



## **POLYTECHNIC OF NAMIBIA**

### **HAROLD PUPKEWITZ GRADUATE SCHOOL OF BUSINESS**

Highlighting the importance of incorporating indigenous knowledge into new product development and commercial production processes through a study on the attitudes and preferences of mahangu flour consumers in Northern Namibia

**Steven William Denk**

**9850503**

Thesis presented in partial fulfilment of the requirements for the degree of Master of International Business in the Harold Pupkewitz Graduate School of Business at the POLYTECHNIC OF NAMIBIA.

SUPERVISORS:

Prof. Grafton Whyte

Dr. Shameem Ali

July 2013

## **DECLARATION**

I, Steven William Denk, hereby declare that the work contained in this thesis entitled, *Highlighting the importance of incorporating indigenous knowledge into new product development and commercial production processes through a study on the attitudes and preferences of mahangu flour consumers in northern Namibia*, is my own original work.

It is submitted in partial fulfilment of the requirements for the degree of Master of International Business at the Polytechnic of Namibia. It has not, in its entirety or in part, been submitted previously for any degree or examination at this or any other institution of higher learning.

Signature .....

Date .....

## **RETENTION AND USE OF THESIS**

I, Steven William Denk, being a candidate for the degree of Master of International Business accept the requirements of the Polytechnic of Namibia relating to the retention and use of Master's theses deposited in the Library.

In terms of these conditions, I agree that the original of my thesis deposited in the Library will be accessible for purposes of study and research, in accordance with the normal conditions established by the Librarian for the care, loan or reproduction of theses.

Signature .....

Date .....

## **ACKNOWLEDGEMENTS**

I acknowledge Dr. Grafton Whyte for his guidance and support. I have a deep appreciation for his experience and management style. His assistance in forming my ideas in the initial stages of the research is greatly appreciated. Much of his insights were incorporated into this research.

I acknowledge Dr. Shameem Ali for his guidance and support. I have a deep appreciation for his student-centred approach, his technical skills and his teaching skills. The latter of which I was a direct recipient of during the finalisation and write-up of this research.

## **DEDICATION**

I dedicate this work to my beautiful wife, Patience, and my two beautiful daughters Akina and Amani.

I love you. And thank you.

## Contents

Declaration.....	2
Retention and use.....	3
Acknowledgements.....	4
Dedication.....	5
Abstract.....	8
Appendices.....	164
1. Introduction and Background .....	11
1.1. Background .....	11
1.2. Problem Statement.....	12
1.3. Significance of the Study.....	14
1.4. Research Objective .....	15
1.5. Research Questions .....	15
1.5.1. Do traditional mahangu consumers have a negative attitude towards Meme Mahangu because Namib Mills omitted incorporating indigenous knowledge into the development and production of Meme Mahangu? .....	15
1.5.2. Are the most preferred mahangu flour attributes those attributes emanating from the traditional lactic acid fermentation process? .....	15
1.5.3. How important is indigenous knowledge in the production of traditional food products? .....	16
1.5.4. What are the production differences between traditionally processed mahangu flour and commercially processed Meme Mahangu flour?.....	16
1.5.5. What are the benefits of the lactic acid fermentation process? .....	16
1.5.6. How is consumer decision making influenced by subcultures? .....	16
1.6. Definitions of Concepts.....	16

1.7.	Organisation of the thesis.....	19
2.	Literature Review.....	20
2.1.	Introduction to the Chapter.....	20
2.2.	Understanding Consumer Behaviour.....	20
2.3.	Consumers in their social and cultural context .....	21
2.4.	Perceptions influencing mahangu consumer’s behaviour.....	22
2.5.	Consumer preferences for pearl millet and sorghum .....	23
2.6.	Mahangu as a Staple Food.....	26
2.7.	Commercialisation of Pearl Millet in context .....	27
2.8.	The pearl millet grain – its structure and composition.....	28
2.9.	Pearl Millet processing in Namibia .....	29
2.9.1.	Traditional Milling.....	29
2.9.2.	Industrial Milling .....	30
2.10.	Presenting the case for the Lactic Acid Fermentation Process.....	31
2.11.	Indigenous Knowledge.....	34
2.11.1.	An Introduction to Indigenous Knowledge .....	34
2.11.2.	Indigenous knowledge and building sustainable communities.....	36
2.11.3.	Application of Indigenous Knowledge to Traditional Products .....	43
2.12.	Conceptual Framework for Measuring Attitudes .....	46
2.13.	Theoretical Framework for Measuring Attitudes .....	48
2.13.1.	Fishbein’s Multiattribute Model .....	48
2.14.	Conceptual and Theoretical Framework Discrete Choice Experiments.....	51
2.14.1.	Conceptual Framework Consumer Decision Making.....	51
2.14.2.	Choice Based Conjoint Analysis – Theoretical Framework .....	57
2.15.	Summary of the chapter .....	59
3.	Research Methodology.....	61
3.1.	Introduction to the Chapter.....	61
3.2.	Research Design.....	61
3.3.	Sampling.....	62
3.4.	Data Collection Tools .....	62
3.5.	Analysis .....	63
3.6.	Limitations .....	63

3.7.	Scope and Delimitation.....	63
3.8.	The Quantitative Research Tools.....	63
3.8.1.	Fishbein’s Multiattribute Model .....	64
3.8.2.	Choice Based Conjoint Analysis .....	74
4.	Chapter 4 Findings and discussion.....	84
4.1.	Introduction to the Chapter.....	84
4.2.	Survey Overview .....	84
4.3.	Application of Fishbein’s multi-attribute model to measure consumer attitudes..	89
4.4.	Discrete choice experiment .....	110
4.1.1.	Multinomial Logit Analysis.....	125
5.	Conclusions and recommendations.....	133
5.1.	Introduction to the chapter .....	133
5.2.	Study Conclusions .....	133
5.3.	Recommendations .....	143
5.4.	Summary of Chapter .....	149
6.	List of References.....	150

### **Abstract**

Incorporating indigenous knowledge into new product development and by extension commercial production processes is critical for the successful commercialisation of traditional products. Traditionally, mahangu grain goes through a process referred to as the lactic acid fermentation process. The mahangu grain is exposed to a chemical reaction causing the taste, colour and texture of mahangu porridge to be altered. The results from the discrete choice experiment shows that mahangu consumers prefer the attributes emanating from the lactic acid fermentation process.

However due to the lack of exposure to the lactic acid fermentation process, Meme Mahangu flour do not possess any of the attributes the choice data revealed to be the most preferred mahangu flour attributes. Attitudes were measured based on Fishbein's multi-attribute model. The results showed a negative attitude towards Meme Mahangu. This could be attributed to the fact that the attributes preferred by mahangu consumers (i.e. light coloured porridge) are not present in Meme Mahangu. The results from the choice data collected from the discrete choice experiment shows that the most preferred mahangu flour attributes are those attributes emanating from the lactic acid fermentation process and that the least preferred mahangu flour attributes being those attributes present in mahangu flour that have not been fermented. A sour taste, light colour and soft texture are the attributes most preferred and those emanating from the lactic acid fermentation process. The colour of mahangu porridge has the highest relative importance (52%) with the maximum share of preference falling on light coloured mahangu porridge.

Three main recommendations are proposed. These recommendations can significantly enhance the commercial value of mahangu flour and contribute to the improvement of the livelihood of small scale farmers in northern Namibia.

## **1. Introduction and Background**

### **1.1. Background**

On the 5<sup>th</sup> of July 2005, Cabinet resolved that, pearl millet (*Pennisetum glaucum* (L) R (BR)), commonly known as mahangu in Namibia, should become a controlled crop under the Namibian Agronomic Board Act 20 of 1992. Pearl Millet was designated a controlled crop under the Namibian Agronomic Act of 1992. It was subsequently published in the Government Gazette, No. 4047 of 15 May 2008.

The commercialization of pearl millet was positioned as the strategy that can alleviate poverty and improve the standard of living for small-scale farmers in the Northern Communal Areas (NCA) of Namibia. Research stressed the fact that the Namibian consumer market is very sensitive to the quality of fermented pearl millet meal in the context of the taste, colour, odour and texture related attributes (Mallet & Du Plessis, 2001). Consultants from the French research centre CIRAD in Mallet and Du Plessis (2001, p. 51), stressed the importance of ensuring a regular quality of processed products, particularly the wet processed flour, through specifications and standards, and promoting good manufacturing practices.

Very little has been done to understand the preferences of mahangu consumers in Namibia. And even less has been done to incorporate local knowledge into product development and production of mahangu flour. It is within this context that the researcher wanted to study the attitudes and preferences of mahangu flour consumers from northern Namibia. However it is the research into the preferences related to the lactic acid fermentation process as an indigenous mahangu milling technique that makes this research unique.

The researcher wanted to understand how mahangu consumers value the mahangu flour attributes (sour taste, light colour) emanating from the lactic acid fermentation process. The lactic acid fermentation process is an important step in the traditional mahangu milling process. However this is omitted from the production processes of commercial miller, Namib Mills, in their processing of Meme Mahangu flour. The fermentation of the grain lowers the pH thus contributing to the development of the sour taste preferred by mahangu consuming households (Mallet & Du Plessis, 2001, p. 36; Barrion, 2008, p.30). Fermentation reduces the viscosity of stiff porridges (Lost Crops of Africa, 1996, p. 300). And Reichert (1979) in Barrion (2008, p. 31) reported that acidic conditions in the lactic acid fermentation process cause the grey pH sensitive pigment to change to creamy-white due to the presence of acid. These attributes emanating from the lactic acid fermentation process are highly preferred by the mahangu flour consumers.

The lactic acid fermentation process is thus a critical step in the milling process. However, Namib Mills, producer of Meme Mahangu, do not include the lactic acid fermentation process in their industrial milling processes (Barrion, 2008, p. 33). Traditional knowledge is a key part of everyday life for hundreds of thousands of Namibians. Traditional consumers of mahangu flour in Namibia are descendants of African communities who have over the years preserved customs, practices and skills passed on from generation to generation. Being brought up on a diet of thin mahangu porridge, mahangu drinks, and stiff mahangu porridge processed and prepared using traditional processes and techniques, provides the framework for future decision making, specifically in the marketplace. Thus if the stimuli (Meme Mahangu) do not conform to the expectations of the mahangu consumer, negative attitudes toward the product can develop.

## **1.2. Problem Statement**

When private organisations omit to incorporate indigenous knowledge into their product development and production processes, they increase the probability that their products would be shunned by the communities they are producing the products for.

Based on the researcher's personal experience and observations, traditional consumers of mahangu in Namibia are from African communities who have preserved customs, practices and skills (indigenous knowledge) passed on from generation to generation. Being brought up (experience) on a diet of thin mahangu porridge, mahangu beverages, and stiff mahangu porridge, processed and prepared using traditional processes and techniques, provides the mahangu consumer with a framework of expectations (what mahangu flour products should taste like, what it should look like and what it should feel like).

This framework guides their buying behaviour. Preparation, processing and consumption rituals repeated every day over a long period condition the members of that respective subculture. Thus exerting a strong influence on the way these members will perceive food, get motivated about food, their attitudes toward food, what they've learned about food and what they are willing to learn about food. According to Schiffman & Kanuk (2010); Peter & Olson (2010), a consumer's internal framework of motivational, perceptual and attitudinal factors (amongst others) guides their buying behaviour.

Culture is said to form the consumer's framework of concepts. This is done by the consumer consciously linking together images, objects, stimuli or events (Blythe, 2006, p. 309) and uses these to make purchase decisions.

When Namib Mills introduced Meme Mahangu they seemingly ignored the importance of incorporating indigenous knowledge into their product development

and commercial milling processes. The commercial milling processes deployed to make Meme Mahangu do not include the traditional lactic acid fermentation process.

The lactic acid fermentation process gives mahangu flour and by extension the porridge, its unique taste and colour. When mahangu consumers acquainted with traditionally produced mahangu flour had a taste of Meme Mahangu, the distinct taste and colour (stimuli) was absent. Many of these households thus developed a negative attitude towards Meme Mahangu and, through the word-of-mouth communication system, conveyed this to other members in their subculture.

Namib Mills perhaps did not take cognizance of the fact that subcultures have a strong influence on consumer behaviour and this led to the design, production and marketing of a product not adhering to the requirements of the regular mahangu consumer in Namibia leading to mahangu consumers developing a negative attitude towards Meme Mahangu.

### **1.3. Significance of the Study**

The commercialisation of mahangu as a controlled crop and the importance of indigenous knowledge have bearing on national economic reconstruction issues. The development of sustainable communities across Namibia and the adoption of mahangu flour as the national staple food for Namibia have far reaching impacts on the local economy in terms of food security, value addition and export options.

Namib Mills in particular would find this study particularly interesting and valuable.

Commercial organisations, however, shudder at the possible costs associated with the incorporation of indigenous knowledge, particularly into their production processes. Government should, from this study, realise that the preservation of

indigenous knowledge can pave the way for the development of sustainable rural communities who are the custodians of indigenous knowledge.

This study also provides a wake-up call to the law makers about the importance of preserving African knowledge through a scientific approach of establishing a body of knowledge based on science and not on myths.

This study also serves as a wake-up call for Namibians who rely primarily on multinational companies for the development of products/solutions for Namibia.

#### **1.4. Research Objective**

The main purpose of the research is to highlight the importance of incorporating indigenous knowledge into product development and production processes by private commercial establishments and entities.

The study also want to show the extent to which the mahangu consumer appreciates the attributes associated with the fermentation (traditional lactic acid fermentation) against attributes associated with non-fermented mahangu flour.

#### **1.5. Research Questions**

**1.5.1.** Do traditional mahangu consumers have a negative attitude towards Meme Mahangu because Namib Mills omitted incorporating indigenous knowledge into the development and production of Meme Mahangu?

**1.5.2.** Are the most preferred mahangu flour attributes those attributes emanating from the traditional lactic acid fermentation process?

#### **Sub-questions**

**1.5.3.** How important is indigenous knowledge in the production of traditional food products?

**1.5.4.** What are the production differences between traditionally processed mahangu flour and commercially processed Meme Mahangu flour?

**1.5.5.** What are the benefits of the lactic acid fermentation process?

**1.5.6.** How is consumer decision making influenced by subcultures?

## **1.6. Definitions of Concepts**

**Attitude:** A person's overall evaluation of a concept.

**Attitudes towards object (Ao):** Consumer's overall evaluation (like/dislike) of an object. The object in this study is mahangu flour.

**Belief evaluation:** Reflects how favourably a consumer perceives an attribute or consequence associated with a product.

**Belief strength:** The perceived strength of association between an object and its relevant attributes or consequences.

**Choice-based conjoint (CBC) analysis:** Choice based conjoint is also referred to as discrete choice modelling, discrete choice or choice analysis. The researcher, for most of the time, referred to choice-based conjoint analysis as discrete choice modelling or the discrete choice experiment.

**Choice-set:** In discrete choice experiments, choice sets are synonymous with tasks which is a single choice question. The discrete choice experiment for this study consisted of 8 choice sets each with a different variation of mahangu flour alternatives.

**Concept:** Refers to the product offering defined using one level from each of the multiple attributes. In this study, one level from taste, one level from colour and one level from texture to form a product concept or product alternative.

**Counts:** Refers to the simple method for summarising respondent preferences in CBC experiments showing the probability of respondents selecting a particular attribute level (sour taste, light colour, soft texture).

**Design:** The design refers to the number of attributes in the study and the number of levels per attribute.

**Effects coding:** A data coding method deployed for representing the levels of categorical attributes. Effects coding is very similar to dummy coding except that utility weight of the reference level is set to the negative sum of the other levels within the same attribute rather than being held at zero. With effects coding the part-worths are zero-centered within each attribute.

**Importance:** The maximum impact an attribute can exert on product choice.

**Indigenous knowledge:** This study will adopt the definition of indigenous knowledge as a knowledge system including a system of classification, a set of empirical observations about the local environment, a system of self management, and a means of passing of knowledge from one generation to the next (Johnson, 1992; Rahman, 2000, in Vazquez, 2011). Indigenous knowledge also refers to traditional ecological knowledge that refers to the matured, long standing traditions and practices of local communities (Hinz & Ruppel, 2008; Vazquez, 2011).

**Lactic acid fermentation:** Lactic acid fermentation is a household level food technology that involves putting the decorticated mahangu grains in water for 24 to 48 hours in water at a temperature of 29 degrees Celsius. Lactic acid fermentation or

fermentation has been recorded as reducing the viscosity of stiff porridges, providing a sour taste and the acidic conditions caused by the lactic acid fermentation process causes the metal present in metal-flavanol complex to dissociate and alter the grey pigment present in pearl millet into a creamy-white colour which is preferred by mahangu consumers (Mallet and Du Plessis, 2001; Barrion, 2008; and Lost Crops of Africa, 1996).

**Level:** a degree or amount of an attribute i.e. “sour” or “bitter”

**Likelihood:** A measure of fit in choice-based conjoint, indicating the probability that the observed choices would have resulted given the estimated part-worths.

**Mahangu flour:** This study will adopt the local name “mahangu” to describe pearl millet (*Pennisetum glaucum* (L) R (BR)).

**Meme Mahangu:** *Meme Mahangu* is the commercially produced mahangu flour. This study refers only to the *Meme Mahangu Pure* and not *Meme Mahangu Mixed*. The latter is mixed with maize meal and is not to be confused with *Meme Mahangu Pure*. When, in this study, reference is made to *Meme Mahangu*, it refers to *Meme Mahangu Pure*.

**Multi-attribute attitude models:** Models designed to predict consumers' attitudes toward attitude objects based on their beliefs about and evaluations of associated attributes or expected consequences.

**Multinomial logit:** Also known as MNL is a multivariate statistical model for relating utilities to probabilities of choice. MNL is often used for estimating part-worth utilities based on discrete choice questionnaires involving multiple product alternatives per choice task.

**Part-worth:** The utility associated with a particular level of an attribute in a multi-attribute conjoint analysis model. The total utility for the product is made up of the part-worths of its separate attributes.

**Utility:** An economic concept that, when used in the context of conjoint analysis, refer to a buyer's liking for (desirability of) a product alternative.

### **1.7. Organisation of the thesis**

This thesis consists of five (5) chapters.

**Chapter One** introduces the problem and provides the background information on the lactic acid fermentation process and the mahangu consumer decision making framework.

**Chapter Two** provides the literature on consumer behaviour, benefits of lactic acid fermentation, traditional and commercial milling processes and the importance of indigenous knowledge in traditional food production. The conceptual and theoretical frameworks for attitude measurement and discrete consumer choice behaviour are also outlined in this chapter.

**Chapter Three** provides the detail on the research methodology and the plan deployed to execute this study.

**Chapter Four** presents and discusses the results of the attitudinal study and the discrete choice experiment.

**Chapter Five** provides the conclusions based on the overall aim of this research study and on the specific research questions outlined in Chapter 1

## **2. Literature Review**

### **2.1. Introduction to the Chapter**

Indigenous knowledge is an asset of African communities that are not being exploited for its commercial and social benefits. Acid fermentations have proved a key food processing technology borne from indigenous knowledge. Lactic acid fermentations not only improve the aesthetics and taste of mahangu flour, it also increases shelf life of mahangu flour. Furthermore, it introduces specific benefits for babies into weaning foods. Traditional milling processes differ from commercial milling processes. Commercial milling does not include the lactic acid fermentation (steeping) process. Consumer decision making is influenced by repeated experiences and exposure to common practice and custom in subcultures, specifically among the ethnic groups in Namibia whose staple food is mahangu.

Further to presenting the theoretical base discussed above, this chapter presents the conceptual and theoretical frameworks for measuring attitudes and determining choice probabilities.

### **2.2. Understanding Consumer Behaviour**

Individuals and groups spend their money, effort and time searching, selecting, purchasing, using, evaluating and disposing of their preferred products (Schiffman & Kanuk, 2010; Peter & Olson, 2010; Hawkins, Best, & Coney, 1998). Consumer

behaviour is defined as the “dynamic interaction of affect, cognition, behaviour, and the environment by which human beings conduct the exchanges of their lives” (Peter & Olson, 2010, p. 5). In other words, consumer behaviour basically involves the thoughts and feelings people experience and actions they perform when making decisions to buy a product within a specific environmental setting and influence or need aroused by marketing communications and other marketing stimuli.

### **2.3. Consumers in their social and cultural context**

Consumer socialization is defined as the process by which children acquire skills, knowledge, attitudes and experiences necessary to function as consumers (Schiffman & Kanuk, 2010). Steenkamp (1997) in Marreiros & Ness (2009) made specific reference to three groups of factors influencing the decision process when consumers intend purchasing food:

- properties/attributes of the food,
- factors related to the consumer,
- and environmental factors.

Consumer socialization studies have shown that pre-adolescent children acquire their consumption skills through observation of their parents and older siblings. Intergenerational socialization refers to the phenomena where certain product loyalties or brand preferences are transferred from one generation to another (Schiffman & Kanuk, 2010). They further state that these intergenerational transfers of brand preferences are also being influenced by grandparents who play a key role in the socialization of their own children. Grandparents are important in African subcultures (ethnic groups) and they play a big role in the raising of their grandchildren through exposure to traditional practices. Additionally, they facilitate the transfer of skill to the younger generation through a learn-by-doing approach.

Culture on the other hand can be defined as the sum total of learned beliefs, values and customs that serve to direct the consumer behaviour of members of a particular society. The influences of the three levels of subjective culture are important in the study of consumer behaviour. The first of these three levels is the supranational level reflecting the underlying dimensions of culture that impact the multiple cultures or different societies.

Secondly the national level reflect shared core values, customs, personalities and pre-dispositional factors that tend to capture the national character of the citizens of that particular country (Schiffman & Kanuk, 2010, p. 367).

The researcher's interest lies with the third level which is the group level factors which are concerned with various subdivisions of a country or society. The country or society is normally subdivided along tribal/ethnic lines, social or other dominant subcultures present in a country or society during a specific period in time. These subjective cultures (ethnic for example) play an important role in determining our beliefs, practices, and values, which in turn impact our social norms, attitudes, behavioural intentions, and ultimately, our behaviour.

#### **2.4. Perceptions influencing mahangu consumer's behaviour**

Consumers behave according to their perceptions, rather than on the basis of objective reality. For every individual, reality is a total personal phenomenon, influenced by that individual's needs, wants, values, and personal experiences (Schiffman & Kanuk, 2010). Perception is the process by which an individual selects, organises, and interprets stimuli to form their perception of the world. This influenced by our needs, expectations and experiences to highlight a few (Schiffman & Kanuk, 2010).

#### **Selection**

The stimulus that gets selected depends on two major factors in addition to the physical attributes, package design, brand name and advertisements of the stimulus itself.

### **Perceptual Organisation**

Consumers tend to organise stimuli into groups and perceive them as unified wholes. Thus the perceived characteristics of even the simplest stimulus are viewed as a function of the whole to which the stimulus appears to belong.

### **Perceptual Interpretation**

Because perception is a personal phenomenon, the researcher set out to measure individual perceptions using a discrete choice experiment.

## **2.5. Consumer preferences for pearl millet and sorghum**

Consumer behaviour, introduced earlier, is the study of a person's behaviour aimed at understanding how individuals behave towards the products, services, experiences and ideas they choose to satisfy their unfulfilled needs.

Onyanga, Ochanda, Mwasaru, Ochieng, and Mathooko (2012) studied consumer preferences for pearl millet based breakfast cereals and recorded consumers' preferences/degrees of likes and dislikes (using a 9-point hedonic scale) on the attributes taste, colour, texture, aroma and overall acceptability. Instantized breakfast cereal products were successfully developed from detoxified white and red sorghum as well as pearl millet flours composited with pigeon pea. The most

preferred breakfast cereal was the one produced from white sorghum flour with the cereal produced from pearl millet flour coming in at second (Onyanga et al., 2012).

Ohiopehai, Botsalo, Mpotokwane, Santo, Domingues, and Faria (1998), studied consumer preferences and utilisation of sorghum and millet in the rural areas of Botswana through the participatory rural appraisal method (PRA) in the context of integrating traditional knowledge of the rural population and the knowledge through potential technology made available through experimentation and incorporating these into the uses of sorghum and millets.

Focus on understanding consumption patterns and processing techniques (amongst others) aimed at uncovering indigenous knowledge in these areas and incorporating them into the uses of sorghum and millets on a wider scale. Understanding consumer preferences at this level is very broad and will not provide ample insights into consumer preferences that could possibly be incorporated into developing new products that will reflect these preferences and ultimately lead to a greater uptake for sorghum and pearl millet based products among rural and urban consumers.

Laswai, Shayo, and Kundi (2003) attempted to uncover elements on consumer preferences for sorghum and millet products in the SADC region of Africa. Their focus however was on millet and sorghum varieties and not on the preferred mix of attributes households consuming these products would prefer. It is necessary to draw a distinction between farmer seed preferences (from the grower's perspective) and final consumer preferences (from the consumer's perspective). Laswai et al.,(2003) however combined both leading to an inadequate understanding of final consumer preferences which was alluded to in the title of their research report.

Muui, Muasya, and Kirubi (2013) had a similar approach. Traits specifically related to final consumer preference such as 'good taste' is very broad and do not shed light on the final consumer preference. Focus on seed traits should thus include only traits related to the pearl millet variety (seed selection) such as drought resistance, yield, maturing stage and so on and not traits directly attributed to the actual consumption of millet products such as taste, colour, texture, aroma, and so on.

Bichard, Dury, Schonfeldt, Moroka, Motau, and Bricas (2005) in their exploratory study on consumption practices among urban consumers in Polokwane through their focus groups and individual interviews identified that people in Polokwane obtain food through farming and gardening and through exchanges with people living in rural areas.

Barrion (2008) refer to urban agriculture as the informal transferring of food from rural areas to migrants living in urban areas. According to Barrion (2008) these urban migrants receive significant amounts of Namibia's mahangu produce from relatives in Namibia's rural areas. Bichard et al., (2005) also revealed negative attitudes toward millet products which could have been formed from early childhood experience and word-of-mouth.

Mafuru, Norman, and Fox (2007) studied how consumers evaluate quality attributes of sorghum (final consumer perspective) based on different varieties in order to determine marketing potential relating to the different improved sorghum varieties. Focus groups were used to identify quality attributes consumers consider important in their decision making. Food panel experiments, where each customer tasted six samples of sorghum *ugali*, and their reactions recorded, were conducted.

Conjoint analysis and logistical preference analysis were applied to determine consumer perceptions of variety performance and level acceptance. Colour, taste, texture, aroma and price were the attributes with three levels each that were used to identify the most important attributes and preferences consumers use as criteria when purchasing and consuming sorghum *ugali*.

Ndjeunga and Nelson (2000), give that very sensory studies have been documented on pearl millet quality. Attributes (texture, colour, taste and keeping quality), included in the survey instrument were those ranked high in the focus group meetings. Food panel experiments were conducted where consumers were asked to evaluate the attributes of *Tuwo* (non-fermented and fermented pearl millet thick porridge) and scoring preference for the respective varieties (five different varieties) using a five point preference scale with 0 being the least preferred and 4 being the most preferred. Ndjeunga *et al* (2000) used conjoint analysis as their valuation technique with the consumer's relative preferences for the attributes estimated with an ordered probit model.

## **2.6. Mahangu as a Staple Food**

Pearl Millet (*Pennisetum glaucum* (L.) R. Br.) is a staple food and provides a major supply of food and constitutes a major supply of energy and protein to large number of people living in Africa and Asia. There are several components to estimate grain and food quality such as visual quality, nutritional quality, including digestibility, milling and processing characteristics, cooking and keeping quality, consumer

acceptability and storage stability (Maiti and Wesche-Ebeling, 1997). The nutritional quality of pearl millet grain is directly related to its chemical composition. The pearl millet (mahangu) grain is an important source of energy in the form of starch, but it can also contribute significant amounts of fibre, minerals and other nutrients to the diet.

## **2.7. Commercialisation of Pearl Millet in context**

Pearl Millet (*Pennisetum glaucum* (L.) R. Br.), commonly known as Mahangu in Namibia, is a traditional staple food crop of the semi-arid tropical zones of Africa and Asia. Pearl Millet is the most drought tolerant cereal and can grow in soils of low fertility (Mallet & du Plessis, 2001). Pearl Millet has excellent storage qualities, giving it advantage over other crops where inter-annual food security is necessary (Tyler and Bennett, 1993) cited by Mallet & Du Plessis (2001). According to FAO, Namibia's total cereal production for 2009 translated into 124,000 tonnes (FAO, 2009).

On the 5<sup>th</sup> of July 2005 Cabinet resolved that pearl millet (mahangu) should become a controlled product under the Namibian Agronomic Board Act 20 of 1992. Pearl millet (mahangu) was designated a controlled crop under the Namibian Agronomic Act 20 of 1992, published in the Government Gazette, No.4047 of 15 May 2008. The commercialisation of mahangu was in line with what was highlighted in the National Agricultural Policy (1995) which positions the commercialisation of pearl millet as a strategy that can alleviate poverty and improve the standard of living of small-scale farmers in the Northern Communal Areas of Namibia. The Ministry of Agriculture, Water and Rural Development (MAWRD) projects and the Namibian Agronomic Board (NAB) over the years targeted increased productivity and the promotion of commercialisation. The targeted efforts involved the stimulation of local production of mahangu and sorghum, improving post-harvest- and draught animal

power technology, generic promotion of mahangu and sorghum, the dissemination of market information as well as market facilitation.

These included but were not limited to the promotion of mahangu grain and flour (raising demand), information and training programmes for small millers, improvement of small millers' mahangu flour packaging and improved mahangu grain standards (NAB, 2004).

Further efforts aimed at positioning commercialisation amongst small-scale farmers have included information dissemination, informal trade brokerage, promotion of small scale commercial milling services and campaigns to encourage small scale producers to market their produce through cooperatives (NNFU, 2003; NASSP, 2004) cited in Musaba and Muzanima (2009).

However, very little has been done to understand the mahangu consumer. Very little is documented on the perceptions, attitudes and preferences of mahangu consumers in Namibia. Very little is also being done to preserve indigenous knowledge in the last remaining pockets of African societies found in Namibia.

## **2.8. The pearl millet grain – its structure and composition**

Pearl Millet consists of small tear shaped kernels. The pearl millet grain is made up of three main components: the pericarp, the germ and the endosperm (Barrion, 2008). The presence of polyphenols (or tannins) gives the grain its bitter taste and reduces its digestibility (Mallet & Du Plessis, 2001). Polyphenolics include phenolic acids, flavanoids and tannins (Barrion, 2008). The pearl millet grain is small (3-15mg) but has a proportionately larger germ than all other cereal grains, therefore it tends to contain a high content of triglycerides, which are rich in unsaturated fatty acids (Nantanga, 2006). The germ is usually removed because it is relatively high in oil, which makes the product become rancid faster, thereby decreasing its palatability

(Hoseney, 1994). Phytic acid has anti-nutritional effects on minerals and affects the digestibility of proteins and starch. It can be reduced significantly by dehulling, which basically entail separating the endosperm from the outer envelopes, the latter of which are known to contain tannins causing the bitterness of the grain (Mallet & Du Plessis, 2001).

The refinement of the grain includes processes such as milling that separate anatomical parts of the grain to produce a palatable foodstuff (Hoseney, 1994). To reduce the undesirable tastes due to the presence of polyphenols in millet, the rural housewife dehulls the grains and allows for the semi-processed grain to ferment (Mallet & Du Plessis, 2001).

Different tastes are documented in previous research; a sour taste (Barrion, 2008), bitter taste (Mallet & Du Plessis, 2001), and a plain taste (researcher's personal experience). It is therefore important to establish the preferred taste amongst mahangu flour consuming households as a means to support the commercialisation efforts of pearl millet.

## **2.9. Pearl Millet processing in Namibia**

### **2.9.1. Traditional Milling**

The objective of milling is to achieve the anatomical separation of the pericarp, the germ and the endosperm, as well as to reduce the endosperm into fine particles (Barrion, 2008). Traditionally pearl millet is hand pounded using a pestle and mortar, by women, into flour (Mallet & Du Plessis, 2001; Natanga, 2006; Barrion, 2008). The milling process in Namibia involves decortication, steeping (fermentation) and reduction of the grain to flour (Natanga, 2006). The decortication process involves removal of the material commonly known as bran (pericarp and germ) with the

primary function of improving the palatability of the flour and storage quality of flour (Taylor, 2004) in Natanga (2006); (Barrion, 2008). The second stage involves reducing the endosperm into fine particles (Taylor and Dewar, 2001) in Barrion (2008).

During the two-stage milling process certain nutritional losses occur due to the removal of the pericarp layers and germ, where most of the micro and macro-nutrients are found in high concentrations (Barrion, 2008) and increase the palatability by removing in the aleurone layer (found between the endosperm and the pericarp) responsible for the bitter taste caused by polyphenols (tannins) found mainly in the aleurone layer (Mallet and Du Plessis, 2001).

Mallet and Du Plessis (2001) gave the following as the major processing steps present in traditional milling of mahangu. These are; 1) Winnowing and screening grain, 2) dehulling, 3) fermenting, 4) first pounding into flour plus sieving, 5) second pounding plus sieving, and finally 6) drying of flour.

Natanga (2006) gives decortication as the first step, 2) steeping (lactic acid fermentation), 3) the drying of the decorticated and steeped grain, 4) milling the decorticated and steeped grains into flour 5) drying of the flour.

Barrion (2008) gives step 1) as conditioning the grain, 2) decortication, 3) steeping (lactic acid fermentation), 4) sun drying, and 5) pulverising (reducing grain into flour).

### **2.9.2. Industrial Milling**

According to Barrion (2008) the industrial dry milling process for mahangu in Namibia consists of several processes. Within these processes the use of complex continuous systems of precision roller mills, sifters and air classifiers are being

applied. The process generally consists of five unit operations: 1) conditioning (tempering), 2) decortication, 3) roller milling, 4) sifting and 5) purification (Barrion, 2008). During the conditioning process the grains are placed in steeping bins and water is poured onto them (Barrion, 2008). It is important, to note that the grains do not go through the lactic acid fermentation process (steeping) which is a key step in the traditional milling process.

We can thus safely conclude that the grains used to produce Meme Mahangu flour were not fermented.

#### **2.10. Presenting the case for the Lactic Acid Fermentation Process**

Lactic acid fermentations are used worldwide to produce foods such as sour cream, yogurt, sauerkraut and pickled vegetables of all kinds. In Africa it is traditionally used to flavour and preserve porridges and to produce popular foods such as *bogobe* (sour sorghum porridge), in Botswana *nasha* (sour sorghum and millet) in the Sudan, and *obusera* (sour millet porridge) in Uganda. Many people in different parts of Africa prefer the sharp flavour of these fermented porridges (Lost Crops of Africa, 1996, p. 300).

The value of lactic acid fermentation as a process for upgrading a grain's taste and nutritive value has been largely been ignored by food producers (Lost Crops of Africa, 1996). Further to its aesthetic, taste and nutritional benefits, lactic acid fermentations remain one of the most practical ways to preserve food. Lactic acid fermentations make foods resistant to spoilage. The bacteria rapidly acidify the food to a pH so low that dangerous organisms are no longer able to grow. They also produce hydrogen peroxide that kills organisms that cause food spoilage. Although lactic acid fermentation is declining in large parts of Africa, fermentation have a future and deserve recognition and attention (Lost Crops of Africa, 1996, p. 300).

Fermentation is a household level food technology that reduces the viscosity of stiff porridges. It also raises the levels and bioavailability of proteins, vitamins, and minerals. It enriches the foods through synthesis of some B vitamins, it adds flavour and it helps protect foods from diarrhoea-causing micro-organisms (Lost Crops of Africa, 1996).

“Sour” porridges are very popular in Africa and seem to have many of the characteristics required as a weaning food and also helping to reduce the risk of pathogenic diarrhoea amongst babies (Lost Crops of Africa, 1996).

Traditional mahangu milling includes the lactic acid fermentation process. This procedure is described here. During the traditional milling process, the decorticated grains are steeped and fermented for 24 to 48 hours in water at a temperature of 29°C at which lactic acid fermentation takes place, decreasing the pH of the steeping water (Mallet and Du Plessis, 2001; Barrion, 2008). Soaking and fermentation of grain before reducing it into flour is a traditional practise that improves digestibility and nutritional value of grain products. Lactic acid fermentation also improves the taste and texture and extends the shelf life of flour (Mallet and Du Plessis, 2001).

The slightly fermented mahangu meal was highlighted as a luxury product for a specific segment. CRIAA SA-DC consultants recommended that further research be conducted into soaking/fermenting of decorticated mahangu grain (CRIAA SA-DC, 1999a) in Mallet and du Plessis, (2001).

Reichert (1979) in Barrion (2008) reported that acidic conditions cause the metal present in the metal-flavanol complex to dissociate and expose to the acidic environment alters the grey pigment present in the pearl millet into a creamy-white colour. This creamy-white colour of the mahangu porridge is the colour preferred by the mahangu consumer in Namibia.

Fermentation of cereals inhibits the negative effects of phytic acids and tannin and the lowering of the pH contributes to the development of the sour taste preferred by mahangu consuming households (Mallet and Du Plessis, 2001; Barrion, 2008).

The flour produced by Namib Mills is darker and does not have the distinct sour taste mahangu consumers prefer. The reason for this is because the mahangu grains used to produce Meme Mahangu were not exposed to the lactic acid fermentation process (Barrion, 2008).

Tannin levels responsible for the bitter taste in pearl millet (Mallet and Du Plessis, 2001) were shown to drastically reduce with alkali treatments, malting and fermentation in research on breakfast cereals through experiments conducted on sorghum and pearl millet (Onyango, Ochanda, Murasura, Ochieng and Mathooko, 2012).

The consumer market is very sensitive to the quality of the fermented mahangu meal (colour, taste, odour, texture) (Mallet and Du Plessis, 2001).

A very strong consumer preference, and thus demand, for mahangu products, especially the slightly fermented mahangu flour produced by wet processing have been identified and could fetch premium prices amongst mahangu consuming households in the urban areas (Mallet and Du Plessis, 2001).

The lactic acid fermentation process in the traditional milling process is indeed a delicate process responsible for changes in the colour and taste of flour of decorticated and fermented pearl millet grains. Namib Mills do not incorporate the lactic acid fermentation process into their industrial milling processes. The distinct sour taste and lighter coloured flour/porridge is absent due to the omission of the lactic acid fermentation process from the industrial milling process.

This study thus aimed at understanding the preferences for mahangu from a mix of attributes including taste, colour, and texture. The focus on taste, colour and texture is investigated against a mix of attributes emanating from the lactic acid fermentation process and attributes present in non-fermented mahangu flour i.e. Meme Mahangu.

## **2.11. Indigenous Knowledge**

### **2.11.1. An Introduction to Indigenous Knowledge**

Johnson (1992) and Rahman (2000), in Vazquez (2011) describes indigenous knowledge as a knowledge system including a system of classification, a set of empirical observations about the local environment, a system of self management, and means for the passing of knowledge from one generation to the next. Many other definitions of indigenous knowledge exist. Similarly the concept of traditional knowledge or traditional ecological knowledge (TEK) generally refers to the matured, long-standing traditions and practises of certain regional, indigenous, or local communities, and encompasses the wisdom, knowledge, and teachings of these communities (Hinz & Ruppel, 2008; Vazquez, 2011).

Within the domain of these knowledge systems we find that developing countries continue to rely heavily on the importation of scientific and technical knowledge from foreign sources. The choice to mine their own intellectual resources or to create the conditions for generating, even at considerable cost, such knowledge domestically is not an easy one to make, albeit an urgent one. The continuous debate on the classification of indigenous knowledge as scientific domain and the preservation of Western-centred attitudes by Namibian leaders when it comes to solving local problems are proving to be the key determinants in the collection,

growth and development of indigenous knowledge across a spectrum of societies faced with similar situations.

Further, to determine the feasibility of reducing the technological gap, the conventional procedure among economists has been to compare the potential costs and benefits of an investment in domestic research to and development with the costs and benefits of acquiring useful knowledge from abroad (James, Street & Jedlicka, 1980). The problem is that the costs saved on foreign technology are incorporated into the profits of one company.

Although indigenous knowledge and the application of the skills are labour intensive it serves the dual purpose of sustaining the community and by providing an outdoor lab for scientific investigation that younger generations can probe to develop new solutions to our evolving problems. Developing countries are still the largest importers of knowledge with very few success stories on successful implementation of “foreign knowledge” to indigenous problems.

Developing countries are never certain of the precise and full nature of what is being bought because it was never developed locally and does not have its research foundations in the local sphere of problems, experiences and knowledge. Contrary to popular belief indigenous knowledge is dynamic, provisional, transitory and highly negotiable. Communities rework environmental knowledge, constantly adding to it and discarding existing knowledge which has been superseded or have become irrelevant (Briggs, Sharp, Yacoub, Hamed, and Roe, 2006). It is clear that for us to understand indigenous knowledge and develop it into knowledge that could lead communities to the frontiers of development change we need to build repositories of indigenous knowledge that is continuously mined for best practise techniques spread to other communities faced with similar situations. The systematic reduction of

imported knowledge to a transition into engaging foreign resources on key problems for local solutions should be the goal of developing countries.

Western science and indigenous knowledge should not be seen as competing with each other for a place at the table. This thinking seems to be the result of some of the empirical literature on indigenous knowledge and the way participants are trained to think and the context within which they operate. Rather the context within which knowledge is being applied should be understood.

Indigenous knowledge can be viewed as a much more pragmatic, utilitarian way of the application of knowledge (technology) to everyday demands of life whereas western science searches for knowledge of universal significance that is not context-related. Indigenous knowledge can also be viewed as a social product closely linked to a cultural and environmental context (Briggs, 2005).

The Rio Declaration and the Rio Agenda 21 of 1992 as quoted in Hinz & Ruppel (2008) expects Governments to develop and strengthen national arrangements to consult with indigenous peoples and their communities with a view to reflecting their needs and incorporating their values and traditional and other knowledge and practices into national policies and programmes.

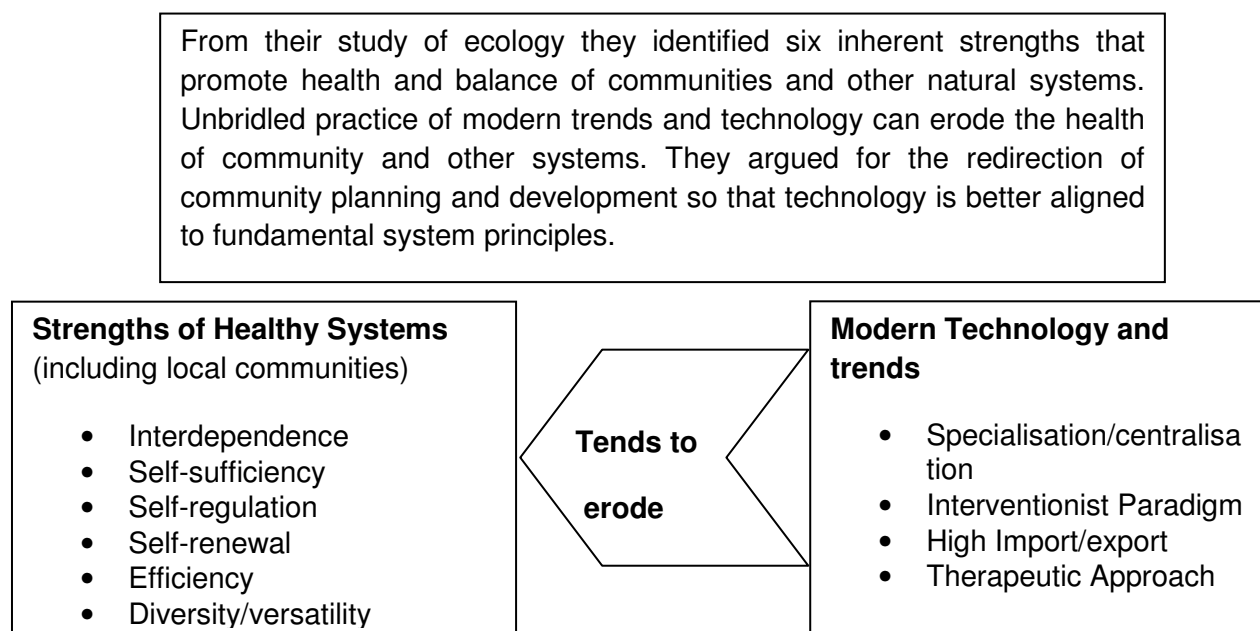
Indigenous knowledge is important and concerted efforts in the development of repositories of knowledge of best practice and the preservation of the practice of these skills and the transfer of knowledge should be carefully protected and cradled even in the face of the challenges of globalization which can be seen as the commoditization of western science.

### **2.11.2. Indigenous knowledge and building sustainable communities**

Lewis, & Jay (2000) highlights the importance of achieving true sustainability through a “think global, act local” approach. The focus here is on developing an ecologically-based redirection of technology, professional pursuits and personal/family/neighbourhood/village interactions focused toward fostering sustainable local communities. They proposed a conceptual model and guidelines of healthy communities drawn from natural ecosystems. It is based on the premise that certain unifying principles, including transfer of energy and cycling of materials, are known to govern the functional mechanisms of systems at all levels from individual organisms and ecosystems to the biosphere.

The human race and its associated activities, including local communities, are a part of this design and are ultimately subject to these natural guidelines. They argue that the exposition and understanding of these principles is the basis for sustainable living practices.

**Figure 2.1 Six Pillar Strengths that should be fostered in communities to assure their health (Lewis & Jay, 2000, p. 1)**



These strengths in more detail as outlined in Lewis & Jay (2000, p.3);

**Interdependency** – The various components of the system, such as various members of a community, come to exist together due to interdependent needs of energy, cycling of materials and other interactive needs. Different ethnic tribes in Namibia should interact with each other and share knowledge as a means of establishing best practice and harvesting tried and tested methods for those communities deprived of such knowledge.

**Self-sufficiency** – Minimal reliance on external providers, especially for core needs, assures greater stability (Lewis & Jay, 2000). Food security in the Namibian context is an important factor in our communities becoming self-sufficient

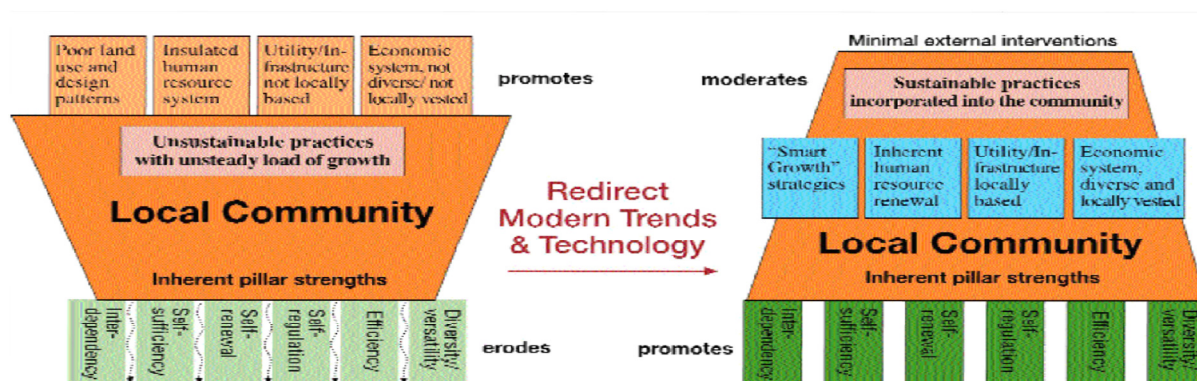
**Self regulation** – Natural ecosystems maintain the balance within certain bounds. This factor is known as the 'balance of nature' or 'homeostasis'. This balance is maintained by an array of biofeedback loops and the system always operates at optimal utility (Lewis & Jay, 2000). It is extremely important for our communities to understand the importance of self-regulation. Capitalism has developed a mindset of greed and our communities are now destroying the natural resources through exploitation of resources at a rate that is not sustainable.

**Self-renewal** – the ability of organisms of a community to provide for their adequate perpetuation via effective reproduction, defence, and other strategies as well as the necessary material for their well being, determines the ultimate survival of their species(Lewis & Jay, 2000). What are we doing in years of drought? Do we have any mechanisms in place to ensure that we survive harsh conditions? Indigenous knowledge that is not applied and preserved will be lost when calamity strike, Namibian communities will be unprepared because the preparation that has been passed down from generation to generation would be lost.

**Efficiency** – In natural systems there is no waste, and high efficiency is assured through natural selection (Lewis & Jay, 2000). Maximum use of resources is assured through food web/chains and recycling of materials. Every part of mahangu is being utilised and waste is reduced to its minimum. Consumerism that is taking hold of our societies is just the opposite as the creation of waste is the order of the day.

**Diversity/versatility** – Diversity is a vital feature for stability of a system. It provides the ability to cope with cycles of fluctuating conditions. At the individual organism level the corresponding feature for diversity is versatility. Vital skills preserved and sustained through private organisation support can provide communities with the opportunity of experimenting with different social innovations that can help communities cope with the cycles of fluctuating conditions.

**Figure 2.2 Sustainable vs. unsustainable business practices (Lewis & Jay, 2000, p. 33)**



The following were given as guidelines for ecologically-based communities, (Lewis & Jay, 2000, p. 43).

- Land use and design patterns based on smart growth principles that;
  - *Preserve historic and cultural assets (skills and food processing techniques passed on from generation to generation)*
  - *Provide urban to rural interfaces that support farm to in-town relationships (urban agriculture – urban consumers actively buying rural produce)*
- An inherent human resource renewal system that:
  - Promotes formal/informal lifelong learning for all citizens through intergenerational, peer-to-peer and team processes (Lewis & Jay, 2000) *(the sustainable practices that are being practised in a rural setting would provide a platform for scientific experiments and outdoor learning experiences that will ensure that the local knowledge is preserved and enhanced)*
  - Foster strong mutual respect and interaction between schools, parents, other citizens and businesses (Lewis & Jay, 2000) *(urban dwellers buying products from rural farmers, schools visiting rural areas for scientific projects, incorporating skills and knowledge into mainstream practices will foster strong mutual respect and interaction between all key players in the Namibian society)*
- Strong local sufficiency in core infrastructural needs insured by:
  - Local government-owned or authority-owned and operated services which are responsive to the voice of the citizens (Lewis & Jay, 2000).
  - *Private locally-owned and operated services and/ or locally designed and operated public/private partnerships (using knowledgeable communities to ferment the grains)*

- *Industry/business strategy that:*
  - *Is diverse and strongly invested in the community*
  - *Maximises coexistence of local businesses with nationally- or regionally owned chains*
  - *Seeks broad balance of business sectors that respect and support community integrity (Lewis & Jay, 2000).*

### **Preserving Historic and Cultural Resources**

All communities have their own unique history and culture. A diverse repertoire of traditions, products, and lifestyles give identity, meaning, and continuity to the members of each community (Lewis & Jay, 2000). Members of the community value and preserve historical assets such as landmarks, buildings, arts, music and food (Lewis & Jay, 2000, p. 37).

### **Economics**

In the interest of economic stability and quality of life, every community needs:

- ready access to the full range of goods and services such as food, shelter, and clothing;
- a local economy vibrant enough to provide all local citizens with sufficient income to purchase needed goods and services, and
- a local economy based on adequate diversity and local ownership to insure survival and stability through ongoing cyclical business swings.

An integral part of a stable economy is the assurance of an adequately trained and diverse workforce that meets the needs of business. A requisite of sustainability is that local business and industry function in a way that is ecologically sound and assures the protection and renewal of the natural, human, and historic/cultural

resource base. In examining a healthy community it is apparent that it fosters and is highly reliant on the six support pillars drawn from our analysis of natural ecosystems. The various components of the community are highly interdependent ((Lewis & Jay, 2000, p. 36).

### **Insulated human resource Service Systems**

Historically, human service needs, including education on skills and practises passed from generation to generation, were provided for within the context of families, neighbour-to-neighbour and the larger community context (Lewis & Jay, 2000, p.38).

It is within the context of sustainably developed communities that the sustainable growth of indigenous knowledge can thrive. Communities can take charge of what is theirs and develop in line with national development policy practices that can lead to food security and the sustenance of food products that can be sold to the urban consumer with strong roots to rural areas. These historical and cultural resources are the bridges by which cohesive relationships are maintained among members of the community, which in turn foster a common vision.

In this atmosphere there is empowerment of the customer/recipient to determine quality of service/product to the customer within a quality framework established through best practice across communities with similar situations. An integral part of a stable economy is the assurance of an adequately trained and diverse workforce that meets the needs of business.

Even in the face of indigenous knowledge practices being extremely labour intensive, it proves effective for the development agenda in the sense that a adequately trained and diverse workforce develop within the communities can be

accessed in these communities (curbing urbanization). This provides for the sustenance of the community that are provided with the resources to develop in accordance with time as it is captured in the community and later by extension the nation. It is within this context that local research and development can be fostered and the high levels of foreign technology importation can be restricted or at least tailored to the needs of the communities.

### **2.11.3. Application of Indigenous Knowledge to Traditional Products**

Indian farmers and traditional grain processors have been evolving a number of traditional practises through years of experience through trial and error methods. Their primary aim was to avoid huge losses that are occurring in stored pulse grains due to insect and pest infestation (Reddy, 2005).

Realising the importance of efficient storage and processing methods in pulse crop production systems, methods involving scientific principles were introduced to hasten up the process. These include the use of chemicals and fumigation methods in storage, heavy machinery for milling, and application of substances such as waste oil and synthetic colours to impart shining appearances to the end product (Reddy, 2005).

These new methods not only require huge power sources at the cost of human labour employment but also cause dust pollution in and around the plants and ill effects for the consumer's health (Reddy, 2005).

Whereas traditional practises are more humane in nature, hence the blending of traditional and scientific technologies is needed to come up with more environmental and human friendly methods of processing practises (Reddy, 2005).

The application of indigenous knowledge in India to storage practises of grain lead to the grain being stored between 6-12 months without it being infested by any pests and it compares very well with commercially produced products (Reddy, 2005).

Transfer of indigenous knowledge and skill in food processing from the older generations to the younger, and building on their knowledge for production, processing and preservation of food is necessary.

Soaking and germination enhances enzymic hydrolysis of phytates. Cereal porridges have been prepared by combining germination and fermentation to improve flavour, digestibility of the products and increase the content of vitamins and minerals. Organic acids such as acetic, lactic, citric, formic and butyric acids produced are produced during fermentation. Reduction in phytates in the diet increases the absorption of minerals such as calcium and iron. Fermentation reduces the phytate content by releasing endogenous phytases during the process (Reddy, 2005).

There is a failure of knowledge transmission from generation to generation because of attitude formation relegating these methods into categories of primitive technologies. There is potential for creating awareness of the value of indigenous foods and preparation and conservation methods. According to Walingo (2008) recipe development offers the potential for increased product variety for the changing tastes and for improved marketability of the products. He argues that the adoption of non-African cultures, changing tastes, diets and lifestyles have negatively influenced the consumption of indigenous foods and contributed to the loss of indigenous knowledge and skills in food preparation, food combinations of nutritional value and food preservation. Transfer of indigenous knowledge in food processing, preparation

and diet combinations to communities needs to be profiled to identify processes that identify processes that promote (Walingo, 2008).

The Food and Agriculture Organisation (FAO) identified the need for indigenous knowledge to be merged with modern agricultural systems to ensure the best nutritional and cultural needs of native communities (Kuhnlein, Erasmus & Spigelski, 2009) in Vazquez (2011).

Ashekele, Embashu & Cheikhyoussef (2012) points out that knowledge and skills in traditional food and drink processing was passed on from one generation to another forming a body of knowledge generally referred to as the indigenous knowledge system (IKS). They further state that IKS products and processes show the skills and knowledge of the indigenous communities in Namibia, and the world over, to transform and harness their natural environment for their benefits. They further add that it is extremely important to understand and document and ultimately commercialise indigenous knowledge. The incorporation of western technologies into the indigenous technological operating context could lead to an increase of indigenous products.

Research and development should be concentrated on the development of more local products and markets which are indigenous (Ashekele et al., 2012). It is within this context that programmes should be implemented that can build a repository of local knowledge and practices across communities as the first step. The second step should involve engaging with other communities in Africa (research points at many similarities between different African communities in their local practices, specifically when it comes to the processing of food products).

It is through the built up of a repository of local, continental and global knowledge on practices and skills that have been preserved and that have stood the

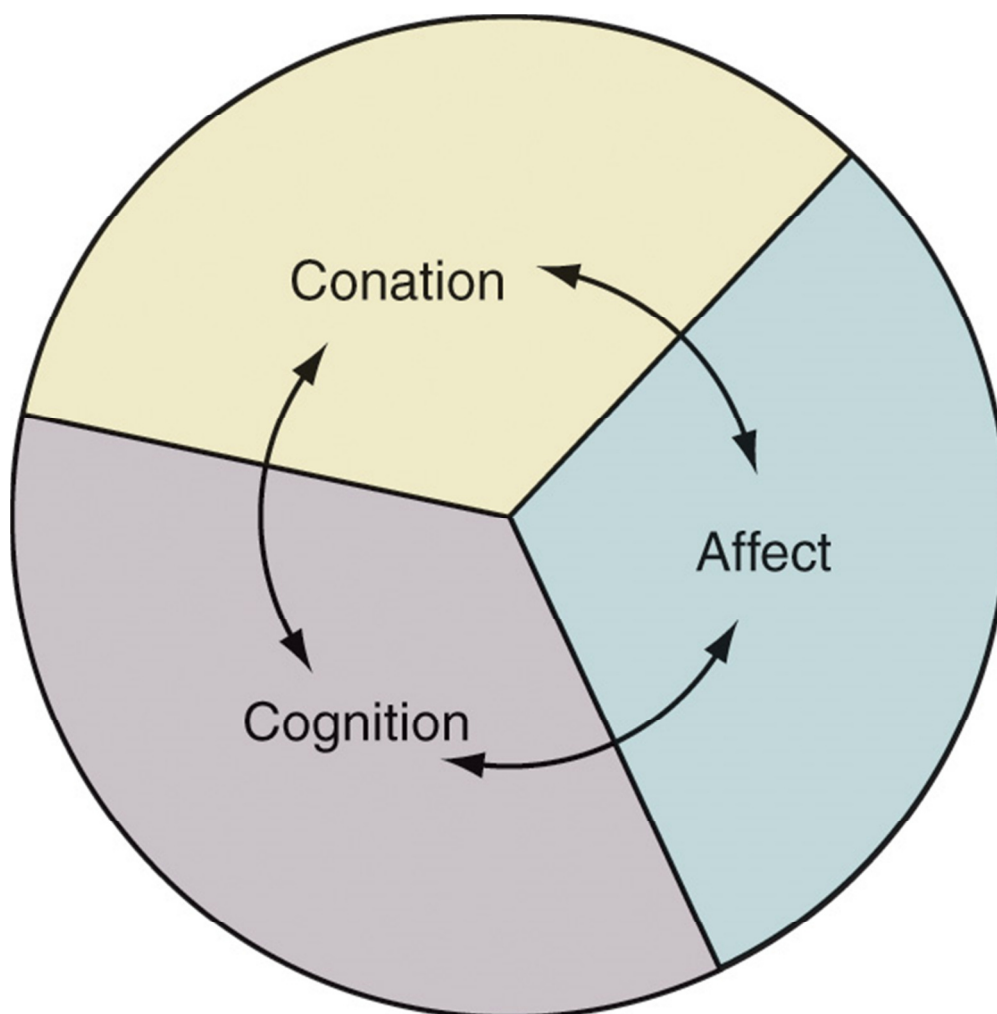
test of time, that we will be able to identify sustainable practices that could be fast-tracked to other communities. These communities might, through lack of exposure or through a depletion of knowledge as the result of wars and oppression, have outdated knowledge and practices that could be replaced by those that have established top position amongst those ranked as best practice.

The merge of Western technologies with local knowledge would see the establishment of products preferred by the local communities as well as the sustainable development of local communities through rural empowerment. The importance of incorporating indigenous knowledge into industrial food processing is clear and should be done. However the question lies in the support government will provide to private sector companies taking initiatives incorporating local knowledge and by default adopting the local skilled workforce into their production processes.

### **2.12. Conceptual Framework for Measuring Attitudes**

The tri-component model is a useful conceptual framework for measuring attitudes. The tri-component model consists of the cognitive component, the affective component and the behavioural component.

**Figure 2.3 Tri-component Attitude Model (Schiffman & Kanuk, 2010, p. 249)**



### **Cognitive Component**

The cognitive component measure consumer beliefs on an attitude object. The knowledge and perceptions that are acquired by a combination of direct experience with mahangu flour and related information from family members, friends, advertisements and other sources, take the form of beliefs. Beliefs that the attitude object (mahangu flour) possesses specific attributes (features of the product or specific benefits associated with the product) will be measured on an attitudinal scale. (Schiffman & Kanuk, 2010).

### **Affective Component**

Feelings or emotional reactions to an attitude object represent the affective component of an attitude. Evaluations such as “I like Meme Mahangu’s dark colour” may come from a very vague or general feeling developed about a specific product without any cognitive information or beliefs about the product. Or it may result from several evaluations of the product’s performance on each of several attributes (Hawkins & Mothersbaugh, 2013).

### **Behavioural Component**

The behavioural component is one’s tendency to respond in a certain manner toward an object or activity. The behavioural component provides response tendencies or behavioural intentions (Hawkins & Mothersbaugh, 2013).

## **2.13. Theoretical Framework for Measuring Attitudes**

### **2.13.1. Fishbein’s Multiattribute Model**

The researcher used Fishbein’s theory as the base for measuring attitudes towards Meme Mahangu and traditional mahangu flour. The researcher applied Fishbein’s multi-attribute model to evaluate the salient beliefs causing overall attitude i.e. people tend to like objects that are associated with “good” characteristics and dislike objects they believe have “bad” attributes. In Fishbein’s multi-attribute model, overall attitude toward an object is a function of two factors; the *strength* of the salient beliefs associated with the object and the *evaluations* of those beliefs (Peter & Olson, 2010). The model proposes that:

$$A_o = \sum_{i=1}^n b_i e_i$$

where

$A_o$  = attitude toward the object

$b_i$  = strength of the belief that the object has attribute  $i$

$e_i$  = evaluation of attribute  $i$

$n$  = number of salient beliefs about the object

(Peter & Olson, 2010, p. 138)

The multi-attribute attitude model accounts for the integration process by which product knowledge and the evaluations and strengths of salient beliefs is combined to form an overall evaluation or attitude towards the attitude object, which in this study is mahangu flour. The model however, does not claim that consumers actually add up the products or belief strength and evaluation when forming their attitudes toward objects.

Rather, this and similar models attempt to predict the attitude produced by the integration process (table 2.1), they are not meant to describe the actual cognitive operation by which knowledge is integrated (Peter & Olson, 2010).

**Table 2.1 Consumer's Integration Process**

<p>The integration process concern how consumers combine different types of knowledge to;</p> <ol style="list-style-type: none"><li>1) form overall evaluations of products, other objects, and behaviours</li></ol> <p>and,</p> <ol style="list-style-type: none"><li>2) choose among alternative behaviours, such as a purchase.</li></ol> <p>In the first instance, consumers combine knowledge and affective feelings about a product or a brand to form an overall evaluation of brand</p>
---

attitude

**Model Components:** The two major elements of Fishbein's multiattribute model are the strengths and evaluations of the salient beliefs. The consumer has salient beliefs about the brand's attributes. These beliefs vary in content, strength, and evaluation (Peter & Olson, 2010).

**Belief strength ( $b_i$ )** is the perceived probability of association between the product and its relevant attributes. Belief strength is measured by having consumers rate this probability of associations for each of their salient beliefs.

**Belief evaluation ( $e_i$ )** is associated with each salient belief. Belief evaluation reflects how favourably the consumer perceives that attribute. Marketers measure the  $e_i$  component by having consumers indicate their evaluation of (favourability toward) each salient belief.

The evaluations of salient beliefs influence the overall  $A_o$  in proportion to the strength of each belief ( $b_i$ ). Thus, strong beliefs about positive attributes have greater effects on  $A_o$  than do weak beliefs about equally positive attributes. Likewise, a negative ( $e_i$ ) reduces the favourability of  $A_o$  in proportion to its ( $b_i$ ) "weight".

Fishbein's multi-attribute model was used to determine the overall evaluations of mahangu consumers toward Meme Mahangu and traditional mahangu flour.

## **2.14. Conceptual and Theoretical Framework Discrete Choice**

### **Experiments**

#### **2.14.1. Conceptual Framework Consumer Decision Making**

Figure 2.4 presents a model of decision making giving the input stage, the process stage and the output stage. In the process stage of the model we identify the individual consumer processes that are continuously being influenced by external forces (marketing messages, culture, family and friends amongst others) and experience gained through interacting with environment and through personal experience gained from the evaluation of the output resulting from the individual's decision making processes. Because these factors influence and interact with each other no factor can be fully understood in isolation, thus the necessitating of a framework within which the analysis would be nested. However the researcher, for this study, is particularly interested in focusing on the external influences, particularly from a cultural point of view. Presenting a model of consumer decision making that reflects the cognitive (problem solving) consumer and, to some degree, the emotional consumer (Schiffman & Kanuk., 2010).

#### **The Input Stage**

The input stage influences the consumer's recognition of a product need and consists of two major sources of information which includes company marketing efforts and the external sociological influences on the consumers (cultural and sub-cultural memberships, family, friends, neighbours, social class). The input component draws on the external influences that serves as sources of information about a

particular product and influence a consumer's product related values, attitudes, and behaviour (Schiffman & Kanuk, 2010). Understanding the non-marketing socio-cultural influences, which, when internalised influences the consumer's purchase decisions. The subcultures in the Northern Communal Areas (NCAs) help individuals define concepts that influence their thoughts and feelings and the actions they perform in the consumption processes. Certain technical and social norms differ according to culture (Blythe, 2006).

### **Process**

The process component of the model is concerned with how consumers make decisions. As pictured in the process component of the overview decision model (figure 2.4) the act of making a consumer decision consists of three stages:

- 1) need recognition;
- 2) pre-purchase search and
- 3) evaluation of alternatives (Schiffman & Kanuk, 2010).

The one essential element of a decision is the existence of *alternatives*. That is, you must have a *choice* to make between at least two different things, only one of which you can select. If you don't have alternatives, then you may have a problem, but it isn't a decision problem. Most significant decisions involve situations where the various alternatives can lead to *differing consequences or outcomes*. If the results of all decisions are the same then the decision problem does not warrant much analysis (Kirkwood, 1997, p. 2).

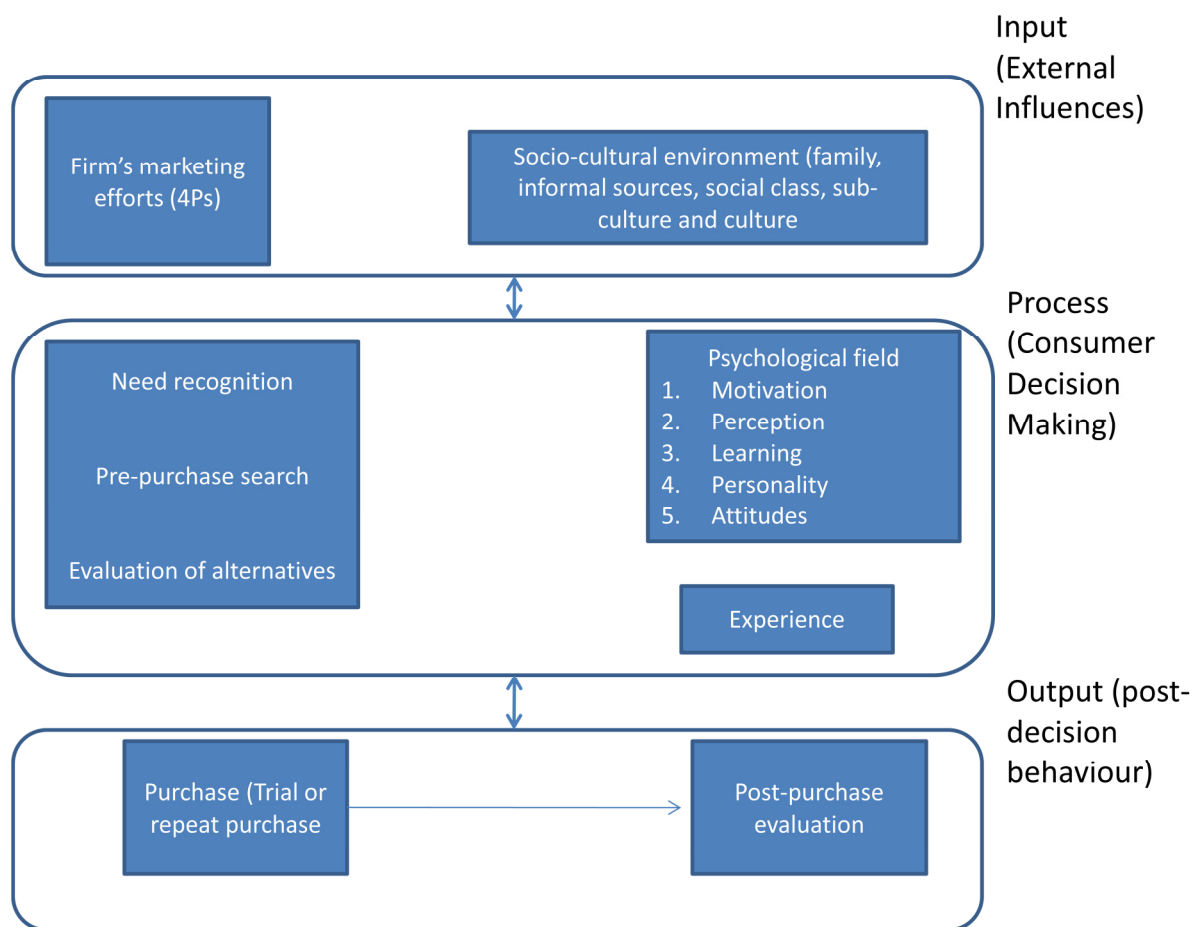
Research reveals that consumer decision making models involving decision making on food takes on a cognitive approach to consumer behaviour. Here the decision-making process and the information processing of marketing stimuli are

central to explain consumer behaviour (Verbeke, 2000) in Marreiros & Ness (2009). They further state that the decision process is facilitated by information processing mechanisms and conditioned by psychological, social, cultural, and social influences that usually involve the peripheral route.

### **Output**

Output concerns two closely associated kinds of post-decision activity which is purchase behaviour and post-purchase evaluation. The objective of both activities is to increase the customer's satisfaction with his or her purchase (Schiffman & Kanuk, 2010).

**Figure 2.4 Consumer Decision Model (Schiffman & Kanuk, 2010, p. 483)**



Louviere, Eagle, and Cohen (2005) provides another view of the consumer decision making process where the individual moves from being unaware of the certain product or need to fulfilling the need or purchasing the product to satisfy the need or want a conceptual framework for real market decisions.

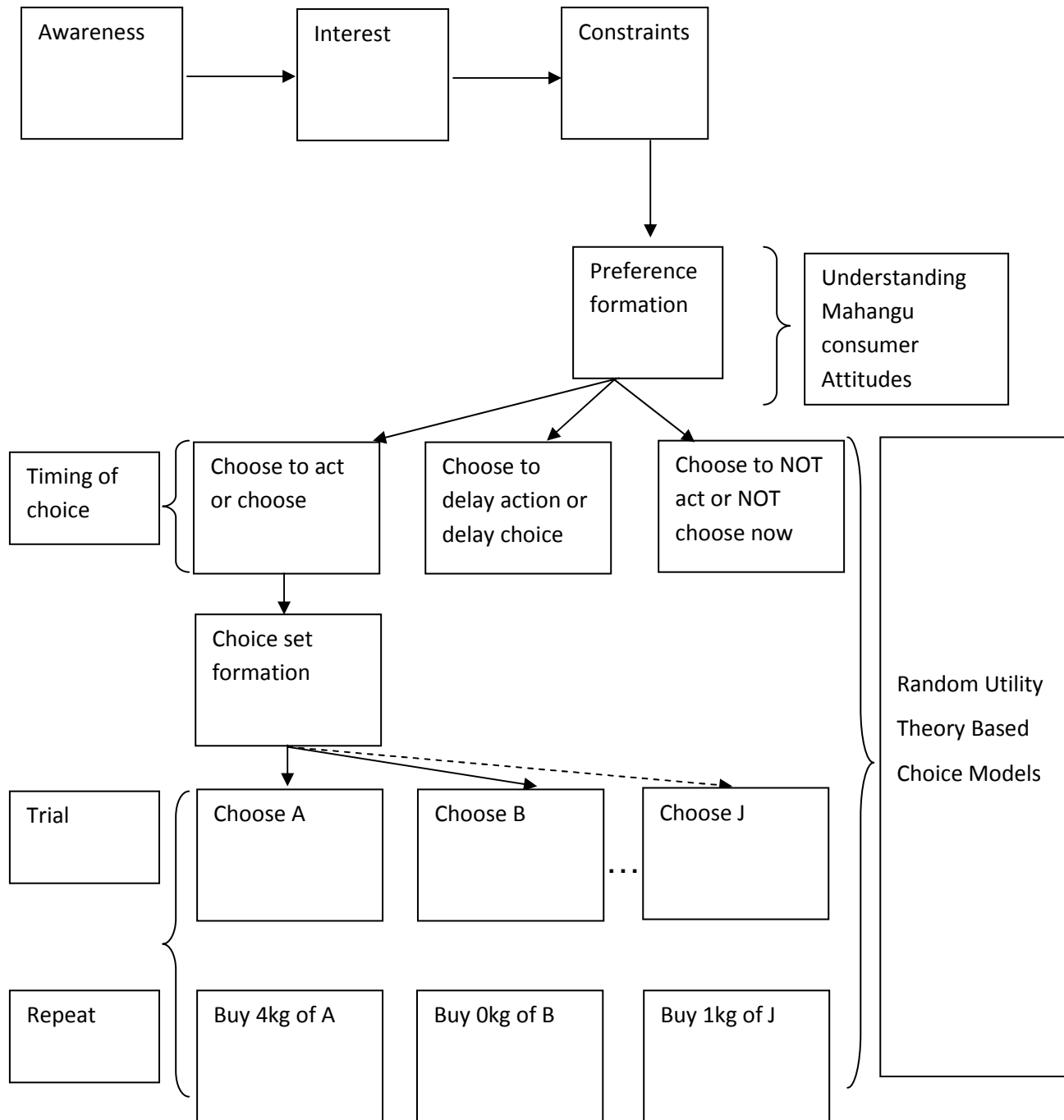
Figure 2.5 represents the stages that most consumers go through before making decisions. The consumer will first have to become aware of the different purchase options within a product category. This stems from developing some level of interest in a specific product in a product category before choosing in it. Constraints such as income, time, peer influence advertising and the situational context are all factors a consumer might consider before deciding on whether to choose and what to choose. When consumers choose to act or choose, they develop

what they call “decision strategies” or “utility functions” that eventually result in the formation of sets of offerings called “choice sets” Louviere et al., (2005).

The one essential element of a decision is the existence of *alternatives*. That is, you must have a *choice* to make between at least two different things, only one of which you can select. If you don't have alternatives, then you may have a problem, but it isn't a decision problem. Most significant decisions involve situations where the various alternatives can lead to *differing consequences or outcomes*. If the results of all decisions are the same then the decision problem does not warrant much analysis (Kirkwood, 1997, p. 2).

Once choice sets are formed, decisions are made about if and when to choose, and, if choosing, what to choose, how many to choose. Following choice, consumers evaluate what was chosen and may re-evaluate their levels of interest in the category or particular offerings in it.

**Figure 2.5 Hierarchy of consumer decisions. Adapted from Louviere, et al, (2005:8)**



### **2.14.2. Choice Based Conjoint Analysis – Theoretical Framework**

Discrete choice models are based on random utility theory (RUT). RUT is a long standing well tested theory of choice behaviour that can take inter-linked behaviours into account (Louviere et al., 2005; Louviere, Flynn & Carson, 2010). According to Louviere et al., (2005); Lusk & Parker (2009); Hauser & Urban (1977), RUT was established by McFadden, who extended Thurstone's (1927) original theory of paired comparisons (pair of choice alternatives). This random utility model predicts choice probabilities by observing perceptions of all relevant choice alternatives and estimating underlying preference functions to predict choice (McFadden 1975, 1980), where unobserved random variables may enter the determination of utility for each consumer, as well as between consumers (McFadden, 1977). RUT thus provides an explanation of the choice behaviour of humans.

With the discrete choice experiment designed for this study, each respondent had a choice from three product profiles presented in each of the 8 (eight) choice sets provided for in the experiment. The responses to the choice questions can be analysed using the random utility framework, where the systematic component of the utility function is assumed to depend on the attributes of the choice option. In addition to the systematic component, the utility function is assumed to contain a random component representing the fact that the analyst cannot observe people's preferences with certainty. It is assumed that the consumer chooses the option that generates the highest utility given available options and constraints. The utility of alternative  $m$  in choice set  $k$  for individual  $j$  can be written as;

$$U_{jkm} = X_{km}\beta + \varepsilon_{jkm}$$

(1)

where  $X_{km}$  is a vector of variables representing characteristics of the  $m$ -th choice alternative in choice set  $k$ .  $\beta$  is a vector of unknown parameters and  $\varepsilon_{jkm}$  is the error term. Let the probability that person  $j$  chooses alternative  $m$  from choice set  $k$  with  $M$  possible choice options, particular to that person,  $K_j$ , be as follows:

$$P(m|K_j) = P[(X_{mj}\beta + \varepsilon_{mj}) > (X_{nj}\beta + \varepsilon_{nj})] \text{ for all } n \text{ options in choice set } K_j, \quad (2)$$

Equation (2) states that the probability that an individual chooses an alternative from some set of offerings is equal to the probability that sum of the systematic and random components of this alternative for that individual is larger than the sum of the systematic and random components of all other alternatives available to that person (Louviere, et al. 2005; Louviere, et al. 2010).

With the random errors in equation (1) independently and identically distributed across the  $m$  alternatives and  $j$  individuals with a *Gumbel* distribution, the probability that an individual selects a specific alternative is a function of the attributes that describes the alternative and the individual's utility for each of those attributes. More formally:

$$P_{jm} = \frac{\exp(X_m \beta_j)}{\sum_{n=1}^M \exp(X_n \beta_j)}, \quad (3)$$

where  $P_{jm}$  is the probability that the alternative  $m$  is selected by the  $j$ -th mahangu consumer,  $X_m$  is a vector of attribute levels for the alternative, and  $\beta_j$  is the vector of part-worths for respondent  $j$ .

For this research, the consumer's utility function for alternative  $m$  is assumed to be the taste of the porridge the flour produces, the colour of the porridge the flour

produces, texture of the porridge the flour produces, and the stickiness of the porridge;

$$X_m = B_1 (taste)_m + B_2 (colour)_m + B_3 (texture)_m + B_4 (stickiness)_m$$

(4)

With the maximum likelihood estimates of the parameters in (1) obtained by the log-likelihood measure;

$$LL = \sum_{j=1}^J \sum_{k=1}^K \sum_{m=1}^M y_{jkm} \ln(p_{km})$$

(5)

$p_{km}$  is a function of the part worth vector ( $w$ ), which is the set of part-worths we are solving for.

Effects coded utilities have an average value of zero for each attribute. The utilities represent the value that respondents place on each attribute level. Because the zero point is the average, we can say that any level above the zero line is more preferred than the average, while those below the line are less preferred (Bakken, Interactive, Frazier & Brown).

Attribute importance generally is calculated by finding the percentage of the range in utilities (maximum less minimum utility) across attributes. Attribute importance provide a summary measure that is easy to compute and has intuitive meaning, but without appropriate reference to the specific attribute levels involved, an importance means very little. The importances are directly related to the attribute level ranges that the analyst used in the experiment (Orme, 2010).

## **2.15. Summary of the chapter**

Indigenous knowledge is an asset of African communities that is a result of applied longitudinal research that is not being exploited for its commercial and social benefits. Acid fermentations have proved a key food processing technology born from indigenous knowledge. Lactic acid fermentations not only improve the aesthetics and taste of mahangu flour but also increase shelf life of mahangu flour and introduce specific benefits for babies into weaning foods.

The harvesting and application of indigenous knowledge holds the key for building sustainable rural communities with direct benefits on the economy of Namibia and social problems such as urbanisation. Traditional milling processes differ from commercial milling processes. Commercial milling does not include the lactic acid fermentation (steeping) procedure. Consumer decision making is influenced by repeated experiences and exposure to common practice in their subcultures, specifically among the ethnic groups in Namibia whose staple is mahangu.

The conceptual and theoretical frameworks presented in this chapter inform the research methodology outlined in Chapter 3.

### **3. Research Methodology**

#### **3.1. Introduction to the Chapter**

Following from the review of relevant literature in Chapter 2, this chapter outlines the research process that was applied to the major research questions of the study.

The two research questions are presented here.

- Do traditional mahangu consumers have a negative attitude towards Meme Mahangu because Namib Mills omitted to incorporate indigenous knowledge into the development and production of Meme Mahangu?
- Are the most preferred mahangu flour attributes those attributes emanating from the traditional lactic acid fermentation process?

#### **3.2. Research Design**

Methodologically a quantitative research design was deployed to draw conclusions from the study population that could be inferred from the sample to the broader population of mahangu consumers.

A survey was deployed for the descriptive research so that the researcher could learn about mahangu consumers' attitudes towards Meme Mahangu and traditional mahangu flour. Fishbein's multi-attribute model was used as the literature base for measuring the overall attitude of mahangu consumers towards Meme Mahangu and traditional mahangu flour. Experimental design, in the form of a discrete choice experiment was used to collect choice data to measure utility assigned to each attribute level displayed across the choice sets. Each respondent had to choose from three mahangu flour profiles/alternatives displayed in the choice set.

### **3.3. Sampling**

Mahangu consumers from Oshikoto, Oshana, Ohangwena, Omusati and Kavango formed the target population of this study. Inhabitants of these regions are primary mahangu growers, producers and consumers within the Namibian context. The Polytechnic of Namibia's student population provided a rich source of the target population consisting of mahangu consumers from Oshikoto, Oshana, Ohangwena, Omusati and Kavango regions respectively.

A probabilistic stratified sampling technique was deployed with a random sample taken from each stratum (Ohangwena, Oshana, Omusati, Oshikoto and Kavango) categorised according to regions in the sampling list. A list of students from these regions was requested from the Polytechnic's MIIS department based on specified criteria. The list was cleaned for students who attended school in these regions but were not originally from these regions (i.e. attended school in Ohangwena but were originally from the Karas region) and would thus not qualify as a mahangu consumer. Surnames and region of origin were the primary criteria used for cleaning the sampling list. Thereafter potential respondents in the sampling list were clustered according to the five regions (Oshikoto, Oshana, Ohangwena, Omusati, and the Kavango regions). A simple random sample was drawn from each of the stratum (regions) relative to the number of students in the selected stratum. Email invitations to participate in the survey were sent to their email addresses.

The responses to the mailed invitations were poor. The researcher then adopted a non-probabilistic sampling technique, in the form of convenience sampling, selecting respondents who were readily available, and who adhered to the criteria of the target population specified under this heading in the opening paragraph.

### **3.4. Data Collection Tools**

An online survey was administered to collect the primary data from the respondents. Email invitations were delivered to each respondent's email address. The researcher also administered the survey in person to the identified target respondents.

### **3.5. Analysis**

The choice data arising from this conjoint choice experiment was analysed using the Multiinomial Logit (MNL) model as a function of the experimental design variables in SPSS software. Descriptive and inferential statistics is also presented. Fishbein's multi-attribute model was used to determine the overall attitude of mahangu consumers toward Meme Mahangu and traditional mahangu flour.

### **3.6. Limitations**

This study is limited by the non-random sampling technique that was deployed (convenience sample).

### **3.7. Scope and Delimitation**

Participation is delimited to mahangu consumers from the Ohangwena, Oshikoto, Oshana, Omusati and Kavango regions who consume traditional and Meme Mahangu flour. Mahangu consumers in Windhoek, who are not from these regions, were excluded from the study. The results of this study will be generalisable to mahangu consumers who are from these regions. The results in this study will not be generalisable to mahangu consumers who are not from the regions outlined in this study.

### **3.8. The Quantitative Research Tools**

Through a quantitative research design the researcher answered the major research questions presented here;

- Do traditional mahangu consumers have a negative attitude towards Meme Mahangu because Namib Mills omitted to incorporate indigenous knowledge into the development and production of Meme Mahangu?
- Are the most preferred mahangu flour attributes those attributes emanating from the traditional lactic acid fermentation process?

The researcher answered these questions through,

- Descriptive research – determine mahangu consumers' overall attitude towards Meme Mahangu and traditionally produced mahangu flour using Fishbein's Multiattribute Model.
- Experimental research – a discrete choice experiment was designed and deployed to collect choice data. The choice data was analysed using the MNL model to reveal the part-worths and total utility for fermented and non-fermented mahangu flour attributes and mahangu flour profiles respectively. The attribute levels were displayed in the mahangu flour profiles across 8 choice sets, with each choice set displaying 3 profiles which were randomly selected from the pool of 24 profiles. The discrete choice experiment =  $(2^3 * 3^1) = 2 * 2 * 2 * 3 = 24$  mahangu flour profiles.

### **3.8.1. Fishbein's Multiattribute Model**

An online research platform was used to design the questionnaire and to develop the discrete choice experiment.

The survey began with general questions on demographics. Branching logic was deployed to sift through respondents that have never consumed mahangu flour related products before (see figure 3.1 for an illustration of the logic applied). Those who were established as mahangu consumers were asked general questions on

mahangu consumption and purchasing patterns. Question 5 terminated the survey, thus if a respondent answered 'No' to question 5, the survey was terminated as the respondent would be deemed irrelevant.

**Table 3.1 Branching Logic for Question 5**

<p><b>Do you consume Mahangu flour?</b></p> <ol style="list-style-type: none"><li>1. Yes</li><li>2. No</li></ol>
--

The second branching option was incorporated here. Rationale for branching logic here was to sift through those mahangu consumers who have never consumed Meme Mahangu. Those respondents who selected "No" were redirected to the discrete choice experiment (choice-based conjoint questions).

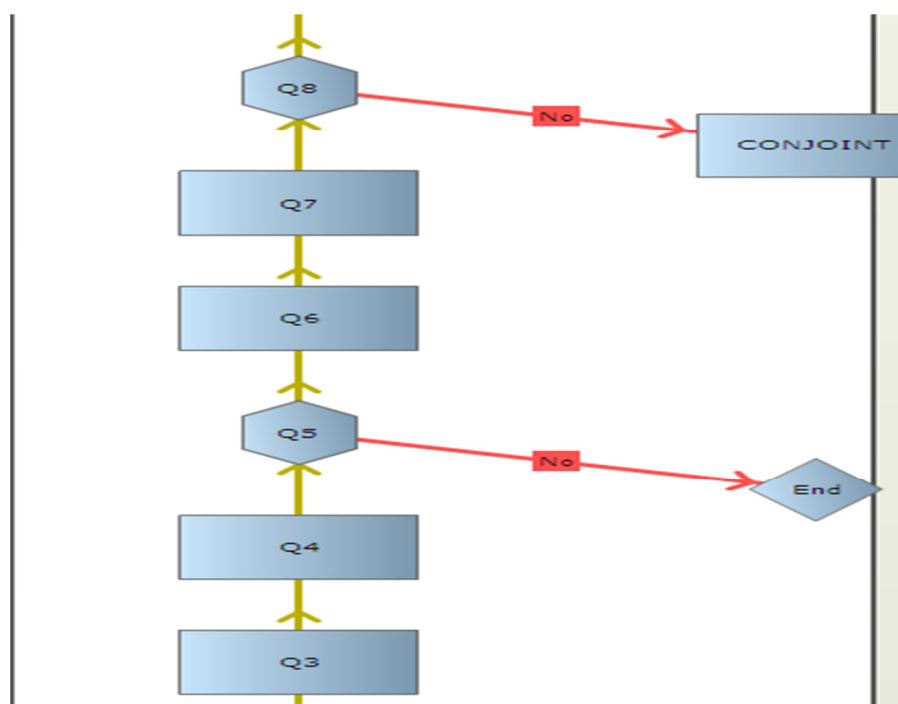
**Table 3.2 Branching Logic for Question 8**

<p><b>Have you ever consumed Meme Mahangu?</b></p> <ol style="list-style-type: none"><li>1. Yes</li><li>2. No</li></ol>
---

Selecting "Yes" directed the respondent to the next set of questions aimed at measuring their overall attitude towards Meme Mahangu and traditional mahangu respectively.

Figure 3.1 illustrates the branching logic deployed for the survey.

**Figure 3.1 Branching Logic Deployed for the Survey**



### **Measuring Attitudes**

#### **The Cognitive Component**

The first part of the tri-component model consist of a person's cognitions, that is, the knowledge and perceptions that are acquired by a combination of direct experience with the attitude object and related information from a variety of sources (Schiffman & Kanuk, 2010). Ndjeunga & Nelson (2000), in their study on mahangu preferences reported that mahangu flour attributes, texture, colour, taste and keeping quality, were rated high in their focus group sessions as attributes associated with mahangu quality. Mafuru et al. (2007); Barrion (2008); and Mallet & Du Plessis (2001) also reported that mahangu flour attributes, taste, colour and texture, as key attributes associated with mahangu flour quality. No study however included fermentation as a salient attribute linked to the quality of mahangu flour.

These findings, the researcher's personal experience and experiments with Meme Mahangu formed the basis of the attribute selection used in this study. For the component of the study measuring attitudes the following attributes were used;

- Fermented or non-fermented mahangu grain,
- Taste of the porridge the flour produces and,
- Colour of the porridge the flour produces.

These attributes were used as the basis to measure the strength of cognitive beliefs on the Meme Mahangu and traditional mahangu flour respectively. They also served the basis for the evaluation of the beliefs for both Meme Mahangu and traditional mahangu.

The cognitive component of the tri-component model is in line with Fishbein's multi-attribute model. The two major elements of Fishbein's multiattribute model are the strengths and evaluations of the salient beliefs.

**Belief strength ( $b_i$ )** is the perceived probability of association between a product and its relevant attributes. Belief strength is measured by having consumers rate this probability of associations for each of their salient beliefs.

Respondents were asked to rate the probability of association for each of the salient beliefs as shown here in this question outlined in the table below:

**Table 3.3 Measuring the strength of consumer's product beliefs (Meme Mahangu)**

Please indicate the degree to which you believe the following statements about Meme Mahangu flour to be true or false.

	Abso lutely true	rue	rue	rue	rue	alse	alse	alse	alse	alse	Abso lutely false
Mahangu grains used to produce Meme Mahangu flour was not fermented (was not put in water to ferment).	<input type="checkbox"/>										<input type="checkbox"/>
Meme Mahangu flour produces porridge with a plain taste.	<input type="checkbox"/>										<input type="checkbox"/>
Meme Mahangu flour produces porridge that is darker than traditional Mahangu porridge.	<input type="checkbox"/>										<input type="checkbox"/>

**Table 3.4 Measuring the strength of consumer’s product beliefs (Traditional Mahangu flour)**

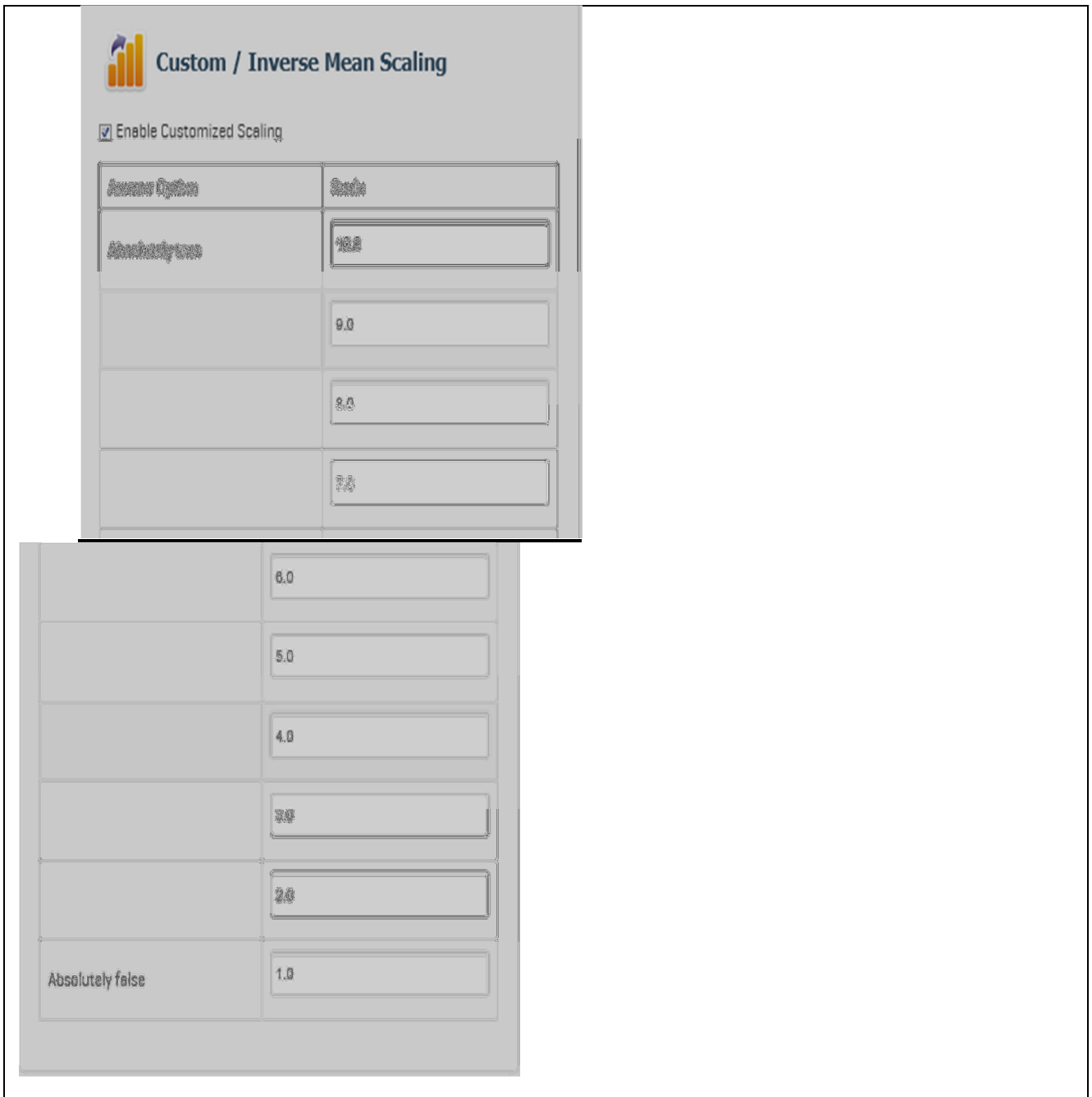
Please indicate the degree to which you believe the following statements about Traditional Mahangu flour (mahangu flour from your village) to be true or false.

	Abs olutely true	rue	rue	rue	rue	alse	alse	alse	alse	alse	Abs olutely false
The grains used to produce the traditional Mahangu flour were put in water to ferment.	<input type="checkbox"/>										<input type="checkbox"/>
Traditional Mahangu flour produces porridge with a sour taste.	<input type="checkbox"/>										<input type="checkbox"/>
Traditional Mahangu flour produces porridge that is light in colour.	<input type="checkbox"/>										<input type="checkbox"/>

**The scale:** This researcher deployed a 10-point scale with a weight of 10 for “Absolutely true” and 1 for “Absolutely false”. The customized scale that was used in

this research is illustrated below in Figure 3.2.

**Figure 3.2 Customised scale used to measure beliefs**



**The affective component**

A consumer's emotions or feelings about a particular product or brand constitute the affective component of an attitude. These emotions and feelings are frequently treated by consumer researchers as primarily evaluative in nature; that is, they capture an individual's direct or global assessment of the attitude object (the extent to which a consumer rates the attitude object as 'good' or 'bad').

**Belief evaluation** ( $e_i$ ) is associated with each salient belief. Belief evaluation reflects how favourably the consumer perceives that attribute. Marketers measure the  $e_i$  component by having consumers indicate their evaluation of each salient belief.

**Table 3.5 Evaluating consumer's product beliefs (Meme Mahangu flour)**

How would you rate the following statements about Meme Mahangu flour?					
	Very Bad	Bad	Neither good nor bad	Good	Very Good
The mahangu grains used to make Meme Mahangu flour are not fermented (grains are not put in water to ferment).	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meme Mahangu flour produces porridge with a plain taste.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meme Mahangu flour produces porridge that is dark in colour.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Table 3.6 Evaluating consumer's product beliefs (Traditional Mahangu flour)**

How would you rate the following statements about Traditional Mahangu flour (mahangu flour from your village).					
	Very bad	Bad	Neither bad nor good	Good	Very good
The mahangu grains used to produce traditional Mahangu flour were put in water to ferment.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Traditional Mahangu flour produces porridge with a sour taste.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Traditional Mahangu flour produces a porridge that is light in colour.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



**The scale:** This researcher made use of a 5-point scale with a weight of “-2” allocated for “Very Bad” and “2” for “Very Good”. The customized scale that was used in this research is illustrated below in Figure 3.3.

**Figure 3.3 Scale for evaluating beliefs**

Answer Option	Scale
Very Bad	-2.0
Bad	-1.0
Neither good nor bad	0.0
Good	1.0
Very Good	2.0

### The Conative Component

Conation, the final component of the tri-component attitude model, is concerned with the likelihood or tendency that an individual will undertake a specific action or behave in a particular way with regard to the attitude object. In marketing and consumer research, the conative component is frequently treated as an expression of the consumer's intention to buy.

**Table 3.7 Willingness-to-buy (Meme Mahangu)**

Which of the following statements best describes the choice that you will buy Meme Mahangu flour the next time you purchase Mahangu flour?

- I definitely will buy Meme Mahangu
- I probably will buy Meme Mahangu
- I am uncertain whether I will buy Meme Mahangu
- I probably will not buy Meme Mahangu
- I definitely will not buy Meme Mahangu

Fishbein's theory was used in the analysis of the belief strength measured from the consumers' probability of association ratings for each of their salient beliefs about mahangu flour. The researcher measured the strength of each belief ( $b_i$ ) by having the respondents indicate the degree to which they agree with the attribute statements made about mahangu flour. Similarly the respondents' belief evaluations reflected how favourably they (mahangu consumers) perceive the attributes of mahangu flour. The researcher measured the  $e_i$  component by having consumers indicate their evaluation of each salient belief. The evaluations of salient beliefs influenced the overall  $A_o$  in proportion to the strength of each belief ( $b_i$ ). Thus, strong beliefs about positive attribute statements had greater effects on  $A_o$  than do weak beliefs about equally positive attributes. Likewise, a negative ( $e_i$ ) reduces the favourability of  $A_o$  in proportion to its ( $b_i$ ) "weight".

Fishbein's multiattribute model was utilised as the base for measuring mahangu consumers' overall attitude toward Meme Mahangu and traditional mahangu flour as a function of two factors; the *strength* of the belief the object has a specific attribute and the *evaluation* of that respective attribute . The model:

$$A_o = \sum_{i=1}^n b_i e_i$$

Where,

$A_o$  = attitude toward the object

$b_i$  = strength of the belief that the object has attribute  $i$

$e_i$  = evaluation of attribute  $i$

$n$  = number of salient beliefs about the object

(Peter & Olson, 2010, p.138)

### **3.8.2. Choice Based Conjoint Analysis**

#### **3.1.1.1. Overview**

Choice-based conjoint analysis is an application of discrete choice modelling deployed to understand consumer decision making. The modelled preferences for mahangu flour required data – that is the observations of individuals' choices i.e. the choice data. The analytical framework is based on the Random Utility Model (RUM) initially outlined by Thurstone and further developed by McFadden and Manski in which utility has a systematic and a random component. The random component may come from unobserved or unobservable attributes, unobserved taste variations, measurement errors or specification errors. Utility is not directly observable, but can be estimated from observed choices.

Choice Based Conjoint (discrete choice) are distinct from other conjoint methods because preferences are elicited by asking respondents to choose one alternative from those presented, rather than asking respondents to rank alternatives, or give them a rating and because the analysis is based on random utility theory (RUT) and not on self-evident measurement theory. In particular when using scales and a neutral option is provided the respondent tend to choose the neutral option which does not provide the researcher with a clear cut indication of the respondent's preference. A large portion of market research commissioned in Namibia is descriptive in nature rather than predictive. Descriptive information is useful to characterize demographics, usage patterns, and attitudes of individuals. Beyond descriptive information, decision makers in Namibia need survey research tools that can predict what the consumers will buy when faced with a variety of brands available with so many product characteristics (Orme, 2010).

To decide what product to sell, decision makers may use their own intuition or the recommendations from those in the industry for many years. These strategies are narrow-minded and reactive. Consumer oriented organisations test potential products in the market through market test evaluations. Buyers are shown the product concepts and asked questions regarding their purchase intent or the products are actually placed in the market for a period of time under a limited marketing budget. These tests can be quite time consuming and expensive and tend to investigate only a limited number of variations of the product concept. Choice based conjoint analysis is a cost effective method of testing a great number of product concepts in a relatively short time across a large number of consumers. The Internet as a communications technology further enhances the speed at which target audiences can be reached and surveyed.

The key characteristics of discrete choice experiments are that respondents evaluate product profiles composed of multiple conjoint elements (attributes or features). Based on how respondents evaluate the combined elements (the product concepts) we deduce the preference scores that they might have assigned to individual components of the product that would have resulted in those overall evaluations (Orme, 2010, p. 31). Marketing professor Paul Green recognized that the article by Luce and Tukey (1964) as cited in (Orme, 2010, p. 32) on conjoint analysis, published in a non-marketing journal, could be useful in the context of marketing problems such as understanding how buyers made complex purchase decisions, to estimate preferences and importance for product features, and to predict buyer behaviour. By the early 1980s, conjoint analysis was gaining in popularity among leading researchers and academics possessing considerable statistical knowledge and computer programming skills. In 1985, Johnson and his new company, Sawtooth Software, released a software system called Adaptive Conjoint Analysis (ACA).

Johnson discovered that he could programme a computer to administer the survey and collect the data. The computer could adapt the survey to each individual in real-time, asking only the most relevant trade-offs (Orme, 2010, p. 32).

Jordan Louviere and colleagues did not rest on their laurels and were adapting the idea of choice analysis among available alternatives and multinomial logit models to primarily, transportation and marketing problems. The groundwork for modelling choice among multiple alternatives had been laid by McFadden in the early 1970s.

In choice analysis, the buyers did not rank or rate series of products prior to purchase, they simply observed a set of available alternatives and make a choice. From a theoretical and statistical standpoint, choice analysis was more defensible than ratings-based conjoint analysis. With discrete choice there typically was not enough information to model each respondent's preferences.

Rather, aggregate or summary models of preference were developed across groups of respondents. Aggregate models were subject to various problems such as independence from irrelevant alternatives (IIA or the red bus/blue bus problem) and ignorance of the separate preference functions for latent subgroups.

Discrete choice experiments are typically more difficult to design and analyse than traditional full-profile conjoint or ACA. Commercial software made it much easier to design and conduct CBC studies. With individual-level models under HB, IIA and other problems due to aggregation were controlled or solved (Orme, 2010, p. 35).

The choice data analysed were collected from the discrete choice experiment designed and administered to the target respondents. Discrete choice experimentation involves the design of product profiles on the basis of product attributes specified at certain levels, and requires respondents to repeatedly choose

one alternative from different sets of profiles offered to them instead of ranking/rating all profiles. The choice data from the administered discrete choice experiment was analysed using the Multinomial Logit (MNL) model as a function of the experimental design variables (Chrzan & Orme, 2000; Louviere & Woodworth, 1983) using maximum likelihood technique.

### **3.1.1.2. Designing the stimuli**

Stimuli, in discrete choice experiments, can be either full profile or partial profile. The researcher used the full profile experiment displaying a level from every attribute in the study in every product profile. This study used a four-attribute conjoint study with attributes “Taste” with three levels and “Colour, Texture and Stickiness” with two levels each. This can be written as  $(2^3 * 3^1) = 2 * 2 * 2 * 3 = 24$  profiles. The researcher subsequently designed a discrete choice experiment with 8 (eight) choice sets. Each choice set had three product profiles. Thus 8 choice sets, each with 3 profiles, translates to the full 24 profiles.

The following outlines the attributes and their corresponding levels;

$A_1$  : Taste {plain, sour, bitter}

$A_2$  : Colour (Light in colour, Dark in colour)

$A_3$  : Texture (Firm, Soft)

$A_4$  : Stickiness (Sticky on hand, Not sticky on hand)

### **3.1.1.3. Coding of levels**

Effects type coding was deployed for the coding of the levels for presenting the part-worths for the attribute levels. When all attributes are coded this way and each

level appears with equal frequency in the design, the sum of the part-worths across attributes is equal to zero.

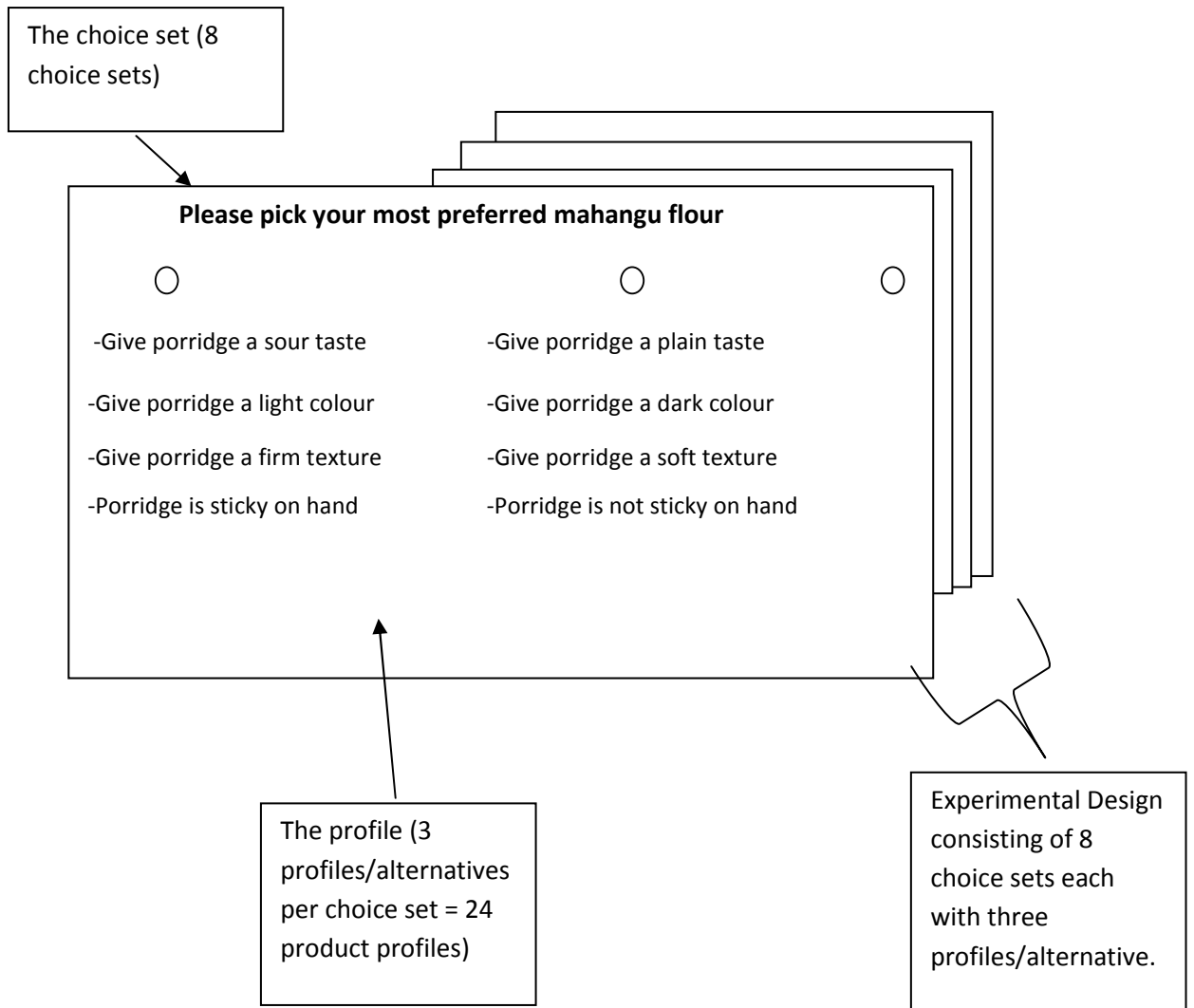
**Table 3.8 Attribute and attribute levels**

Attribute	Definition	Levels	Coded
Taste	Taste of the cooked stiff porridge the flour produces.	Plain Sour Bitter	[1] [2] [3]
Colour	Colour of the cooked stiff porridge the flour produces.	Light in colour Dark in colour	[1] [2]
Texture	Texture of the cooked stiff porridge the flour produces.	Firm Soft	[1] [2]
Stickiness	Stickiness of the porridge on hand	Sticky on hand Not sticky on hand	[1] [2]

**3.1.1.4. The Discrete Choice Experiment**

Respondents chose their preferred profile among sets of experimentally controlled sets of profiles and these choices were modelled using multinomial logit (MNL) as a function of the experimental design variables.

**Figure 3.4 The Discrete Choice Experiment**



With the discrete choice experiment designed for this study, each respondent had a choice from three product profiles presented as a choice set across 8 (eight) choice sets provided for in the experiment.

The responses to the choice questions can be analysed using the random utility framework, where the systematic component of the utility function is assumed to depend on the attributes of the choice option. In addition to the systematic component, the utility function is assumed to contain a random component representing the fact that the analyst cannot observe people's preferences with certainty. It is assumed that the consumer chooses the option that generates the highest utility given available options and constraints. The utility of alternative  $m$  in choice set  $k$  for individual  $j$  can be written as;

$$U_{jkm} = X_{km}\beta + \varepsilon_{jkm} \quad (1)$$

where  $X_{km}$  is a vector of variables representing characteristics of the  $m$ -th choice alternative in choice set  $k$ .  $\beta$  is a vector of unknown parameters and  $\varepsilon_{jkm}$  is the error term. Let the probability that person  $j$  chooses alternative  $m$  from choice set  $k$  with  $M$  possible choice options, particular to that person,  $K_j$ , be as follows:

$$P(m|K_j) = P[(X_{mj}\beta + \varepsilon_{mj}) > (X_{nj}\beta + \varepsilon_{nj})] \text{ for all } n \text{ options in choice set } K_j, \quad (2)$$

Equation (2) states that the probability that an individual chooses an alternative from some set of offerings is equal to the probability that sum of the systematic and random components of this alternative for that individual is larger than the sum of the systematic and random components of all other alternatives available to that person (Louviere et al., 2005; Louviere et al., 2010).

With the random errors in equation (1) independently and identically distributed across the  $m$  alternatives and  $j$  individuals with a Gumbel distribution, the probability that an individual selects a specific alternative is a function of the

attributes that describes the alternative and the individual's utility for each of those attributes. More formally:

$$P_{jm} = \frac{\exp(X_m \beta_j)}{\sum_{n=1}^M \exp(X_n \beta_j)} \quad , \quad (3)$$

where  $P_{jm}$  is the probability that the alternative  $m$  is selected by the  $j$ -th mahangu consumer,  $X_m$  is a vector of attribute levels for the alternative, and  $\beta_j$  is the vector of part-worths for respondent  $j$ . For this research, the consumer's utility function for alternative  $m$  is assumed to be the taste of the porridge the flour produces, the colour of the porridge the flour produces, texture of the porridge the flour produces, and the stickiness of the porridge;

$$X_m = B_1 (\text{taste})_m + B_2 (\text{colour})_m + B_3 (\text{texture})_m + B_4 (\text{stickiness})_m \quad (4)$$

The researcher deemed it necessary to remove the attribute *stickiness* as a parameter for the estimation of the part-worth utilities using the MNL model. More formally the utility function for alternative  $m$  that would be presented in the findings and included in the primary discussion of the results is assumed to be the taste of the porridge the flour produces, the colour of the porridge the flour produces and the texture of the porridge the flour produces;

$$X_m = B_1 (\text{taste})_m + B_2 (\text{colour})_m + B_3 (\text{texture})_m \quad (5)$$

With the maximum likelihood estimates of the parameters in (1) obtained by the log-likelihood measure;

$$LL = \sum_{j=1}^J \sum_{k=1}^K \sum_{m=1}^M y_{jkm} \ln(p_{km})$$

(6)

$p_{km}$  is a function of the part worth vector ( $w$ ), which is the set of part-worths we are solving for. Effects coded utilities have an average value of zero for each attribute. The utilities represent the value that respondents place on each attribute level. Because the zero point is the average, we can say that any level above the zero line is more preferred than the average, while those below the line are less preferred (Bakken, Interactive, Frazier & Brown)

Attribute importance generally is calculated by finding the percentage of the range in utilities (maximum less minimum utility) across attributes. Attribute importance provide a summary measure that is easy to compute and has intuitive meaning, but without appropriate reference to the specific attribute levels involved, an importance means very little. The importances are directly related to the attribute level ranges that the analyst used in the experiment (Orme, 2010). Based on the analysis of the observed data the following marketing questions can be answered;

- 1) What is the part-worth of each of the mahangu flour attribute levels
- 2) What is the relative importance of the mahangu flour attributes?
- 3) What is the overall utility of specific mahangu flour profiles?



## **4. Chapter 4 Findings and discussion**

### **4.1. Introduction to the Chapter**

This chapter provides all the key findings from the attitudinal study and the analysis of the choice data from the discrete choice experiment. The chapter starts with a general overview of the survey and an outline of the demographics of the respondents who have participated in the survey for this study. Then it moves over to discuss the findings from the attitudinal study and finally it presents the analysis of the data from the discrete choice experiment.

### **4.2. Survey Overview**

In table 4.1 we have the statistic indicating that one hundred and thirty-one (131) viewed the survey, 80 started the survey and 28 dropped out after starting, with 54 completed giving us a completion rate of 67.5%. Average time it took for respondents to complete the survey was 11 minutes.

**Table 4.1 Survey overview statistic**

Viewed	Started	Completed	Completion Rate	Drop Outs (After Starting)	Average Time to Complete Survey
131	80	54	67.5%	26	11 minutes

**Figure 4.1 Pie Chart of the Survey overview statistic**

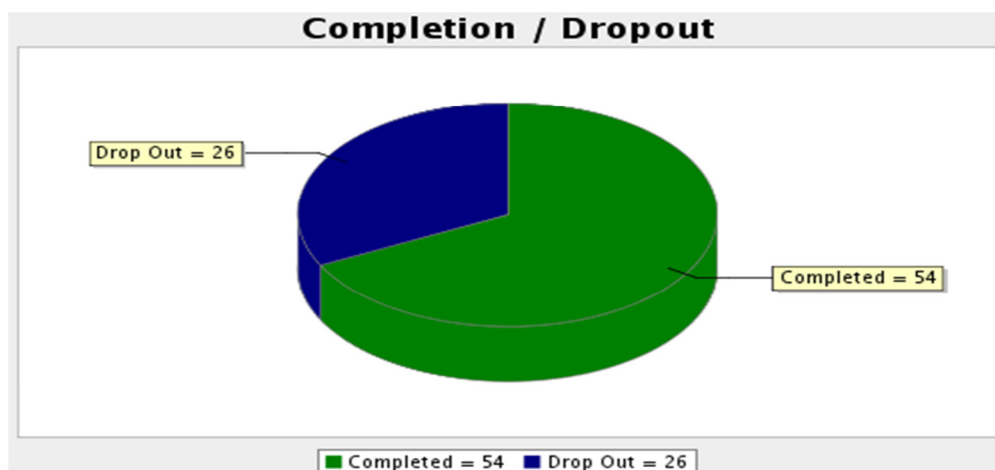
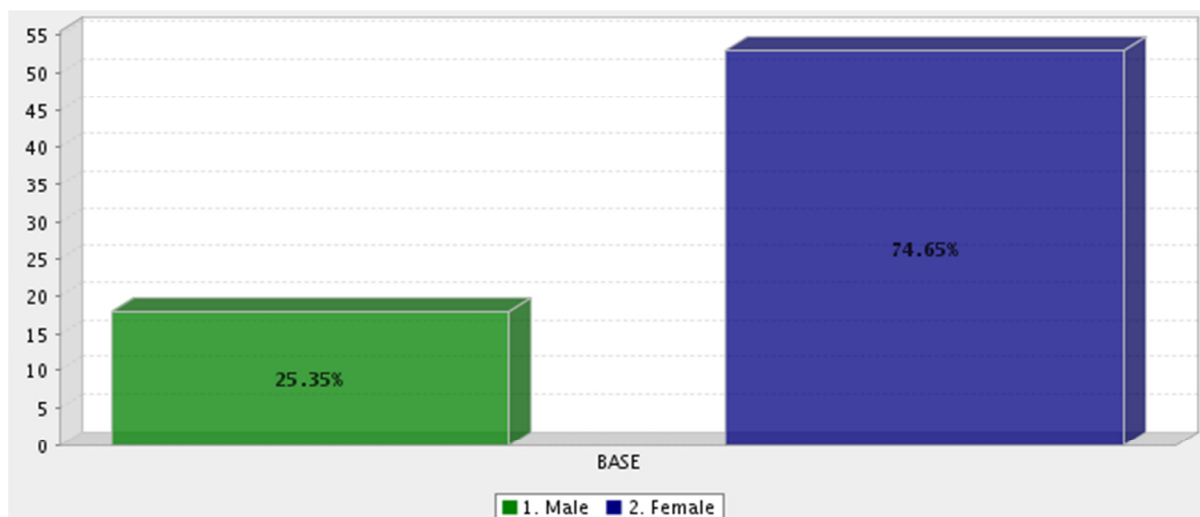


Figure 4.2 Gender split

Gender

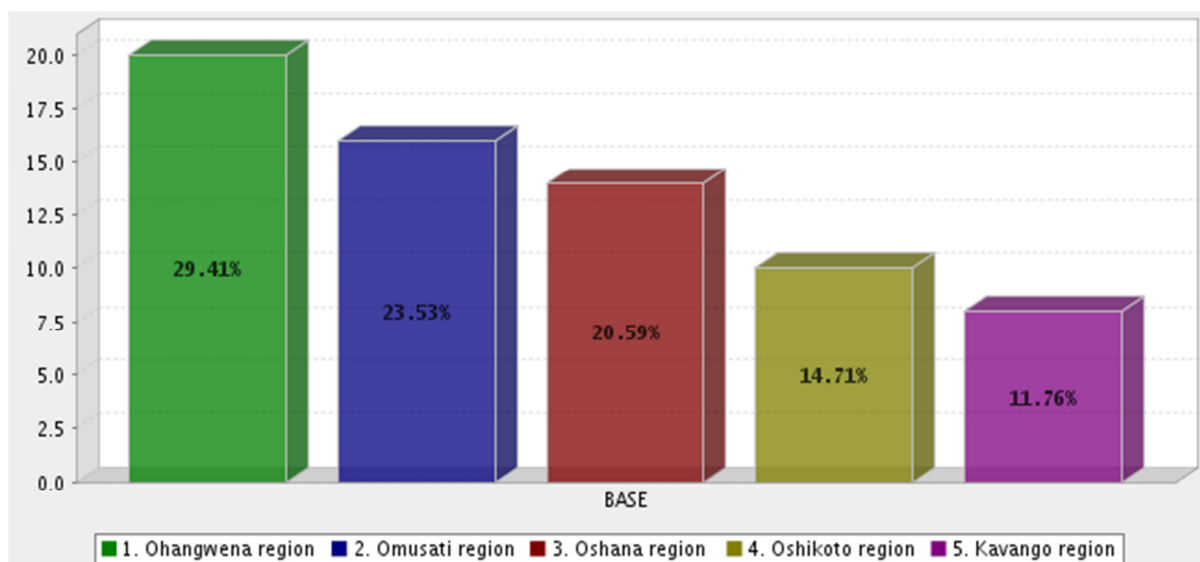


The representation from figure 3.2 might at first appear skewed. The reader should however, understand that the researcher deliberately sought this distribution due to the fact that women are the ones who traditionally fulfil the roles of processing and preparing mahangu flour and thus formed the core target population. This assumption is supported by Mallet & Du Plessis (2001); Natanga (2006); Barrion (2008) and the researcher's personal experience.

### **Region**

Respondents from the four O regions (Omusati, Oshana, Oshikoto, and Oshana) in the north central regions of Namibia and the Kavango in the north east region of Namibia were represented. These regions are the primary mahangu producers, processors and consumers in Namibia and made them the ideal target segments of the mahangu consumer population.

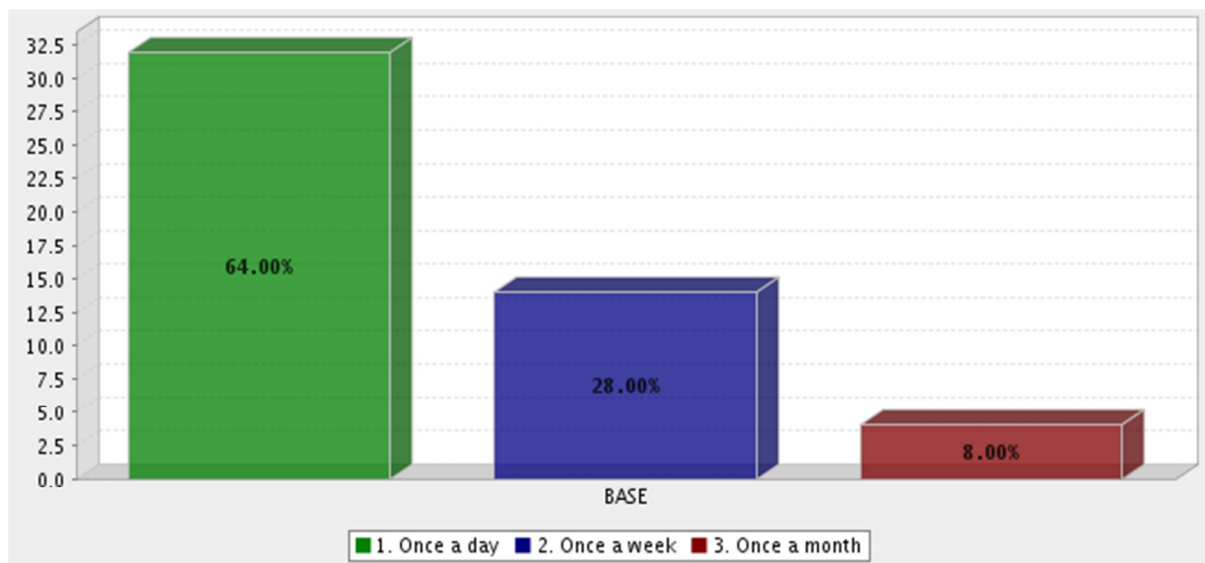
**Figure 4.3 Region**



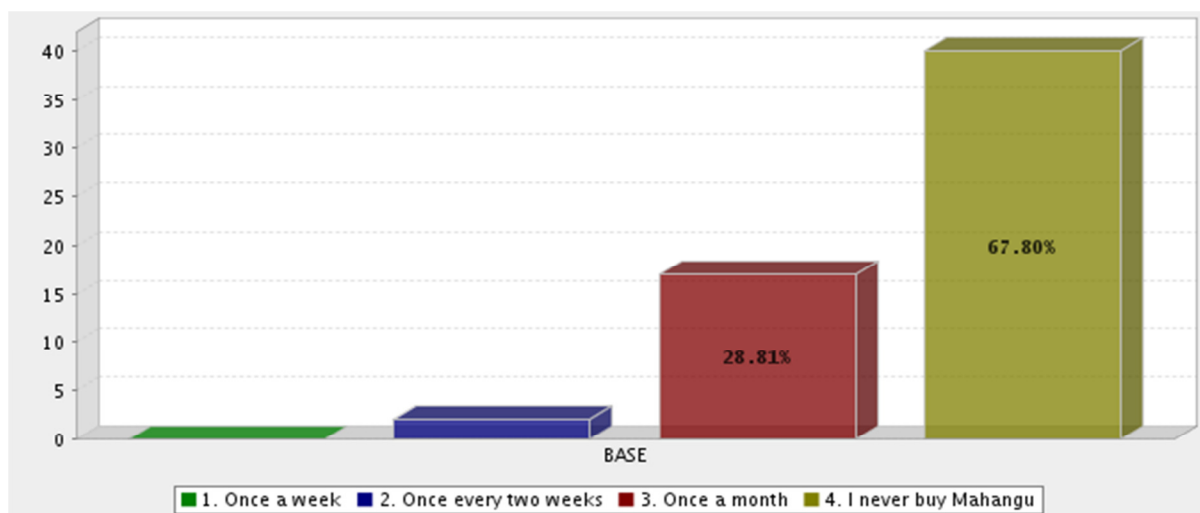
### **Mahangu flour Consumption Patterns vs. Purchasing Frequency**

The following bar charts provide a brief overview of the consumption patterns and purchase frequency of those who participated in the survey.

**Figure 4.4 Q6. How often do you consume Mahangu flour?**



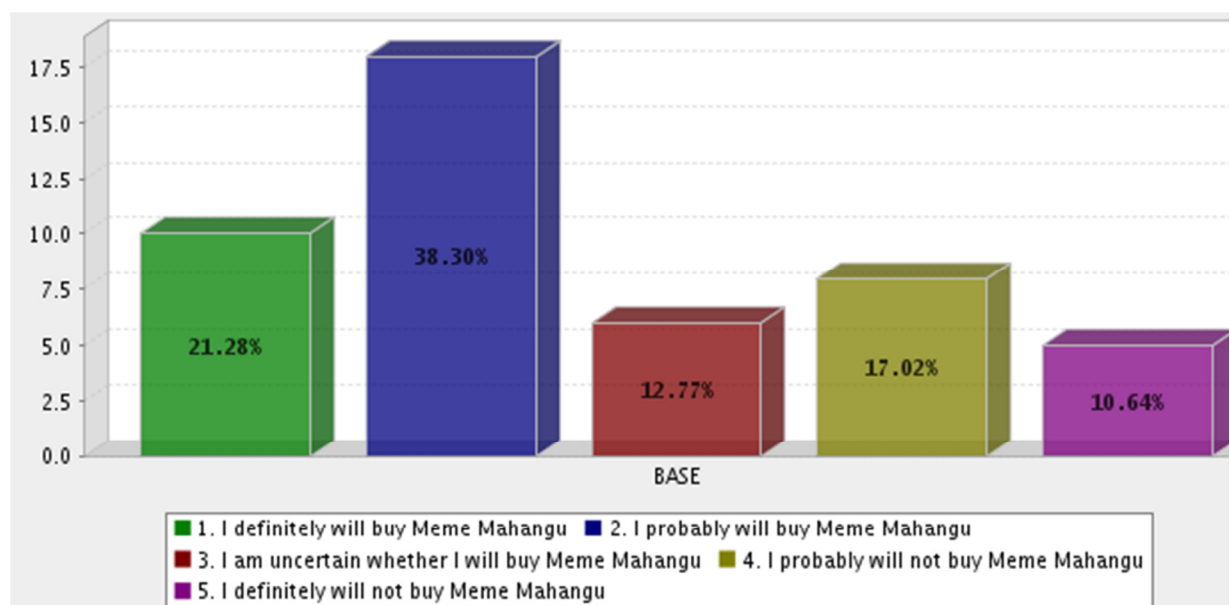
**Figure 4.5 Q7. How often do you buy Mahangu flour?**



In line with expectation, mahangu consuming households from the major mahangu consuming regions in Namibia do not buy mahangu flour often. 68% of the respondents said that they never buy mahangu flour.

Interestingly enough the researcher found that, when he measured their intention to buy, a great number of the respondents indicated that they would buy Meme Mahangu the next time they buy mahangu flour as can be seen from figure 4.6 and table 4.3.

**Figure 4.6 Q12. Which of the following statements best describes the choice that you will buy Meme Mahangu the next time you purchase mahangu flour?**



It could be hypothesised that the high percentage (60%) of positive attitude towards buying Meme Mahangu is directly attributable to the fact that mahangu grain from the rural areas are in scarce supply due to the drought Namibia is facing. Also, the absence of a commercial variety available on the shelves of the retailers in the market could have influenced their decisions. Also the role mahangu play in the food consumption culture of the regular mahangu consuming household they see no other option but to buy Meme Mahangu.

#### **4.3. Application of Fishbein’s multi-attribute model to measure consumer attitudes**

Fishbein's multiattribute model was used to measure mahangu consumer's overall attitude toward Meme Mahangu and Traditional Mahangu as a function of two factors; the *strength* of the salient beliefs associated with the object and the *evaluations* of those beliefs. The model:

$$A_o = \sum_{i=1}^n b_i e_i$$

Where,

$A_o$  = attitude toward the object

$b_i$  = strength of the belief that the object has attribute  $i$

$e_i$  = evaluation of attribute  $i$

$n$  = number of salient beliefs about the object

**Table 4.4 Belief strength that the grains used to produce Meme Mahangu were not fermented**

<b>Answer</b>	<b>Count</b>	<b>Percent</b>
Absolutely true	25	53.19%
True	1	2.13%
True	2	4.26%
True	3	6.38%
True	1	2.13%
False	1	2.13%
False	1	2.13%
False	3	6.38%
False	2	4.26%
Absolutely false	8	17.02%
Total	47	100%
<b>Custom Scale Mean : 7.064</b>		

On a 10-point scale “Absolutely True” where scored a 10, and “Absolutely False” scored a 1. Aggregated across 47 respondents a mean score of 7.064 was calculated. This shows that the respondents have a strong belief that the grains used to produce Meme Mahangu were in fact not fermented. Based on the current commercial production practices grains used to produce Meme Mahangu are not fermented. The mean highlighted here would be incorporated into the formula to calculate the mahangu consumers overall attitude towards Meme Mahangu.

**Table 4.5 Mahangu consumer’s belief strength on the taste of Meme Mahangu**

Answer	Count	Percent
Absolutely true	10	21.28%
True	0	0.00%
True	3	6.38%
True	1	2.13%
True	3	6.38%
False	1	2.13%
False	3	6.38%
False	2	4.26%
False	2	4.26%
Absolutely false	22	46.81%
Total	47	100%
Custom Scale Mean : <b>4.213</b>		

Aggregated across 47 respondents a mean score of 4.213 calculated. The respondents do not have a strong belief that Meme Mahangu flour produces porridge with a plain taste.

**Table 4.6 Belief Strength that Meme Mahangu flour produces a porridge that is darker than Meme Mahangu**

Answer	Count	Percent
Absolutely true	2	45.65%
	1	
True	2	4.35%
True	1	2.17%
True	1	2.17%
True	6	13.04%
False	0	0.00%
False	0	0.00%
False	1	2.17%
False	1	2.17%
Absolutely false	1	28.26%
	3	
Total	4	100%
	6	
<b>Custom Scale Mean : 6.457</b>		

Table 4.6 shows that respondents have a strong belief that Meme Mahangu flour produces a porridge that is darker than traditional mahangu flour. Aggregated across 46 respondents a mean score of 6.457 was calculated.

**Evaluation of attributes associated with Meme Mahangu**

Here respondents were asked to evaluate the same attributes associated with Meme Mahangu.

**Table 4.7 Evaluation of beliefs on fermentation**

Answer	Count	Percent
Very Bad	6	13.33%
Bad	14	31.11%
Neither good nor bad	12	26.67%
Good	10	22.22%
Very Good	3	6.67%
Total	45	100%
Custom Scale Mean : <b>-0.222</b>		

A five-point scale where used to measure their evaluation of the attributes associated with Meme Mahangu with “Very Bad” scored “-2”, Bad “-1”, Neither good nor bad, “0”, Good, “1”, and Very Good scored “2”. The aggregated mean score of

negative 0.222 translates into a negative evaluation of the fact that Meme Mahangu grains were not fermented.

**Table 4.8 Evaluations based on the taste of Meme Mahangu**

Answer	Count	Percent
Very Bad	4	8.89%
Bad	29	64.44%
Neither good nor bad	7	15.56%
Good	3	6.67%
Very Good	2	4.44%
Total	45	100%
Custom Scale Mean : <b>-0.667</b>		

The aggregated mean score of negative 0.667 tells us that mahangu consumers do not like mahangu porridge with no taste. The choice data from the discrete choice experiment reveals a sour taste as the most preferred taste for mahangu porridge.

**Table 4.9 Evaluations that Meme Mahangu flour produces a porridge with a dark colour**

Answer	Count	Percent
--------	-------	---------

Very Bad	4	8.89%
Bad	20	44.44%
Neither good nor bad	13	28.89%
Good	5	11.11%
Very Good	3	6.67%
Total	45	100%
Custom Scale Mean : <b>-0.378</b>		

Colour of mahangu porridge is a very important attribute for mahangu consumers. And bad news for Namib Mills, because those surveyed indicated a very strong belief that Meme Mahangu flour produces a porridge that is darker than traditional porridge and the evaluations of porridge with a dark colour extremely negative with 52% of the total respondents rating a dark coloured porridge as bad. The aggregated mean score of negative 0.378 shows the lowest score for dark coloured mahangu porridge out of the three attributes associated with Meme Mahangu flour.

**Measuring and evaluating belief strengths of traditional mahangu flour.**

**Table 4.10 Measuring beliefs that traditional mahangu were fermented**

Answer	Count	Percent
Absolutely true	37	86.05%
True	2	4.65%
True	1	2.33%
True	1	2.33%

True	0	0.00%
False	0	0.00%
False	0	0.00%
False	0	0.00%
False	1	2.33%
Absolutely false	1	2.33%
Total	43	100%
Custom Scale Mean : <b>9.442</b>		

Eighty six percent (86%) believe that the grains used to produce traditional mahangu flour were fermented, with only 4.7% believing that it is false. This shows a very strong belief that traditional mahangu grains go through the fermentation process. This is further proof of what is indicated in the literature review that the traditional milling process includes the lactic acid fermentation process. The aggregated means score calculated for this dataset is 9.442.

**Table 4.11 Belief strength of the sour taste of traditional mahangu**

Answer	Count	Percent
Absolutely true	14	32.56%
True	2	4.65%
True	5	11.63%
True	0	0.00%

True	2	4.65%
False	0	0.00%
False	1	2.33%
False	1	2.33%
False	3	6.98%
Absolutely false	15	34.88%
Total	43	100%
Custom Scale Mean : <b>5.535</b>		

Mahangu consuming households do not have a very strong believe that traditional mahangu flour produces porridge with a sour taste. The aggregated mean score for the dataset is calculated at 5.535.

**Table 4.12 Belief strength on the colour of traditional mahangu porridge**

Answer	Count	Percent
Absolutely true	24	55.81%
True	3	6.98%
True	2	4.65%
True	2	4.65%
True	2	4.65%
False	1	2.33%
False	2	4.65%

False	1	2.33%
False	0	0.00%
Absolutely false	6	13.95%
Total	43	100%
Custom Scale Mean : <b>7.698</b>		

More than 70% of the respondents believe that traditional mahangu flour produces porridge with a light colour. The aggregated mean score for this dataset was calculated at 7.698.

### **Evaluation of attributes associated with Meme Mahangu**

Here respondents were asked to evaluate the same attributes associated with Meme Mahangu.

**Table 4.13 Evaluation on the fermentation of traditional mahangu**

Answer	Count	Percent
Very bad	1	2.27%
Bad	3	6.82%

Neither bad nor good	6	13.64%
Good	19	43.18%
Very good	15	34.09%
Total	44	100%
Custom Scale Mean : <b>1.000</b>		

A five-point scale where used to measure their evaluation of the attributes associated with Meme Mahangu with “Very Bad” scored “-2”, Bad “-1”, Neither good nor bad, “0”, Good, “1”, and Very Good scored “2”. The aggregated mean score of positive 1.0 translates into a positive evaluation of the fact that traditional mahangu grains were fermented before they were pounded into flour.

**Table 4.14 Evaluating the sour taste of fermented mahangu porridge**

Answer	Count	Percent
Very bad	7	15.91%
Bad	13	29.55%
Neither bad nor good	8	18.18%

Good	11	25.00%
Very good	5	11.36%
Total	44	100%
Custom Scale Mean : <b>-0.136</b>		

The aggregated mean score is negative 0.136. Looking at table 4.19 we see that the evaluations are balanced with the neutral option providing the key in how the result will be swung. It is interesting to note at this stage that the discrete choice experiment brought out the utility for sour taste which will swing this result to a positive evaluation of the sour taste of traditional mahangu porridge.

**Table 4.15 Evaluating the colour of traditional mahangu**

Answer	Count	Percent
Very bad	0	0.00%

Bad	3	6.82%
Neither bad nor good	8	18.18%
Good	15	34.09%
Very good	18	40.91%
Total	44	100%
Custom Scale Mean : <b>1.091</b>		

Colour is definitely the most important attribute for mahangu consumers. The aggregated mean score for this dataset was calculated at 1.091.

It is interesting to note that the respondents evaluated the attributes associated with non-fermented mahangu flour negatively. They also associate these attributes with Meme Mahangu flour. On the other hand the respondents evaluated the attributes associated with fermented mahangu flour positively. They associate these attributes with traditional mahangu flour and not with Meme Mahangu.

Fishbein's multiattribute model was used to measure mahangu consumer's overall attitude toward Meme Mahangu and Traditional Mahangu as a function of

two factors; the *strength* of the salient beliefs associated with the object and the *evaluations* of those beliefs. The model:

$$A_o = \sum_{i=1}^n b_i e_i$$

Where,

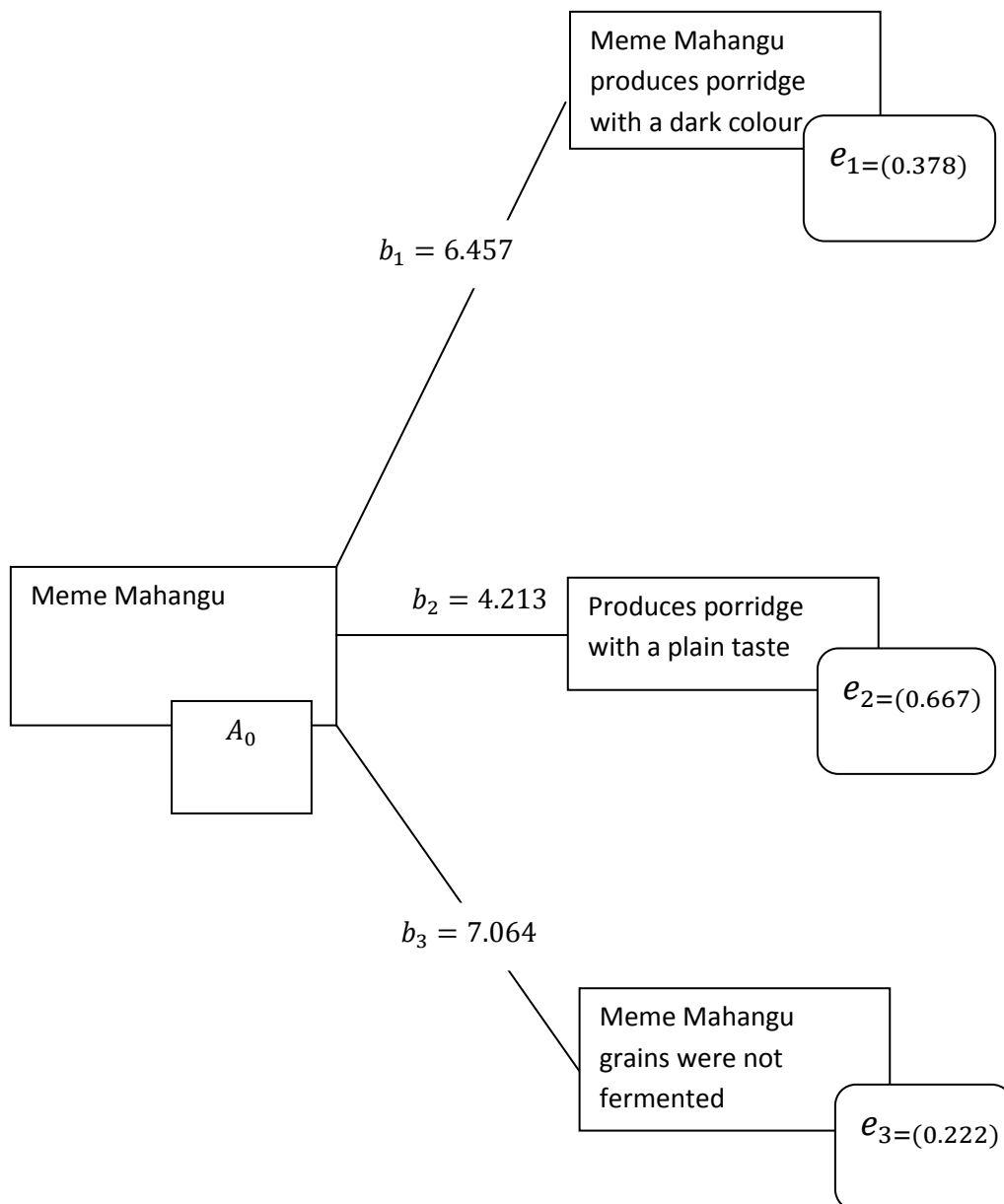
$A_o$  = attitude toward the object

$b_i$  = strength of the belief that the object has attribute  $i$

$e_i$  = evaluation of attribute  $i$

$n$  = number of salient beliefs about the object

**Figure 4.19 Overall attitude towards Meme Mahangu**



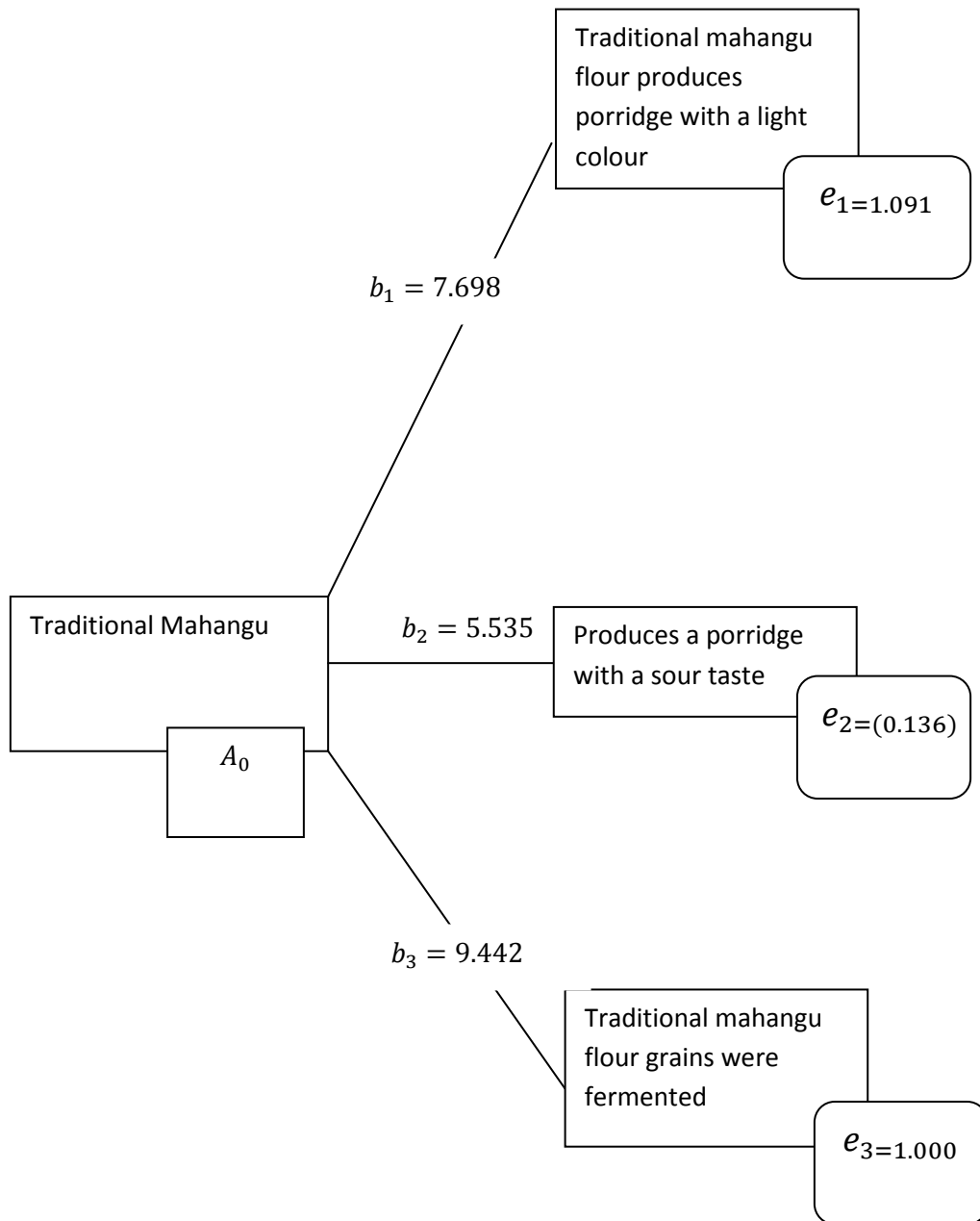
$$Attitude_{Meme\ Mahangu} = \sum_{i=1}^3 b_i e_i$$

$$A_0 = (6.457)(-0.378) + (4.231)(-0.667) + (7.064)(-0.222)$$

$$A_0 = (-2.44) + (-2.82) + (-1.57)$$

$$A_0 = -6.83$$

**Figure 4.20 Overall attitude towards traditional mahangu**



$$Attitude_{Meme\ Mahangu} = \sum_{i=1}^3 b_i e_i$$

$$A_0 = (7.698)(1.091) + (5.535)(-0.136) + (9.442)(1.000)$$

$$A_0 = 8.34 + (-0.75) + 9.44$$

$$A_0 = 17.03$$

## **Discussion on the attitudes toward Meme Mahangu and traditional mahangu flour**

### **Belief Strength (Meme Mahangu – Fermentation)**

There is strong believe among respondents (those who have consumed Meme Mahangu) that the grains used to produce Meme Mahangu flour were not fermented. This is indicated on a 10-point scale with an aggregated mean score of 7.064. Compared to the actual production practices of Meme Mahangu flour the respondents' share the right believe, Meme Mahangu grains are not fermented.

### **Belief Evaluation (Meme Mahangu – Fermentation)**

The respondents were asked to evaluate the fact that Meme Mahangu grains were not fermented. This attribute received a negative evaluation with an aggregated mean score of negative 0.222.

### **Belief Strength (Meme Mahangu – Taste)**

The mahangu consumers thus do not have a very strong believe that Meme Mahangu flour produces porridge with a plain taste. The aggregated mean score for this dataset was calculated as 4.213.

### **Belief Evaluation (Meme Mahangu – Taste)**

Respondents do not like mahangu porridge with a plain taste. An aggregated mean score of negative 0.667 was calculated.

### **Belief Strength (Meme Mahangu – Colour)**

There is a strong believe amongst the respondents that Meme Mahangu flour produces a porridge that is darker than the porridge traditional mahangu flour produces. The aggregated mean score for the data set is calculated as 6.457.

### **Belief Evaluation (Meme Mahangu – Colour)**

The respondents do not like mahangu porridge that is dark in colour. The mahangu consumers surveyed indicated a very strong belief that Meme Mahangu produces a porridge that is darker than traditional porridge and the evaluations of porridge with a dark colour scored extremely negative with 52% of the total respondents rating a dark coloured porridge as bad. The aggregated mean score for this dataset is calculated as negative 0.378.

### **Belief Strength (traditional mahangu – Fermentation)**

Eighty six percent (86%) of the mahangu consumers surveyed belief that the grains used to produce traditional mahangu flour were fermented, with only 4.7% believing that it is false. This shows a very strong believe that traditional mahangu grains go through the fermentation process. This is further proof as outlined in the literature that traditional milling includes the lactic acid fermentation process. The aggregated mean score calculated for this dataset is 9.442.

### **Belief Evaluation (traditional mahangu – Fermentation)**

Seventy-seven percent (77%) of the respondents evaluated the lactic acid fermentation process of traditional mahangu positively. We can thus draw the conclusion that the fermentation process is an extremely important attribute for the

mahangu flour consumer in Namibia. The aggregated mean score calculated for this dataset is 1.000.

### **Belief Strength (traditional mahangu – Taste)**

Respondents have an average believe that traditional mahangu flour produces porridge with a sour taste. The aggregated mean score for the dataset is calculated as 5.535.

### **Belief Evaluation (traditional mahangu – Taste)**

Here the aggregated mean score is calculated as negative 0.136. It is interesting to note that the choice data from the discrete choice experiment revealed that sour taste is the most preferred mahangu flour attribute. This could possibly be attributed to the choice from a basket of alternatives against the scaled response on a single attribute.

### **Belief Strength (traditional mahangu – Colour)**

Respondents have a strong believe that traditional mahangu flour produces porridge with a light colour. The aggregated mean score for this dataset was calculated as 7.698.

### **Belief evaluation (traditional mahangu – Colour)**

Colour is definitely the most important attribute for the mahangu consumers surveyed. The aggregated mean score for this dataset was calculated as 1.091.

### Interpreting the scores – Fishbein’s multi-attribute model

$$Attitude_{Meme\ Mahangu} = \sum_{i=1}^3 b_i e_i$$

$$A_0 = (6.457)(-0.378) + (4.231)(-0.667) + (7.064)(-0.222)$$

$$A_0 = (-2.44) + (-2.82) + (-1.57)$$

$$A_0 = -6.83$$

The negative evaluation of the attributes associated with Meme Mahangu show that respondents dislike attributes associated with non-fermented mahangu flour. They also have a very strong believe that Meme Mahangu flour possess the attributes associated with non-fermented mahangu flour. The overall evaluation of Meme Mahangu flour is negative.

$$Attitude_{Traditional\ Mahangu} = \sum_{i=1}^3 b_i e_i$$

$$A_0 = (7.698)(1.091) + (5.535)(-0.136) + (9.442)(1.000)$$

$$A_0 = 8.34 + (-0.75) + 9.44$$

$$A_0 = 17.03$$

The positive evaluation of the attributes associated with traditional mahangu show that respondents like attributes associated with fermented mahangu flour. They also have a very strong believe that traditional mahangu flour possess the attributes associated with fermented mahangu flour. The overall evaluation of traditional mahangu flour is positive.

#### 4.4. Discrete choice experiment

Respondents had to select their most preferred mahangu flour from a selection of three (3) mahangu flour profiles/alternatives presented in each choice set across a total of eight (8) choice-sets. This is a total of 24 mahangu flour profiles that were displayed to every individual respondent ( $n = 51$ ). Thus a total number of 1224 profiles displayed across 8 choice-sets to 51 respondents.

**Table 4.16 Choice Sets**

		Freq uency	Per cent	Valid Percent	Cumulati ve Percent
	1	153	12. 4	12.4	12.4
.0	2	153	12. 4	12.4	24.9
V	3	153	12. 4	12.4	37.3
alid	4	153	12. 4	12.4	49.8
	5	153	12. 4	12.4	62.2
.0					

6	153	12.4	12.4	74.6
.0		4		
7	153	12.4	12.4	87.3
.0		4		
8	153	12.4	12.4	100.0
.0		4		
Total	1224	100.0	100.0	
otal		.0		

The three alternatives were, on average, displayed 408 times to each respondent ( $n=51$ ) translating to 1224 times the three profiles with varying attribute levels were displayed to the respondents as choices from which they would select their most preferred mahangu flour across the 8 choice sets provided for the discrete choice experiment.

**Table 4.17 Mahangu flour alternatives**

	Frequency	Percent	Valid Percent	Cumulative Percent
Mahangu flour 1	408	33.3	33.3	33.3
Mahangu flour 2	408	33.3	33.3	66.7
Mahangu flour 3	408	33.3	33.3	100.0
Total	1224	100.0	100.0	

The 0/1 choice data that came from the discrete choice experiment was analysed with the Multinomial Logit (MNL) model using SPSS software. Table 4.18

outlines the interpretation of the 0/1 choice data. Out of the 1224 profiles displayed only a third of the profiles were selected (1 out of 3 alternatives selected in a respective choice set).

**Table 4.18 Mahangu Flour Selections/preferences**

		Freq uency	Per cent	Valid Percent	Cumulative Percent
o	N	816	66. 7	66.7	66.7
Valid es	Y	408	33. 3	33.3	100.0
otal	T	1224	100 .0	100.0	

### **Crosstab Flour \* Taste**

As presented in table 4.19, mahangu flour producing “porridge with a sour taste” is the most preferred texture attribute level within the attribute texture.

Of the total 386 times the attribute level “porridge with a plain taste” was displayed as part of the 1224 mahangu flour alternatives, spread across 8 choice sets, with three mahangu flour alternatives in each choice set and administered to 51

respondents, it was not selected 71.2% of the time as the preferred attribute level to form part of the most preferred mahangu flour alternative. Taste attribute level, “porridge with a plain taste” was only included into the preferred mahangu flour alternative 28.8% of the time (only selected 111 times as part of the preferred mahangu flour alternative out of the 386 times).

Out of the total 416 times, the taste attribute level “porridge with a bitter taste” was displayed as part of the 1224 mahangu flour alternatives, it was not selected 68.5% of the time as the preferred taste attribute level of the most preferred mahangu flour alternative. And with this the taste attribute level, “porridge with a bitter taste” was included into the preferred mahangu flour alternative 31.5% of the time (selected 131 times as part of the most preferred mahangu flour alternative out of the 416 times it was displayed as a taste level across the 1224 alternatives).

Out of the total 422 times, the taste attribute level “porridge with a sour taste” was displayed as a taste level across the 1224 mahangu flour alternatives, it was not selected 60.7% of the time as the preferred taste attribute level to form part of the most preferred mahangu flour alternative. And with this the taste attribute level, “porridge with a sour taste” was included into the most preferred mahangu flour alternative 39.3% of the time (selected 131 times as part of the most preferred mahangu flour alternative out of the 416 times it was displayed as a taste level across the 1224 alternatives).

Of the 408 most preferred alternatives selected by the 51 respondents, the taste attribute level, “porridge with a sour taste”, was included 40.7% of the time to form part of the most preferred alternative. Taste attribute level, “porridge with a bitter taste” has a probability of 0.321 of being selected to form part of the most preferred

alternative. Taste attribute level, “porridge with a plain taste”, has a probability of 0.272 of being selected to form part of the most preferred mahangu flour alternative.

The taste level “porridge with a sour taste” is thus the most preferred taste attribute level with a 0.407 probability of being selected as part of the most preferred alternative.

**Table 4.19 Crosstab (Mahangu Flour\*Taste)**

			Taste			Total
			Plain	Sour	Bitter	
Flour	Not preferred	Count	27 5 <sub>a</sub>	25 6 <sub>b</sub>	28 5 <sub>a, b</sub>	816
		% within Flour	33.7%	31.4%	34.9%	100.0%
		% within Taste	71.2%	60.7%	68.7%	66.7%
		% of Total	22.5%	20.9%	23.3%	66.7%
		Total	5%	9%	3%	7%
	Preferred	Count	11 1 <sub>a</sub>	16 6 <sub>b</sub>	13 1 <sub>a, b</sub>	408
		% within Flour	27.2%	40.0%	32.1%	100.0%
		% within Taste	28.9%	39.5%	31.6%	33.3%
		% of Total	9.1%	13.6%	10.4%	33.3%
		Total	6%	2%	6%	4%
Total	Count	38 6	42 2	41 6	122 4	

	% within	31.	34.	34.	100
Flour		5%	5%	0%	.0%
	% within	10	10	10	100
Taste		0.0%	0.0%	0.0%	.0%
	% of	31.	34.	34.	100
Total		5%	5%	0%	.0%

Each subscript letter denotes a subset of Taste categories whose column proportions do not differ significantly from each other at the .05 level.

**Table 4.20 Chi-Square Tests (Mahangu Flour\*Taste)**

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.118 <sup>a</sup>	2	.004
Likelihood Ratio	11.037	2	.004
N of Valid Cases	12 24		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 128.67.

A chi-square test was performed and a statistically strong relationship was found between the mahangu flour selected and the taste of the porridge the mahangu flour will produce,  $X^2(2, N = 1224) = 11.12, p = .004$ .

From table 4.19 asymptotic significances is less than 0.05. Since the value is less than 0.05, we can conclude that a statistically significant relationship exists between the selection of mahangu flour and the taste of the porridge the flour produces. We can conclude that the relationship observed in the cross tabulation is real and not due to chance. Symmetric measures are based on the chi-square

statistic. From table 4.19 we can see the strength of association between the variables is very weak.

**Table 4.21 Symmetric Measures**

	Value	Asymp. Std. Error <sup>a</sup>	Approx. T <sup>b</sup>	Approx. Sig.
Interval by Interval Pearson's R	.021	.028	.749	.454 <sup>c</sup>
Ordinal by Ordinal Spearman Correlation	.020	.028	.714	.475 <sup>c</sup>
N of Valid Cases	12			
	24			

a. Not assuming the null hypothesis. b. Using the asymptotic standard error assuming the null hypothesis. c. Based on normal approximation.

### **Crosstab Mahangu Flour \* Texture**

As presented in table 4.22 mahangu flour producing porridge with a soft texture is the most preferred texture attribute level. Of the total 635 times, the attribute “porridge with a firm texture” was displayed as part of the 1224 mahangu flour alternatives, it was not selected 72% of the time as the preferred attribute level of the preferred mahangu flour alternative. And attribute level, “porridge with a firm texture” was only included into the preferred mahangu flour alternative 28% of the time (only select 178 times as part of the preferred mahangu flour alternative out of the 635 times).

Out of the total 589 times, the attribute “porridge with a soft texture” was displayed as part of the 1224 mahangu flour alternatives, it was not selected 61% of

the time as the preferred attribute level of the preferred mahangu flour alternative. And attribute level, “porridge with a soft texture” was included into the preferred mahangu flour alternative 39% of the time (230 times as part of the preferred mahangu flour alternative out of the 589)

Of the 408 most preferred alternatives selected by the 51 respondents, the attribute level, “porridge with a soft texture”, was included 56.4% (0.564) of the time to form part of the most preferred alternative. The mahangu flour attribute level, “porridge with a firm texture” was included 43.6% (0.436) of the time to form part of the most preferred alternative. Thus on aggregate, out of the 408 preferred mahangu flour alternatives the attribute level “porridge with a firm texture” was only selected as part of the most preferred mahangu flour profile 143 times.

Thus the attribute level, “porridge with a firm texture”, has a probability of 0.436 of being selected/included into the most preferred mahangu flour alternative. And with attribute, “porridge with a soft texture”, having 0.564 chance of being selected into the most preferred mahangu flour alternative.

**Table 4.22 Crosstab Flour\* Texture**

				Texture		Total
				Firm	Soft	
Count				45	359	81
				7 <sub>a</sub>	6 <sub>b</sub>	6
Flour	F preferred	Not preferred	% within Flour	56.0%	44.0%	10.0%
			% within Texture	72.0%	61.0%	66.7%
				0%	0%	
				0%	0%	

		% of Total	37.	29.	66.
			3%	3%	7%
		Count	17	230	40
			8 <sub>a</sub>	<sub>b</sub>	8
		% within	43.	56.	10
	Preferre	Flour	6%	4%	0.0%
d		% within	28.	39.	33.
		Texture	0%	0%	3%
		% of Total	14.	18.	33.
			5%	8%	3%
		Count	63	589	12
			5		24
		% within	51.	48.	10
	Flour		9%	1%	0.0%
Total		% within	10	100	10
		Texture	0.0%	.0%	0.0%
		% of Total	51.	48.	10
			9%	1%	0.0%

Each subscript letter denotes a subset of Texture categories whose column proportions do not differ significantly from each other at the .05 level.

**Table 4.23 Chi-Square Tests Flour\*Texture**

	Value	Df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	16.692 <sup>a</sup>	1	.000		
Continuity Correction <sup>b</sup>	16.200	1	.000		
Likelihood Ratio	16.714	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	16.678	1	.000		
N of Valid Cases	1224				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 196.33.

b. Computed only for a 2x2 table

A chi-square test was performed and a statistically strong relationship was found between the mahangu flour selected and the texture of the porridge the mahangu flour will produce,  $X^2(2, N = 1224) = 16.692, p < .001$ . We can conclude that the relationship observed in the cross tabulation is real and not due to chance. Symmetric measures are based on the chi-square statistic. From table 4.22 we can see that a statistically significant relationship exists between the mahangu flour selected and the texture the mahangu flour produces.

**Table 4.24 Symmetric Measures Flour\*Texture**

	Value	Asymp. Std. Error <sup>a</sup>	Approx. T <sup>b</sup>	Approx. Sig.
Interval by Interval Pearson's R	.117	.028	4.110	.000 <sup>c</sup>

Ordinal by Ordinal	Spearman Correlation	.117	.028	4.110	.000 <sup>c</sup>
N of Valid Cases		12			
		24			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis. c. Based on normal approximation.

### **Crosstab Flour \* Colour**

As presented in table 4.25, mahangu flour producing porridge with a light colour is the most preferred. Of the total 586 times the dark coloured porridge was displayed as part of a mahangu flour alternative it was not preferred/selected 75% of the time.

Of the 408 alternatives selected by the 51 respondents, the attribute level porridge that is light in colour was selected 65% of the time. The mahangu flour attribute, “porridge that is dark in colour” was only selected 35% of the time as the desired colour attribute level forming part of the preferred mahangu flour alternative. Thus out of the 408 preferred mahangu flour alternatives the attribute level “porridge that is dark in colour” was only selected as part of the preferred mahangu flour profile 143 times.

The colour attribute level, dark in colour, have a probability of 0.35 in being selected/included into the preferred mahangu flour alternative. Colour attribute level, “porridge that is light in colour”, have a 0.65 probability in being selected into the preferred mahangu flour alternative.

Table 4.25 Crosstab Flour\*Colour

			Colour		Total
			Lig ht	Dar k	
Flour	Not preferred	Count	37	443	81
			3 <sub>a</sub>	b	6
		% within Flour	45.	54.	10
		% within Colour	7%	3%	0.0%
		% of Total	5%	2%	7%
	Preferred	Count	26	143	40
			5 <sub>a</sub>	b	8
		% within Flour	65.	35.	10
		% within Colour	41.	24.	33.
		% of Total	5%	4%	3%

Total	% of	21.	11.	33.
	Total	7%	7%	3%
	Count	63	586	12
		8		24
	% within	52.	47.	10
	Flour	1%	9%	0.0%
	% within	10	100	10
	Colour	0.0%	.0%	0.0%
	% of	52.	47.	10
	Total	1%	9%	0.0%

Each subscript letter denotes a subset of Color categories whose column proportions do not differ significantly from each other at the .05 level.

**Table 4.26 Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	40.349 <sup>a</sup>	1	.000		
Continuity Correction <sup>b</sup>	39.582	1	.000		

Likelihood Ratio	40.847	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	40.316	1	.000		
N of Valid Cases	12				
	24				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 195.33.

b. Computed only for a 2x2 table

A chi-square test was performed and a statistically strong relationship was found between the mahangu flour selected and the colour of the porridge the mahangu flour will produce,  $X^2(1, N = 1224)40.35, p < .001$ . We can conclude that the relationship observed in the cross tabulation is real and not due to chance.

From table 4.27 we can see that there is a significant difference between the choices of the respondents in terms of their selection of mahangu flour and the colour of the porridge they want the flour to produce.

**Table 4.27 Symmetric Measures**

		Value	Asymp. Std. Error <sup>a</sup>	Approx. T <sup>b</sup>	Approx. Sig.
Interval by Interval	Pearson's R	-.182	.028	-6.454	.000 <sup>c</sup>
Ordinal by Ordinal	Spearman Correlation	-.182	.028	-6.454	.000 <sup>c</sup>
N of Valid Cases		12			
		24			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis. c. Based on normal approximation.



### 4.1.1. Multinomial Logit Analysis

**Table 4.28 Elements of the design**

<p>GENLOG Taste Colour Texture WITH Respondent          /CSTRUCTURE=Flour          /MODEL=MULTINOMIAL          /PRINT=FREQ RESID ADJRESID ZRESID DEV ESTIM CORR COV          /PLOT=NONE          /CRITERIA=CIN(95) ITERATE(20) CONVERGE(0.001) DELTA(0.5)          /DESIGN Taste Colour Texture Colour*Taste Colour*Texture Taste*Texture.</p>
--

**Table 4.29 Data about data**

		N
	Valid	12
		24
Cases	Missing	0
	Weighted	12
	Valid	24
	Defined	24
Cells		
Cells	Structural	0
	Zeros	
	Sampling	0
	Zeros	
Categories	Flour	2
	Taste	3
	Colour	2
	Texture	2

**Table 4.30 Goodness-of-Fit Tests<sup>a,b</sup>**

	Value	Df	Sig.
Likelihood Ratio	.187	2	.911
Pearson Chi-Square	.187	2	.911

a. Model: Multinomial

b. Design: Constant + Taste + Color + Texture + Taste

\* Color + Color \* Texture + Taste \* Texture

The goodness-of-fit table presents two tests of the null hypothesis that the model adequately fits the data. The null hypothesis is true.

**Table 4.31 Best and Worst Profile/Alternative**

<b><u>Best Mahangu Flour Profile/Alternative</u></b>	<b><u>Worst Mahangu Flour Profile/Alternative</u></b>
Flour produces porridge with a sour taste	Flour produces porridge with a plain taste
Flour produces porridge that is light in colour	Flour produces porridge that is dark in colour
Flour produces porridge with a soft texture	Flour produces porridge with a firm texture

Table 4.31 outlines the best and worst mahangu flour profiles. Table 4.32 provides the mahangu consumer preferences across the 408 profiles selected. From

the profiles selected we identify the most preferred mahangu flour alternative as the mahangu flour producing porridge with a sour taste, a light colour and a soft texture.

**Table 4.32 MNL Cell Counts and Residuals<sup>a,b</sup>**

Taste	Color	Texture	T	Observed		Expected		Residual	Standardized Residual
				Count	%	Count	%		
Plain	Light	Soft	Fi	32	7.8%	32.	7.9%	-	-.036
			Lrm			194		.194	
	Dark	Soft	S	44	10.8%	43.	10.7%	.194	.031
			Fi	15	3.7%	14.	3.6%	.194	.051
	Dark	Soft	S	20	4.9%	20.	4.9%	-	-.044
			Lrm			194		.194	
Sour	Light	Soft	Fi	54	13.2%	53.	13.1%	.967	.142
			Lrm			033	0%	.7	
	Dark	Soft	S	<b>56</b>	<b>13.7%</b>	<b>56.</b>	<b>14.0%</b>	-	<b>-.138</b>
			Fi	26	6.4%	26.	6.6%	-	-.193
	Dark	Soft	S	30	7.4%	29.	7.1%	.967	.186
			Lrm			033	0%	.7	
Bitter	Light	Soft	Fi	30	7.4%	30.	7.5%	-	-.145
			Lrm			773	0%	.773	
			S	49	12.0%	48.	11.8%	.773	.119

	Fi	21	5.1	20.	5.0	.77	.176
ark	D <sup>rm</sup>		%	227	%	3	
	S	31	7.6	31.	7.8	-	-.143
	oft		%	773	%	.773	

The Pearson goodness-of-fit statistic is based on the cells of the cell count and the residuals table. The observed column reports the number and percentage of cases. The best profile which is highlighted above was selected (count) a total of 56 out of the 408 profiles across 8 choice sets selected. This translates into 13.7% under the observed columns. If the expected cases vary from the observed cases then the model does not adequately fit the data. However from the table provided above we can see that the data adequately fits the model as there are very small differences between the observed and the expected cases reported. The small residuals are further proof that the model adequately fits the data.

### Calculating Utilities and Attribute Importances

Table 4.33 Elements of the design

<pre> HILOGLINEAR Taste(1 3) Colour(1 2) Texture(1 2) /CWEIGHT=Respondent /METHOD=BACKWARD /CRITERIA MAXSTEPS(10) P(.05) ITERATION(20) DELTA(.5) /PRINT=FREQ RESID ASSOCIATION ESTIM /DESIGN.                 </pre>
--

The researcher used the hierarchical loglinear model to run the parameter estimates.

Table 4.32 Parameter Estimates

Effect	Parameter	Estimate	Std. Error	Z	Sig.	95% Confidence Interval
						Lower Bound
Taste*Color*Texture	1	-.006	.079	-.075	.940	-.161
	2	.029	.071	.407	.684	-.110
Taste*Color	1	.074	.079	.938	.348	-.081
	2	.030	.071	.421	.674	-.109
Taste*Texture	1	-.012	.079	-.152	.879	-.167
	2	.092	.071	1.301	.193	-.047
Colour*Texture	1	-.003	.053	-.051	.959	-.107
Taste	1	.207	.079	2.618	.009	-.363
	2	.215	.071	3.031	.002	.076
Colour	1	.305	.053	5.747	.000	.201
Texture	1	-.136	.053	-2.574	.010	-.240

In general the ratio of the absolute magnitudes of the standardized parameter estimates (labelled 'Z' in the parameter estimates table above) for any two cells reflects the relative preference (utilities) of those parameters in explaining the frequencies in the table. These standardised parameters are parameters divided by their standard errors and are shown in the Z column in table 4.32. We are solving the utilities for taste levels (plain, sour, bitter), colour attribute levels (light in colour, dark in colour) and texture (firm, soft). In table 4.33 we took the relative preferences/utilities from the standardised parameter estimate column (column labelled z) in Table 4.32 for the attributes and their respective levels. The last level is omitted i.e. the utility for "bitter taste" is omitted from the table, with only "Plain" taste (level 1 @ -2.618), and "Sour" taste (level 2 @ 3.031) respectively. The parameter estimate for the left out category is the negative sum of the printed parameter estimates (since all estimates for the respective attribute levels must add to 0). The value for "Bitter" taste is thus calculated at  $-0.413$ . The procedure for the other attributes with two levels is just the opposite of the parameter estimate provided i.e.  $5.747 - 5.747 = 0$ .

**Table 4.33 Part-worth Utilities and Attribute Importance**

<b>Part-worth utilities for taste levels</b>	<b>Part-worth utilities for colour levels</b>	<b>Part-worth utilities for texture levels</b>
Sour taste= 3.031	Light coloured porridge= 5.747	Firm= -2.574
Bitter taste= 0.413	Dark coloured porridge= 5.747	Soft= 2.574
Plain taste = 2.618	Utility range= 11.494	Utility range= 5.148
Utility Range= 5.649		
Relative Importance of the attribute taste= $5.649/(5.649+11.494+5.148)$ = 25%	Relative Importance of the attribute colour= $11.494/(5.649+11.494+5.148)$ = 52%	Relative Importance = $5.148/(5.649+11.494+5.148) =$ 23%

### Discussion

Importance of an attribute indicates the maximum impact an attribute can exert on product choice.

From table 4.33 the importance for the attributes were calculated by finding the percentage of the range in utilities (maximum less the minimum utility) across the three attributes. The scores of the attribute levels presented in table 4.33 are referred to as the part-worth utility (preference). Thus the maximum taste level preference is the “sour” taste with a part-worth score of 3.031. It is above the zero line and indicates a strong preference for a sour taste in mahangu porridge. An even stronger

preference for mahangu porridge with a light colour with a part-worth score of 5.747 is indicated. From this we arrive at the conclusion that colour is the most important attribute from the bundle of attributes – taste, colour and texture. Thus colour exerts the maximum impact on mahangu flour choice with an importance percentage of 52%.

## **5. Conclusions and recommendations**

### **5.1. Introduction to the chapter**

This chapter presents the conclusions of the study based on the research questions and the findings thereof.

### **5.2. Study Conclusions**

The aim of this study was to highlight the importance of incorporating indigenous knowledge into product development and production processes by showing that mahangu consumers developed a negative attitude towards Meme Mahangu because Meme Mahangu flour were not fermented (traditional lactic acid fermentation process).

Through well designed research questions this aim was achieved through a review of current literature on indigenous knowledge and a quantitative probe of the respondents' feelings, evaluations, and choice behaviour through attitude scales and discrete choice experiments. The primary research questions were answered in the context of the existing literature on the importance of indigenous knowledge in the production of traditional food products, the benefits of lactic acid fermentation and an understanding of the influences of subcultures on consumer decision making. It is against this background that the primary data collected through attitude measurement answered the research question: *“Do traditional mahangu consumers have a negative attitude towards Meme Mahangu because Namib Mills failed to incorporate indigenous knowledge into the development and production of Meme Mahangu?”* In the context of the existing body of literature on the importance of indigenous knowledge in the production of traditional food products the following conclusions hold.

***Indigenous knowledge is important in the production of traditional food products.***

Indigenous knowledge is viewed as a much more pragmatic, utilitarian way of the application of knowledge (technology) to everyday demands of life whereas western science searches for knowledge of universal significance that is not context-related. Indigenous knowledge can thus be viewed as a social product closely linked to a cultural and environmental context (Briggs, 2005).

Indian farmers found that the application of indigenous knowledge to storage practises of grain lead to the grain being stored between 6-12 months without it being infested by any pests and it compares very well with commercially produced products. This is an extremely important conclusion because the application of indigenous knowledge does not include the use of chemicals and fumigation methods in storage, heavy machinery for milling, and application of substances such as waste oil and synthetic colours to impart shining appearances to the end product. Traditional germination and fermentation techniques were used to improve flavour, digestibility of the products and increase the content of vitamins and minerals. Organic acids such as such as acetic, lactic, citric, formic and butyric acids are produced during fermentation were being applied to improve texture, taste and colour of traditional products (Reddy, 2005).

Application of contemporary technologies require huge power sources at the cost of human labour employment bust also cause dust pollution in and around the plants and ill effects for the consumer's health. Traditional practises on the other hand are more humane in nature; hence the blending of traditional and scientific technologies is needed to come up with more environmental and human friendly methods of processing practises (Reddy, 2005).

The Food and Agriculture Organisation (FAO) identified the need for indigenous knowledge to be incorporated with modern agricultural systems in order to ensure the best nutritional and cultural needs of native communities (Kuhnlein, Erasmus & Spigelski, 2009) in Vazquez (2011).

Research and development should be concentrated on the development of more local products and markets which are indigenous (Ashekele, et al, 2012). It is within this context that programmes should be implemented that can build a repository of local knowledge and practices across communities as the first step. The second step should involve engaging with other communities in Africa (research point to many similarities between different African communities in their local practices, specifically when it comes to the processing of food products).

The importance of incorporating indigenous knowledge into industrial food processing is clear and should be done. However the question lies in the support government will provide to the private sector companies taking initiatives where they incorporate local knowledge and by default adopting the local skilled workforce into their production processes.

***The lactic acid fermentation process in the traditional mahangu milling processes has many benefits.***

Lactic acid fermentations are used worldwide to produce foods such as sour cream, yogurt, sauerkraut and pickled vegetables of all kinds. In Africa it is traditionally used to flavour and preserve porridges and to produce popular foods such as *bogobe* (sour sorghum porridge), in Botswana *nasha* (sour sorghum and millet) in the Sudan, and *obusera* (sour millet porridge) in Uganda. Many people in different parts of Africa prefer the sharp flavour of these fermented porridges (Lost Crops of Africa, 1996, p. 300).

The value of lactic acid fermentation as a process for upgrading a grain's taste and nutritive value has been ignored. Lactic acid fermentation remains one of the most practical ways to preserve food and its aesthetic, taste and nutritional benefits make it a popular food processing technique in Africa (Lost Crops of Africa, 1996; Mallet & Du Plessis, 2001). Lactic acid fermentations make foods resistant to spoilage. The bacteria rapidly acidify the food to a pH so low that dangerous organisms are no longer able to grow. They also produce hydrogen peroxide that kills organisms that cause food spoilage. Although lactic acid fermentation is declining in large parts of Africa, fermentation have a future and deserve recognition and attention (Lost Crops of Africa, 1996, p. 300).

Fermentation reduces the viscosity of stiff porridges (Lost Crops of Africa, 1996)

Fermentation lowers the pH of the grain which contributes to the development of the sour taste preferred by mahangu consuming households (Mallet and Du Plessis, 2001; Barrion, 2008). "Sour" porridges are very popular in Africa (Lost Crops of Africa, 1996).

Reichert (1979) in Barrion (2008) reported that acidic conditions cause the grey pigment present in the pearl millet to change into a creamy-white colour.

Slightly fermented mahangu meal was highlighted as a luxury product for a specific segment. CRIAA SA-DC consultants recommended that further research be conducted into soaking/fermenting of decorticated mahangu grain (CRIAA SA-DC, 1999a) in Mallet and du Plessis (2001).

Tannin levels (responsible for the bitter taste in pearl millet) (Mallet and Du Plessis, 2001) were shown to drastically reduce with alkali treatments, malting and

fermentation in research on breakfast cereals using sorghum and pearl millet (Onyango, Ochanda, Murasura, Ochieng and Mathooko, 2012).

The fermentation step in the traditional milling process is indeed a delicate process responsible for changes in taste, colour and texture of mahangu flour. Consumers who prefer this distinct sour taste and the lighter coloured flour emanating from the lactic acid fermentation process do not prefer Meme Mahangu.

***There are significant production differences between traditionally processed mahangu flour and commercially processed Meme Mahangu flour.***

**Table 5.1 Production difference between traditional milling processes and commercial milling processes**

<b>Traditional Milling Processes</b>	<b>Industrial Milling Processes</b>
1) Decortication 2) steeping (lactic acid fermentation), 3) the drying of the decorticated and steeped grain, 4) milling the decorticated and steeped grains into flour 5) drying of the flour (Mallet & Du Plessis, 2001; Natanga, 2006; Barrion, 2008)	1) conditioning (tempering), 2) decortication, 3) roller milling, 4) sifting and 5) purification (Barrion, 2008)
Includes the lactic acid fermentation process	Does not include the lactic acid fermentation process
Produces flour that produces porridge that is light in colour with a distinct sour taste.	Produces flour that produces porridge with a dark colour and a plain taste.

***The mahangu consumer's behaviour towards the consumption and purchasing of mahangu flour is influenced by their subculture.***

The sum total of mahangu consumer utilities (part-worths) for specific mahangu attribute levels pointed to a product profile that is very different to what is currently available in the market in the form of Meme Mahangu.

Consumer behaviour basically involves the thoughts and feelings people experience and actions they perform when making decisions to buy a product within a specific environmental setting. They are influenced by peers, family or the subculture to make specific decision and their wants and desires are continuously aroused by marketing communications and other marketing stimuli. These include comments and subtle influences from those in your sphere and in whose sphere of influence you choose to be in (ethnic grouping/community, close/extended family, friends, colleagues and so on).

Messages from brand communication, price information, and other environmental factors continuously provide you with a plethora of choices to choose from. In Namibia consumers don't have such a wide range of choices to choose from in the marketplace, specifically when it comes to mahangu flour. They only have Meme Mahangu. Thus the impact on the dominant player's market share won't be realised immediately. Unless a new product is introduced that provides for the needs of the mahangu consumer and gradually takes away the market share from the dominant players in the market.

These needs can be understood by studying the mahangu consumer in their social context, their cultural context and the subjective influences of ethnic groupings. A large part of Namibia's economically active population was brought up in households with very strong ties to traditional practices and customs.

Skills and knowledge acquired through traditional practices and a rich experience base influence these individual's information processing mechanisms.

These individuals were conditioned by psychological, cultural, and social influences that are influencing their behaviour. It could be hypothesized that this phenomena is even stronger and more frequent in African communities with strong rural connections, specifically when it comes to preparation, taste and aesthetics of traditional staple products. This makes it extremely important for organisations to understand the traditional practices that have a strong influence on the decision making of these customers. Schiffman & Kanuk (2010) argues that these intergenerational transfers of brand preferences are also being influenced by grandparents who play a key role in the socialization of their own children and grandchildren.

From the diverse value systems across different ethnic groups in Namibia, we can safely conclude that marketers in Namibia deal with a very broad range of perceptions, not just within the different ethnic groupings, but also across different ethnic subcultures found in Namibia. Thus a one-size-fit all approach should not be adopted in Namibia. Organisations can however make generalisations about perceptions based on traditional consumption practices and the different perceptions of ethnic groups within the Namibian context and provide tailored products for the respective ethnic groupings based on their preferences. The traditional heritage passed on from generation to generation is manifested strongly in the consumption of traditional foods i.e. *Herero bread, Oshifima, Oshikundu, and donkey meat* to mention a few. Ethnic subcultures thus play an important role in determining our beliefs, practices, and values, which in turn impact our social norms, attitudes, behavioural intentions, and ultimately, our behaviour. We can thus conclude that mahangu consumers' attitude towards Meme Mahangu flour are influenced by their beliefs, practices and values stemming from their respective ethnic subculture.

### ***Mahangu consumers have a negative attitude towards Meme Mahangu!***

Existing theory provided the basis for the selection of the attributes used for this study on attitudes and for measuring choice probability using a discrete choice experiment. Fermentation, taste and colour were selected as the most important attributes for the measurement of attitudes. Taste, colour, texture and stickiness were selected as the attributes for the discrete choice experiment.

#### **Fermentation**

The value of lactic acid fermentation as a process for upgrading a grain's taste and nutritive value has been ignored (Lost Crops of Africa, 1996). Further to its aesthetic, taste and nutritional benefits, lactic acid fermentations remain one of the most practical ways to preserve food. Although lactic acid fermentation is declining in large parts of Africa, fermentation have a future and deserve recognition and attention (Lost Crops of Africa, 1996, p. 300). Fermentation is a household level food technology that reduces the viscosity of stiff porridges. It also raised the levels and bioavailability of proteins, vitamins, and minerals. It also enriches the foods through synthesis of some B vitamins, it adds flavour and it helps protect foods from diarrhoea-causing microorganisms.

#### **Taste**

"Sour" porridges are very popular in Africa and seem to have many of the characteristics required as a weaning food and also helping to reduce the risk of pathogenic diarrhoea amongst babies. Fermentation of cereals inhibits the negative effects of phytic acids and tannin and the lowering of the pH contributes to the development of the sour taste preferred by mahangu consuming households (Mallet and Du Plessis, 2001; Barrion, 2008).

In Africa lactic acid fermentation is traditionally used to flavour and preserve porridges and to produce popular foods such as *bogobe* (sour sorghum porridge) in Botswana, *nasha* (sour sorghum and millet) in the Sudan, and *obusera* (sour millet porridge) in Uganda. Many people in different parts of Africa prefer the sharp flavour of these fermented porridges (Lost Crops of Africa, 1996, p. 300). Different tastes with regard to mahangu porridge are documented in previous research; a sour taste (Barrion, 2008), bitter taste (Mallet & Du Plessis, 2001), and a plain taste (researcher's personal experience).

### **Colour**

Reichert (1979) in Barrion (2008) reported that acidic conditions cause the metal present in the metal-flavanol complex to dissociate and alters the grey pigment present in the pearl millet into a creamy-white colour.

### **Texture**

Fermentation is a household level food technology that reduces the viscosity of stiff porridges (Lost Crops of Africa, 1996).

We can conclude that the attributes selected for this research study were the most important and relevant attributes for measuring attitudes toward Meme Mahangu and traditional mahangu as well as determining the choice probabilities through a discrete choice experiment.

### ***Mahangu consumers display a negative attitude towards Meme Mahangu***

From the study we can conclude that Namib Mills' failure to incorporate indigenous knowledge into the development and production of Meme Mahangu caused the negative attitude towards Meme Mahangu.

### Findings to support claim

Ndjeunga et al. (2000) determined that texture, colour, taste and keeping quality were ranked the highest in the focus group meeting they held on determining the attributes associated with quality mahangu flour. Mafuru et al. (2007); Barrion, (2008); Mallet & Du Plessis, 2001) also established taste, colour, texture and aroma as the key attributes related to quality of mahangu flour. Fermentation is a key factor in enhancing the taste and colour of these important attributes.

Namib Mill's omission to incorporate the indigenous practice of lactic acid fermentation into their production processes have led to consumers developing a negative attitude towards Meme Mahangu.

$$Attitude_{Meme\ Mahangu} = \sum_{i=1}^3 b_i e_i$$

$$A_0 = (6.457)(-0.378) + (4.231)(-0.667) + (7.064)(-0.222)$$

$$A_0 = (-2.44) + (-2.82) + (-1.57)$$

$$A_0 = -6.83$$

The negative evaluation of the attributes associated with Meme Mahangu show that respondents dislike attributes associated with non-fermented mahangu flour. They also have a very strong believe that Meme Mahangu flour possess the attributes associated with non-fermented mahangu flour. The overall evaluation of Meme Mahangu flour is negative.

### ***Are the most preferred mahangu flour attributes the attributes emanating from the lactic acid fermentation process?***

Yes, the attribute levels with the highest part-worth utilities are those attributes emanating from the lactic acid fermentation process. Research shows clearly that the

lactic acid fermentation process improves taste, texture and colour of mahangu flour (Mallet and Du Plessis, 2001).

The most important attribute levels for mahangu consumers based on respondents choices are:

- “Porridge that is light in colour” is the most preferred colour level (emanating from the lactic acid fermentation process)
- “Porridge with a sour taste” as the most preferred taste level (emanating from the lactic acid fermentation process)
- “Porridge with a soft texture” as the most preferred texture level (emanating from the lactic acid fermentation process)

Colour has the maximum impact on consumer’s choice of mahangu flour. The attributes outlined in the worst profile are those attributes associated with non-fermented mahangu flour. These attributes include a dark colour, a plain taste and a slimy texture during preparation.

The lactic acid fermentation process is thus an extremely important food processing technology for mahangu consumers in northern Namibia.

### **5.3. Recommendations**

Food security can be achieved through a national strategy on growing, production and marketing of mahangu flour. Mahangu has the potential of becoming Namibia’s staple food. Mahangu has excellent storage qualities, giving it advantage over other crops where inter-annual food security is necessary (Tyler and Bennett,1993) cited by Mallet & du Plessis (2001). This fact cannot be more important and more relevant in the context of the drought we are currently experiencing.

The commercialisation of mahangu was in line with what was highlighted in the National Agricultural Policy (1995) which positions the commercialization of mahangu as a strategy that can alleviate poverty and improve the standard of living of small-scale farmers in the Northern Communal Areas of Namibia.

The Ministry of Agriculture, Water and Rural Development (MAWRD) projects and the Namibian Agronomic Board (NAB) over the years targeted increased productivity and the promotion of commercialisation. The targeted efforts involved the stimulation of local production of mahangu and sorghum, improving post-harvest- and draught animal power technology, generic promotion of mahangu and sorghum, the dissemination of market information as well as market facilitation.

Very little has been done to understand the mahangu consumer. Very little is documented on the perceptions, attitudes and preferences of mahangu consumers in Namibia. And very little has been done to preserve indigenous knowledge in the last remaining pockets of African societies found in Namibia. Indigenous knowledge and mahangu flour goes hand-in-hand. Thus it is extremely important to understand the indigenous practices associated with the production of mahangu flour.

### **Recommendation 1**

The Rio Declaration and the Rio Agenda 21 of 1992 highlighted in Hinz & Ruppel (2008) expects Governments to develop and strengthen national arrangements to consult with indigenous peoples and their communities with a view to reflecting their needs and incorporating their values and traditional and other knowledge and practices into national policies and programmes.

Based on the findings and conclusions of this study the researcher thus puts forth the following recommendation at national level.

***Governments should develop and strengthen national arrangements (Government –local community level, private institution level – local community level, Government – private institution level) to consult with indigenous peoples and their communities with a view to reflecting their needs and incorporating their values and traditional and other knowledge and practices into national policies and programmes. Government and private institutions should thus promote the acquisition/collection, preservation and application of indigenous knowledge as a national priority.***

Indigenous knowledge is important and concerted efforts in the development of repositories of knowledge of best practice and the preservation of the practice of these skills and the transfer of knowledge should be carefully protected and cradled even in the face of the challenges of globalization which can be seen as the commoditization of western science.

## **Recommendation 2**

The findings and conclusions of this research has pin-pointed the importance of incorporating indigenous knowledge into product development and production processes.

***Private organisations such as Namib Mills should incorporate into their research and development budgets specific actions to build a repository of indigenous knowledge and to apply this knowledge to the product development and production processes of the organisation.***

Because Namib Mills did not incorporate traditional practices and customs into their product development and production processes they developed and re marketing a product mngu consumers don't prefer. It is only when the supply from

the rural areas dry up that mahangu consumers turn to Meme Mahangu because they have no other option. Meme Mahangu is primarily bought to produce *Oshikundu*. Specific recommendations to Namib Mills include;

- *Namib Mills should incorporate into their production processes the lactic acid fermentation process in order to produce a fermented variety of Meme Mahangu.*
- *Namib Mills should then embark on an aggressive rebranding and marketing communications campaign that includes package design, in-store testing, and television and print adverts highlighting the most preferred mahangu attributes on their packaging and other communication materials.*
- *They should conduct this study on large scale within the regions highlighted in this study.*

### **Recommendation 3**

The study puts forth a third recommendation directly impacting the local communities who are the custodians of traditional knowledge which have been passed down from generation to generation. This recommendation incorporates policy recommendations at national level and private organisation initiatives at a local level.

***Local communities should start with documenting their local knowledge and seek to continuously built-up a local repository consisting of local, continental and global knowledge on traditional practices and skills that have been preserved and that have stood the test of time. The aim of this base of knowledge would be to adapt current knowledge based on international “best practice” amongst traditional communities globally.***

*Some communities might, through lack of exposure or through a depletion of knowledge as the result of wars and oppression, have outdated knowledge and practices that could be replaced by those that have established top position amongst those ranked as best practice.*

*Indigenous knowledge is important and concerted efforts in the development of repositories of knowledge of best practice and the preservation of the practice of these skills and the transfer of knowledge should be carefully protected and cradled even in the face of the challenges of globalization which can be seen as the commoditization of western science.*

*The recommendation further includes the development of ecologically based communities that will act as a platform to document, preserve and apply local knowledge to local problems.*

The following are given as guidelines for ecologically-based communities in Lewis and Jay (2000, p. 43). These guidelines incorporate the local community, the private sector, educational sector and Government as the policy developer. Only the most important guidelines directly relating to the preservation and application of indigenous knowledge are highlighted here.

- Land use and design patterns based on smart growth principles that;
  - *Preserve historic and cultural assets (skills and food processing techniques passed on from generation to generation)*
  - *Promote neighbourhood which are effectively integrated with educational, recreational, and business needs*
  - *Provide urban to rural interfaces that support farm to in-town relationships(urban agriculture – urban consumers actively buying rural produce)*

- An inherent human resource renewal system that:
  - *Promotes formal/informal lifelong learning for all citizens through intergenerational, peer-to-peer and team processes (the sustainable practices that are being practised in a rural setting would provide a platform for scientific experiments and outdoor learning experiences that will ensure that the local knowledge is preserved and enhanced)*
  - *Foster strong mutual respect and interaction between schools, parents, other citizens and businesses (urban dwellers buying products from rural farmers, schools visiting rural areas for scientific projects, incorporating skills and knowledge into mainstream practices will foster strong mutual respect and interaction between all key players in the Namibian society)*
- Strong local sufficiency in core infrastructural needs insured by:
  - *Private locally-owned and operated services and/ or locally designed and operated public/private partnerships (using knowledgeable communities to ferment the grains. The fermented grains can then be transported to the millers where they are milled, packaged and distributed)*
- Industry/business strategy that:
  - *Is diverse and strongly invested in the community*
  - *Maximises coexistence of local businesses with nationally- or regionally owned chains*
  - *Seeks and negotiates agreements by which all industry/business participants are strongly invested as corporate citizens*

- *Seeks broad balance of business sectors that respect and support community integrity.*

#### **5.4. Summary of Chapter**

This study is a step toward understanding and harnessing the value of indigenous knowledge for commercial purposes. It is also a step in the direction of determining the exact needs and wants of the Namibian consumer. The Namibian consumer is no stranger to product solutions that were designed based on the preferences of another country's consumers. We need to take ownership of our resources (intellectual and natural resources) and exploit these resources for the full benefit of our communities. This study has shown that there is a strong relationship between traditional/indigenous knowledge and the consumption behaviour of the Namibian consumer, albeit the mahangu consumer. The documentation, preservation, and active experimentation with indigenous knowledge are of utmost importance. The recommendations provided for in this study should thus be given due consideration in light of the findings and conclusions of this study with the aim of escalating this study into a national study.

## 6. List of References

- Barrion, C.S. (2008). *Pearl Millet Milling: Comparison between traditional Namibian fermentation (semi-wet) milling and dry milling*. (Masters dissertation, University of Pretoria, South Africa, 2008).
- Bakken, P.E., Interactive, A.M., Frazier, J.W. & Brown.,M. (2001). *Conjoint Analysis: Understanding Consumer Decision Making*. Retrieved June 29, 2013, from the World Wide Web, . <http://www.terry.uga.edu/rgrover/chapter14.pdf>
- Blythe, J. (2006). *Principles and Practice of Marketing*. London, England: Thomson Learning
- Briggs, J. (2005). The use of indigenous knowledge in development: problems and challenges. *Progress in Development studies* 5, 2 (2005) pp. 99-114
- Briggs, J., Sharp, J., Yacoub, H., Ahmed, N., & Roe, A. (2007). The nature of indigenous knowledge production: Evidence from Bedouin communities in Southern Egypt. *Wiley InterScience*. 239-251.doi10.1002/jd.1337
- Hauser, J.R., & Urban,L. (1977). *Direct Assessment of Consumer Utility Functions*. Working Paper 843-76
- Green,P.E., Krieger, A.M., & Wind, J.W. (2001).Thirty years of Conjoint Analysis: Reflections and Prospects. *Interfaces*, 31 pp. S53-S73.

- Hinz, M.O. & Ruppel, O.C.(2008). *Biodiversity and the Ancestors:Challenges to customary and Environmental Law*. Windhoek, Namibia:John Meinert Printing
- James, D.D., Street, J.H., & Jedlicka, A.D. (1980). Issues in indigenous research and development in third world countries. *Social Science Quarterly, University of Texas Press 0038, p. 589 - 599*
- Kirkwood, K.W.(1997).*Strategic Decision Making*. California, America: Wadsworth Publishing Company.
- Louviere, J.J., & Eagle, T.C. (2005).Conjoint Analysis: Methods, Myths and Much More. *CenSoC working paper no. 05-001*.
- Louviere, J.J. & ,Flynn,T.N.(2010).Discrete Choice Experiments are not Conjoint Analysis. *Journal of Choice Modelling, 3(3), pp 57-72*.
- Maiti,R.,&Wesche-Ebeling,P.(1997).*Pearl Millet Science*. Enfield: Science Publishers.
- Mafuru J.M., Norman, D.W., & Fox, J.S. (2007) Consumer Perception of Sorghum Variety Attributes in the Lake Zone Tanzania. *Proceedings of the AAAE conference* 171-176
- Mallet, M., & Du Plessis, P. (2001) *Mahangu Post Harvest Systems*. Windhoek.CRIAA-SA-DC

- Marreiros, C., & Ness, M. (2009). A conceptual framework of consumer food choice behaviour. *Cefage-UE Working Paper 2009/0*. Retrieved from <http://www.cevage.euvora.pt>
- McFadden, D. (1977). *Modelling the choice of residential location*. Connecticut: Cowles Foundation for Research in Economics. Retrieved from <http://cowles.econ.yale.edu/P/cd/d04b/d0477.pdf>
- McFadden, D., (1996). *Rationality for Economists?*. California: University of California, Berkeley. Retrieved from <http://emlab.berkeley.edu/eml/nsf97/mcfadden.pdf>
- National Academy of Sciences.(1996). *Lost Crops of Africa: Volume 1, Grains*. Washington, USA: National Academy Press.
- Peter, J.P, & Olson, J.C (2010). *Consumer Behaviour and Marketing Strategy*. New York, USA: McGraw Hill.
- Reddy., B.S.,(2005). Indigenous knowledge on pulse storage and processing practices in Andhra Pradesh. *Indian Journal of Traditional Knowledge*, Volume . 5(1), January 2006, pp. 87-94

University of Groningen.(1999).*Faculty of Economics. Dissertations*, Retrieved April,

30, 2013, from the World Wide Web,

<http://dissertations.ub.rug.nl/files/faculties/eco/1999/M.C.Haaijer/pdf>

Vazquez, J.M. (2011). The role of indigenous knowledge & innovation in creating

food sovereignty in Oneida nation of Wisconsin. Iowa State University,

*Graduate Theses and Dissertations. Paper 10137*.Retrieved April, 15, 2013,

from the World Wide Web, <http://lib.dr.iastate.edu/etd>

Walingo, M.K.,(2008) Indigenous Food Processing Methods that Improve Nutrient

Bioavailability in Plant-based Diets of the Kenyan Population: The Example of

Zinc.*International Union of Food Science & Technology* (2008), Chapter 14.

Retrieved from <http://www.ajol.info/index.php/ajfand/article/view/19210>

**APPENDIX A: MNL ESTIMATES INCLUDING STICKINESS AS AN ATTRIBUTE**

**Cell Counts and Residuals<sup>a,b</sup>**

Taste	Colour	Texture	Stickiness	Flour	Observed		Expected		Residual	Standardized Residual	Adjusted Residual	Deviance
					Count	%	Count	%				
Plain	Light	Firm	Sticky	Not preferred	43	78.2%	43.198	78.5%	-.198	-.065	-.088	-.629
				Preferred	12	21.8%	11.802	21.5%	.198	.065	.088	.632
		Not Sticky	Not preferred	27	57.4%	29.656	63.1%	-2.656	-.803	-1.087	-2.251	
			Preferred	20	42.6%	17.344	36.9%	2.656	.803	1.087	2.387	
	Soft	Sticky	Not preferred	38	69.1%	37.066	67.4%	.934	.269	.665	1.375	
			Preferred	17	30.9%	17.934	32.6%	-.934	-.269	-.665	-1.348	
		Not Sticky	Not preferred	21	43.8%	19.079	39.7%	1.921	.566	.911	2.007	
			Preferred	27	56.3%	28.921	60.3%	-1.921	-.566	-.911	-1.926	





		Not preferred	19	43.2%	19.147	43.5	-.147	-.045	-.061	-.542
						%				
	Not Sticky	Preferred	25	56.8%	24.853	56.5	.147	.045	.061	.544
						%				
		Not preferred	45	86.5%	44.094	84.8	.906	.350	.666	1.353
						%				
	Sticky	Preferred	7	13.5%	7.906	15.2	-.906	-.350	-.666	-1.305
						%				
Firm		Not preferred	36	72.0%	37.268	74.5	-1.268	-.412	-.697	-1.579
						%				
	Not Sticky	Preferred	14	28.0%	12.732	25.5	1.268	.412	.697	1.631
						%				
Dark		Not preferred	43	78.2%	42.957	78.1	.043	.014	.024	.295
						%				
	Sticky	Preferred	12	21.8%	12.043	21.9	-.043	-.014	-.024	-.295
						%				
Soft		Not preferred	24	55.8%	23.681	55.1	.319	.098	.271	.801
						%				
	Not Sticky	Preferred	19	44.2%	19.319	44.9	-.319	-.098	-.271	-.795
						%				

## APPENDIX B EXPERIMENT DESIGN

Design Type :  
Random ▾

**Concept Simulator**

Approx. Number of Respondents: 100 ▾

If you were to buy Mahangu flour, what type of Mahangu flour should it be? What characteristics should it have? Please select your most preferred Mahangu flour from the profiles provided in each of the eight choice sets provided below.

Taste of the porridge the flour produces	Plain	Bitter	Sour
Color of the porridge the flour produces	Light in color	Dark in color	Light in color
Texture of the porridge the flour produces	Firm	Soft	Firm
Stickiness of the porridge on the hand	Not sticky on hand	Not sticky on hand	Not sticky on hand
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Step 4 of 8

If you were to buy Mahangu flour, what type of Mahangu flour should it be? What characteristics should it have? Please select your most preferred Mahangu flour from the profiles provided in each of the eight choice sets provided below.

Taste of the porridge the flour produces	Sour	Sour	Bitter
Color of the porridge the flour produces	Light in color	Dark in color	Light in color
Texture of the porridge the flour produces	Soft	Firm	Soft
Stickiness of the porridge on the hand	Sticky on hand	Not sticky on hand	Not sticky on hand
	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### APPENDIX C CHOICE DATA

Response ID	Task ID	Concept ID	Taste	Color	Texture	Stickiness	Selected
5207293	1	1	1	1	2	1	0
5207293	1	2	1	1	1	2	0
5207293	1	3	2	1	1	2	1
5207293	2	1	3	2	2	1	0
5207293	2	2	1	2	2	1	0
5207293	2	3	1	1	1	1	1
5207293	3	1	1	2	1	1	0
5207293	3	2	3	2	1	1	1
5207293	3	3	3	1	1	2	0
5207293	4	1	1	1	2	2	1
5207293	4	2	2	2	1	1	0
5207293	4	3	3	2	1	1	0
5207293	5	1	2	2	2	1	1
5207293	5	2	1	1	1	1	0
5207293	5	3	3	1	1	1	0
5207293	6	1	2	1	2	1	1
5207293	6	2	2	2	1	2	0
5207293	6	3	3	1	1	1	0
5207293	7	1	3	2	2	1	0
5207293	7	2	3	2	2	2	1
5207293	7	3	3	2	1	2	0
5207293	8	1	3	1	2	2	1
5207293	8	2	2	2	1	1	0
5207293	8	3	2	2	2	2	0

## **APPENDIX D: SURVEY**

Hello: My name is Steven Denk. I am collecting data for my thesis on the importance of incorporating indigenous knowledge into new product development. You are invited to participate in my survey on consumer preferences and attitudes on Mahangu flour. In this survey, 200 people will be asked to respond to questions about their personal preferences regarding Mahangu flour. Questions about Meme Mahangu will also be posed to you. Finally you will be provided with 8 choice sets each with three Mahangu flour product profiles from which you should choose your most preferred Mahangu flour. It will take approximately 10 minutes to complete the questionnaire. Your participation in this study is completely voluntary. There are no foreseeable risks associated with this project. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point. It is very important for us to learn your opinions. Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. If you have questions at any time about the survey or the procedures, you may contact Steven Denk at [sdenk@polytechnic.edu.na](mailto:sdenk@polytechnic.edu.na). Please start with the survey now by clicking on the Continue button below.

Please indicate your gender.

1. Male
2. Female

Please indicate the region you are from.

1. Ohangwena region
2. Omusati region
3. Oshana region
4. Oshikoto region
5. Kavango region

Please indicate your employment status.

1. Employed
2. Unemployed
3. Student

Do you consume Mahangu flour?

1. Yes
2. No

How often do you consume Mahangu flour?

1. Once a day
2. Once a week
3. Once a month

How often do you buy Mahangu flour?

1. Once a week
2. Once every two weeks
3. Once a month
4. I never buy Mahangu

Have you ever consumed Meme Mahangu flour?

1. Yes
2. No

How satisfied were you with Meme Mahangu flour based on the following experiences:

	Very Unsatisfied	Unsatisfied	Neutral	Satisfied	Very Satisfied
Taste of the porridge it produces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Colour of the porridge it produces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Texture of the porridge it produces	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Which of the following statements best describes the choice that you will buy Meme Mahangu flour the next time you purchase Mahangu flour?

1. I definitely will buy Meme Mahangu
2. I probably will buy Meme Mahangu
3. I am uncertain whether I will buy Meme Mahangu
4. I probably will not buy Meme Mahangu



How would you rate the following statements about Traditional Mahangu flour (Mahangu flour from your village).

	Very bad	Bad	Neither bad nor good	Good	Very good
The mahangu grains used to produce traditional Mahangu flour were put in water to ferment.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Traditional Mahangu flour produces porridge with a sour taste.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Traditional Mahangu flour produces a porridge that is light in colour.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>