ASSESSMENT OF CONSUMER ATTITUDES AND MOTIVATION TO CONSUME FOODS FROM EDIBLE INSECTS: THE CASE OF CRICKET-FLOUR BUNS

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Assessment of Consumer Attitudes and Motivation to Consume Foods from Edible Insects: The Case of Cricket-Flour Buns

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DECLARATION

This thesis is my original work and has not been presented for a degree in any other University.

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DEDICATION

To my parents, Ephrahim and Rose Pambo, for teaching me the constructs of life and hard work, to my wife, Rachel and my daughters Rosebella and Ruby, for the new dawn in my life. To my brothers Dave and Sam, and sisters Winnie, Zaina, Veron, Ephy and Selly, for your care and support.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

LIST OF ACRONYMS

A-C-V	Attributes – Consequences (Benefits) – Values (life goals)
CFI	Comparative Fit Index
DANIDA	Danish International Development Agency
FAO	Food and Agriculture Organization of the United Nations
FFEI	Foods from edible insects (used interchangeably with insect-based products/foods)
GFI	Goodness of Fit Index
HVM	Hierarchy Value Map
ICCO	Inter Church Organization for Development Cooperation
JAR	Just-About-Right
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KEBS	Kenya Bureau of Standards
KNBS	Kenya National Bureau of Statistics
KNH	Kenyatta National Hospital
MEC	Means-End Chain theory
NACOSTI	National Commission of Science, Technology and Innovation
PBC	Perceived Behavioural Control
PCA	Principal Component Analysis
REML	Restricted Maximum Likelihood
RMSEA	Root Mean Square Error of Approximation
SEM	Structural Equations Model
TPB	Theory of Planned Behaviour

ABSTRACT

Studies suggest that insect-based foods can be a potential remedy to the identified nutrition challenges, particularly as a sustainable source of protein. This study investigated households' intentions, attitudes and motivations to consume insect-based foods. It employed data collected from 432 rural-households drawn from western and eastern regions of Kenya to assess consumer behaviour with respect to foods from edible insect (FFEI). The study employed theory of planned behaviour (TPB) to predict intentions of the surveyed households to consume FFEI. The study also determined the sensory appropriateness of cricket-based buns (example of FFEI) using just-about-right (JAR) scales, and then assessed the motivations to consume FFEI. Finally, the study analyzed the roles of differentiated information on sensory evaluations and consumer motivations in addition to the level of product involvement and emotions that consuming cricket-based buns evoke. Results showed that i) households from western region, where edible insects are more familiar and widely eaten, have higher intentions to consume FFEI; ii) evaluation of sensory appropriateness is significantly influenced by the information provided; iii) cricket-based buns evoke more positive emotions in consumers; and, iv) participants are motivated to consume cricket-based buns to achieve four life goals (values) namely, good health, long life, happiness and being (food) secure. This study therefore demonstrates the market potential for processed products from edible insects (such as cricket-flour buns), and also reveals that the perceived negative sensory features of FFEI are likely to be a barrier to consumer acceptance. The barriers could be removed (hedged) by providing balanced and targeted marketing information. The study also demonstrates that campaigns meant to promote consumption of FFEI should incorporate 'real' products (e.g., cricket-flour buns) are incorporated as exhibits for the participants to see, touch and taste.

CHAPTER ONE

INTRODUCTION

1.1 Background

Access to sufficient and healthy food is both a fundamental human right, and a prerequisite for people to achieve their full physiological potential. Availability of enough and healthy food also determines people's economic activities (Belluco *et al*., 2013; FAO, 2013). Policy makers, therefore prioritize policies aimed at promoting food access and utilization. However, availability of enough and healthy food remains a serious challenge. This is because population continues to grow rapidly, and is estimated to reach 9 billion by the year 2050 (FAO, 2010). The current food production levels therefore needs to increase drastically to satisfy the growing population. At the same time, land and other natural resources that play a central role in food production are becoming increasingly scarce, overused and less sustainable (FAO, 2013).

Intensive farming systems like proper crop and livestock husbandry, proper use of inorganic fertilizers, chemicals and improved seeds, genetic selection, and recently genetic engineering, for example, development of genetically modified organisms (GMOs), are being used to increase food production. However, increasing yields through agricultural intensification (for instance, increased use of inorganic fertilizers and non-selective chemicals) greatly pollutes the environment. In the long run, intensive agriculture can reduce food production unless sustainable approaches are employed (Belluco *et al*., 2013). Therefore, innovative ways of producing more food are required, and newer (re-emerging) foods that increase dietary diversity becomes very important.

Among the re-emerging foods, edible insects has recently received increased attention from both public and private organizations (FAO, 2013; Halloran *et al*., 2015). These insects are a rich source

of protein that can improve human diet, especially for individuals suffering from poor nutrition due to protein deficit. Insects often contain relatively more protein and minerals than meat, hence insect-based foods are a potential superior alternative to conventional meat. Consumption of insects also conserves the environment because they are exceptionally efficient in converting what they eat into consumable tissue (Losey & Vaughan, 2006). Moreover, insects feed on a wide range of plants, while rearing them requires far less space and generates less greenhouse gases compared to conventional livestock (van Huis & Vantomme, 2014). While, the capturing, processing, transporting and marketing of edible insects can provide income and livelihood opportunities around the world (FAO, 2010; Pambo *et al*., 2016; 2017).

In recent times, however, the practice of consuming insects (entomophagy) has declined in many societies, and has often been shunned as old-fashioned, fear inspiring/disgusting and primitive (Pambo *et al*., 2018). Yet, among various cultures, insects are abundant and remain a potential food and an essential source of proteins, fat, minerals and vitamins (Paoletti & Dreon, 2005). For some members of the growing middle and upper income groups of urban society in developing countries, insects are a 'nostalgic' food that they associate with rural lifestyle (FAO, 2010). To others, insects are a 'primitive' food source typically eaten by people of low economic status. Therefore, consumer acceptance remains the largest barrier to the edible insect-based value-chains.

To overcome the challenges of acceptance of insect-based foods, Hartmann & Siegrist (2016) suggested that edible insects should be processed into ingredients, and blended into popular dishes. Processing insects is also important in developing rural areas where most insect-based entreprises are located (in terms of rural livelihood opportunities) (FAO, 2013). Indeed the literature suggests that processing insects from 'visible' serving forms to 'invisible' forms would promote wider acceptance (Hartmann & Siegrist, 2016; Pambo *et al*., 2017; 2018). However, artificial rearing of

edible insects (such as crickets) and processing them into ingredients for blending with other foods is still in its infancy in Kenya (Alemu *et al*., 2017), and little is known about how consumers are likely to react to the blending of popular foods with insects. This study therefore intends to provide insights on attitudes and motivation to consume foods from edible insects (FFEI).

1.2 Problem statement

Of all foods that supply proteins to the diet, meat bears the greatest impact on the environment (FAO/WHO, 2005; FAO, 2013). A meat-based diet requires a significantly greater amount of environmental resources per calorie compared to a more grain-based diet. For example, to produce 1 kilogram of meat, 2-15 kilograms of plant proteins is inefficiently converted (Paoletti & Dreon, 2005; Chakravorty *et al*., 2013). Indeed, of all the activities consumers are undertaking in and around their homes, food consumption generally has the largest total effect on the environment, estimated at 20-30% (Tukker & Jansen, 2006).

Insect-based foods is one approach that is being promoted in Kenya[1] and other developing countries as an alternative source of proteins to conventional meat. But research on its prospects and acceptance by the households has been rare and sporadic (Alemu *et al*, 2017; Pambo *et al*., 2018). Most of the studies on insect-based foods largely focus on the nutritional aspects and the potential benefits of entomophagy (Ayieko *et al*., 2010; van Huis, 2013; Halloran *et al*., 2014). The underlying theme of these studies is that consumers are rational and therefore, should accept and consume FFEI based on the implied benefits. Only a few of these studies assess the processes consumers undergo while making consumption decisions. For example, Ayieko *et al*. (2010) used test trials and workshops before arriving at an acceptable constituent of insect-based product,

[1] The study is part of 'GREEiNSECT' project, which aims to improve production and consumption of protein and mineral-rich edible insects, particularly crickets, by the households that suffers from low protein uptake.

dough specifically. None of the past studies delve into consumer decision making process to enable the understanding of their attitudes and values that motivate their consumption behaviour.

Further, to date, very few studies (for example, Alemu *et al*., 2017) have investigated consumer demand (preferences) for foods from edible insects in Kenya. These studies mostly use the neoclassical random utility theories to elicit preferences for new products. Specifically, consumers are presented with hypothetical insect-based products and asked for their choice. The elicited choices are later used to assess their preferences. However, as Okello *et al*. (2013) explained, the information given in such utility maximization/rationality approaches is unbalanced and conceals the full range of attributes that are associated with the new food products (FFEI in the current case). More precisely, the negative attributes or aspects of the product that is perceived to be offensive are normally ignored. Thus, the existing research on consumer acceptance of FFEI (and new foods in general) are apparently characterised with narrow focus on the role of social, practical and contextual issues, which are key to consumer acceptance. Moreover, such conventional rationality approaches assume that people have relatively stable attitudes, values and preferences which exert a significant influence on food consumption across a range of social contexts (House, 2016). To the contrary, Hoeffler (2003) reported that the trade-offs elicited for new products like FFEI are usually unstable, because they are constructed at the time of measurement, rather than retrieved from something the consumer knows already.

The current study address these inadequacies in literature by employing the subjective expected utility theory particularly, the theory of planned behaviour (TPB), to determine consumer attitudes and intentions to consume FFEI. TPB has been used widely within the social psychology literature to provide consistent estimates, especially with new products (Ajzen, 1991). TPB is reinforced

with the means-end chain (MEC) analysis (Grunert *et al*., 1995; Reynolds and Olson, 2001), to explore individual motivations for consuming FFEI.

1.3 Objectives

The major objective of this study is to assess consumer behaviour and choice regarding foods from edible insects (FFEI) in Kenya, in order to inform how best to commercialize these products. The specific objectives pursued are:

1. To analyse the factors that influence households' behavioural intentions to consume FFEI.
2. To assess how the households evaluate the sensory properties of FFEI.
3. To determine the level of product involvement and emotions that consumption of cricket-based buns evoke in participants.
4. To analyse the personal motivations for consuming FFEI.
5. To assess the effect of differentiated nutrition information on motivations to consume FFEI.

In order to achieve objective one, the study first identifies and compares behavioural intentions to consume FFEI among rural-households drawn from western region of Kenya where entomophagy is common (familiar), and eastern region where the practice is uncommon. Familiarity with food has been shown to drive food choice in general, and is expected to influence intentions to consume FFEI (Verbeke, 2015). The study then analyzes the factors that predict the intentions to consume FFEI. It applies an extended theory of planned behaviour (TPB) that introduces personal norms as well as an interaction-effect of self-identity and familiarity with edible insects as additional constructs.

The TPB posits that intentions are the proximal determinant of behaviour, and are defined as the antecedents of the actual behaviour[2]. This theory follows the logic of individual's utility-maximization decision making. It thus embraces the idea that a behaviour such as consuming FFEI is first and foremost driven by the individual considerations. The theory posits that intentions are predicted by three components i.e., attitudes towards the behaviour, subjective norms and perceived behavioural control. In the essay, a fourth component is introduced i.e., an interaction-effect of self-identity and familiarity as an additional construct. Thus, the intentions to consume FFEI are evaluated by the sum of the four components as products of their respective regression weights. Side dish

The second objective of the study concerns assessing the households' expected and actual sensory evaluation of the appropriateness of a common and popular bakery product (namely, a bun) made from blended wheat-flour and cricket-flour. This study uses the cricket-flour buns to represent FFEI. Prior to the sensory evaluation, participants were randomly assigned to three treatment arms that differed in terms of the product-information provided. Thus, treatment effects of the sensory evaluation was assessed. Consumer knowledge (i.e., level of product information) is a major factor reported to influence consumer choices or acceptance of products. Objective two was achieved by assessing how households' evaluate the sensory attributes of the cricket-flour buns before and after actual tasting. It adopts the Just-about-right (JAR) scaling, which is a directional tool for sensory evaluation, to assess the expected and actual rating of the appropriateness of six sensory attributes of cricket-flour buns. The attributes evaluated were: sweetness/sugary, smell, colour, texture/softness, taste, and crumbliness/ease of handling. In addition, the perceived nutritious of

[2] At this point, it is important to keep in mind that there is a difference between the intention and actually transforming this intention into behaviour. Sometimes barriers (or objective obstacles) prohibit the realization of start-up plans. Such barriers might arise from changing circumstances or from misjudgment. For example, an individual might believe that his family members will support his decision to consume FFEI, but later discover that this is not the case.

the cricket-flour buns was also evaluated on identical JAR scale to enable direct comparison with the sensory attributes. The attributes were selected based on the results of focus group discussions conducted prior to the actual field experiment.

Objective three involved an analysis of the level of product involvement (i.e., consumers' interest in the product or product relevance) that insect-based foods elicit. Product involvement can lead to greater perception of its attribute' differences, product importance, and greater commitment to choosing it, which can ultimately increase its acceptance. Finally, this objective also concerned an investigation of the effect of information on the emotions that the consumption of cricket-flour buns evoke.

To achieve objective four and five of the study i.e., understanding what motivates households to consume FFEI and the role of differentiated information, a means-end chain analysis was employed to examine the effect of positive and perceived negative information on the motivations to consume cricket-based buns. Means-end chain (MEC) analysis combined with the laddering technique, is considered to be an effective approach for assessing the link/association between the product attributes (A), the perceived benefits or consequences (C) of its consumption and personal values (V) that drive consumption of the product. The A-C-V associations yield a hierarchical value map (HVM). This technique is uniquely suitable for exploring how the content of mental models that influence consumer' decision making relating to acceptance of cricket-flour buns depends on the type of information treatment.

1.4 Justification for the study

There is increased interest in insects as food for a sustainable solution to food and nutrition insecurity and hence the need to study its acceptance. The study provides important information on attitudes towards and motivations to consume traditional foods, in general, and FFEI, in

particular, by the households in Kenya. This is important to both agricultural sector (since it involves cultivation/rearing of insects) and food industry in Kenya, as it provide avenues for value addition. Local and international organizations have set up programmes to promote insects as food globally and in Kenya, hence the need for supporting mechanisms along the insect' value-chains. Among the organizations, researchers at Jaramogi Oginga Odinga University of Science and Technology, Jomo Kenyatta University of Agriculture and Technology, the International Center for Insect Physiology and Ecology, FAO and the scientific community[3], are currently conducting pilot trials for cultivating crickets, together with the local farmers. The study will assist these organizations with relevant information on consumer behaviour to enable them design appropriate promotion and marketing strategies and channels.

This study differs from others that have looked at edible insects in Kenya in several ways. First, it considers processed foods from edible insects (FFEI) instead of 'whole' insects. The idea is that individuals who may nurture distaste for consuming 'whole' insects because of a perceived inconvenience, disgust[4] and fear due to the unpleasant physical properties such as the hard cover, long appendages, hairs and smell, may prefer the blended products. Second, the study employs TPB to determine attitudes and intentions of consumers, then follows this up with MEC analysis to reveal the motivations driving those intentions. To the best of my knowledge, this is the first study to apply both TPB and MEC in consumer analysis of a novel insect-based food product in Kenya. It also set the study a part from others that employs utility maximization theories, as the basis of consumer choices. Finally, the study employs a field experiment where participants are

[3] Among the scientific community promoting cricket value chains in Kenya are: GREEiNSECT, INSFEED and ENTOFOOD; funded by DANIDA, IDRC/ACIAR and BMZ/GIZ. 'Flying Food' project funded by ICCO Company (ICCO- Inter Church Organization for Development Cooperation, representing an international Public Private Partnership; an established NGO based in the Netherlands. www.icco.nl) (Münke-Svendsen et al., 2016).

[4] Disgust is used in the study interchangeably with sickened or grossed out, rather than to signify a feeling of annoyance or anger.

randomly exposed to either positive or perceived negative information regarding FFEI. The rationale is to understand the effect of consumer' knowledge on FFEI consumption, hence informing the design of FFEI promotional campaigns and marketing strategies. The outcome from this study is likely to contribute to revitalizing traditional cultures, especially consumption of insect-based products, thus increasing the diversity of food, especially of protein origin.

The rest of this thesis is structured as follows: Chapter 2 highlights a review of relevant literature that has been used to contextualize this study. Chapter 3 discusses the methodology, while Chapter 4 presents results and discussions. Finally, Chapter 5 summarizes the study and then present the conclusions, policy implications and recommendations for future research. The survey instrument used to generate quantitative data used in this study and other supporting information are presented in the APPENDICES.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section reviews the relevant literature to provide the context within which this study is based. It begins by assessing the status of entomophagy in Kenya. Precisely, who consumes edible insects? When and where? How do they collect and process them? It therefore documents the potential relevance of insect-based products in the households' diets. It also discusses the potential demand (market) for FFEI. This is followed by an analysis of the stakeholders in the edible insect value-chains. The idea is to identify the institutions and individuals that may potentially possess key incentives or barriers for the edible insects' industry in Kenya. The section then delves into the approaches to studying food-choice behaviour where discrete choice modeling and cognitive theories are discussed in detail. Finally the section narrows down to the theoretical framework of the study.

2.1.1 Consumption of edible insects in Kenya: Status analysis

The consumption of edible insects is more common among communities in the western regions of Kenya (Christensen *et al*., 2006). In these communities, insects form a regular part of diet, mostly as a side dish, a snack, or an ingredient in composite dishes. Consumption is concentrated in some months of the year. This is majorly due to the seasonality of these insects, in some cases dictated by the weather (FAO, 2010; Ayieko *et al*., 2010). However, there are pilot attempts, in western, eastern and central (Machakos, Nairobi and Kiambu counties) regions of Kenya, to rear these insects by developing and adapting simple technologies for small-scale production to ensure year round availability (Halloran *et al*., 2015; Pambo *et al*., 2018).

A large variety of edible insects are available within the lake region for use by the local communities. Ayieko *et al*. (2010) indicated that the region is endowed with termites, crickets, grasshoppers, locusts and a collection of edible lake flies. Christensen *et al*. (2006) reported that the available insects are collected around homesteads, particularly deserted homes and more readily available during wet period. For example, collection of lake flies peaks during the onset of long rains (around March-April). They are harvested at their nest openings on the ground in the morning, when the sun is moderately warm. Termites are harvested at their nest openings on the ground in the evening by placing a basket on the nest openings. Other types of termites are trapped using light from a lantern lamp (at night). Large swarms are collected into a clean container for fresh consumption or (limited) processing. Crickets are hunted in their dark hideouts already identified during the day. They are also tracked by the whizzing sounds that they make during the night. Once captured (harvested), the insects are kept in clean containers and later air-dried for about 14 days to ensure sufficient moisture loss.

The collected insects are mostly consumed 'whole' (where the insects are visible), while fresh or fried and salted. Some households also process and mix (blend) them with other food items such as flour. Kinyuru at al. (2013), for example, observed that some mothers in western Kenya dry and grind termites into powder and use it as a sprinkle in baby porridge. Given that the period of transition from breastmilk to solid food is highly critical for the development of infants, this mixture forms a nutritious weaning-food. The author (ibid) also indicated that termites, local vegetable (*Amaranthus SP.)* and small fish (*dagaa*) have been blended for complementary feeding with cereal grains i.e., to fortify traditional cereal grains. Other than infant foods, edible insects have also been used recently as ingredients in the pilot production of wheat buns (Kinyuru *et al*.,

2009); crackers, muffins, sausages and meat loaf (Ayieko *et al*., 2010); as well as cricket-flour buns (Pambo *et al*., 2016; Alemu *et al*., 2017).

2.1.2 Stakeholders in the edible insects' value-chains in Kenya

The major stakeholders in edible insect value-chains in Kenya include the food industry (private sector), consumers, the health sector, and the Government. Each of these sectors have different, but strongly, interdependent interests and roles to play. The food industry is enthusiastic about developing new insect-based foods and argue that these products add value in terms of opening up new markets, new customers, and opportunities for profitable business based on product differentiation rather than price competition. Health workers and nutritionists play an important role in the success of FFEI by educating consumers on their benefits, given the trust consumers have on these professionals.

The government's role of food policy formulation and legislation also greatly affects FFEI industry in Kenya. Currently, there is no policy framework to regulate FFEI development and trade. Indeed, the Crop and Livestock Act, Cap. 321, Laws of Kenya (as revised in 2012) fails to recognize or categorize 'edible insects' either as animals or plants. However, the Kenya National Guidelines on Nutrition and HIV/AIDS recognizes edible insects as a part of traditional foods and culture, and states that: "Common sources of animal proteins in Kenya include milk and milk products, beef, poultry, chicken, eggs, fillet, dried small fish (*dagaa*) and edible insects" (Republic of Kenya, 2006, p. 11). Moreover, it recommends that food security in HIV-affected households can be addressed in rural areas by promoting traditional practices of harvesting, preserving and consuming indigenous foods such as edible insects. The policy framework in Kenya therefore allows consumption of traditional foods like edible insects, but without a proper regulatory framework on standards of quality and safety. Trading on insect-based foods therefore remains

restricted by the absence of specific standards regarding capture/harvesting and processing of these food products (KEBS, 2014; Halloran *et al*., 2015).

2.1.3 Potential risks of edible insects

Edible insects open up a lot of opportunities to improve existing foods and develop new food products and supplements (FAO, 2010; Belluco *et al*., 2013). FAO (2010; 2013) reported positive attitudes and strong interest in edible insects and related foods across numerous cultures. However, it also indicated that numerous factors weigh heavily on the success of mass production and consumption of insect-based foods. It recommended that understanding the consumer dynamics, ranging from their perceptions and attitudes, environmental concerns, communication channels, to their motivations and personal values, is critical to successfully launch and promote edible insects and products among non-consuming populations.

FFEI can however create a potential risk to the public if individuals and companies market insect-based products whose associated risks are not sufficiently evaluated and regulated by government agencies. The consumer is more concerned about self-care and personal health (van Huis, 2013), and needs to be provided with information about the safety and quality of new foods. Consumers may therefore be reluctant to accept foods from edible insects if the Government fails to play this role. This shows the importance of all the stakeholders working together and especially educating consumers thereby allowing them to make informed decisions about dietary choices.

2.2 Approaches to studying food-choice

Discrete choice modeling (DCM) and cognitive theories are the main approaches in consumer theory to explain food choice behaviour. The basic foundations of DCM lie in Lancastrian microeconomics in which individuals derive utility from characteristics or attributes of a good (Lancaster, 1966); and in random utility models/theory (RUM/RUT), in which utility has a

deterministic and probabilistic component (McFadden, 1973). Utility is considered to be unobservable (to the researcher), i.e., a random variable, which can be measured as a probability that rational consumers make choices of goods from which they obtain the highest utility in any given choice set. The randomness arises from the effects of unobserved attributes and taste heterogeneity, salient individual characteristics and measurement errors.

The underlying assumption in DCI is that each consumer chooses a single option that yields the greatest utility. Utility is only known by the consumers and cannot be observed directly by researchers. Researchers only observe certain attributes of alternatives available to consumers and some consumer characteristics. If researchers make assumptions about the distribution from which the taste parameters are drawn, they will be able to forecast demand by modeling the probability of purchase (Anderson *et al*., 1992).

The random utility model (RUM) represents the fundamental approach for the econometric analysis of consumer choice within DCI (Adamowicz *et al*., 1994). It is based on the hypothesis that individuals make choices according to attributes of alternatives along with some degree of randomness (McFadden, 1973; Manski, 1977). The model suggests that consumer's utility is represented by two components, a deterministic and a random component. The deterministic component is a function of observable product attributes, following Lancaster's characteristic theory that recognized how consumers select among different food attributes when choosing diets (Lancaster, 1966). The deterministic portion of consumer's utility can be modeled as a function of these product attributes.

DCI posits that the n^{th} consumer is faced with discrete choices between a conventional buns and cricket-based buns, depending on the features of each product. A choice on either alternative offers some utility that comprises two components:

$$U_{nj} = V_{nj} + \varepsilon_{nj} \quad (1)$$

Where U_{nj} is the n^{th} consumer's utility when choosing alternative j; V_{nj} is the deterministic component of the utility function based on product attributes for alternative j; ε_{nj} is the stochastic component of the utility function. The n^{th} consumer will choose alternative j if $U_{nj} > U_{nl}$ for all $l \neq j$. The probability that the n^{th} consumer chooses alternative j is given by;

$$Lnj = \text{prob}\{j \text{ is chosen}\} = \text{prob}\{Vnj + \varepsilon nj \geq Vnl + \varepsilon nl \text{ ; for all } l \in Cn\} \quad (2)$$

Where C_n is the set of all possible alternatives for the nth consumer.

Assuming that the observable utility component (V_{nj}) is a linear function of perceived product attributes (x) and there are k attributes for each alternative, then the functional form of this utility component is given as:

$$V_{nj} = \sum_{k=1}^{K} \beta_k X_{njk} = \beta' X_{njk}$$

K= number of attributes. (3)

Where X_{njk} is the k^{th} attribute value for the j^{th} alternative for the n^{th} consumer and β_k represents the coefficient to be estimated which represents the value the consumer places on that particular attribute. The probability that individual n chooses alternative j becomes;

$$L_{nj} = \frac{\exp(\beta' X_{njk})}{\sum_l \exp(\beta' X_{nlk})} \quad (4)$$

Parameters in this model can be estimated using numerical methods such as Newton's or the maximum likelihood estimate (Greene, 2000). However, such estimations do not accommodate

preference heterogeneity among consumers. That is, the coefficients of variables that enter the DCM are assumed to be the same for all people, implying that different people with the same observed characteristics have the same values (i.e., attribute valuation) for each factor entering the model. McFadden (1973) argued that most DCM estimations rarely accommodate learning (personal or social). A change in the attribute of one alternative changes the probabilities of the other alternatives proportionately such that the ratios of probabilities remain the same. In other words, it is assumed that the errors are independently distributed across alternatives. Furthermore, most DCM assume that unobserved factors are independent in situations with repeated choices for each decision maker. This substitution pattern can be unrealistic in many settings (Brownstone &Train, 1999).

Cognitive theories on the other hand maintains that people are considerate and rational in their food choices, which are further assumed to be influenced by a number of fronts. These include attitudes (both affective and cognitive attitudes), social influence and perceptions of personal control over choices (Ogden, 2003). Examples of cognitive theories are: Health Belief Model (Becker & Rosenstock, 1984), Means-end Chain (MEC) theory (Reynolds and Olson, 2001), Protection Motivation Theory (Rogers, 1985), Theory of Reasoned Action (Ajzen & Fishbein, 1980) and Theory of Planned Behaviour (Ajzen, 1988). The underlying theme of all these theories is that consumer choices are complex behaviours likely to be influenced by factors such as benefits, attitudes, perceptions of control, mood, stress, anticipated enjoyment, convenience, among others.

Cognitive theories therefore, offer useful platforms for overcoming a number of the weaknesses that have been highlighted under DCI. For instance, under DCI, consumers are presented with hypothetical insect-based products (such as cricket-flour buns) and asked for their choice. The elicited choices are later used to assess their preferences. However, as Okello *et al*. (2013)

explained, the information given in such utility maximization/rationality approaches is unbalanced and conceals the full range of attributes that are associated with the new food products like cricket-flour buns. More precisely, the negative attributes or aspects of the product that is perceived to be offensive are normally ignored.

Cognitive theories, for example, Theory of Planned Behaviour (TPB) allows ideas from both developmental approach (through normative influence) and the psychophysiological approach (through affective responses to food) to be incorporated (Ajzen, 1991). In addition, results from Theory of Planned Behaviour research can readily be applied to the development of interventions. These factors renders the Theory of Planned Behaviour more useful for the current study. This study therefore employs TPB for the same reasons, then complement it with MEC analysis, particularly laddering technique.

2.3 Theoretical framework

2.3.1 Theory of Planned Behaviour (TPB)

The theory of planned behavior (Ajzen, 1991) is one of the most widely used and well-supported social psychological (cognitive) theories for predicting human behaviour. The central premise of the model is that behavioural decisions are not made spontaneously, but are the result of a reasoned process in which behaviour is influenced, albeit indirectly, by attitudes, norms, and perceptions of control over the behaviour (Smith *et al*., 2007). The TPB is an extension of an earlier Theory of Reasoned Action (Ajzen & Fishbein, 1980), which proposed that an individual's participation in a behaviour (consumption of edible insects and its products or at least being involved in edible insects' value chains, in this case) could be predicted by his/her motivation to perform the behaviour (i.e., intention). Intention is predicted by an individual's evaluation of how favorable the behaviour is (i.e., attitudes) in addition to the individual's perceived social pressure to

participate in the behaviour (subjective norm, SN). In creating the TPB, Ajzen (1991) added perceived behavioral control (PBC) to the Theory of Reasoned Action. PBC was defined as an individual's perceived ease or difficulty of performing the behaviour and was proposed as a predictor of both intention and behaviour (Conner & Armitage, 1998).

The TPB model, in its original formulation, proposes that attitudes (i.e., evaluation of the target behaviour), subjective norms (i.e., perceived social pressure regarding performance of the behaviour), and perceived behavioural control (i.e., perceived control over performance of the behaviour), influence behaviour primarily through their impact on behavioural intention. Hence, intention is seen as the proximal determinant of behaviour, as shown in Figure 2.1 (Sparks & Shepherd, 1992; Conner & Armitage, 1998).

Ajzen (1991) explained that salient beliefs are the determinants of an individual's behaviour and actions. Salient beliefs can be categorized as behavioural beliefs, normative beliefs, or control beliefs. Behavioural beliefs are predictors of Attitudes, normative beliefs of Subjective Norms, and control beliefs of Perceived Behavioural Control. In order for beliefs to be predictive, they must be salient. Salience varies between individuals and also can vary based on situations that are present in an individual's life.

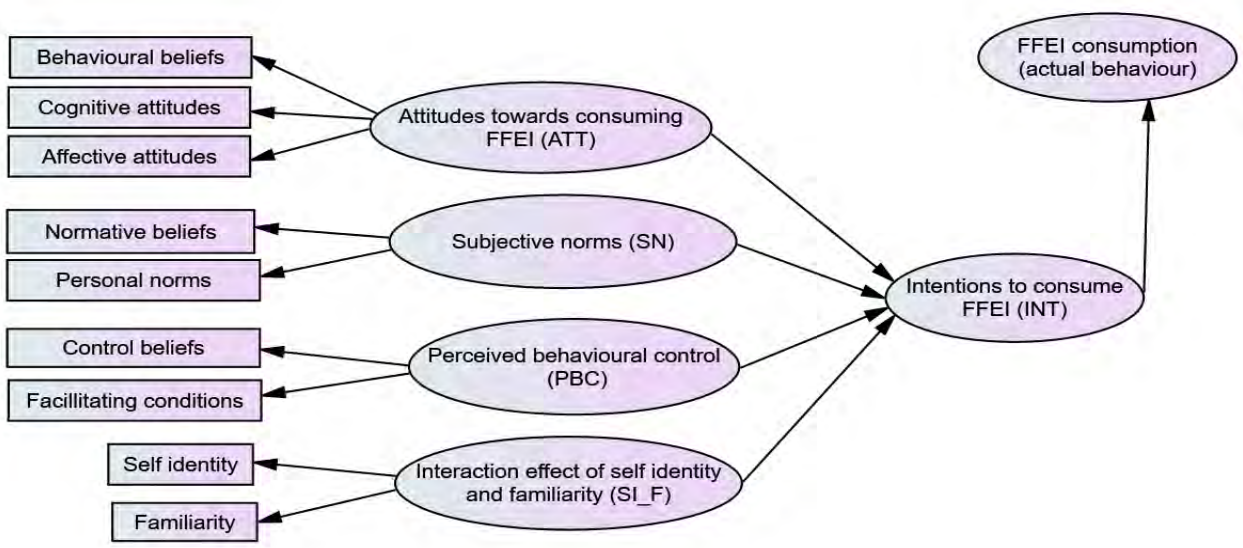

Figure 2.1: Conceptual framework.
The theory of planned behaviour extended with personal norms as an antecedent to subjective norms and an interaction-effect of self-identity and familiarity as separate regressor; based on: Ajzen (1991).

2.3.2 The TPB variables used in the study

As already discussed in section 2.3.1, the TPB is a parsimonious model containing three main variables, Attitudes (ATT); Subjective Norms (SN) and Perceived Behavioural Control (PBC). Decades of research have demonstrated that the model (in its original form) is able to predict behavioural performance accurately. Nevertheless, in presenting the TPB, Ajzen (1991) suggested that if further predictors can be identified, the TPB is open to expansion (Conner & Armitage, 1998). This has led to the consideration of a number of additional predictors within the context of the TPB. In the present study, the roles of personal norms and simultaneous effect of self-identity and familiarity (SI_F) were examined.

Attitude (ATT) is an evaluation of how positive or negative the consequences of doing a specific behaviour are perceived to be. ATT is proportional to the sum of the product of an individual's behavioural beliefs (bi) and the strength of each belief (ei), as in Eq. (5). Behavioural beliefs can pertain to a behaviour being beneficial, good, fun, enjoyable, pleasant, or any other consequential outcome that could occur from performing a behaviour.

To illustrate how behavioural beliefs affect ATT, an individual who evaluates the benefits and taste of FFEI as the most important factors of determining whether or not to eat the products, and evaluates benefits as high and taste as decent (i.e., neutral) would have a moderately positive ATT towards cricket-flour buns. Ajzen (1991) discussed research that has differentiated affective attitudes from instrumental attitudes based on the specific behavioural belief associated with the ATT. If the belief pertains to emotional evaluations of the behaviour (e.g., enjoyable, pleasant) it is said to reflect affective attitudes. General evaluations of the behaviour (e.g., good, favorable, positive), in contrast, are said to reflect instrumental attitudes.

$$ATT \propto \sum_{i=1}^{n} b_i \cdot e_i \tag{5}$$

Subjective Norms (SN) are the perceived approval or disapproval that people who are important to the individual (otherwise known as "salient referents" such as one's family members, peers, etc.) hold about a behaviour (Ajzen & Fishbein, 1980). SN is proportional to the sum of the product of each normative belief (ni) and the individual's motivation to comply (mi) with the salient referents that are perceived to hold the belief, as in Eq. (6). Normative beliefs pertain to beliefs, attitudes, and social pressures that the salient referents have about the behaviour. For example, if an individual identifies his/her family as a moderately salient referent and a roommate as an extremely salient referent, the roommate's evaluation will have a larger effect on the individual's

perception of SN. If the roommate accepts entomophagy (eating edible insects), the individual will likely perceive eating FFEI as more normative, even if his/her family does not like the practice. Salient referents vary between individuals, as some individuals may strongly consider their family's evaluation, while other individuals may strongly consider their significant other's, peers' or workmate's evaluation of a particular behaviour.

$$SN \propto \sum_{i=1}^{n} n_i \cdot m_i \tag{6}$$

Perceived Behavioural Control (PCB) is an individual's perceived ability to do a specific behaviour i.e. feels that the performance of the behaviour is under his/her volitional control (Ajzen, 1991). PBC is proportional to the sum of the products of the individual's evaluation of control beliefs (ci) and the perceived power (pi) of those beliefs, as in Eq. (7). Control beliefs are the perceived barriers and opportunities to perform the behaviour. Perceived power is how much a specific control belief affects the individual's ability to perform the behaviour. For example, if an individual believes availability and cost strongly influence his/her ability to practice entomophagy, and also perceive FFEI as being less available and expensive, he/she will likely perceive having low behavioural control over eating FFEI, consequently decreasing the probability of consuming cricket-flour buns.

$$PBC \propto \sum_{i=1}^{n} c_i \cdot p_i \tag{7}$$

Within the construct of subjective norms, the study consider personal norms, together with social norms, as additional predictors. Personal norms represent feelings of moral obligation or personal responsibility to perform, or to refuse to perform, certain behaviour (Verbeke, 2005). Social norms could prevent people from performing a particular behaviour, such as consuming FFEI. This could

occur, for instance, if a family member disapproves the consumption of FFEI. Nevertheless, the personal responsibility may lead to performing the behaviour for another reason, such as giving the family a nutritious meal. Thus there could be a conflict in norms (i.e., mixed-feelings) between personal norms and social norms (Verbeke, 2005).

Self-identity is generally interpreted as a label that people use to describe themselves. It is assumed to be the product of social interaction and the cause of subsequent behaviour (Sparks & Shepherd, 1992). For example, the labels 'green' and 'healthy' - portray environmental and health concerns, respectively (Cook *et al*., 2002). Support for entomophagy is anchored on claims that insect' value-chains are environmentally friendly (FAO, 2013; Tan *et al*., 2015). It is therefore likely that consuming FFEI is an expression of environmental and health concerns (Hartmann & Siegrist, 2016). Such expressions embody self-identity, which has been shown to influence food purchase intentions (Sparks & Shepherd, 1992). Sparks' & Guthrie (1998) also argued that ones' self-identity as a health-conscious consumer has a predictive effect on consumption of a diet low in animal fats, independent of the effects of other TPB variables. These studies support the placement of self-identity as a direct determinant of intention.

Given that consumer behaviour such as food purchase decisions are expected to be repeated frequently (Aakkula *et al*., 2005), the effect of the TPB-constructs should be observed when the effects of familiarity (past behaviour) are controlled (Smith, 2007). Although the effects of self-identity and familiarity have been determined independently in literature, self-identity in most cases correlate highly with familiarity (Smith *et al*., 2007). This has led some authors, for instance Fekadu & Kraft (2001), to question whether familiarity and self-identity are measures of the same underlying construct. The debate as to whether familiarity and self-identity are measures of the same underlying construct warrant their simultaneous analysis. Examination of the interaction-

effect of self-identity and familiarity will therefore, contribute to a greater understanding of the relationship between self-identity and familiarity in the prediction of consumption behaviour.

Behavioural intention (BI) is the willingness and motivation of an individual to perform the behaviour (Conner & Armitage, 1998). Thus, the theory views a person's intention to perform a behaviour as the immediate determinant of action (Ajzen, 1991). In fact, the theory suggests that once you have a good understanding of intention, behaviour is not that difficult to predict. Barring unforeseen events or challenges, such as skills and resources, or opportunities not freely available, a person will usually act in accordance with his intention, according to the theory (Ajzen & Fishbein, 1980). As previously stated; ATT, SN, and PBC are all components of the TPB that predict an individual's intention to perform a behaviour. With the inclusion of an interaction of self-identity and familiarity (SI_F) to the original TPB (Figure 1), BI is evaluated by the sum of ATT, SN, PBC and SI_F (indicated as SI in equation 4) as products of their respective regression weights (w), as in Eq. (8). A construct with a higher regression weight has more influence on an individual's BI, according to Smith *et al*. (2007).

$$BI = w_1 ATT + w_2 SN + w_3 PBC + w_4 SI \tag{8}$$

A behaviour is a specific action (e.g., frequent consumption of cricket-flour buns) that may also be dependent on demographic (D; e.g., age, gender, ethnicity, culture) and social environmental (SE; e.g., region, exposure to other traditions, peers) variables (Conner & Norman, 2005). BEH is evaluated by the sum of BI, D and SE as products of their respective regression weights (Eq. 9). A construct with a higher regression weight has more influence on an individual's BEH.

$$BEH = w_5 BI + w_6 D + w_7 SE \tag{9}$$

Therefore, the following four hypotheses are tested:

1. Ho: Favourable attitudes positively influence consumers' intentions to consume FFEI.
2. Ho: Subjective norms positively influence intentions to consume FFEI.
3. Ho: PBC positively predict intentions to consume FFEI.
4. Ho: The interaction-effect of self-identity and familiarity has positive effect on intentions to consume FFEI.

2.3.3 Application of the Means-End Chain (MEC) approach

In the context of insect-based foods the means-end chain (MEC) theory posits that an individual will consume FFEI [in this case, the cricket-flour buns] (means) to generate particular benefits that will ultimately serve to attain more abstract personal values (end) that the consumer associate with the consequence (Barrena & Sánchez, 2009). The theory argues that perceived self-relevant product attributes (A) lead to consequences (C) which lead to certain personal values (V) being fulfilled.

The attributes are the characteristics of the product that create utility for the product and are normally associated with one or several consequences. Consequences are the desired outcomes (benefits) that an individual wants in a product (Okello *et al*., 2013; Arsil *et al*., 2014). These consequences can be direct, indirect, physiological, psychological or sociological in nature (Lind, 2007). For example, local availability of crickets (an attribute) can be associated with proper/efficient utilization of local resources (first consequence), which then either creates employment opportunities or help in maintaining local diversity (second consequence). Personal values are the end states of the MEC analysis and are cognitive representations of an individual's existential goals (Okello *et al*., 2013). They are similar to personal needs/desires that motivate the actions taken or decisions made by an individual. Values represent standards that guide thought and action i.e., they translate individual needs into a socially acceptable format (Lind, 2007; Arsil

et al., 2014). They reflect inner motives associated, in our case, with cricket-flour buns consumption.

An attribute-consequence-value (A-C-V) sequence forms a chain referred to as a ladder, and a collection of all the ladders for a given domain forms a hierarchical value map (HVM) that illustrates all the major means and end values, and describes individuals' behaviour based on their personal values (Okello *et al*., 2013). The maps thus comprise a number of product attributes that are linked to a large set of consequences, which, in turn, are normally linked to a small set of personal/core values.

The consequences and values are typically generated using laddering technique. The technique is able to "bring to the surface" the personal values about a product that are usually hidden within individual's mind (Reynolds & Gutman, 1988). The technique has its roots in personal construct theory developed by Kelly (1955) and has been used extensively in many consumer studies that attempt to delve into the sub-conscious mind of an individual (Lind, 2007; Barrena & Sánchez, 2009). It has been applied in African country context by Largerkvist *et al*. (2015) and Okello *et al*. (2013).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Introduction

This chapter addresses the design, tools and techniques that was applied to collect data for the study. The chapter specifically highlights sampling and data collection procedures, study area, field experiment procedures and the statistical analyses.

3.2 Sampling and data collection

The survey was conducted in two counties[5] namely Siaya (in western region of Kenya) and Machakos (in eastern region), as shown in Figure 2. Western region was selected for this study because consumption of edible insects is more common among its various communities. In addition, Siaya county has been hosting numerous pilot programmes that aim to promote consumption of insect-based products, especially cricket-based foods (Alemu *et al*., 2017). In contrast, consumption of edible insects in Machakos county is relatively uncommon. The two counties were also targeted because of the high levels of poverty and food insecurity, which was expected to result in low consumption of protein rich animal foods. Indeed, low percapita consumption of protein is a problem of most inhabitants of the two regions (KNBS, 2012). The diets in the two regions tend to be dominated with staple cereals comprising maize, sorghum, and finger-millet (Christensen *et al*., 2006). It is therefore envisaged that these communities would benefit from improved nutrition when flour from the popular staples are enriched with cricket-powder.

[5] County is a geographical and an administrative unit of devolved government in Kenya.

The data for the study was collected from rural households through personal interviews between January and March, 2016. Explorative research including extensive literature search and six focus group discussions were conducted as part of the research design and the findings used to refine the survey questionnaire. The focus group discussions helped in identifying the relevant behaviours related to FFEI consumption. The findings of the focus-group discussions are available in Pambo *et al*. (2016). Prior to the main survey, a pre-test of measurement scales was performed with 36 participants drawn from a neighbouring county (Vihiga county, see Figure 3.1).

The pre-test was used to; i) assess the ease of understanding of the questions by respondents and their appropriateness under the study context, ii) to establish whether the designed TPB-measures were valid for the extended TPB-constructs, and iii) to minimize the differences in observed and real responses as suggested by Verbeke (2005). Additionally, the pre-test helped to confirm that participants could follow the steps of the field experiment (employed to achieve objectives 2-5), and also to ensure that research questions were presented in a uniform manner. The few questions which appeared complex were modified by the research team. Therefore, the feedback mechanism offered by the pretest-survey provided vital lessons to the research team and lead to the adaptation of the methodology employed in this study.

The questionnaire also included items forming variables related to the types of edible-insects known to participants, and other socio-economic aspects such as income, education, and household size, in order to monitor their effect on intentions to consume FFEI. Questions on sensory evaluations using the JAR scales, questions related to personal involvement, moods, familiarity with insect-based foods and socio-economic characteristics were also gathered.

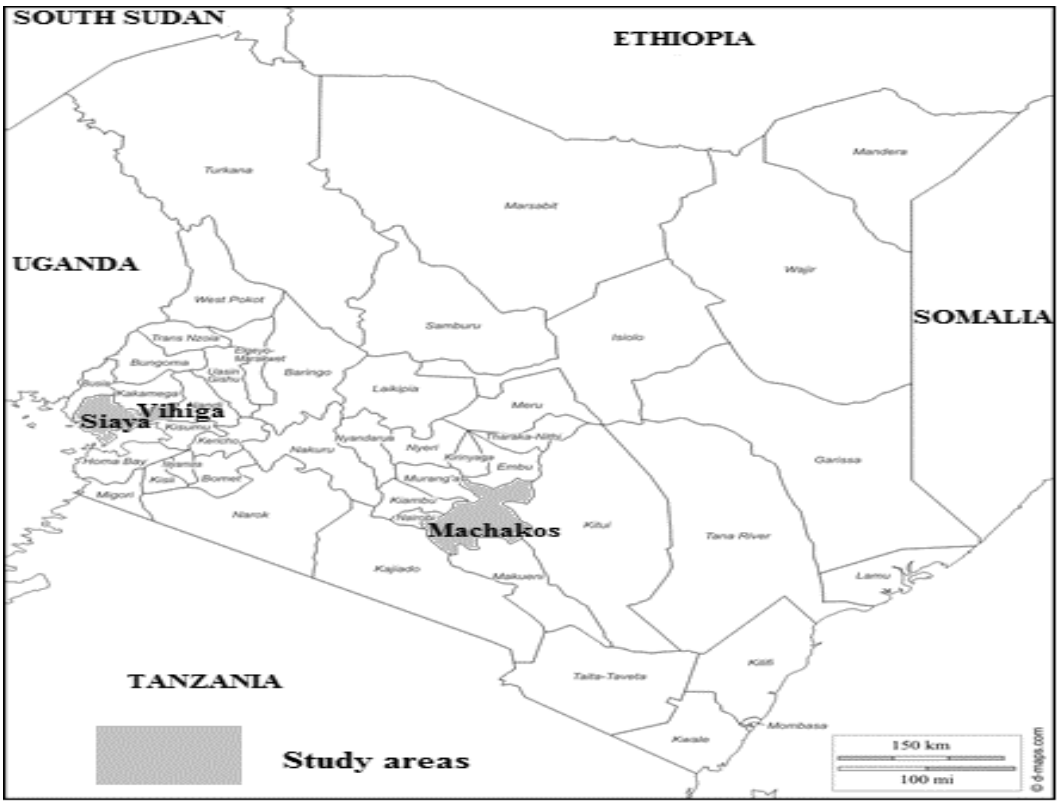

Figure 3.1: Geographical regions of Kenya where the study was conducted (d-maps.com)

The questionnaires were administered by five trained enumerators (research assistants) through face-to-face method. This method of data collection was preferred because the respondents' concerns and questions could be addressed at hand by the interviewers, and further clarifications given instantly. It also guaranteed higher response rate and was ideal for the 'tasting' sessions within the 'home' environment. This method was also instrumental in ensuring that only members of the household who make food-related decisions answered the questionnaire. The enumerators were accompanied and introduced to the households (participants) by the village elders who are well known by the people (are villagers) and by the Government. Thus, they were not seen as strangers by the participants. These measures were taken to ensure that the collected data was devoid of any potential hypothetical bias. All the enumerators had long experience in data

collection and a minimum of University/Bachelor's degree. They were supervised by the researcher. The team translated the whole questionnaire into Kiswahili, the most widely spoken (national) language to ensure that enumerators administered all questions the same way and that questions retained intended meanings.

The sampling of the respondents proceeded as follows: First, two counties, Siaya and Machakos, were purposively selected. From each county, four administrative locations were randomly sampled, followed by random selection of one ward in each of the four locations. Next, three villages were randomly selected from each ward and in each village, a list of all households was generated with the help of local/village elders. From each village list, eighteen households were randomly sampled for the interview. This procedure yielded a total of 432 participants, with one-half from western region and the other half from eastern region. Within each household, either the head of the household, the spouse or an adult who participates in food purchase decisions was interviewed.

In order to generate a sub-sample for the laddering data, from among the sampling households in each village, either two or three were randomly selected (proportionate to size) from each of the treatment arms to take part in the laddering interviews. This procedure yielded a total of 54 participants, which were fairly distributed among the three treatment groups.

3.3 Measurements and reliability

Concerning objective one, behaviour (BEH) was defined for all participants as regular consumption of FFEI for the next 12 months. Participants were asked to use this definition when answering all TPB related questions. All questions were measured on a 5-point scale (except those for affective attitudes which were measured on a 7-point scale) and only the endpoints were

anchored. Where appropriate, variables were reverse corded. The questions were developed following the procedure proposed by Fishbein & Ajzen (1975).

More than two items were used for all the TPB constructs in the questionnaire to achieve a greater reliability of the results. For all the belief, normative and control variables, a corresponding outcome evaluation statement measuring either the subjective evaluation (i.e., motivation to comply) was included. These two corresponding measures were then multiplied to obtain a composite indirect measure for each TPB construct as suggested by Fishbein & Ajzen (2010).

Factor loadings for each construct and cross-factor loadings were then conducted before the variables were included in the structural equations model to make judgment on convergent validity and construct validity. All factor loadings were over 70% and were larger for each construct than for the relative cross-factor loadings, implying construct validity. Moreover, the composite reliability for each factor extracted from the principal component analysis (PCA) exceeded 0.7, thus establishing convergent validity. A reliability test was further conducted and yielded Cronbach alphas for all factors above 0.75 as shown in Table 1. Following Verbeke & Vackier (2005), the test-results above the 0.7 cut-off value provided a satisfactory measure for internal consistency and confirmed the reliability of the study measures.

Table 3.1: Description of TPB questions and measurements (variables)

Construct	Items	Factor analysis PCA_variance (%)	Reliability score (α)
Attitudes: (*Behavioural beliefs*)	*"Eating FFEI within the next 1year would mean…?"* **Bbelief_1**: Consuming foods that are safe **Bbelief_2**: Consuming food that tastes good **Bbelief_3**: Consuming foods that are healthy	86	
(*Cognitive attitudes*)	**CognitiveAtt_1**: Consuming FFEI is favourable **CognitiveAtt_2**: Consuming FFEI is beneficial	84	0.89
(Affective attitudes)	**AffectiveAtt_1**: Consuming FFEI make me feel sad **AffectiveAtt_2**: Consuming FFEI make me feel disappointed	84	
SN: (*Normative beliefs*)	**Nbelief_1**: My family would encourage me to consume FFEI **Nbelief_2**: My religious leaders would approve of me consuming FFEI **Nbelief_3**: My peers would approve of me consuming FFEI **Nbelief_4**: My neighbours would approve of me consuming FFEI	71	0.77
PBC: (*Control beliefs*)	**Cbelief_1**: I find it easy to judge the safety of FFEI **Cbelief_2**: FFEI are readily available for me **Cbelief_3**: Consuming FFEI depends only on my decision **Cbelief_4**: How much *Control* do you think you have over whether you can consume or avoid consuming FFEI within the next 1 year?	85	0.88
Personal norms	**Pnorms_1**: How important would it be to give your family FFEI? **Pnorms_2**: Consuming FFEI would make me feel like I'm making a personal contribution to conserving the environment **Pnorms_3**: Consuming FFEI would make me conform to my culture	72	0.75
BI	**BI_1**: I intend to consume FFEI within the next 1 year **BI_2**: For me to consume FFEI within the next 1 year would be... **BI_3**: For sure I will consume FFEI within the next 1 year	77	0.76
Self-identity	**Sidentity_1**: I consider myself as a typical consumer of FFEI **Sidentity_2**: I look at myself as a person who will consume FFEI **Sidentity_3**: I am concerned that what I consume affect the environment	86	0.83

Notes: BI imply behavioural intention; PCA_variance imply principal component analysis explained variance

Regarding objective two, Just-about-right (JAR) scaling was used to assess the expected and actual evaluation of the appropriateness of six sensory attributes, namely: sweetness/sugary, smell, colour, texture/softness, taste and crumbliness/ease of handling. Nutrition/nutritious attribute was also evaluated using the same JAR scale to warrant a direct comparison with the other attributes. The JAR scale has gained popularity within the food industry especially at an early stage of product development (Li *et al*., 2014). It was therefore appropriate for this study because the cricket-flour buns were new to the respondents. The attributes were scored on a 5-item nominal JAR scale ranging from 'much too little' to 'much too much'. Softness was mainly regarded as a 'mouthfeel' attribute of cricket-flour bun, while crumbliness was a 'hand-feel' attribute that measured the ease with which the buns break apart. The attributes evaluated were selected based on the findings of six focus group discussions conducted as a baseline study (Pambo *et al*., 2016). These group discussions revealed that taste, nutritious/nutrition, colour, texture, and crumbliness were the key attributes consumers could relate cricket-flour buns to.

In the JAR scaling, two nominal opposite endpoints, for example ''Much too little" and ''Much too much", are placed at each polar end of the scale, and the midpoint is JAR, which is assumed to be an individual's ideal level (Moskowitz, 2001). JAR scaling therefore evaluates the appropriateness of an attribute relative to this ideal level. Normally, the extremes (endpoints) are estimated by the deviation of the participant's scale rating from the JAR (Li *et al*., 2014). The perceived appropriateness of an attribute (e.g., taste) can be increased if it is perceived as ''Much too little tasty,'' or decreased if it is perceived as ''Much too much tasty''. Consequently, Moskowitz (2001) argues that JAR scale is a directional tool that can inform the direction of food innovations aimed at increasing consumer acceptance.

To achieve objective three, participants measured personal involvement by responding to the following statement: "Please evaluate the product (cricket-flour bun) that is before you, against the following series of descriptive scales". The personal involvement scale adopted from Zaichkowsky (1985) and Lagerkvist *et al*. (2015) was used. The scale contained the standard 20-item measures. Involvement was measured using bipolar items rated on a seven-point scale such that the total possible score ranged from a low of 20 to a high of 140.

Several tools have been developed to measure consumers' emotions during product development contexts (Schifferstein *et al*., 1999). Cardello *et al*. (2012) compared a 39-item versus a 14-item questionnaires of scaled emotions to measure emotional responses to different foods, including chocolate and potato chips. King and Meiselman (2010) used an EsSense Profile that employed 39-emotion-terms, whereas Chrea *et al*. (2009) employed the Geneva Emotion Scale with 36-items designed for oduors. One common denominator of the highlighted tools, except Cardello *et al*. (ibid), is that they consist of a large number of terms on emotions. This makes the implementation of the tool cognitively burdensome to the respondents. Further, the translation of many of the emotions (terms), which are well-known in English, into other languages (e.g., Kiswahili and local vernacular used in this study areas) becomes a major challenge because of difficulty of finding culturally appropriate and/or equivalent words/terms. Therefore, an EmoSemio profile comprising 23 items, applied successfully by Largekvist *et al*. (2016) under the same context and culture as this study, was adopted. The emotional question presented to the participants was: "Please describe how you feel right now considering the cricket-flour bun that you have just tasted." The 23 items were measured on a 5-point scale from ''not at all" to ''extremely".

3.4 Data analysis

Data concerning objective one was analyzed in SPSS_AMOS Graphics 22 software (Arbuckle, 2013), using covariance-based structural equation modelling (SEM). This method allows for concurrent testing of all causal hypotheses of the model and provides an overall measure of the model fit. SEM is suitable for measuring the unobserved latent variables using observed/measured variables. Model parameters were estimated by approximating the implied covariance matrix as closely as possible to the sample covariance matrix (Bollen, 1989; Hu & Bentler, 1999). The χ^2 goodness-of-fit test was used to determine whether the theoretical model fits the data well. Comparative fit index (CFI) was included as the index of incremental fit, and Root Mean Square Error of Approximation (RMSEA) was included as an absolute fit index. General rules of thumb for acceptability of model fit using these indices are: < 0.10 for RMSEA; > 0.90 for the GFI and CFI; and < 5 for χ^2/df (Bollen, 1989; Hu & Bentler, 1999; Byrne, 2010; Arbuckle, 2013).

Concerning objectives two and three and to determine the success of the experimental randomization process and test whether the data can be split by treatment categories, an independent sample Kruskal-Wallis test was performed. The same test was performed to assess whether the samples of JAR data originated from the same distribution i.e., to examine the omnibus effect of the information provision between the three treatments. Further, Mann-Whitney tests were used to examine whether pair-wise samples originated from the same distribution. Also, a series of related-samples Friedman within-treatments tests were employed to assess whether expected and actual likings had the same distribution.

Linear mixed effects models with information treatment as the between-subjects factor and socio-economics variables as the within-subjects factor were used to examine the effect of information on the appropriateness of the nutritional attribute. The models were estimated with a random

intercept to account for individual heterogeneity in scale usage and response behaviour. A Restricted Maximum Likelihood (REML) model was adopted for the parameter estimation. Lastly, the mean emotional responses were estimated with the EmoSemio questionnaires for each of the three treatments. An independent-sample Kruskal-Wallis test was performed to examine whether there was treatment-specific discrimination between emotions. A series of Mann-Whitney tests were then performed to assess whether pair-wise differences between the samples were supported.

3.5 Cricket-flour buns development

Past studies e.g., Hartmann & Siegrist (2016) acknowledged that acceptance of insect-based foods can be enhanced if they are served with familiar and widely consumed products. Therefore, this chapter deemed 'buns' (generally bread) typically based on wheat flour, appropriate. Buns were preferred because they are smaller, hence portable, relative to other types of bread products. They were prepared by replacing 10% wheat flour with cricket-flour and baked in a standard way ordinary buns are baked. Baking was conducted by trained technicians at the Food Processing Workshop Unit of the Jomo Kenyatta University of Agriculture and Technology, Kenya, and was based on a recipe developed by Kinyuru *et al*. (2009) and modified by Alemu *et al*. (2017a).

After baking, the buns were packed, labeled and transported to the study site safely and securely. At the study sites, they were stored in sufficiently aerated room, at room temperature. The buns were used in the field for up to four days, with fresh buns from the store being used each day. Although they were still suitable for consumption beyond the fourth day, they were discarded to mitigate the effects of potential variation in the properties of the products on peoples' sensory evaluation, as suggested by Alemu *et al*. (2017a). In the field, the research team (i.e., the researcher and five trained research assistants) assessed the sensory properties of the buns, especially the taste

and smell, before the commencement of each field work-day to detect any changes in characteristics of the buns. The team's experience was that the characteristics of the buns remained fairly the same during the four days.

3.6 Experiment and the type of information

The field experiment implemented in this chapter involved three treatments, and participants in each treatment were given different information regarding cricket-flour buns based on the treatment-group to which they were randomly assigned. Group 1 (*Control*) received only basic information on processing and safety features of cricket-flour buns. In addition to this; group 2 (Treatment 1: *Benefits*) received detailed information on nutritional benefits, particularly proteins, as well as other economic and environmental merits of switching to insect-sourced proteins. On the other hand, group 3 (Treatment 2: *Drawbacks*) received information on the perceived negative sensory attributes of cricket-flour buns. Appendix 2 provides detailed information on the three treatments. The description of the information relating to the processing and safety features was important because most participants were expected to be knowledgeable regarding 'whole' crickets as food as opposed to cricket-flour products (Alemu *et al*., 2017b). It was therefore, necessary to inform participants about the changes involved in processing. Furthermore, information regarding safety of the cricket-flour buns was included to enhance participation in the experiment, especially the tasting of buns. Safety is one of the main reasons why consumers reject insect-based foods (Verbeke, 2015; Hartmann & Siegrist, 2016).

Participants where approached and interviewed at their homes during the field experiment. The home environment was considered appropriate situational context because it is where food preparation and eating mostly take place in rural settings targeted by the study. Following Lagerkvist *et al*. (2016), it was important to keep the situational context as close to the real

decision-making situation as possible in order for the respondents to provide the most salient criteria in their sensory evaluation.

3.7 Steps in the experiment

In step 1, upon recruitment participants were informed about what the study entailed and consent to participate obtained from each individual. Participants who did not wish to taste the cricket-flour buns were allowed to withdraw their participation. Overall, only six participants withdrew their participation. For participants who consented, data on demographic characteristics, physical and financial assets owned as well as familiarity with foods from edible insects were recorded.

In step 2, the enumerator read the general information aloud to the participants. Each participant was then given treatment specific information (details in Appendix 2), then asked questions regarding his/her product involvement.

In step 3, the enumerator placed a packet containing three cricket-flour buns on a table (or an equivalent), removed one bun from the packet and cut/divided it into two to expose the inside. The participant was not allowed to use any sense other than visual at this point. The participant was then asked to provide the expected sensory evaluation of the cricket-flour buns using the JAR scale.

In step 4, the participant was requested to rinse his/her mouth with water in preparation for actual tasting of the cricket-flour buns. The participant was then requested to taste a sliced bun 2-3 times (i.e., at least 2 bites). After the actual tasting, the participant was again asked to rate his/her actual sensory experiences using the same JAR scale. The consumption requirement in this step was expected to increase attentiveness and to enhance cognitive processing of the stimulus leading into the subsequent evaluation task.

In step 5, the participant described his/her moods and feelings about the cricket-flour bun tasted. Lastly, in step 6, the participant was informed that he/she could keep the remaining two buns as a reward for participation in the experiment. This was done to reduce the risk of in-kind endowment effects, which could have distorted the expected and/or actual liking (Lagerkvist *et al*., 2016).

3.8 The laddering process

The laddering interviews (both soft and hard laddering techniques) were used to investigate the effect of positive and negative information on consumers' mental models regarding foods from edible insects. As described by Okello *et al*. (2013), soft laddering technique gives the respondent more freedom by typically allowing him/her to trace own mental models with little interruption and to follow as much as possible his/her own flow of speech. On the contrary, hard laddering technique allows less freedom to the respondent as the interviewer controls the flow to ensure that the respondent verifies the structure and associations between constructs (Barrena & Sánchez, 2009).

The laddering interviews were preceded by field experiments where participants were approached and interviewed at their homes. The home environment was considered appropriate situational context because it is where food preparation and eating mostly take place. Following Lind (2007), it was important to keep the situational context as close to the real decision-making situation as possible in order for the respondent to provide the most salient criteria in the laddering interviews. The product (i.e., cricket-flour buns) formulations and steps followed in carrying out the field experiment are described in detail, in the previous chapters.

As described in section 3.6, the respondents were provided information about the cricket-flour buns and then asked to taste about two slices of the buns. Next, the interviewer started each

laddering session by asking the respondent to consider: i) the information given regarding edible insects in general, ii) the cricket-flour bun just tasted and, iii) the remaining two cricket-flour buns, as suggested by Reynolds and Gutman (1988) and adopted by (Lind, 2007; Okello *et al*., 2013; Arsil *et al*., 2014). The interviewer then proceeded to give the statement below (adopted from Okello *et al*., 2013) to the respondent:

"*We are interested in what comes to your mind and what you would think of when considering the following question (please, note that the results will be anonymous):*

What would make you be interested (or not interested) in consuming the cricket-flour buns (you've just tasted) again?"

Based on the response to this question, attributes (i.e., features/characteristics of cricket-flour buns) that would make the respondent want to consume cricket-flour buns or otherwise, were listed, and formed the starting point for the laddering interviews.

The interviewer then used a series of "*why is that important to you*" questions, which forms the premise of laddering technique, to trace the A-C-V structures associated with each attribute. Evidence shows that this process of interviewing "induces" the respondents to dig into the subconscious mind and retrieve the motivations, which Okello *et al*. (2013) refer to as mental constructs or models. These models are considered to motivate actual decisions and the associations among the constructs in the mind of the respondent. Each interview lasted for about 25 minutes on top of the main survey.

3.9 Content analysis for the laddering data

Data from laddering interviews were analyzed following the recommendations by Reynolds & Gutman (1988). The answers from the laddering interviews were classified according to whether they were attributes, consequences or values. A set of summary codes were then developed to ensure that all the attributes, consequences and values mentioned by the respondent were covered. The codes ware developed by trained experts to improve consistency during content analysis procedure. Arsil (2014) recommended that trained judges should be employed to guarantee higher inter-judge reliability.

MECanalyst 1.0.15 software was then used to analyze the coded data. This software produces a mental map with a summary implication matrix (SIM) that depicts how often concepts that have been mentioned are linked to each other, both directly and indirectly. Following Barrena & Sánchez (2009), the number of times each variable was mentioned as the end versus the origin of a relationship was compared while ordering the matrix. The software also allows for the aggregation of the means-end chains (MEC) into a hierarchical value map (HVM). The HVM in this case depicts the motivational decision structure of the respondents' decision to consume cricket-flour buns (Grunert & Grunert, 1995).

The next step in constructing HVMs was to identity a "cut-off level". As Reynolds and Gutman (1988) suggested, the "rule of thumb" for researchers is to try multiple cut-off levels and then choose the HVM that produces interpretable and informative solutions. The key decision to construct the HVM is to determine which cells or linkages in the SIM to be portrayed as the dominant relationships in the matrix (Arsil *et al*., 2014). Additionally, the proportion of active links and cells at or above the cut-off level can also be used to determine the cut-off level, with levels >50 per cent taken as the threshold (Pieters *et al*., 1995).

The HVMs for the current study were constructed using a cut-off level of 2, except the general one representing the whole sample, which had a cut-off level of 4. These levels represented between 60 and 70 per cent of active links at or above the cut-off level and was considered appropriate for choosing the cut-off level (Arsil *et al*., 2014). The HVMs were then graphically presented, with the attributes at the bottom of the maps and the values at the top. The concepts were proportionally rendered with the most important concept as the largest arrow (nodes) i.e., the most important arrow was the widest (Lind, 2007). The HVMs also show the response rate particularly the number and the percentage of the total amount of links connecting the categories.

3.10 Ethical review and approval of study

The study was approved by the Board of Post-graduate Studies of the Jomo Kenyatta University of Agriculture and Technology (JKUAT) and the National Commission for Science, Technology and Innovation (NACOSTI). All procedures involving human subjects were reviewed and approved by the Kenyatta National Hospital/University of Nairobi Ethical Review Committee (KNH/UON-ERC). In addition to obtaining the necessary approvals, the cricket-flour buns used in the study were tested and approved by the Kenya Bureau of Standards (KEBS/TES/5963/M/15) as suitable for human consumption and for use in this study (see Appendix 3 for details).

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results of the study. First, the general socioeconomic characteristics of the participants are presented to facilitate understanding of the participants and the success of the randomization while sampling. This is followed by presenting the results for each of the stated objectives, and thereafter a detailed discussions and contextualization of the findings.

4.2 Analysis of factors that influence households' behavioural intentions to consume FFEI.

4.2.1 Main characteristics of the participants

Table 4.1 presents the characteristics of the study respondents and shows that both the mean household age, education, income and group membership, were higher in eastern region, while the household size was higher in western. In eastern region there were almost equal number of male and female participants, while western region had more female participants, which reflects the regional livelihood opportunities i.e., while the dominant enterprise in western is a male-dominated motorcycle transport service (popularly known as '*boda boda*'), eastern region is dominated by agricultural-enterprises, especially dairy (zero-grazing), where both sexes are actively involved.

Table 4.1: Description of the main characteristics of the sample-participants

Variables	Whole sample	Western region	Eastern region	Mann-Whitney [a]
	Means (SD)			
Descriptive				
Average age of household members (years)	28.1 (11.8)	24.6 (10.5)	31.2 (12)	0.034
Size of the household	4.9 (2.1)	5.5 (2.1)	4.2 (1.7)	0.031
Frequencies				
Income category (%)				
Low income (< 70,400)	33.1	43.5	22.7	< 0.001
Medium income (from 70,400 - 260,000)	33.1	34.7	31.5	0.047
High income (above 260,000)	33.8	21.8	45.8	<0.001
Gender (% Female)	55.6	60.2	50.9	0.011
Highest education level attained (%)				
Non-school & incomplete primary	20.4	33.3	7.9	<0.001
Primary school	39.1	46.3	33.8	0.007
Secondary school	27.5	14.8	38.4	0.004
Some College (no University)	7.6	2.8	10.2	<0.001
University	5.4	2.8	8.8	0.004
The household is a member of a community based organization (% yes)	62.9	56	71.3	0.007
Who *Control*s financial assets				
Female	25.2	25.5	25.1	0.141
Male	45.7	50	41.7	0.023
Both male and female	29.1	24.5	33.2	0.041
How many times did you consume any kind of insects within the last 12 months?	1.48	2.12	1.06	< 0.001
Sample size	432	216	216	

Notes: [a] Hypothesis: the distribution of the variables for participants from western and eastern regions is the same; Standard deviations (SD) for continuous variables are in parentheses

Participants were also knowledgeable about locally available edible insects. As reported in Figure 4.1, western region showed higher knowledge of all the common edible insects in Kenya, except termites, where the two regions were nearly at par. The most widely known edible insects in the two regions were termites, grasshopper, cricket and black ants. Lake flies were mainly known as edible insects among the participants from western region. This finding is in line with our a priori expectations because none of the respondents in eastern region lived near a lake.

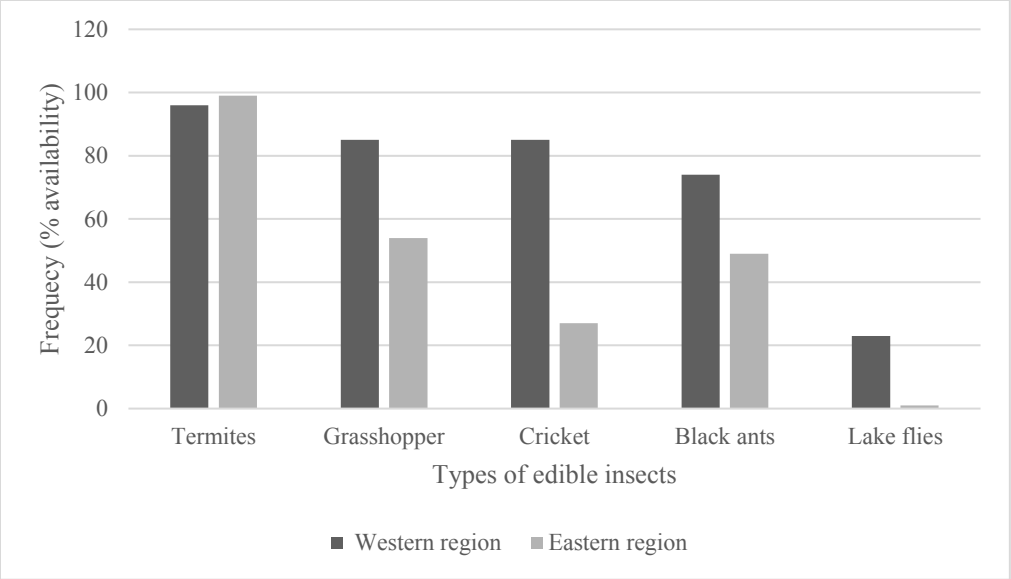

Figure 4.1: Knowledge of the most common edible insects available in Kenya

4.2.2 Intentions to consume FFEI

Participants in general expressed high intentions to consume FFEI. As reported in Table 4.2, the mean score of the Likert scale responses was 3.89, and was significantly higher than the 'neutral' value of 3, with $t(431) = 19.69,\ p < 0.001$. The results further show that the mean value of intentions to consume FFEI in western (4.13) was significantly higher than for eastern region (3.66). The attitudes towards consuming FFEI were generally positive, but more so for participants from western region. However, the cognitive attitudes (related to thinking rather than feelings) were significantly higher for eastern region. The findings of the analysis of subjective norms suggest that participants perceive that social-referents such as family members, peers, neighbours and religious leaders would approve of them consuming FFEI. Moreover, the mean score for personal norms (the internal pressure or personal responsibility to perform the behaviour) was also positive (4.03), suggesting that it was not in conflict with the social norms (external pressure). Familiarity, that is, the average number of times participants actually consumed edible insects during the past one year (in 2015) was higher (2.12) for western compared to 1.06, for eastern

region ($p < 0.001$). However, it was interesting that insects are actually consumed by households in eastern region where entomophagy is considered rare in Kenya.

Table 4.2: TPB variables by study region (means and standard deviations [SD])

TPB constructs	Variables	Whole sample		Western region		Eastern region		
		Mean	**SD**	**Mean**	**SD**	**Mean**	**SD**	**p-value[a]**
Attitudes	Behavioural beliefs	4.19	1.14	4.49	0.93	3.88	1.25	<0.001
	Cognitive attitudes	5.62	1.32	5.44	1.42	5.81	1.18	0.005
	Affective attitudes	3.92	0.32	3.95	0.31	3.88	0.41	0.007
Subjective norms	Normative beliefs	3.76	1.33	4.03	1.27	3.48	1.33	<0.001
	Personal norms	4.03	1.2	4.39	0.89	3.68	1.35	<0.001
PBC	*Control* beliefs	4.11	1.01	4.42	0.81	3.78	1.23	<0.001
Intentions	Behavioural intentions	3.89	0.94	4.13	0.89	3.66	0.94	<0.001
	Self-Identity	3.66	1.08	3.96	0.99	3.37	1.08	<0.001
	Familiarity	1.48	0.46	2.12	0.31	1.06	0.36	<0.001

Notes: [a] Test the null hypothesis that variable-means for western and eastern regions are the same.

4.2.3 Factors predicting intentions to consume FFEI and hypotheses testing

A Shapiro-Wilk's test (Shapiro & Wilk, 1965; Razali & Wah, 2011) show that the intention to consume FFEI' estimates are approximately normally distributed. Specifically, the Skewness has a value of 0.453 (SE=0.411) while a Kurtosis is 0.512 (SE=0.629). Therefore, the Maximum Likelihood Estimation (MLE) method was applied as the standard algorithm for parameter estimation (Byrne, 2010). The χ^2, Goodness of Fit Index (GFI), Comparative Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA) showed acceptable fit for the model i.e., χ^2 *(df) = 392.76 / 85;* $\rho < 0.001$; GFI = 0.919; CFI = 0.907; RMSEA = 0.082. These results indicate that the extended TPB was suitable for explaining the intentions to consume FFEI.

Figure 4.2 shows the path coefficients for the whole sample. For the purposes of interpretation, standardized coefficients are reported. The strongest influencing variable on intentions to consume FFEI is the interaction-effect of self-identity and familiarity (SI_F), with a path coefficient of 0.59. Specifically, the finding suggest that if the SI_F were to increase by 1 unit, the intentions to consume FFEI would increase by 59%. Perceived behavioural control (PBC) followed with a path coefficient of 0.21, attitudes 0.16, and subjective norms 0.04. All paths were significant ($p < 0.05$), and jointly explained 45% of the variations of the intentions to consume FFEI. Consequently, subjective norms had the least effect on the intensions to consume FFEI.

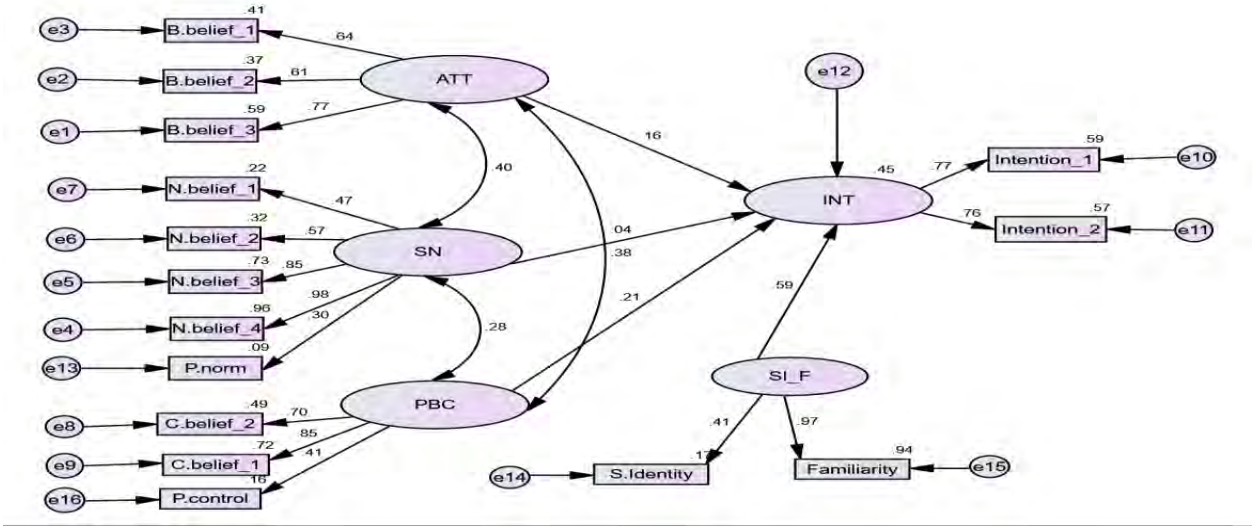

Figure 4.2: Structural equations model results for the whole sample

Hypothesis 1 stated that a favourable attitudes towards FFEI would positively influence participants' intentions to consume them. The results (Figure 4) showed that consumers' attitudes towards or evaluation of FFEI independently accounted for 16% of the intentions to consume the product, hence no evidence to reject Hypothesis 1 ($\chi^2 = 4.63$; $p < 0.05$). The results also showed that the subjective norms, PBC and the SI_F had positive and significant ($p < 0.05$) effect on the intentions to consume FFEI. Thus, hypotheses 2, 3 and 4, of the study could also not be rejected.

Table 4.3 presents the results by region. All the paths are significant ($p < 0.05$), but only two are significantly different between the two regions. The paths linking attitudes and PBC to the intentions to consume FFEI ($p < 0.001$). The finding means that the effects of attitudes and PBC on intentions to consume FFEI are significantly different between participants from western and eastern regions. At a more abstract level and following the argument of Pambo *et al.* (2016), these differences demonstrates that basic culinary processes informing FFEI-choice, may be very different even within a relatively unified cultural region.

Table 4.3: Standardized path coefficients and significance by study region

Path	Western region		Eastern region		χ^2
	Coefficient	**p**	**Coefficient**	**p**	
ATT → INT	0.35	< 0.001	0.16	< 0.001	< 0.001
SN → INT	0.09	0.01	0.17	< 0.001	0.086
PBC → INT	0.13	0.01	0.22	< 0.001	< 0.001
SI_F → INT	0.43	< 0.001	0.45	< 0.001	0.081
R^2	58		< 0.001		

Notes: INT imply intentions; ATT imply attitudes; SN imply subjective norms; PBC imply perceived behavioural control; SI_F imply interactional-effect between familiarity and self-identity, χ^2 test the hypothesis that path coefficients for the two consumer regions are equal.

Apparently, PBC has a reversed effect i.e., has larger influence on intentions to consume FFEI than attitudes in eastern region, but lower in western region. The explanation borrows from the observation of Urban *et al.* (2012) that people who are more familiar with FFEI can easily identify the relevant barriers to consuming the product, and any possible solution. PBC embodies FFEI consumption-barriers which are expected to impact participants from eastern region more because they are less familiar with FFEI. Possibly, intentions to consume FFEI are affected much more with control barriers among individuals who are less familiar with such foods, probably because either they lack experience, cares less, or even are indifferent.

4.2.4 Correlations among variables associated with intentions to consume FFEI

The TPB and socioeconomic variables associated with the participants' intentions are reported in Table 4.4. Intentions to consume FFEI positively correlated with *affective attitudes*[6] in the two regions ($p<0.001$), whereas for *cognitive attitudes,* the correlations were only significant for western region. Correlations with personal norms and self-identity were higher for eastern, but insignificant for PBC items in the same region.

Table 4.4: Correlations of observed variables with Intentions to consume FFEI

Item	**Pearson correlation**		
	Whole sample	**Western region**	**Eastern region**
Cognitive attitudes	0.03	0.14**	0.05
Affective attitudes	0.24***	0.20***	0.30***
Social norm	0.36***	0.16**	0.46***
Personal norms	0.43***	0.27***	0.39***
Perceived *Control*	0.21***	0.19***	0.08
Facilitating conditions	0.14	0.01	0.11
Self-identity	0.61***	0.53***	0.59***
Socioeconomic characteristics			
Household (HH)size	0.02	-0.18	0.02
HH Income	-0.08	-0.03	0.03
Mean HH education	-0.06	-0.02	0.16**
Mean HH age	-0.01	0.09	0.07
Gender	0.11**	0.03	0.24***
Familiarity with edible insects	0.64***	0.59***	0.69***
N	432	216	216

Notes: *** 1%; ** 5%; * 10% Significance level.

Correlations between the intentions to consume FFEI with the mean household size was negative for western, but positive (though not significant) for eastern, while education was positive and

[6] Affective attitudes relates more to the 'feelings' while cognitive attitudes are largely concerned with 'thinking' (Dean et al., 2008).

significant for eastern but negative and insignificant for western. Gender correlated positively in both regions, but was only significant for eastern region.

4.2.5 Discussions

The first objective of the study was to analyse and compare intentions to consume FFEI between western region of Kenya, where entomophagy is widely common and culturally rooted, and eastern region where the practice is uncommon, using an extended TPB. Results show that participants in general expressed high motivations to consume FFEI because the Likert scale' mean-measures for all the extended TPB-constructs are significantly higher than the 'neutral' value (*neither… nor…*). Further, the results also reveal that all the measures, except those related to cognitive-attitudes, are significantly higher for western than eastern region, suggesting that consumers in western region are more motivated to consume FFEI.

These results confirm the efficacy of the extended TPB that include an interaction-effect of self-identity and familiarity. Indeed, the results indicate that the extended TPB model accounts for a significant proportion (58%) of the variation in the intentions to consume FFEI. Further, all the study hypotheses could not be rejected indicating that FFEI are very relevant to consumers' self-concept. The results compare favourably with those of other studies (Armitage and Conner, 2001; Cook *et al*., 2002; Verbeke & Vackier 2005; Dean *et al*, 2008; Thøgersen, 2009). For example, Cook *et al*. (2002) found that TPB explained 24% of the variations in intention to purchase organic vegetables; Verbeke & Vackier (2005) found that it explained 52% variations in fish consumption behaviour among Belgian consumers; Thøgersen (2009) found that it accounted for 18% of the variations in intentions to purchase organic tomatoes and tomato sauce; while Dean *et al*. (2008) found that an extended TPB accounted for 39% of the variations of intentions to consume

processed-foods (Pizza), and 60% variations of intentions to consume fresh-foods (organic-apples).

Attitudes and PBC significantly influence intentions to consume FFEI. Thus, respondents who report a more positive attitude toward FFEI, and who perceive that they have control over their consumption behaviour reports stronger consumption intentions. The effects of perceived external support or social pressure on FFEI consumption intentions is also significant indicating that it is easy for participants to establish clearly defined social referents. Moreover, the positive and significant influence of personal norms suggests that consumers (participants) possess the moral imperative (internal drive) to consume FFEI, rather than to avoid it. Hence, the personal obligations associated with consuming FFEI stems from a positive personal-drive to do something good like preserving culture, conserving the environment, providing nutritious meal for the family or increasing dietary diversity (see Table 3.1).

Self-identity is a strong predictor of consumption intentions even after the mediation with consumer region, such that participants who perceive themselves as typical consumers of FFEI or who feel that they are similar to individuals who consume FFEI are more likely to have positive intentions. The results corroborate those of Smith *et al*. (2007), who reported that self-identity influences 'consumer behaviour/conduct' and the 'purchase of preferred product brand', respectively. The effects of self-identity observed here add to a growing body of literature (for a review, see Armitage & Conner, 2001; Smith *et al*., 2007), justifying self-identity as a useful addition to the TPB.

Most research in consumer domain have investigated the role of self-identity, but has not determined whether the effects of self-identity emerge when the role of familiarity is controlled.

The concern is that a measure of self-identity as a 'typical FFEI' consumer or a 'health-conscious person' may merely make certain consumption-related consequences salient i.e., the measure of self-identity may simply bring to intuition some outcomes of a behaviour that could influence consumption attitudes (Sparks & Shepherd, 1992). The other concern is that measures of self-identity are actually measures of past-behaviour (familiarity in our case), with people possibly inferring their self-identities from an examination of their past-behaviour (Sparks and Guthrie, 1998). These concerns on employing self-identity measures as an independent construct in TPB warranted the testing for the interaction-effect of self-identity and familiarity (SI_F). Indeed, one important contribution of this chapter is the examination of their simultaneous effects.

The interaction-effect of self-identity and familiarity (SI_F) highly predicts intention to consume FFEI, suggesting that the effect of self-identity is a function of repeated experience of performing the relevant behaviour (familiarity). When the results are moderated by consumer region, the surprising finding is that SI_F has stronger influence (45%) on intentions to consume FFEI in eastern region where entomophagy is less-common compared to western region (43%). The explanation could be that intentions to consume FFEI become less under the control of cognitive factors and more under the control of habitual (routine) processes at higher levels of familiarity, as suggested by Fekadu & Kraft (2001).

Results of the correlations of the extended TPB and key socioeconomic variables with intentions to consume FFEI as reported in Table 5, show that affective attitudes was a better predictor of intentions to consume FFEI for both regions. In fact, the cognitive component is significant only for western. This suggests that participants evaluate their FFEI-consumption behaviours not only in terms of physical attributes (e.g., costs and benefits), but also in terms of the feelings it generate. This finding is in line with Dean *et al*. (2008) who argued that the perceived costs of buying some

food products can be offset by the positive feelings that it generates. Correlations with education is positive and significant for eastern region, but negative (though insignificant) for western. This suggests that intentions to consume FFEI are positively influenced with increased knowledge regarding its benefits among individuals who are less familiar with edible insects. However, where the practice is widespread (familiar), individuals abandon entomophagy as they become more educated. Somehow with increased education, the individuals consider some of their traditions as 'primitive' or outdated.

4.3 Evaluation the sensory appropriateness of cricket-flour buns.

4.3.1 Expected sensory evaluation

Expected JAR results (Table 4.5) indicated differences between treatments in relation to five of the seven attributes. The expected sensory appropriateness for colour, texture, taste, crumbliness and nutritious attributes, differed between the information treatments. However, the hypothesis that expected appropriateness for sweetness and smell attributes differed between treatments was rejected. Given that the evaluations occurred prior to tasting, the respondents could only form sensory expectations based on the available treatment-specific information, personal beliefs and the visual presentation of the cricket-flour buns as displayed. However, Lagerkvist *et al*. (2016) observed that participants could have also formed mental representations that possibly played a role in the expected JAR evaluation ratings.

The information effect for nutritious attribute was significantly different among the three groups. Interestingly, the share for nutritious attribute was highest for the *Control* group (55%), and lowest for the *Drawbacks* group (41%). This suggests that the nature of information provided modulated the expectations on the perceived nutritional appropriateness of the cricket-flour buns. Specifically, the main effect of information on the *Benefits* and *Drawbacks* unexpectedly

decreased participants' expected appropriateness of the nutritious attribute. That information influenced expected appropriateness for the nutritional attribute is further evident from the findings that a larger proportion of the *Drawbacks* sample (32%) rated the attribute as '*Too little*' compared to only 2% and 17% for *Benefits* and *Control* groups, respectively. Similarly, participants in the *Drawbacks* group considered colour and taste attributes to be at the upper and lower level of appropriateness, respectively.

The Mann-Whitney pair-wise test between the *Control* and *Drawbacks* groups indicated that the information about the expected sensory changes (i.e., the effect of processing) had a discriminatory effect on all the attributes except for sweetness/sugary. The *Drawbacks* group expected taste to be on the lower level of appropriateness while the *Control* group expected a higher level. However, the groups expected both smell, colour and softness to be on the upper level, confirming that participants were able to show concern for 'negative' sensory attributes, even without being informed.

Table 4.5: Evaluation of the appropriateness of sensory attributes before tasting (Expectations).

Treatment	Feature	Proportion of JAR counts per treatment					Kruskal-Wallis[a]	Mann-Whitney[b]		
		Much too little	Too little	JAR	Too much	Much too much		B_C	D_C	B_D
Control (n = 145)	Sweetness	0.15	0.11	0.34	0.39	0.01	0.992			
	Smell	0.01	0.36	0.15	0.49	0	0.084			
	Colour	0	0.15	0.35	0.49	0.01	<0.001			
	Texture	0	0.21	0.17	0.59	0.03	<0.001			
	Taste	0	0.21	0.19	0.58	0.02	<0.001			
	Crumbliness	0.41	0.24	0.24	0.09	0.02	<0.001			
	Nutritious	0	0.17	0.55	0.25	0.03	<0.001			
Benefits (n = 144)	Sweetness	0	0.32	0.34	0.29	0.05		0.814		
	Smell	0.06	0.2	0.22	0.52	0		0.337		
	Colour	0.06	0.16	0.53	0.24	0.01		<0.001		
	Texture	0	0.13	0.75	0.09	0.03		<0.001		
	Taste	0	0.07	0.85	0.07	0.01		<0.001		
	Crumbliness	0.01	0.19	0.43	0.35	0.02		<0.001		
	Nutritious	0	0.02	0.49	0.25	0.24		<0.001		
Drawbacks (n = 143)	Sweetness	0.01	0.39	0.17	0.42	0.01			0.986	0.911
	Smell	0.17	0.16	0.06	0.42	0.19			0.047	0.097
	Colour	0.01	0.05	0.08	0.32	0.54			<0.001	<0.001
	Texture	0	0.8	0.13	0.79	0			<0.001	<0.001
	Taste	0.01	0.44	0.38	0.17	0			<0.001	<0.001
	Crumbliness	0	0.11	0.75	0.13	0.01			<0.001	0.051
	Nutritious	0.08	0.32	0.41	0.17	0.02			<0.001	<0.001

[a] Test of equal proportions across treatments by each attribute. [b] Test of the null hypotheses that the two samples originated from the same distribution. Pairwise comparisons; between: B_C *Benefits* & *Control*; D_C *Drawbacks* & *Control*; B_D *Benefits* & *Drawbacks* (**Note**: B = *Benefits*, C = *Control*, & D = *Drawbacks*).

The results further revealed differences between the *Benefits* and *Drawbacks* treatment groups regarding assessment of the appropriateness of the sensory attributes except for sweetness, smell and crumbliness. The JAR balance between the attributes was different for the two groups. Whereas the *Benefits* group, in most cases, expected the sensory attributes to be JAR, the *Drawbacks* group leaned more towards the upper end of the scale. Although both groups rated the expected smell as '*Too much*', it was surprising that the share of the *Benefits* group doing so was higher. The implication is that the perceived 'bad smell' of crickets is likely to be a barrier to the

acceptance of cricket-based foods. This barrier may not be mitigated by simply providing information about the nutritional merits of such foods. The findings corroborate those reported by Pambo *et al*. (2016) that participants considered 'bad smell' among the factors that would inhibit their consumption of cricket-based foods.

4.3.2 Actual sensory evaluation

As reported in Table 4.6, the results of the evaluation of the appropriateness of sensory attributes of cricket-flour buns after tasting (actual) indicated that there was increased discrimination between samples after tasting the cricket-flour buns. The Kruskal-Wallis test of differences between treatment-samples were statistically significant for all the sensory attributes. In addition, contrary to what was observed for the expected liking, sweetness/sugary appeared to be significantly different across samples. Both the *Control* and the *Drawbacks* groups had expected sweetness to be on the upper side of appropriateness scale (i.e., expected too much sugary) while the *Benefits* group expected sweetness to be on the lower side. Results for actual sensory evaluation however, showed a balanced rating (JAR) for the three samples. Moreover, the results indicate that even though discrimination between treatments increased with the tasting of the buns, the within-sample discrimination was generally lower as revealed by the pairwise Mann-Whitney tests. These findings indicate that the opportunity to taste cricket-flour buns had an immediate positive influence on attribute ratings by participants in the three treatment-groups. Indeed, the information effect for nutritious attribute was significantly different among the three groups. Specifically, most participants (47%) in the *Benefits* group perceived the cricket-flour buns to have 'excess level of nutrition, whereas the findings of the other two groups were more balanced at JAR (i.e., 69% for the *Control* group and 71% for *Drawbacks*).

Table 4.6: Evaluation of the appropriateness of sensory attributes after tasting (Actual).

Treatment	Feature	Proportions of JAR counts per treatment					Kruskal-Wallis[a]	Mann-Whitney[b]			Friedman test[c]
		Much too little	Too little	JAR	Too much	Much too much		B_C	D_C	B_D	
Control (n = 145)	Sweetness	0	0.12	0.81	0.5	0.02	0.027				0.089
	Smell	0	0.2	0.75	0.03	0.02	<0.001				<0.001
	Colour	0.01	0.08	0.75	0.15	0.01	<0.001				<0.001
	Texture	0	0.19	0.49	0.29	0.03	<0.001				0.118
	Taste	0	0	0.83	0.14	0.03	<0.001				0.002
	Crumbliness	0.02	0.21	0.59	0.18	0	<0.001				<0.001
	Nutritious	0	0	0.69	0.29	0.02	<0.001				0.036
Benefits (n = 144)	Sweetness	0.08	0.12	0.72	0.07	0.01		0.134			0.244
	Smell	0.06	0.17	0.69	0.07	0.01		0.726			<0.001
	Colour	0	0.06	0.74	0.19	0.01		0.291			0.009
	Texture	0.01	0.08	0.84	0.06	0.01		<0.001			0.171
	Taste	0	0.06	0.81	0.07	0.06		0.105			0.029
	Crumbliness	0.02	0.01	0.67	0.24	0.06		<0.001			0.317
	Nutritious	0	0.06	0.47	0.23	0.24		0.001			0.715
Drawbacks (n = 143)	Sweetness	0	0.01	0.99	0	0			0.233	0.006	0.581
	Smell	0	0.17	0.49	0.33	0.01			<0.001	<0.001	<0.001
	Colour	0.01	0.05	0.43	0.22	0.29			<0.001	<0.001	<0.001
	Texture	0	0.11	0.77	0.11	0.01			<0.001	0.581	<0.001
	Taste	0.01	0.01	0.97	0.01	0			<0.001	0.037	<0.001
	Crumbliness	0.01	0.09	0.68	0.11	0.11			0.005	0.067	0.001
	Nutritious	0	0.15	0.71	0.13	0.01			<0.001	<0.001	0.007

[a] Independent-samples test of equal proportions across treatments by each attribute. [b] Test of the null hypotheses that the two samples originated from the same distribution. [c] Related-samples test that the expected and actual appropriateness follow the same distribution. Pairwise comparisons; between: B_C *Benefits* & *Control*; D_C *Drawbacks* & *Control*; B_D *Benefits* & *Drawbacks* (**Note**: B = *Benefits*, C = *Control*, & D = *Drawbacks*).

Actual tasting of the cricket-flour buns significantly improved the consistency of evaluating the appropriateness of the attributes and the JAR ratings drastically improved for most of the sensory attributes rated in this study. This finding is relevant to product research and development purposes. Even though Lensvelt & SteenBekkers (2014) questioned the efficacy of providing information about entomophagy if consumers have the opportunity to try (i.e., see/touch/taste) real insect-based foods, our results suggests the need to combine marketing information and actual tasting during product promotion. These results corroborates the findings of Pambo *et al*. (2017a)

and Sogari *et al*. (2017) who reported that negative opinions and expectations held by consumers can be counteracted by the opportunity to taste the actual/real products.

Across the samples, most of the attributes were considered appropriate (JAR) after tasting. Smell and colour were however considered, to a lesser extent, to be above the ideal level by the *Drawbacks* group. The indication is that the effects of negative information regarding smell and colour persisted even after tasting. The findings may however also reflect genuine dissatisfaction with the colour and smell of cricket-flour buns as the pairwise tests between the *Drawbacks* and *Control* groups suggest. Indeed, this finding corroborates those reported by Pambo *et al*. (2016) which were based on focus group discussions, and which showed that dark colour and bad smell are among the barriers to consuming cricket-based products. The Friedman tests of the hypothesis that the expected and actual appropriateness follow the same distribution was rejected, implying that the evaluations of the cricket-flour buns after tasting (actual) was different from the prior (expected) evaluations.

Results also revealed treatment-specific differences between actual and expected liking. The *Benefits* group showed fewer differences between the expected and actual appropriateness ratings. Further, smell was the only attribute for which participants in *Benefits* group found that actual tasting modulated their assessment of the 'excess' rating to JAR rating. But, a different pattern emerged for the colour and taste attributes, with actual tasting simply accentuating participants' ideal assessment. Opposite pattern was noted for the *Control* group where tasting generally reduced the "*Too much"* assessment of the attributes, except for crumbliness and nutritious, to JAR. Assessment of "crumbliness" rose from "*Much too little*" to JAR, suggesting that participants in this group thought that the cricket-flour buns would break apart very easily, only to later find them appropriate (i.e., quite solid) after touching and tasting.

For the *Drawbacks* group, the JAR rating on all the sensory attributes changed after tasting. Sweetness changed from 17% JAR before tasting to 99% after tasting. Possibly, the effect of the negative information provided as participants really had no cue of what to expect. Actual tasting simply modulated the assessment of this attribute as participants experienced the product. Somehow they did not find much difference with the regular buns. Both "colour" and "smell" accentuated their "*Too much*" assessment while the JAR score for nutritious attribute was highest in this group. This finding is of great interest to product development. Whereas there is interest in processing of crickets into flour for enriching/blending other products like the cricket-based buns, consumers' perception on the level of nutrition of processed insect-based foods get accentuated with tasting, but so is the case with smell and colour attributes as the buns were rated as strong (too much) smell and unappealing colour. This implies that promotional campaigns need to also address the issue of colour and smell (negatively perceived sensory attributes) that consumers will experience only when consuming the buns in order to minimize the post-purchase dissonance.

4.3.3 Effect of socio-economic characteristics on nutritious attribute rating

The results of the linear mixed effect of information treatment and socio-economic characteristics on nutritious rating indicate that the main effect of nutritional information was significant in both models (Table 4.7). The estimated random intercept was also significant in both models suggesting that participants' evaluation of perceived nutritious before and after tasting was different. The effect of the detailed information regarding the merits of insect-based foods was accentuated for the *Benefits* group than for the *Drawbacks* group whereas, this effect for both groups was significantly different from the *Control* group. These findings reaffirms prior findings that information treatment affected the general assessment of the cricket-flour buns.

The interaction effects between five socio-economic characteristics (i.e., participants' age, gender, level of income, level of formal education, household size) and the treatments (before and after tasting) revealed significant effects for level of education and gender. Relatively more educated participants perceived the cricket-flour buns to have more appropriate level of nutrition. Probably, they were able to better comprehend the experimental context and made personal assessments beyond the information that was provided. This finding is in line with Alemu *et al*. (2017b) and Pambo *et al*. (2017) that consumer' education and knowledge of the merits of insects-based foods can shape perception and shift their consumption behaviour. The implication is that the information package meant to promote entomophagy should be specific to a segment of consumer group and should be discriminated by the level of education (Lensvelt & SteenBekkers, 2014; Tan *et al*., 2015).

Regarding gender, male participants perceived the cricket-flour buns to have more appropriate level of nutrition compared to their female counterparts. This finding compares fairly with the previous ones. For example, Caparros Megido *et al*. (2016) and Barsics *et al*. (2017) identified gender as a key factor in food choice decisions (dietary habits) and sensory assessments. Hartmann & Siegrist (2016) and Alemu *et al*. (2017a) reported that females have a more food-neophobic attitudes towards insect-based foods compared to males. Additionally, Verbeke (2015) argues that males possibly have a more adventurous taste orientation or find the idea of consuming insect-based foods less disgusting than females. The revelation that sensory evaluations were gender specific adds much more insights to the design of campaigns meant to routinize consumption of insect-based foods.

Table 4.7: Effects of socio-economic characteristics on nutrition JAR scoring.

		Model 1		Model 2		Parameter
		F	**Sig.**	**F**	**Sig.**	
Fixed Effects	Treatment	51.18	<0.001	11.58	0.002	
	Benefits					0.754***
	Drawbacks					0.338***
	Level of Education	2.01	0.044	1.96	0.051	
	Log of Income	1.11	0.504	1.14	0.502	
	Age	1.19	0.223	1.19	0.222	
	Gender	4.38	0.049	4.38	0.049	
	Household Size	2.07	0.113	2.05	0.113	
		Wald	**Sig.**	**Wald**	**Sig.**	
Random Effects	Intercept	11.03	<0.001	7.06	<0.001	
Bayesian Criterion (BIC)		1913		1856		

Note: *** imply significance at <0.001

4.4 Personal involvement and emotions of cricket-flour buns

4.4.1 Personal involvement

Descriptive statistics for the personal involvement scale revealed high internal consistency (i.e., high inter-item correlation) with Cronbach's alpha greater than 0.9 and high levels of mean personal involvement, as reported in Table 4.8. The results also indicated that product relevance was treatment-specific. In particular, the *Drawbacks* group showed the lowest mean, and a lower variability. The *Control* group, on the other hand, had the lowest minimum personal involvement value, but with a greater variability. However, an independent-sample Kruskal-Wallis test could not reject equality of distributions of personal involvement across treatments and the *Control* groups.

Table 4.8: Descriptive statistics for the personal involvement scales by type of treatment

	Mean	Std. deviation	Min	Max	Cronbach's alpha
Control (*general information*)	103.69	26.28	28	140	0.977
Treatment 1: *Benefits*	104.97	26.25	29	140	0.981
Treatment 2: *Drawbacks*	101.22	24.93	29	140	0.976

4.4.2 Emotional response by participants

The emotional responses to tasting cricket-flour buns are reported in Table 4.9. Results for the whole sample revealed notable dominance of positive emotions (the first 16 items) over negative emotions (the last 7 items). This finding corroborates those of previous studies (e.g., Spinelli *et al*., 2015; Lagerkvist *et al*., 2016; Schouteten *et al*., 2016), which indicated that positive emotions tend to be more dominant than negative ones after product tasting. Results also showed that "curiosity" was the most positive emotion. The explanation for this can be that participants were not expecting to consume cricket-based buns, or they were highly interested in tasting the buns (possibly) due to the product information that was provided (Sogari *et al*., 2017).

Table 4.9: Emotional responses of participants by treatments

		Mean ratings			Kruskal-Wallis[a]	Mann-Whitney[b]		
	Emotional labels	*Control* (n =145)	Benefit (n =144)	Drawback (n = 143)		Benefit vs Control	Drawback vs Control	Benefit vs Drawback
1	Anti-stress	2.01	1.89	1.93	0.784	0.498	0.622	0.872
2	Relaxed	2.29	2.17	2.29	0.661	0.367	0.789	0.549
3	Amused	2.48	2.54	2.41	0.552	0.561	0.611	0.275
4	Energetic	2.46	3.58	2.33	***<0.001***	***<0.001***	0.312	**<0.001**
5	Merry	2.27	2.36	2.22	0.676	0.598	0.718	0.382
6	Happy	2.67	2.71	2.57	0.528	0.753	0.451	0.263
7	Satisfied	3.06	3.37	2.95	***0.042***	0.051	0.621	***0.023***
8	Tender	1.74	1.78	1.66	0.432	0.697	0.388	0.201
9	Gratified	2.34	2.33	2.19	0.363	0.929	0.253	0.188
10	Cuddled	1.66	1.83	1.66	0.265	0.173	0.931	0.152
11	Sensual	2.16	2.22	2.22	0.963	0.791	0.845	0.951
12	Secure	2.86	2.87	2.89	0.991	0.877	0.931	0.972
13	Happy-Memory	2.94	302	2.85	0.717	0.648	0.771	0.401
14	Generous	2.46	2.44	2.32	0.591	0.963	0.405	0.344
15	Surprised	2.51	3.41	3.34	0.561	0.454	0.298	0.768
16	Curious	3.97	3.78	3.81	0.263	0.122	0.211	0.823
17	Indifferent	1.49	1.51	1.55	0.953	0.812	0.771	0.952
18	Bored	1.16	1.07	1.17	0.401	0.204	0.904	0.256
19	Neglected	1.01	1.02	1.03	0.169	0.316	0.081	0.315
20	Sad	1.01	1.01	1.03	0.766	0.996	0.549	0.553
21	Disappointed	1.11	1.06	1.08	0.959	0.791	0.823	0.964
22	Guilty	1.17	1.13	1.27	0.439	0.898	0.256	0.305
23	Annoyed	1.11	1.11	1.11	0.824	0.689	0.839	0.544

Notes: [a] Test of the null hypothesis (p-values) that the distribution of the emotion is the same across categories of treatment; [b] Test of the null hypotheses (p-values) that the two samples originate from the same distribution; Significant p-values are in bold.

Energetic (item 4) was the relatively more discriminatory emotion across treatments and the pair-wise test suggested that this emotion was highest for the *Benefits* group. This group, it seems, interpreted the positive information provided, especially with regard to nutritious, to imply good health and strength, hence being energetic. The results further revealed more discrimination between the *Benefit* and the *Drawback* groups than between either of these two treatments and the *Control*. This finding further shows that provision of information on the nutritional attributes of cricket-flour buns had an influence on participants' evaluation of the buns. Specifically, nine

positive emotions scored higher for participants in the *Benefits* group, three for the *Control* group and only one for the *Drawbacks*.

The pairwise tests, however revealed minor discriminations between treatments in general, with only two emotional statements showing discrimination between both *Benefits* versus *Control* groups and *Benefits* versus *Drawbacks* groups. No discrimination on emotional statements was observed between *Drawbacks* and *Control* groups. The limited variations amongst the emotional profiles between the groups suggests that participants in both groups were generally pleased with the sensory features of the cricket-flour buns, which indicates the possibility of repeated consumption (Sogari *et al*., 2017). This follows the assertion of Spinelli *et al*. (2015) and Schouteten *et al*. (2016) that consumer emotions are majorly driven by the sensory appeal of a product. Therefore, for cricket-flour buns to be incorporated within the dietary routines, prospective users should first be triggered to taste them in order to associate the positive emotions with them.

4.5 The motivation of households to consume cricket-flour buns

The HVM for the whole sample is presented in Figure 4.3. The respondents were motivated to consume 'cricket-flour buns' by characteristics related to: i) the product (mainly sensory attributes) such as good taste, attractive colour, nutritious, low levels of sweetness (less sugary); ii) the personality e.g., disgusting; and iii) the environment e.g., good for the environment. The most important attributes were good taste (63%) and nutritious (56%). It is interesting that 39% of the respondents rated the 'dark' colour of cricket-flour buns "attractive". Only 17% of the respondents perceived the dark-colour as unattractive. One-third of the respondents rated the cricket-flour buns on the lower side of 'sweetness' scale (less sugary). Surprisingly, they associated this with fitness

benefits namely, energizing or being strong. But still, 14% of the respondents rated cricket-flour buns derogatively as 'disgusting'.

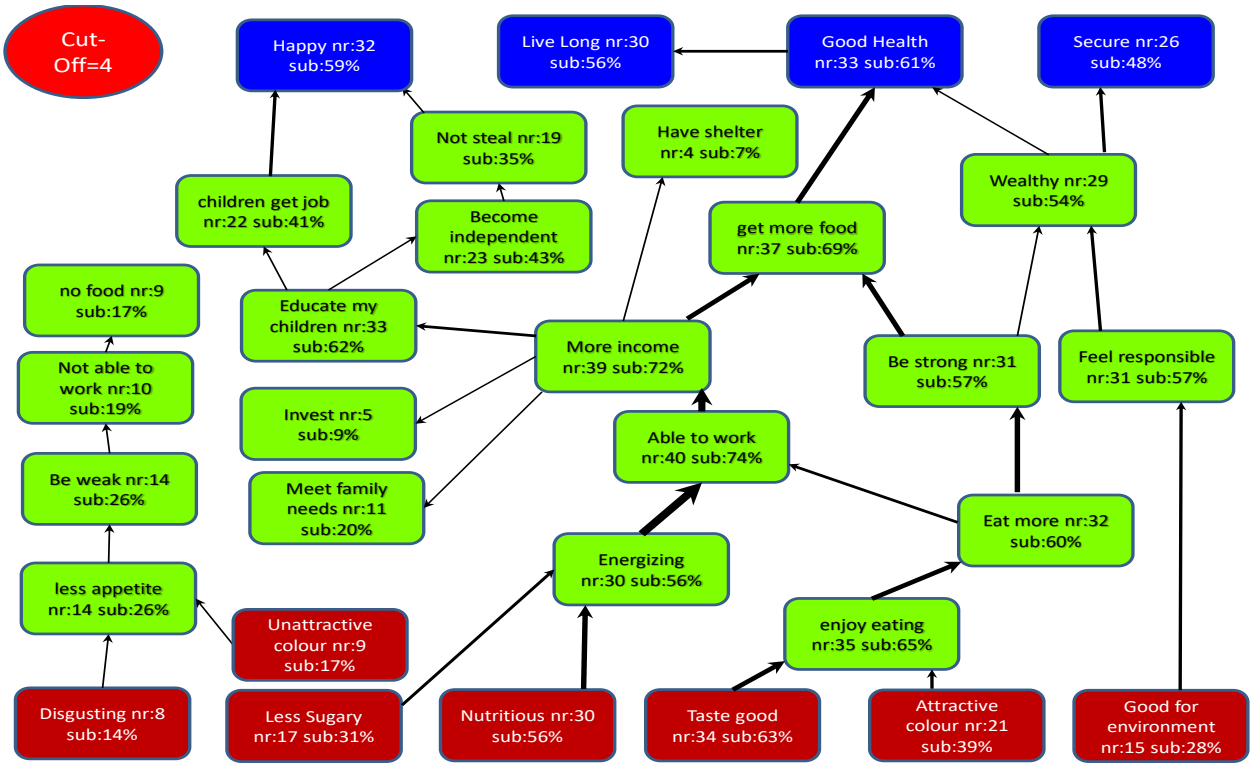

Figure 4.3: The HVM for the whole sample

The general HVM show that sensory attributes of cricket-flour buns were linked to consequences related to appetite for food namely "enjoy eating" and "eat more". Some respondents, however, linked the "nutritious" aspect to getting "more energy". The dominant chains associations related to these sensory attributes are twofold; first, those linking "eat more" to "being strong" which is in turn associated with "getting more food" and ultimately to the values "good health" and "long life". Second, "energizing" is associated with ability to work more, earn more income, get more food and finally to the value "good health".

The attribute "good for environment" was mentioned in the context that consumption of insect-based foods (i.e., the cricket-flour buns) would reduce reliance on meat-based proteins whose production is environmentally degrading. This attribute is mentally linked to feeling "responsible" (to the environment), and to another consequence "becoming wealthy" and ultimately to the value "good health". Participants therefore, conceived cricket-flour buns to embody environmental care, whose sustainable exploitation would generate wealth and promote biodiversity leading to good health. As expected, the consequence "more money" is associated with the value "happiness". Specifically having "more money" is mentally linked to ability to educate children to be morally upright (not thieves) or being able to find jobs (hence becoming independent from parental support) and subsequently later supporting their parents instead.

Thus, the main reasons why the laddering participants would consume cricket-flour buns are good taste, being perceived as nutritious as well as the ability to promote environmental responsibility. They would do so to be strong (energized to work) which allows them to have more food, be wealthy and earn more income to educate children, invest in other enterprises, and also meet other family needs. These benefits of consuming cricket-flour buns, in turn enables the participants achieve four life goals (values) namely, good health, long life, happiness and being (food) secure.

4.6 Effect of differentiated information on motivations to consume cricket-flour buns

4.6.1 The Control group (basic information)

Control group only received basic information regarding processing cricket-flour buns, including the safety considerations. The HVM for this group (Figure 4.4) has four attributes contained in the HVM for the whole sample, with the attributes "good for the environment and disgusting" completely missing. However, its HVM has two new attributes namely, "safe to eat" and "cheap to get".

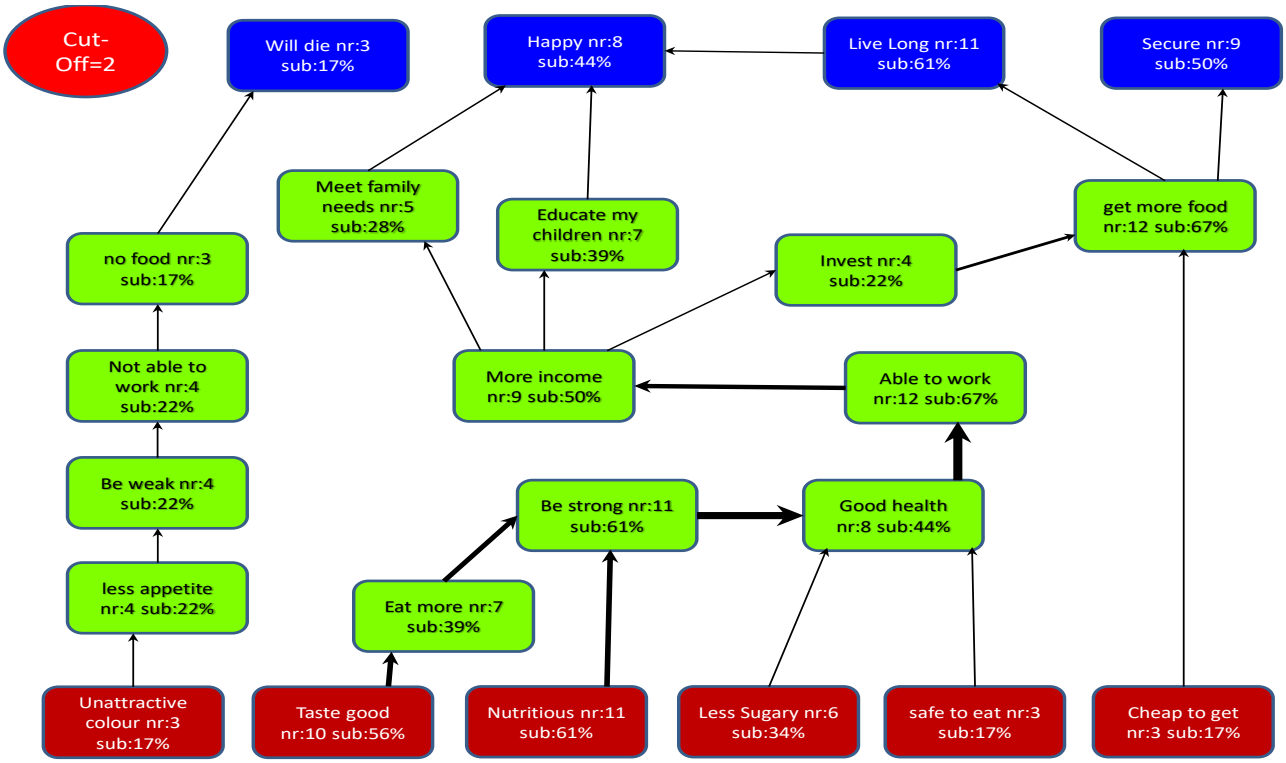

Figure 4.4: HVM for the control: basic information group

The HVM for this group is remarkably distinct in terms of the attribute-consequences linkages. For example, the attribute "less sugary" that was linked with energizing (increased appetite to eat more and become strong) in the HVM for the whole sample is now linked with good health. Participants in this group, it seems, realized that much sugar (sweetness) has negative health effect. Moreover, the information regarding safety procedures undertaken during the processing of cricket-flour buns, which formed part of the narrative provided likely influenced their mental models. For example, the attribute "safe to eat", which participants associated with good health was identified as an important factor that would lead to a decision to consume cricket-flour buns.

The attribute "cheap to get" likely arose from the feeling that crickets are locally available and using them to enrich buns was mentally conceived by participants to imply affordability. Like the

general HVM, participants in the control group also linked "good taste" with increased appetite, hence the ability to eat more, get healthy, work more and earn more income. They also found the "dark colour" of cricket-flour buns unattractive, which they linked with low appetite, hence eating less and becoming weak. Participants further associated increased income with ability to educate children, invest and meet other family needs, just like the whole sample.

The HVM for this group has four values, three of which are the same as those for the general HVM. These are; being food secure, long life, and happiness, with long life (61%) being the dominant value in this HVM. The negative ladder for this group however, ended with a value "will die" resulting from having little food to eat. Thus, participants are motivated to consume FFEI so as not to die, but this requires the colour attribute to be 'attractive' to them.

4.6.2 Effect of positive information

The HVM for the participants who received detailed information on nutrition (proteins), economic and environmental benefits of insect' value-chains (Figure 4.5), has all the attributes contained in the HVM for the whole sample, except "disgusting". Participants in this group (positive-information group) were motivated to consume cricket-flour buns, mostly by good taste (78%), nutritious (72%), good for the environment (39%) and locally available (35%). Just like the previous cases, participants' associated the sensory attributes (good taste and less sugary) with increased appetite to eat more, get stronger and do more work.

Figure 4.5: HVM for Treatment 1: the positive information group

The dominant chains in the HVM for this group include those linking “taste good”, “less sugary” and “nutritious” to “being strong” or “energized”. These are in turn associated with “ability to work” then “get more food” and ultimately to the value “(food) secure”. “Energizing” was also linked to “meeting family needs” and ultimately to the hedonistic value “good life”. Nutritious attribute was also associated with the consequence “more income” which leads to “own children’s success” and then to the values “long life” and “being happy”. This group associated the attribute “good for environment” with the altruistic consequences “care for others” and “being responsible” and ultimately to the value “being successful”. “Good for environment” was also linked to the consequence “more income”. Participants somehow conceived caring for environment to imply increased income, probably due to increased sustainability in the usage of the available resources.

The attribute “locally available”, just like the attribute “cheap to get” reported in the HVM for the control group arose from the fact that crickets are found within the study areas (locally). But contrary to control-group participants’ whose mental models signified affordability, participants in this group mentally associated the attribute with “job creation”, which was part of the information (see Appendix 2) given regarding the benefits of edible insects. Therefore, the information treatment modulated participants’ mental models, and they mentally perceived local existence of crickets as a valuable local resource whose exploitation would develop sustainable value-chains with significant employment opportunities for the benefit of the society. Thus, it would seem they were driven by the altruistic motive of “caring for others” so as to “become responsible” people in the society. This was a measure of “achievement” to participants in this group whose ultimate goal was to become “successful”.

There are some differences in the benefits/consequences of consuming cricket-flour buns in the HVM for the positive information group. The attribute good for the environment that was linked to the consequence being “responsible” in the general HVM was linked to “care for others”. This is probably due to the mental association of the positive benefits (externality) of caring for the environment on other people. This finding suggests that consuming cricket-flour buns is mentally associated with positive environmental effects that accentuates the altruistic motives in the participants who are positively informed. Five unique consequences emerged including, “job creation, more productive, care for others, saves time and time for other duties”. Ultimately, participants in this group were mostly driven to consume cricket-flour buns because they wanted to become food secure, feel successful and have a good, healthy and long lives.

4.6.3 Effect of perceived negative information

Figure 4.6 present the HVM for the group of participants who received negative information (i.e., information on perceived negative sensory differences between cricket-flour buns and ordinary buns). This HVM is remarkably different from the previous ones. For instance, four out of the seven attributes present are negative: has chemicals (impure; 18%), disgusting (39%), hard to eat (18%) and unattractive colour (22%). The positive attributes included good taste (56%), less sugary (39%) and nutritious (33%).

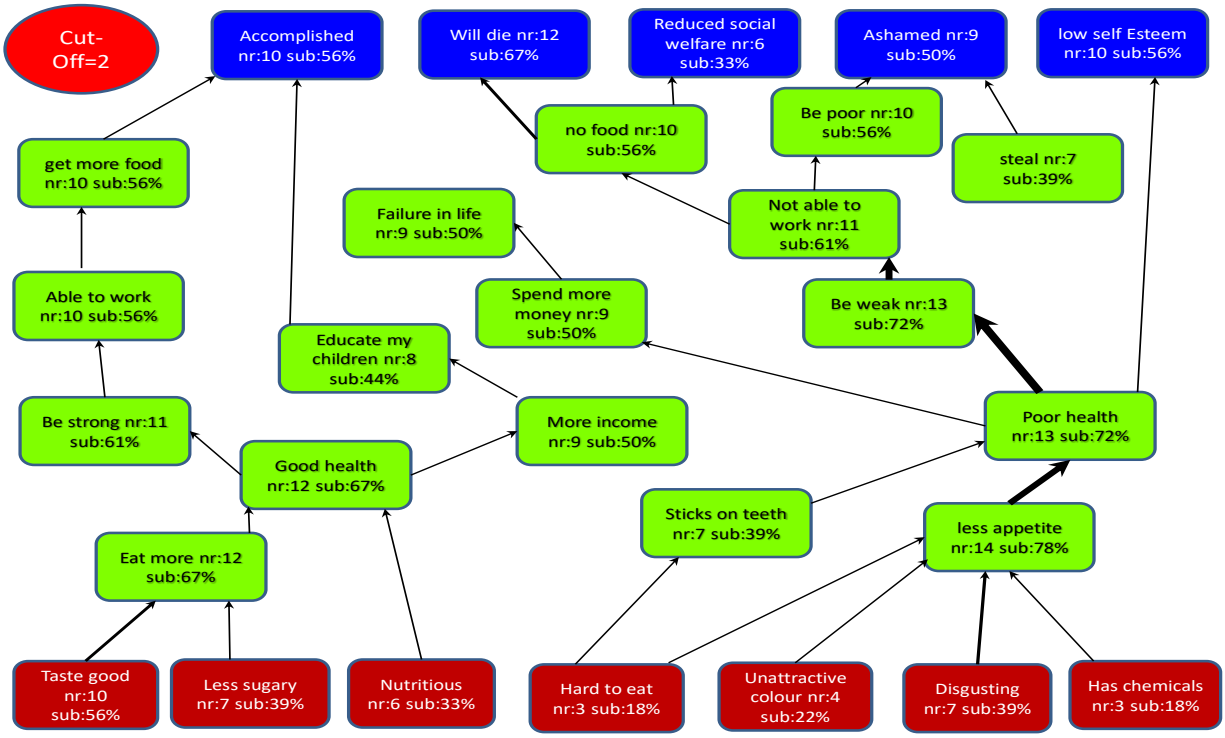

Figure 4.6: HVM for Treatment 2: the negative information group

Notably, the proportions of participants who associated cricket-flour buns with these three positive attributes drastically dropped from the previous HVMs. Attributes for this group are related to either sensory or personality features, without any element of environment occurring. This suggests that the negative sensory information provided to this group influenced their perception

of the buns causing them to rate them less favourably than the other groups. Notably, the dominant chain starts with the attribute "disgusting".

The dominant path was generated by the four negative attributes that were associated with reduced appetite, which participants associated with the consequences "poor health" and general body "weakness". Further, the negative attributes were linked to "inability to work", "lack of food" and increased incidences of vices like "stealing". However, a positive chain linking the positive attributes ("taste good", "nutritious" and "less sugary") to increased appetite, which enables participants to "eat more", "become energized", "educate children" and "have enough food", arose. This was surprising given the negative information-treatment to this group. Somehow, the experience of tasting, smelling and touching the cricket-buns counteracted the perceived negative messages given to this group. The finding corroborates those reported by Combris *et al*. (2007), that real product experiences can overshadow the sensory perceptions held in the mind of a consumer.

Several ladders in this HVM were terminal (not ending with a value) compared to HVMs for positive-information group and the control-group. Possibly, mental conflict occurred between the negative information provided through the narrative (Appendix 2) and the formed perception (actual sensory feeling) based on the real-product experience. This is in line with Lind's (2007) argument that conflicting information (information held in memory versus actual information developed through feeling the real product) particularly with new products, can result in many incomplete ladders.

The HVM for this group ended with five values, of which four are negative. These include: having low self-esteem, being ashamed, reduced social welfare and will die. The only positive value

"accomplished" results from own children's success because they were educated. The same consequence was associated with "happiness" in the previous HVMs. Similar to the control group, the value "will die" was mentally associated with the lack of food to eat as a result of inability to work. It thus appears that the negative sensory attributes associated with cricket-flour buns reduces appetite which participants associate with "not eating enough" hence, poor health then inability to work, which they linked with either becoming poor or lacking food. These consequences are ultimately associated with two values: "low self-esteem" and "reduced social welfare". The value "ashamed" is mentally associated with the consequence "steal", but also with attribute disgusting which suggest that disgust of eating crickets conjures the feeling of shame. This group is therefore, motivated to consume cricket-flour buns so as to feel accomplished, to live (not to die) and have high self-esteem, but is likely to be deterred from eating the buns by the shame that arises from the disgust of eating such buns.

CHAPTER FIVE

CONCLUSIONS AND POLICY RECOMMENDATIONS

5.1 Introduction

This chapter provides the summary, conclusions, policy recommendations and the limitations of this study. It groups the five specific objectives of the study into three main areas then provides the conclusions along the three identified themes.

5.2 Summary

Consumption of edible insects is not a new idea. Evidence from literature attribute the practice back to the dawn of mankind (Christensen *et al*., 2006; Ayieko *et al*., 2010; FAO, 2013; Tan *et al*., 2015; Münke-Svendsen *et al*., 2016). Indeed, the Bible[7] recommends consumption of certain insects (Leviticus 11, 1-32). Ayieko *et al*. (2010) argues that the new idea on the subject, which is an innovation in food science is how the insects are prepared (cooked) and served (gastronomy). The authors further, observed that popularizing the new culinary methods pose considerable challenges to marketing insect-based foods. In Kenya, insects have a long history as a part of the diets for several ethnic groups, particularly those from the western region. But these communities have traditionally gathered these insects from the wild using rudimentary methods, and consumed them either raw or fried and salted (Christensen *et al*., 2006).

To overcome the rudimentary nature of traditional gathering and usage, food scientists have developed new innovations, which involves rearing, processing and blending edible insects into other popular foods. Edible insects can be served as 'whole' where the insects are fully visible (traditional serving method), they can be mixed with other foods where the insects are partly visible

[7] The **Bible** (Torah) Foods permitted and forbidden, Leviticus 11, 1-32, New King James Version, Thomas Nelson, Inc. 1988.

(covered); or insects can be processed and used as ingredients while preparing other foods (invisible/blended). Other studies (for example, Lensvelt & SteenBekkers , 2014; Looy *et al*., 2014; Tan *et al*. 2015; Hartmann & Siegrist, 2016) argue that processing insects transforms them from 'visible' to 'invisible' forms which can promote wider consumer acceptance.

However, processing and incorporating edible insects with common consumer products is expected to result in changes in attributes, such as appearance, taste, texture and colour, of the new insect-based product. Hence, a technology (innovation) aimed at improving the usage of insect-based foods may be in conflict with other product attribute changes.

The main objectives of the current study were three-fold: First, to determine the factors that influence households' intentions to consume FFEI; second, to understand how the households evaluate the sensory properties of FFEI and assess the effect of information on the evaluations, and third, to analyse the motivations of the households to consume FFEI. A summary and conclusions regarding the stated objectives are provided below.

5.3 Factors influencing households' intentions to consume FFEI

To achieve this objective, the study applied an extended TPB model that incorporated a simultaneous analysis of self-identity and familiarity (SI_F). Results indicate that rural households have positive intentions to consume FFEI and those intentions are higher for individuals who are familiar with edible insects. Further, the Likert-scale measures for attitudes, subjective norms, PBC and self-identity are significantly higher than the 'neutral' values, suggesting that they are also positive. These measures, except those related to cognitive attitudes, are also significantly higher for individuals who are familiar with edible insects.

Attitudes, subjective norms, PBC and the SI_F as the main constructs of the extended TPB model, positively and significantly predicted the intentions to consume FFEI. As a result the four hypotheses: H1; H2; H3; and H4, which suggested that a favourable attitudes, subjective norms, PBC, and SI_F, respectively, positively influence consumers' intentions to consume FFEI could not be rejected.

Conclusions regarding objective one, therefore are that: 1) consumers in Kenya have positive attitudes regarding novel foods such as FFEI, especially if such foods are familiar. Therefore, food marketers should design targeted awareness campaigns to increase familiarity; 2) under subjective norms, consumers clearly established their defined referents. Therefore, food marketers interested in FFEI consumption behaviour change has higher chance of success if they target the identified social-referents; 3) consumers who are more familiar with FFEI tend to understand better their consumption barriers. The conclusion is that although the motivation to consume FFEI is high, the ability to do so (PBC) can be absent, hence lowering intentions to consume; and 4) the interaction-effect of self-identity and familiarity (SI_F) has the highest independent effect on intentions to consume FFEI. Following the observation of Smith *et al*. (2007), the conclusion is that repeated engagement in a behaviour may demonstrate to an actor that the behaviour is under his/her volitional control and so, can be performed easily.

The findings of this objective have significant policy implications in the consumer domain and marketing. *First* the results suggest that intentions to consume FFEI relate much more with the feelings rather than the thinking (i.e., cognitive) process of consumer decision-making. The finding that affective attitudes was a better predictor of intentions to consume FFEI for both consumer regions suggest that merely promoting FFEI as nutritious and with economic benefits may prove inefficient in convincing various consumer groups to accept insect-based foods. Campaigns aimed

at promoting FFEI should therefore go beyond functional benefits (e.g., satisfaction of physical needs), and should align with peoples' feelings as signifiers of norms i.e., taste, lifestyle, and self-identity. *Second*, the finding that familiarity leads to development of a self-identity as a typical FFEI consumer, and further that FFEI consumers behave in ways that are congruent with their self-identities signify a powerful marketing strategy. Self-identity, in conjunction with positive attitudes, may play an important role in developing intentions to consume FFEI. However, with increased familiarity, self-identity may play a less critical role in determining intentions. Therefore, differentiated promotion strategies are appropriate for consumers whose familiarity levels are different.

5.4 Evaluations of the sensory appropriateness, personal involvement and emotions

The idea of consuming insect-based foods can result in a strongly affect-laden disgust response in some consumers (Hartmann & Siegrist, 2016). The practice is also influenced by socio-cultural barriers, such as food taboo, as well as psychological barriers, such as food-neophobia (Looy *et al*., 2014; Alemu *et al*., 2017b). This objective was achieved by investigated how the type of information consumers receive about the process of producing insect-based foods influences their evaluation of such foods, before and after tasting. Further, it analysed the level of product involvement and the feelings that insect-based foods evoke. It tested the hypotheses that evaluation of the appropriateness of insect-based foods and the distributions of personal involvement as well as the emotions that these foods elicit across the information treatments, are the same.

The results revealed that the nature of information provided modulated the evaluation of the appropriateness of the product' attributes. Further, whereas the results confirmed the equality of distributions of personal involvement and emotions across treatments and the Control group, the distributions for the expected and actual sensory appropriateness for colour, texture, taste,

crumbliness and nutritious attributes differed. The results further revealed notable dominance of positive emotions, especially 'curiosity', which may suggest that participants were generally surprised to know, see and taste cricket-flour buns (an insect-based food product). Curiosity could have also possibly be drawn from consumer interest in cricket-flour buns. However, the finding should be interpreted with caution because there could be a disjuncture between the initial motivations behind liking cricket-flour buns and the long-term consumers' acceptance (House, 2016), and the initial interests could merely be the characteristics of early adopters of insect-based foods (since cricket-flour buns are novel) (Verbeke, 2015). It is also quite possible that curiosity was due to the fact that the participants were surprised to know that crickets can be used to produce protein-rich buns.

Tasting not only increased consistency in results, but also increased discrimination among treatments. Specifically, the results (after tasting) were generally balanced around the JAR level confirming the immediate impact of actual tasting. While the contextualised treatment-information provided possibly influenced consumers' perceptions and expectations of insect-based foods, the actual tasting of cricket-flour buns eliminated the differences between the JAR evaluations across the treatments. This implies that campaigns meant to promote acceptance of foods from insects would be much more successful if participants are given chance to taste the 'real' products.

Under this objective, the study concludes that: *First*, the prospects of insect-based foods becoming part of regular diets can be enhanced by making them 'appropriate' to the prospective consumers (Tan *et al*., 2016). Improving the sensory properties (appeal) of insect-based foods is one way of making them more 'appropriate' to the prospective consumers (House, 2016; Schouteten *et al*. 2016; Tan *et al*., 2017). The appropriateness of the sensory attributes can be optimized by using 'directional' tools like the just-about-right (JAR) scales as employed in this chapter. For example,

the cricket-flour buns can become more appealing if they are made lighter in colour (e.g., using recommended food colourants to reduce the dark colour) and the perceived 'bad' smell is removed (maybe by use of recommended flavours). *Second*, cricket-flour buns marketers should also focus on increasing their familiarity to the prospective consumers to ensure sustained usage. Familiarity was achieved in this chapter via the information and tasting sessions (Barsics *et al*., 2017). However, House *et al*. (2016) argues that information and tasting sessions within a controlled/experimental environment may not depict the real social environment. Familiarity with a product can accentuate its sensory appeal and enhance repeated consumption (Schouteten *et al*. 2016; Tan *et al*., 2016; Menozzi *et al*., 2017; Alemu *et al*., 2017a). The finding that 'curiosity' was the dominant positive feeling is an indication that participants were not familiar with cricket-flour buns. *Third*, the two strategies of promoting consumption of insect-based foods that were proposed by Lensvelt & SteenBekkers (2014) are highly opportune:

Strategy one is the educational strategy – where individuals are given information regarding the benefits, culinary trends, gastronomy, availability of insect-based products and the regulatory framework (Barsics *et al*., 2017; Sogari *et al*., 2017). The present results supports the efficacy of this strategy. However, the results revealed a dominant and somewhat surprising information-effect: that providing only positive or negative (biased) information to participants exaggerates their assessment of the ideal levels of some sensory attributes. Therefore, information meant for the education strategy need to be balanced with both the positive and the perceived negative messages that are relevant to the product.

Strategy two is the sensory strategy - where individuals are provided with real insect-based foods (as exhibits) to see, touch, taste, and become familiar with. Results in this chapter further supports the efficacy of this second strategy. The sensory strategy that provide consumers with

opportunities to taste real products (like cricket-flour buns) is potentially an effective way of reducing psychological-related barriers reported against insect-based foods, including disgust and appearance (Hartmann & Siegrist, 2016; House, 2016; Menozzi *et al*., 2017).

Over 90% of the participants in the study regions are already familiar with consumption of 'whole' edible insects and are seemingly willing to engage on the subject. They should be targeted with the outreach programmes to increase their familiarity with incorporated/blended/processed insect-based products, which currently is below 5% (see Table 2). The current findings reveal how such outreach programmes can be designed to effectively trigger a dietary change to incorporate insect-based foods.

5.5 Motivations to consume FFEI and the role of differentiated nutrition information

Laddering technique combined with the means-end chain theory was applied to investigate the effect of differentiated information about foods from edible insects (cricket-flour buns in this case) on consumers' mental models and acceptance (consumption motivations). The results indicate that the provision of information on the benefits of edible insects and perceived negative aspects of processed insect-based foods influences participants' mental models. Participants were motivated to consume cricket-flour buns by characteristics that can be categorized into three groups, namely: i) the product (mostly sensory) e.g., taste, colour, perceived nutritious, sweetness (sugary); ii) personality e.g., disgusting, product-knowledge (e.g., more nutrients in one, cheap to get, locally available); and iii) environment e.g., good for the environment. These attributes reflect the kinds of information that participants received (i.e., information treatments modulated participants' mental models). These findings confirm the argument of Lensvelt & SteenBekkers (2014) that education of consumers (information) is key to changing their attitudes towards insect-based foods.

However, attributes which are related to sensory and health (nutritious) aspects dominated all the HVMs suggesting that novel foods should appeal to consumers' sensory approval to enhance consumption. The findings are contrary to those reported by De Groote *et al*. (2010), which suggested that maize consumers in Kenya value price more than sensory properties. Demand issues could explain the disparity of the two findings. Whereas maize is a staple food in Kenya, cricket-flour buns are less known and hitherto not consumed as regular food (Alemu *et al*., 2017).

The control group who neither received sensory nor nutritional information, still identified several sensory and personality based attributes. Seemingly, the sensory experience of tasting the actual product (cricket-flour buns) prior to the laddering interviews influenced them. Despite the information treatment of the respondents in the three groups, participants still conceived cricket-flour buns as tasty, nutritious and less sugary. These findings suggest that the opportunity to taste cricket-flour buns had an immediate positive influence on participants' mental-models, regardless of the information treatments.

Previous consumer studies showed that food choice is primarily motivated by price and health consequences (Roininen *et al*., 2006; Lensvelt & SteenBekkers, 2014), especially when participants have low family incomes (Arsil *et al*., 2014). The health aspect is corroborated by participants from all the three treatment-groups. However, the price aspect is only implied by participants in the control group, who only received the basic information regarding cricket-flour buns. The information-narrative given to the other two groups did not have price-related information. The implication is that food consumption decisions of 'informed' consumers (either positive or otherwise) are influenced by their health and well-being goals (motives) much more than the price of such foods. Therefore, marketing information for novel food products should be designed along the identified goals (values/ends). These results therefore, supports the need for

targeted consumer education as suggested by (Lensvelt & SteenBekkers, 2014; Looy *et al*., 2014; Tan *et al*., 2015).

Regarding policy implications in the consumer domain, current results suggest that: *First*, consumption of novel foods (like cricket-flour buns) can be influenced by the kind of information-package consumers hold or receive, which implies that consumer education on the benefits of such foods can enhance perception and consumption. But it also means that consumers' interaction with perceived negative information about novel foods can reduce consumption. *Second*, campaigns meant to promote consumption of novel foods would yield significant impacts if real products (like cricket-flour buns) are included as exhibits. For instance, participants in the three groups found cricket-flour buns to have "good taste", despite the "bad-taste" narrative given to participants in the negative information group. Participants also mentally associated the attribute "low sugary" with health benefits (hence positive) rather than low sweetness (negative), as would have been the case without product-tasting. These findings therefore, demonstrate that the existing negative perceptions and information about novel foods like cricket-flour buns can be counteracted by the opportunity to taste actual products. Lensvelt & SteenBekkers (2014) questioned whether providing 'targeted' information may not be necessary if households have an opportunity to try insect-based foods. The results described in this chapter revealed that mental models (HVMs) were treatment-specific and the real-products simply modulated the information-effect, hence complementary.

Third, the results are in tandem with the medium and long-term growth policies in Kenya (for example Vision 2030), which consider farming as a business activity. For example, the consequence "more income" (i.e., profitability) is common to participants in all the three treatment-groups. These results corroborate those of Okello *et al*. (2013) who argued that

consumers (producers in the households) are also interested in earning more-income to fulfill other household needs. Participants in the current study see their future (food) security and happiness as dependent on their children getting education and good jobs which should be facilitated by the benefits of making more money from insects' value-chains.

Finally, "more income" or "wealth" are among the most common consequences indicating that the two are key consideration by participants regarding FFEI consumption. Nonetheless, deeper motivational reasons to consume cricket-flour buns are also identified. Obviously, financial reward is not an end, but rather a central 'means' to achieve more selfish or altruistic end-states (values). Therefore, cricket-flour buns marketers should use the themes generated by this study to design their campaign messages, especially those that will relate consumption of cricket-flour buns with/to happiness, food security, good health and long life. Insect-based foods are currently being promoted for their potential to improve; i) nutrition (good health), ii) economic benefits (profit/income) and, iii) environmental care (responsibility). This chapter identifies three additional themes: "happiness", "food security" and "long life", which can be used to promote consumption of foods from edible insects as a sustainable source of proteins.

5.6 Limitations of the study

The study has some limitations that should be addressed by the future studies. *First*, respondents may have difficulty in understanding the meaning of some attributes as used in the JAR scales (in chapter 3), for example, distinguishing texture/softness from crumbliness. *Second*, the tasting condition could also limit the robustness of the results. Although the home environment was considered appropriate situational context because it is where food preparation and eating mostly take place, the author did not control for other relatively important situations, including time lapse from the last meal taken (hunger-level). Alemu *et al*. (2017), for instance, argues that situational

issues like hunger-level could affect the sensory evaluations. *Third*, the study used three information-treatments namely, i) basic information group, ii) positive information group, and iii) perceived negative information group. Future research should investigate if the findings (i.e., evaluation of attributes and mental models) would be different if a fourth group was included and treated with information about both the positive and perceived negative information. *Fourth*, evaluations of the appropriateness of some attributes may be influenced by cognitive factors in addition to perception (Li *et al*., 2014). For instance, a participant who is on a diet may perceive ‘‘sweetness/sugary’’ of cricket-flour buns as a negative attribute, and tend to always rate the buns as ‘‘much too sweet’’, thus limiting the robustness of our results.

Fifth, when new food products (such as cricket-flour buns) are introduced into a culture, they generally induce feelings of fear and refusal (rejections) called food neophobia (Verbeke, 2015; Alemu *et al*., 2017). Food neophobia, defined as the fear and aversion to new foods, may negatively affect the intentions or reduce the motivation to consume insect-based products. Understanding the relationship between cricket-flour buns and food neophobia would be more insightful while designing marketing strategies. Future consumer studies on insect-based foods should therefore, try to control for the likely effects of food neophobia. *Finally*, the design of the study could also limit the robustness of the results, especially focusing on explaining the intentions to consume foods from edible insects (FFEI) and not the actual insects. This is because delving into processed insects’ foods (FFEI) opens a series of questions concerning consumer attitudes and motivations. For instance, when insects are presented in visible format (e.g., see Figure 3), people could identify with them as being ‘familiar’ food. However, if ingredients are processed and blended, people’s understanding of these foods might be very different (Dean *et al*, 2008; Hartmann & Siegrist, 2016). Also as Alemu *et al*. (2017) reported, consumers’ attitudes and

perceptions regarding edible insects' as food include the idea that they are natural (fresh), have crunchy taste, and not processed to any great degree. These could be lost during processing. Thus, factors influencing the intentions to consume visible insects might be quite different from those predicting the intentions to consume processed ones. Therefore, future studies should compare intentions and motivations to consume both 'whole' insects and processed insect-based foods such as FFEI.

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APPENDICES

Appendix 1: Questionnaire

ASSESSMENT OF ATTITUDES AND INTENTIONS TO CONSUME FOODS FROM EDIBLE INSECTS.

CONSUMER SURVEY TOOL

Researchers from Jomo Kenyatta University of Agriculture and Technology (JKUAT) are carrying out a survey on assessment of consumer attitudes and intentions to use foods from edible insects in this county. You've been randomly selected to participate in the survey. Your contribution is voluntary and the information you give will be treated confidentially. You can choose to answer or not answer any question. Your lack of participation or participation itself will not have any adverse consequences on you. The interview will take about 45 minutes. With your permission, I would like to start the interview.

0: Survey quality *Control* [*Please complete this section after the interview, but before your next interview*]

Sub-County		Treatment *(enumerator):* ◯
Location		
Sub-location		
Village		
Phone number [***future correspondence***]		Selected for Laddering?
Your name [***at least 2 names***]		☐ Yes
Date of interview		☐ No
Start time_____	End time _____	

SECTION A: DEMOGRAPHIC AND POTENTIAL MARKETS

PART VIII: DEMOGRAPHIC AND SOCIO-ECONOMIC INFORMATION

1. Kindly give the following information in relation to your household

Number of children below 5 years in your household	House hold Size	Your year of birth	Your relationship to the household head. 1. Head 2. Spouse 3. Son 4. Daughter 5. Other…	Sex of the house-hold 1. Male 2. Female	Years of formal schooling	Marital status 1. Married 2. Single 3. Divorce 4. Widow 5. Other ….	Your employment 1. Government 2. NGO/Private sector 3. Farmer 4. Business 5. Fishing 6. Student 7. Other...	What do you own from this list: 1. Vehicle 2. Ox drawn plough 3. Motor cycle 4. Bicycle 5. TV 6. Radio 7. Cattle 8.Goat/Sheep 9. Poultry 10. Cash crops 11. Other…	How many Acres of land do your household own?	What is your household's annual income	What is your religion? 1. Christian 2. Muslim 3. No religion	How many times a week do you eat meat in your house-hold?

PART I: FAMILIARITY WITH EDIBLE INSECT EATING

2. Have you heard prior to this survey that foods from edible insects are eaten in Kenya?

- ☐ Yes
- ☐ No

3. How did you hear about the practice? [1. Tasted 2. Observed, 3. Media, 4. Told by relatives/friends*]*

4. Are foods from edible insects generally available in this village?

- ☐ Yes
- ☐ No

5. If Yes, name them……

6. Have you ever eaten any kind of food from edible insect?

- ☐ Yes
- ☐ No (***proceed to question 9***)

7. If Yes, what food product did you eat? ……..……

8. When did you last eat? (1). 1 year ago (2). 2-3 years ago (3). Other (specify)…….……...…..

9. If No, why did you not eat foods from edible insects? (You can choose many options)

- ☐ Because foods from edible insects are disgusting
- ☐ Because edible insects are dangerous and risky for health
- ☐ Because eating foods from edible insects would affect my status
- ☐ Other,

  specify……

[Enumerator please don't read: Edible insects contain protein, energy, minerals and vitamins which are very useful for human consumption.]

10. Have you heard prior to this survey that foods from edible insects can provide essential nutrients for humans?

- ☐ Yes
- ☐ No

11. If Yes, what nutrients? .....

12. Do you believe that weather [i.e. rainfall and temperature] patterns over the past five years are different from patterns that were typical ten or more years ago in this village?

- ☐ Yes
- ☐ No [***go to question 14***]

13. If Yes, what causes these changes in weather patterns?

……

SECTION B: TPB CONSTRUCTS

[*Enumerator*] Please give your opinion against each of the following questions. Make each item a separate and independent judgment. Work at fairly high speed through the set of scales. Do not worry or puzzle over individual items. It is your first impressions, i.e., the immediate feelings about the items that we want. On the other hand, please do not be careless, because we want your true impressions.

While some statements may sound similar, there are subtle differences in what is being asked.

PART II: ATTITUDES (ATT)

Behavioural beliefs (b_i)

14. For me, consuming foods from edible insects regularly during the next 12 months would mean . . .

a. "Eating a safe and healthier food"

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

b. "Eating a diet that is highly varied (diversified)";

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

c. "Having more *Control* over my diet";

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

d. "Eating food that taste very good"

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

e. "Eating foods with high nutrition"

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

f. "Eating foods that are affordable (less expensive)"

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

Evaluation of the belief's attribute (e_i)

15. To what degree do you find the following aspects important when making a choice regarding foods from edible insects?

a***. Healthiness/Safety:*** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Totally Important

b***. Price:*** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Totally Important

c***. Diversified diet***: Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Totally Important

d***. Dietary Control:*** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Totally Important

e***. Taste:*** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Totally Important

f. ***Nutritional value:*** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Totally Important

g. ***Meal satisfaction:*** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Totally Important

h. ***Meal desirability:*** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Totally Important

PART III: SUBJECTIVE NORMS (SN)

Normative beliefs (n_i)

16. ***Now think about people who are very important to you:*** To what degree do you agree with the following statements?

a. My family thinks that I should consume foods from edible insects regularly.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

b. My friends think that I should consume foods from edible insects regularly.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

c. The government stimulates me to consume traditional foods like those from edible insects.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

e. Doctors and nutritionists think that I should consume foods from edible insects regularly.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

f. Advertising stimulates me to consume foods from edible insects regularly.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

g. My partner thinks that I should consume foods from edible insects regularly.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

h. The food industry encourages me to consume foods from edible insects regularly.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

i. Most people who are important to me probably think that I should consume foods from edible insects regularly.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

j. Think of the people who are important to you. What percentage of them do you think consume foods from edible insects regularly?

0%: ___1__:___2__:___3__:___4__:___5__: 100%

k. Among the people who are important to you, how much agreement would there be that consuming foods from edible insects regularly is a good thing to do?

None at all: ___1__:___2__:___3__:___4__:___5__: Very High

Personal norm (personal responsibility, moral obligation):

17. Please respond to the following statements about foods from edible insects.

a. To give my family a healthy meal, I'll buy foods from edible insects regularly.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

b. To give my family a nutritious meal, I'll buy foods from edible insects regularly.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

c. To offer my family a varied meal, I'll buy foods from edible insects regularly.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

Motivation to comply (m_i)

18. To what degree do you find the opinion of the following persons/institutions important when making a choice to consume foods from edible insects?

a**. My family:** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

b**. My friends:** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

c**. The government:** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

d**. Doctor/Nutritionist:** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

e**. Advertisement**: Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

f**. My partner:** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

g**. The food Industry:** Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

19. How likely or unlikely is it that your intention to consume foods from edible insects regularly is determined by the views of people who are important to you, e.g., your family, friends or peers?

Very Unlikely: ___1__:___2__:___3__:___4__:___5__: Vary Likely

Personal norm (personal responsibility, moral obligation):

20. To what degree do you find the following aspects important when making foods from edible insects' consumption choice?

a. Give my family a healthy meal:

Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

b. Give my family a nutritious meal:

Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

c. Offer my family a varied meal:

Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

PART IV: PERCIEVED BEHAVIOURAL *CONTROL* (PBC)

Control beliefs (c_i)

21. *Now think about yourself i.e., the power you personally hold regarding eating or avoiding edible insects and products'.* To what degree do you agree with the following statements?

Facilitating conditions

a. I find it easy to judge the quality of foods from edible insects.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

b. I can make many different meals with processed edible insects.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

c. When I consume foods from edible insects, the chance to make a bad choice is small.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

d. Foods from edible insects are easily available for me.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

e. Foods from edible insects are easy to prepare.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

Past experience

i. I am familiar with eating foods from edible insects.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

j. I know a lot of insect foods that can be eaten.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

k. I have much knowledge about foods from edible insects.

Totally Disagree: ___1__:___2__:___3__:___4__:___5__: Totally Agree

Perceived power (p_i)

22. To what degree do you find the following aspects important when making a choice to consume foods from edible insects?

Facilitating conditions

a. Easiness of judging the quality of foods from edible insects.

Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

b. Number of different meals that you can make from edible insects.

Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

c. Small chance of making a bad choice.

Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

d. Availability of edible foods from edible insects.

Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

e. Easiness to prepare foods from edible insects for consumption.

Totally Unimportant: ___1__:___2__:___3__:___4__:___5__: Very Important

PART V: BEHAVIOURAL INTENTION (BI)

23. To what extent do you agree with the following statements?

a. I intend to consume foods from edible insects regularly during the next 12 months:

Extremely Unlikely: ___1__:___2__:___3__:___4__:___5__: Extremely Likely

b. I will make an effort to consume foods from edible insects regularly during the next 12 months:

Definitely False: ___1__:___2__:___3__:___4__:___5__: Definitely True

c. I am determined to consume foods from edible insects regularly during the next 12 months:

Strongly Disagree: ___1__:___2__:___3__:___4__:___5__: Strongly Agree

d. For me to consume foods from edible insects regularly during the next 12 months would be:

Impossible: ___1__:___2__:___3__:___4__:___5__: Possible

PART VI: SELF IDENTITY AND REPORTED BEHAVIOUR

24. Now think about the extent to which you perceive yourself as similar to a person who consume foods from edible insects regularly.

a. I look at myself as a person who consume foods from edible insects regularly.

Strongly Disagree: ___1__:___2__:___3__:___4__:___5__: Strongly Agree

b. I consider myself as a typical consumer of foods from edible insects.

Definitely Not: ___1__:___2__:___3__:___4__:___5__: Definitely Do

SECTION C: CONSEQUENCE OF INSECTS' FOODS

PART VII: FOOD DESIRABILITY AND LIKELYHOOD

25. How often is your choice of which foods to purchase/consume based on your beliefs about whether or not the food is natural (e.g., contains no additives)?

Never: ___1__:___2__:___3__:___4__:___5__: Always

26. How often is your choice of which foods to purchase/consume based on your beliefs about whether or not their production pollutes the environment?

Never: ___1__:___2__:___3__:___4__:___5__: Always

27. How likely or unlikely is it that you would believe statements about the *Benefits* and risks of producing and consuming foods from edible insects by a company engaged in its development?

Extremely Unlikely: ___1__:___2__:___3__:___4__:___5__: Extremely Likely

28. How likely or unlikely is it that your consumption of foods from edible insects will support the development of "Insect-based Industry" (insect-value-chains) in Kenya?

Extremely Unlikely: ___1__:___2__:___3__:___4__:___5__: Extremely Likely

SECTION D: SCALING UP CRICK-BUNS/BREAD

PART IX: JUST ABOUT RIGHT (JAR) SCALES

This part of the questionnaire starts with instructions depending on which treatment the respondent has been assigned to:

	***Control* group**	**Treatment 1**	**Treatment 2**
Information	General information about rearing edible insects and processing them for food/feed and the importance of using insects to produce more food (see below)	Same as *Control* + Detailed information on proteins (what it is, its health *Benefits*/risks. Also information on livelihood opportunities that insects' value-chains create	Same as *Control* + Detailed information about negative product attribute design differences
Stimuli	✓ A real product* (crick-buns/bread) ✓ Pictures of foods from edible insects and their rearing ✓ Also images of standard buns	✓ A real product* (crick-buns/bread) ✓ Images of healthy families (not suffering from kwashiorkor) ✓ Also images of standard buns	✓ A real product* (crick-buns/bread) ✓ Also images of standard buns

*Note: the real product should be the same across all groups.

>> Session starts

[***Enumerator****: Tell the (respondent) that this part of the questionnaire relates to the crick-bun and that the interview in what continues will focus on it*.]

[***Enumerator:*** *PUT the crick-bun on the table (or equivalent). Do not invite the respondent to touch or hold the buns during the first part of this session*.]

[*Now read information below to the respondent and show the real product (and the pictures according to the treatment group) .Please use the separate files that have been prepared for this purpose. Be sure to get a note from the respondent that s/he is OK to continue and have cleared any potential questions before proceeding.*]

General information (read to all): *Control* + others

Enumerator: Please read:	(***Information is given in Appendix 2***)
Show:	The real products and pictures to this treatment.
Ask:	Do you have any question before we proceed?

>> ***For Control group => Continue to Question* 30**

>>Treatment 1 information:

[*Please start with provision of the same information as given to the Control group*].

Enumerator: Please read:	(***Information is given in Appendix 2***)
Show:	The real products to this treatment.
Ask:	Do you have any question before we proceed?

>> ***For Treatment 1 => Continue to Question* 30**

>>Treatment 2 information:

[*Please start with provision of the same information as given to the Control group*].

Enumerator: Please read:	(***Information is given in Appendix 2***)
Show:	The real products to this treatment.
Ask:	Do you have any question before we proceed?

>> ***For Treatment 2 => Continue to Question* 30**

Question 30: Personal involvement

[*Enumerator please read*]: Please judge/assess the product that you now have been shown against the following series of descriptive scales according to how YOU perceive the crick-buns/bread as you have it in front of you now:

Make each item a separate and independent judgment. Work at fairly high speed through the set of scales. Do not worry or puzzle over individual items. It is your first impressions, i.e., the immediate feelings about the items that we want. On the other hand, please do not be careless, because we want your true impressions:

	1	**2**	**3**	**4**	**5**	
Important						Unimportant
Of no concern						Of concern to me
Irrelevant						Relevant
Means a lot to me						Means nothing to me
Useless						Useful
Valuable						Worthless
Trivial						Fundamental
Beneficial						Not beneficial
Matters to me						Doesn't matter
Uninterested						Interested
Significant						Insignificant
Vital						Superfluous
Boring						Interesting
Unexciting						Exciting
Appealing						Unappealing
Mundane						Fascinating
Essential						Nonessential
Undesirable						Desirable

Wanted						Unwanted
Not needed						Needed

Question 31 (Expected liking)
[*Enumerator: please read*]: We would like YOU to focus on a comparison between [(a) crick-bun vs. (b) the standard bun (show the images)].

[***Instruction****: Do not let the respondent use any sense (other than visual here) (no touching, smelling, etc*.]

[*Enumerator: please read*]: Please, take a look at the crick-bun when responding to the following questions. Consider each item as a separate issue. Now please use the scale and rate your expected liking of the product that you now see in front of you:

	Much too little	Too little	Just about right	Too much	Much too much
Sweetness/sugary					
Nutrition/nutritious					
Smell					
Colour					
Texture/softness					
Taste					
Crumbliness/easy to handle					

[*Enumerator: Please request the respondent to go and get you a glass of water. Let her get up and walk to the water source and fetch water. When she returns, inform her that the water is actually for her to drink. Explain that the next step requires that she drinks the water to clear/rinse her mouth, because you would now like her eat/taste some of the crick-bun/bread provided. Buy time here by engaging in "cheap talk" such as explaining it is essential to make a habit to drink water routinely and why water is good for the body. But don't overdo it. When done, ask her to drink the water, rinsing her mouth in the process*.]

Continue next part on the next sheet and do not allow respondents to reconsider their responses after this point

Question 32
[*Enumerator please read this Instruction*: At this point we invite you to **taste** the crick-bun/bread presented here in front of you.

[*Make sure that the respondent has tasted the product before continuing.*]
[*Enumerator please read*]: Please use the scale and rate your liking of the product that you now see in front of you.

	Much too little	Too little	Just about right	Too much	Much too much
Sweetness/sugary					
Nutrition/nutritious					
Smell					
Colour					
Texture/softness					
Taste					
Crumbliness/easy to handle					

[Enumerator: The interview stops at this point unless the respondent has been selected for the laddering interview. Thank the respondent and leave]

Thank you very much [name] for your time and responses!!

Appendix 2: Product information given to each of treatment groups

Control: Basic product information

The products you see before you are buns made from flour mixed with powder produced using crickets. They are made by mixing 10% cricket powder and the normal wheat flour. They are then baked in similar way as the normal buns. The baking process is done in line with Kenya government manufacturing standards; hence these buns meet the safety requirements of Kenya Bureau of Standards (KEBS). These buns are therefore safe for human consumption.

Treatment 1: Positive product information

[Enumerator: *Start by providing general information present in the Control*]

These cricket buns have been enriched with proteins. Protein is an essential nutrient useful for building human body i.e., are one of the building blocks of body tissue, and can also serve as energy source, just like carbohydrates, in case of starvation. Protein deficiency causes kwashiorkor, which is prevalent, particularly in children. Symptoms of kwashiorkor include: retarded growth, loss of hair and skin color, slow healing of wounds, poor digestion, liver damage, and poor immunity (poor health in general).

Foods from edible insects such as these cricket buns are an effective and sustainable strategy (or way) to address protein deficiency among vulnerable populations in developing countries.

Moreover, other animal-based proteins including meat, dairy products and fish are expensive and out of reach of many households. At the same time, production of edible insects provide income opportunities along the value-chains. Foods from edible insects, like cricket buns conserves the environment hence a sustainable source of proteins.

Treatment 2: Negative product information

[Enumerator: *Start by providing general information present in the Control*]

These cricket buns have been produced through enrichment – addition of some nutritious-ingredients that the body needs into a product. However, the process of adding nutritious ingredients to these buns changes some of their sensory attributes.

For example, some consumers have felt that these cricket buns are very dark compared to the ordinary buns that are light-brown on the surface and white or yellow inside. Others have felt that cricket buns don't taste as good as the ordinary ones and that they have "heavy taste" (fatty) in the mouth. Still, other people also find the idea of eating food/buns made from crickets (insects) disgusting.

Appendix 3: Authorization and approval of the study

Appendix 3.1: NACOSTI research authorization

NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone: +254-20-2213471, 2241349, 310571, 2219420
Fax: +254-20-318245, 318249
Email: secretary@nacosti.go.ke
Website: www.nacosti.go.ke
When replying please quote

9th Floor, Utalii House
Uhuru Highway
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No.

Date:

19th August, 2015

NACOSTI/P/15/6022/6938

Kennedy Otieno Pambo
Jomo Kenyatta University of Agriculture
And Technology
P.O. Box 62000-00200
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Exploring consumer attitudes and intention to accept edible insects and products in Kenya: An application of the theory of planned behaviour,"*** I am pleased to inform you that you have been authorized to undertake research in **all Counties** for a period ending **31st December, 2018.**

You are advised to report to **the County Commissioners and the County Directors of Education, all Counties** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

SAID HUSSEIN
FOR: DIRECTOR-GENERAL/CEO

Copy to:

The County Commissioners
All Counties.

The County Directors of Education
All Counties.

National Commission for Science, Technology and Innovation is ISO 9001:2008 Certified

Appendix 3.2: KEBS laboratory test report

Kenya Bureau of Standards
Standards for Quality Life

Fax: +254 (0) 20 6009660
E-mail: info@kebs.org
Website: www.kebs.org

KEBS Centre, Popo Road
P.O. Box 54974, 00200 Nairobi
Tel: +254 (0) 20 6005490, 6005506

Laboratory Test Report

Report Ref: KEBS/TES/5963/M/15

Date: 17 September, 2015

1. Description of Sample: Cricket Scones/Bread
2. Sample Submitted by: Jomo Kenyatta University of Agriculture & Tech
3. Customer Contact: Kennedy O Pambo
4. Customers Ref No: Private
5. Customer's Address: P.O. BOX 62000-00200, Nairobi Kenya
6. KEBS Sample Ref.No: BS201500523
7. Date of Receipt: 11 September, 2015
8. Date Analysis Started: 11 September, 2015
9. Sample Submission Form No: 126861

10. Additional information provided by the customer:

11. Acceptance criteria-title and number of specification against which it is tested:
KS 05-1123 Kenya Standard Specification For Buns

12. Parameters tested and Method(s) of test: as listed in the report below

LABORATORY TEST REPORT

No.	Parameters		Results	Requirements	Test Method No	LOD
1	E. coli	/g	Not detected	Shall be absent	TES/MIC/TM/17	10
2	Salmonella	/30g	Not detected	Shall be absent	TES/MIC/TM/08	1
3	Total Viable Count	cfu/g	>3000	Not Specified	TES/MIC/TM/10	10
4	Yeast and Mould	cfu/g	<10	100Max	TES/MIC/TM/11	10

COMMENTS/REMARKS:
The sample performed as shown

Clarkson Agembo - Manager, Microbiology Laboratory
FOR: MANAGING DIRECTOR

17 September, 2015
Date of Issue

Appendix 3.3: Approval by the KNH-UON ERC

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/493

7th December, 2015

KENYATTA NATIONAL HOSPITAL APPROVED 07 DEC 2015 KNH/UON-ERC P.O. Box 20723-00202 NAIROBI

Kennedy Otieno Pambo
Principal Investigator
J.K.U.A.T

Dear Kennedy,

Revised research proposal: Assessment of attitudes and intention to consume foods from edible insects in Kenya (P609/09/2015)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH-UoN ERC) has reviewed and **approved** your above proposal. The approval periods are 7th December 2015 – 6th December 2016.

This approval is subject to compliance with the following requirements:

a) Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b) All changes (amendments, deviations, violations etc) are submitted for review and approval by KNH-UoN ERC before implementation.
c) Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d) Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e) Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
f) Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
g) Submission of an *executive summary* report within 90 days upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

Protect to discover