean attribute score of >2.5 indicates some level of liking, indicated with a *

[3] A total score of >15 indicates some level of liking, indicated with *

A summary of the results and interpretation of the results, in terms of the comparison between "Hammer-mill white with fibre" and "Hammer-mill yellow with fibre" maize meal is shown in Table 5.2.

TABLE 5.2 A SUMMARY OF THE RESULTS AND INTERPRETATION OF THE RESULTS, IN TERMS OF THE COMPARISON BETWEEN "HAMMER-MILL WHITE WITH FIBRE" AND "HAMMER-MILL YELLOW MAIZE MEAL WITH FIBRE"

Attribute	**Mean scores[1]**		**Significant Difference?**	**Most preferre Sample**
	Hammer –mill white with fibre (n=48)	**Hammer –mill yellow with fibre (n=48)**		
Aroma [2]	2.43 (Between "Dislike moderately" & "Neutral")	2.21 (Between "Dislike moderately" & "Neutral")	No, p>0.1	None
Appearance: colour [2]	2.06 (Between "Dislike moderately" & "Neutral")	2.29 (Between "Dislike moderately" & "Neutral")	No, p>0.1	None
Appearance: Consistency [2]	2.15 (Between "Dislike moderately" & "Neutral")	2.17 (Between "Dislike moderately" & "Neutral")	No, p>0.1	None
Texture: feel (hand) [2]	2.00 ("Dislike moderately")	2.21 (Between "Dislike moderately" & "Neutral")	No, p>0.1	None
Texture: Grittiness (mouth) [2]	1.79 (Between "Dislike very much" & "Dislike moderately")	1.98 (Between "Dislike very much" & "Dislike moderately")	No, p>0.1	None
Taste [2]	1.85 (Between "Dislike very much" & "Dislike moderately")	2.02 (Between "Dislike moderately" & "Neutral")	No, p>0.1	None
Total score [3]	12.08	12.83	No, p>0.1	None

[1] 1=Dislike very much; 2=Dislike moderately; 2.5=Neutral; 3=Like moderately; 4=Like very much

[2] A mean attribute score of >2.5 indicates some level of liking, indicated with a *

[3] A total score of >15 indicates some level of liking, indicated with *

Both maize meal porridge samples elicited some degree of dislike from the participants, overall in terms of all the attributes. There was no significant difference between these two samples. According to the results of the focus-group interviews the participants in Mahlathi village stated that they did not like the coarse (zakhomi) hammer-mill yellow maize meal, but that they liked the hammer-mill yellow (without fibre) because it had a fine texture. The physical properties that

appealed to the sight and feel of the participants was the fineness of the maize meal and cooked consistency.

A summary of the results and interpretation of the results, in terms of the comparison between "Hammer-mill white without fibre" and "Hammer-mill yellow without fibre" maize meal is shown in Table 5.3. Both these maize meal porridge samples elicited some degree of liking from the participants, in terms of the total score. There was no significant difference in terms of aroma, appearance: colour, texture: grittiness and taste although in terms of appearance: consistency ($p=\leq 0.05$) and texture: feel-hand ($p=\leq 0.10$) there was a significant preference between hammer-mill white (without fibre) and hammer-mill yellow (without fibre). It is important to note it is not the sensory attributes per se that are important, but the preferences for particular combinations in different eating contexts as highlighted by Conner and Armitage (2002:6). Participants in Homu 14A highlighted the presence of vitamin A in yellow maize as reason for its acceptability probably due to the fact that, that community had been exposed to Golden Maize in 2004 (vitamin A rich maize). This actually underlines the fact that communities appreciate and remember nutrition education they have been exposed to; which is a plus for nutrition training in general.

Participants in both villages involved in the study cited the non-availability of yellow maize meal except in times of drought when it is supplied by the government for drought-relief whereas commercial roller-mill maize meal is available all year round all. By changing the availability and affordability of a food product it is possible to change its overall acceptability (Nestle *et al.* 1988:S56; Ritson & Hutchins, 1995:22). For example, yellow maize meal is available in Giyani only during periods of drought. Availability of yellow maize meal throughout the year would lead to exposure and familiarity. According to Mela (1999:516) familiar food products tend to be preferred over new or unfamiliar products. The participants in this study expressed their wish that yellow maize meal be made available throughout instead of it being available only during periods of drought.

TABLE 5.3 A SUMMARY OF THE RESULTS AND INTERPRETATION OF THE RESULTS, IN TERMS OF THE COMPARISON BETWEEN "HAMMER-MILL WHITE WITHOUT FIBRE" AND "HAMMER-MILL YELLOW MAIZE MEAL WITHOUT FIBRE"

Attribute	**Mean scores[1]**		**Significant Difference?**	**Most preferred Sample**
	Hammer-mill white No-fibre (n=48)	**Hammer-mill Yellow No fibre (n=48)**		
Aroma [2]	3.13* (Between "Like moderately" & "Like very much"	3.00* ("Like moderately")	No, p>0.1	Hammer-mill white No-fibre
Appearance: colour [2]	3.33* (Between "Like moderately" & "Like very much"	3.25* (Between "Like moderately" & "Like very much"	No, p>0.1	Hammer-mill white No-fibre
Appearance: Consistency [2]	3.31* (Between "Like moderately" & "Like very much"	2.75* (Between "Neutral" & "Like moderately")	Yes, p≤0.05	Hammer-mill white No-fibre
Texture: feel (hand) [2]	3.29* (Between "Like moderately" & "Like very much"	2.85* (Between "Neutral" & "Like moderately")	Yes, p≤0.1	Hammer-mill white No-fibre
Texture: Grittiness (mouth) [2]	3.00* ("Like moderately")	2.83* (Between "Neutral" & "Like moderately")	No, p>0.1	Hammer-mill white No-fibre
Taste [2]	3.06* (Between "Like moderately" & "Like very much"	2.98* (Between "Neutral" & "Like moderately")	No, p>0.1	Hammer-mill white No-fibre
Total score [3]	19.08*	17.67*	No, p>0.1	Hammer-mill white No-fibre

[1]1=Dislike very much; 2=Dislike moderately; 2.5=Neutral; 3=Like moderately; 4=Like very much

[2] A mean attribute score of >2.5 indicates some level of liking, indicated with a *

[3] A total score of >15 indicates some level of liking, indicated with *

A summary of the results and interpretation of the results, in terms of the comparison among "White sifted unfortified"; "White super fortified" and "Hammer-mill white without fibre" maize meal is shown in Table 5.4.

TABLE 5.4 A SUMMARY OF THE RESULTS AND INTERPRETATION OF THE RESULTS, IN TERMS OF THE COMPARISON AMONG "WHITE SIFTED UNFORTIFIED"; "WHITE SUPER FORTIFIED" AND "HAMMER-MILL WHITE MAIZE MEAL WITHOUT FIBRE"

Attribute	**Mean scores:**			**Significant Difference?**	**Most preferred sample:**
	White sifted Unfortified (n=48)	**White super Fortified (n=48)**	**Hammer-mill white no-fibre (n=48)**		
Aroma [2]	3.00* ("Like moderately")	3.56* (Between "Like moderately & Like very much")	2.67* (Between "Neutral & Like moderately")	Yes, p≤0.01	White super Fortified
Appearance: colour [2]	3.02* (Between "Like moderately & Like very much")	3.75* (Between "Like moderately & Like very much")	3.04* (Between "Like moderately & Like very much")	Yes, p≤0.01	White super Fortified
Appearance: Consistency [2]	2.88* (Between "Neutral & Like moderately")	3.50* (Between "Like moderately & Like very much")	3.06* (Between "Like moderately & Like very much")	Yes, p≤0.05	White super Fortified
Texture: feel (hand) [2]	2.83* (Between "Neutral & Like moderately")	3.46* (Between "Like moderately & Like very much")	3.19* (Between "Like moderately & Like very much")	Yes, p≤0.01	White super Fortified
Texture: Grittiness (mouth) [2]	2.75* (Between "Neutral & Like moderately")	3.40* (Between "Like moderately & Like very much")	3,17* (Between "Like moderately & Like very much")	Yes, p≤0.01	White super Fortified
Taste [2]	2.71* (Between "Neutral & Like moderately")	3.50* (Between "Like moderately & Like very much")	2.98* (Between "Neutral & Like moderately")	Yes, p≤0.01	White super Fortified
Total score [3]	17.19*	21.17*	18.11*	Yes, p≤0.01	White super Fortified

[1]1=Dislike very much; 2=Dislike moderately; 2.5=Neutral; 3=Like moderately; 4=Like very much

[2] A mean attribute score of >2.5 indicates some level of liking, indicated with a *

[3] A total score of >15 indicates some level of liking, indicated with *

Thus even though the three samples of porridge elicited some degree of positive liking from the participants, in terms of all the attributes the white super fortified maize meal was preferred significantly above the white sifted unfortified and hammer-mill white maize meal (without-fibre) types. When white sifted unfortified and hammer-mill white no-fibre maize meal types were

compared against each other, in terms of all the attributes except aroma the hammer-mill white (without fibre) was preferred significantly above the white sifted unfortified maize meal porridge.

The **price** of the maize meal was an important factor to be considered when purchasing maize meal. Participants in Homu 14A stated that a similar price for commercial roller-mill and hammer-mill yellow maize meal (without fibre) would result in the purchase of both alike whereas those in Mahlathi said that they would choose yellow fine maize meal. Homu 14A participants stated that they would still choose yellow (17 out of 21) as opposed to Mahlathi participants who would choose white because of the low price. This shows the **willingness** of consumers to buy maize meal types that are affordable and available locally.

The female consumers in Giyani were able to differentiate between the samples of porridge cooked with different maize meal types hence the low total mean scores for commercial white sifted unfortified (16.96 & 17.19), medium for hammer-mill white (without fibre; 19.08 & 18.11) and the highest for white sifted and super fortified (20.67 & 21.17) respectively. The results were reliable and constant (low, medium and highest matching the same samples). From this study one can safely say that perceptions of sensory attributes namely aroma, appearance (colour and consistency), texture (feel-hand and grittiness-mouth) as well as taste /flavour played a major role in the overall acceptability of commercial roller-mill white maize meal, hammer-mill white and yellow maize meal (with and without fibre) among Giyani consumers in the Limpopo Province, SA.

The porridge cooked with commercial roller-mill white super fortified maize meal was preferred the most by the female consumers in Giyani. It is evident from the results that in terms of the overall liking, as well as, for the separate attributes the consumers preferred the White super fortified to both the Big "L" sifted unfortified and Hammer-mill white (without fibre) maize meal. The difference in the acceptability could be attributed to a combination of the sources of the maize meal (mill, origin and quality of the grain used for manufacturing) as well as, the fortification mix added to the fortified maize meal. The consumers' preference for the white super fortified maize meal on a double blind basis is quite surprising and unexpected, compared to the results of a study conducted prior to the implementation of the SA National Fortification Scheme (Department of

Health, 2004:1), where no impact was detected on taste due to the addition of the fortification mix. Furthermore, consumers' preference for the fortified maize meal on a double basis is in contrast to previous findings of research indicating some degree of dislike among consumers regarding fortified maize meal, according to maize millers' opinions (Vermeulen, 2006:10).

5.3 Value of the study

The SA milling industry is characterized by a high level of competition and there is a large range of maize meal products in the local market. Thus strategic research would be invaluable to both commercial and small-scale millers and farmers in order to help them with useful information to produce products that are acceptable to present and future consumers in a competitive market. A major finding of this study relates to fortified maize meal. The study revealed the positive acceptability of white sifted fortified and white super fortified maize meal among Shangaan female consumers in Giyani, Limpopo, SA. The participants had a liking level of between "like moderately" and "like very much" for these fortified maize meal types. This information could be valuable to the manufacturers of the aforesaid maize meal, that is, they should continue using the fortification mix in the production of that maize meal.

Another important finding of this study relates to Giyani female consumers' willingness to accept yellow maize meal mainly due to nutritional considerations. This could present an interesting business opportunity, especially for small-scale millers.

5.4 Recommendations

The results of the study suggest that hammer-mill yellow maize meal be made available throughout the year just like the commercial roller-mill white maize meal instead of making the former available only during times of drought. In other words there seems to be a market potential for yellow maize meal in the Giyani area. Nestle *et al.* (1998:S56) state that by changing the availability of foods it is possible to change the overall acceptability of a food product. However, since the local hammer-millers usually mill grain produced by local households (although sometimes households buy the grain from small scale farmers), the availability of hammer-milled

yellow maize meal could be improved by promoting household land production of yellow maize grain

5.5 Suggestions for further research

- The sample of forty-eight female consumers that participated in the sensory evaluation and the focus-group interviews was too small to make general conclusions about the acceptability and perceptions of commercial roller-mill white maize meal, hammer-mill white and yellow maize meal in Giyani, Limpopo Province, SA. In order to generalize the findings more villages in the Limpopo Province should be studied in order to include male consumers, as well as, a representative range of ethnic groups.

- A further study could also be conducted in which the commercial roller-mill white maize meal can be directly compared to the hammer-mill yellow maize meal to obtain concrete results of acceptability levels using a much large sample so that the findings could be generalised.

- Formally investigating consumer willingness to pay for various maize meal alternatives covered in the study (white sifted unfortified; white sifted unfortified; white super fortified, as well as, hammer-mill white and yellow-with and without fibre) would shed more light on factors that affect consumer acceptability and perceptions of maize meal varieties in Giyani, in the Limpopo Province, SA.

- Since the results suggested a consumer preference for fortified maize meal, the sensory acceptability of fortification mixes from different suppliers, needs to be investigated.

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ADDENDUM A: CONSENT FORM

Name _____ Age range

18-25 Yrs	**25-40 Yrs**	**40 Yrs+**

I _____the undersigned fully understand the requirements of my role as a participant in this study and have consented to take part in this study.

Signature/ cross _____ Date _____

ADDENDUM B: STANDARDIZED RECIPES FOR THE PORRIDGE USED FOR THE STUDY

Recipe: 1 for Homu 14A

1000 ml maize meal } 1st maize meal paste
1000 ml cold water }

1000 ml maize meal } 2nd maize meal paste
1000 ml cold water }

Method

1. Boil 3 L of water in a saucepan at 6 pt on a Defy Kitchenaire electric stove.
2. Make the maize meal paste with 1000 ml maize meal and 1000 ml cold water.
3. Add the paste to the boiling water and stir till smooth.
4. Let the porridge boil for 15 minutes till glossy.
5. Make a second maize meal paste to thicken the porridge.
6. Stir the paste into the boiling porridge.
7. Work it in by beating the porridge until it is even and smooth.
8. Cook for a further 15 minutes.

Recipe: 2 for Homu 14A

750 ml water
1000 ml yellow maize meal
} 1st maize meal paste

750 ml water
750 ml yellow maize meal
} 2nd maize meal paste

Method

1. Boil 3 L of water in a saucepan at 6 pt on a Defy Kitchennaire electric stove.
2. Make the maize meal paste with 750 ml maize meal and 750 ml cold water.
3. Add the paste to the boiling water and stir till smooth.
4. Let the porridge boil for 15 minutes (till glossy).
5. Make a second maize meal paste to thicken the porridge.
6. Stir the paste into the boiling porridge.
7. Work it in by beating the porridge until it is even and smooth.
8. Cook for a further 15 minutes.

Recipe 3: for Mahlathi Village

3 L boiled water

1000 ml cold water

500 ml maize meal

1000 ml maize meal

Method

1. Boil water in a 20 L-tin.
2. Measure out 3L boiling water required for the pap.
3. Make maize meal paste with 500 ml maize meal and 1000 ml cold water
4. Stir in the paste into the boiling water till smooth and boiling.
5. Cook till glossy for at least 15 minutes.
6. Stir in the dry maize meal into the boiling maize meal.
7. Work it in by beating vigorously until the porridge is even and smooth.
8. Cook for another 15 minutes. Stir the porridge every 5 minutes to ensure even cooking.

Recipe 4: for Mahlathi Village

2 L boiling water

750 ml water

1000 ml yellow maize meal

750 ml dry maize meal

Method

1. Boil water in a 20 L-tin.
2. Measure out 2L boiling water required for the pap.
3. Make maize meal paste with 1000 ml maize meal and 750 ml cold water
4. Stir in the paste into the boiling water till smooth and boiling.
5. Cook till glossy for at least 15 minutes.
6. Stir in the dry maize meal into the boiling maize meal.
7. Work it in by beating vigorously until the porridge is even and smooth.
8. Cook for another 15 minutes-stir the porridge every 5 minutes to ensure even cooking.

ADDENDUM C: MODIFIED FACE-SCALE (FOUR-POINT HEDONIC SCALE) FOR MAIZE MEAL PRODUCT ACCEPTANCE BASED ON SENSORY ATTRIBUTES

Sensory evaluation of white maize meal versus yellow maize meal

Name: _____ Date: _____ Time: _____

Please evaluate the following maize meal products for the selected characteristics. Put a cross in the block to match the smiley face that indicates your liking.

Dimension	Rating scale	**Sample 216**	**Codes 924**
Aroma Take a few short sniffs as soon as you remove the foil	=Dislike very much		
	=Dislike moderately		
	=like moderately		
	=like very much		

	Sample code:	**216**	**924**
Appearance Impression of Colour	=Dislike very much		
	=Dislike moderately		
	=like moderately		
	=like very much		

		Sample code:	216	924
Appearance Impression consistency- Look at the cooked Granules- Coarse/fines		=Dislike very much		
		=Dislike moderately		
		=like moderately		
		=like very much		

		Sample code:	216	924
Texture Break a piece Off the cooked product and press it gently between the middle fingers and thumb (feel/touch)		=Dislike very much		
		=Dislike moderately		
		=like moderately		
		=like very much		

		Sample code:	216	924
Texture Grittiness when chewed and swallowed		= Dislike very much		
		=Dislike moderately		
		=like moderately		
		=like very much		

		Sample code:	216	924
Taste/flavour Overall taste/ flavour when chewed and swallowed		=Dislike very much		
		=Dislike moderately		
		=like moderately		
		=like very much		

Thank you for taking part in the study

Sensory evaluation of white maize meal versus yellow maize meal

Name: _____ Date: _____ Time: _____

Please evaluate the following maize meal products for the selected characteristics. Put a cross in the block to match the smiley face that indicates your liking.

Dimension	Rating scale	**Sample 284**	**Codes 693**
Aroma Take a few short sniffs as soon as you remove the foil	=Dislike very much		
	=Dislike moderately		
	=like moderately		
	=like very much		

	Sample code:	**284**	**693**
Appearance Impression of Colour	=Dislike very much		
	=Dislike moderately		
	=like moderately		
	=like very much		

		Sample code:	284	693
Appearance Impression consistency- Look at the cooked Granules- Coarse/fines	= Dislike very much			
	=Dislike moderately			
	=like moderately			
	=like very much			

		Sample code:	284	693
Texture Break a piece Off the cooked product and press it gently between the middle fingers and thumb (feel/touch)	=Dislike very much			
	=Dislike moderately			
	=like moderately			
	=like very much			

		Sample code:	284	693
Texture Grittiness when chewed and swallowed		= Dislike very much		
		=Dislike moderately		
		=like moderately		
		=like very much		

		Sample code:	284	693
Taste/flavour Overall taste/ flavour when chewed and swallowed		=Dislike very much		
		=Dislike moderately		
		=like moderately		
		=like very much		

Thank you for taking part in the study

Sensory evaluation of white maize meal versus yellow maize meal

Name: _____ Date: _____ Time: _____

Please evaluate the following maize meal products for the selected characteristics. Put a cross in the block to match the smiley face that indicates your liking.

Dimension	Rating scale	**Sample** **239**	**Codes** **348**
Aroma Take a few short sniffs as soon as you remove the foil	=Dislike very much		
	=Dislike moderately		
	=like moderately		
	=like very much		

	Sample code:	**239**	**348**
Appearance Impression of Colour	=Dislike very much		
	=Dislike moderately		
	=like moderately		
	=like very much		

		Sample code:	239	348
Appearance Impression consistency- Look at the cooked Granules- Coarse/fines	= Dislike very much			
	=Dislike moderately			
	=like moderately			
	=like very much			

		Sample code:	239	348
Texture Break a piece Off the cooked product and press it gently between the middle fingers and thumb (feel/touch)	=Dislike very much			
	=Dislike moderately			
	=like moderately			
	=like very much			

		Sample code:	239	348
Texture Grittiness when chewed and swallowed		= Dislike very much		
		=Dislike moderately		
		=like moderately		
		=like very much		

		Sample code:	239	348
Taste/flavour Overall taste/ flavour when chewed and swallowed		=Dislike very much		
		=Dislike moderately		
		=like moderately		
		=like very much		

Thank you for taking part in the study

Sensory evaluation of white maize meal versus yellow maize meal

Name: _____ Date: _____ Time: _____

Please evaluate the following maize meal products for the selected characteristics. Put a cross in the block to match the smiley face that indicates your liking.

Dimension	Rating scale	**Sample** **657**	**563**	**Codes** **471**
Aroma Take a few short sniffs as soon as you remove the foil	=Dislike very much			
	=Dislike moderately			
	=like moderately			
	=like very much			

	Sample code:	**657**	**563**	**471**
Appearance Impression of colour	=Dislike very much			
	=Dislike moderately			
	=like moderately			
	=like very much			

		Sample code:	657	563	471
Appearance Impression consistency- Look at the cooked Granules- Coarse/fines		= Dislike very much			
		=Dislike moderately			
		=like moderately			
		=like very much			

		Sample code:	657	563	471
Texture Break a piece off the cooked product and press it gently between the middle fingers and thumb (feel/touch)		=Dislike very much			
		=Dislike moderately			
		=like moderately			
		=like very much			

	Sample code:	657	563	471
Texture Grittiness when chewed and swallowed	= Dislike very much			
	=Dislike moderately			
	=like moderately			
	=like very much			

	Sample code:	657	563	471
Taste/flavour Overall taste/ flavour when chewed and swallowed	=Dislike very much			
	=Dislike moderately			
	=like moderately			
	=like very much			

Thank you for taking part in the study