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# Exploring the Influence of Differentiated Nutrition Information on Consumers' Mental Models Regarding Foods from Edible Insects: A Means-End Chain Analysis

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**ABSTRACT**

This study used a field experiment and means-end chain analysis to examine the effects of positive and perceived negative nutrition information on the households' motivations to consume insect-based foods. It used a random sample of households drawn from rural communities in Kenya. The study found that provision of nutrition information on benefits of edible insects and perceived negative aspects of insect-based foods influences participants' perceptions of insect-based foods and hence acceptance. We also found that tasting real products influenced the nature of mental constructs. The results provide marketers of edible insects with potential marketing messages for promotion.

**KEYWORDS**

Cricket buns; Kenya; laddering; means-end chain; mental models; nutrition information

Entomophagy, the practice of consuming insects, is receiving increased attention due to the rising cost of animal protein (especially the cost of meats), food insecurity, environmental pressures, and population growth (Food and Agriculture Organization FAO 2013). Edible insects have the potential of addressing food insecurity challenges because insect-based proteins compare favorably to protein from conventional livestock in terms of feed conversion efficiency, greenhouse gas and ammonia emissions, and water use (Verbeke 2015). In western Kenya (especially in Siaya, Busia, Bungoma, Kakamega, Kisumu, and Migori counties,[1] among others), edible insects not only are food but also are traded in local markets; hence, they are an economic activity (Münke-Svendsen et al. 2016). They are therefore a nutritious food and a source of income for households (Homann 2015). Recent studies suggest that entomophagy is also practiced in the coastal and other parts of Kenya (Alemu et al. 2017; Pambo et al. 2016a), but as in many other parts of Africa, insects are seasonal and are harvested using rudimentary methods (Looy, Dunkel, and Wood 2014).

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[1]A county is a geographical and an administrative unit with an elected devolved government (Constitution of Kenya, 2010).

The scientific community and the private sector (e.g., ICCO Company) have been campaigning for the promotion of the consumption of insect-based foods by modernizing edible-insect value chains in Kenya (Münke-Svendsen et al. 2016). The focus on edible insects stems from the belief that entomophagy can result in a more energy-efficient food production system. Specifically, edible insects have high feed conversion efficiency and the ability to feed on various feed sources (Halloran et al. 2016); hence, they simultaneously promote food security and facilitate environmental conservation (FAO 2013).

Despite the interest in promoting insect-based foods, little is known about what would motivate households' decisions to consume them. This study used data collected from rural households in western and eastern regions of Kenya to examine psychosocial motivations for the consumption of insect-based foods. It especially examined the cognitive motivations (i.e., mental models) associated with consumption of insect-based products. The product used was a common popular bakery product (namely buns) that was blended with cricket powder (henceforth referred to as cricket buns). The study specifically addressed two questions: (1) what are the consumers' mental models associated with consumption of cricket buns (insect-based foods)? (2) Can households' mental models be modified by the type of information they receive about insect-based foods? Product knowledge (information) is a major factor reported to influence consumer choices or decisions regarding novel products (Lind 2007). Indeed, Verbeke (2015) reported that the information about the nutritional, environmental, and economic benefits of edible insects may be used to promote entomophagy. Understanding the effect of consumer' knowledge on consumption decisions and motivations can provide policy makers with the tools/strategies for incorporating edible insects into the national food system.

This study differs from past studies in that it explores households' perceptions and motivations to consume cricket buns by explaining mental processes associated with the decision to consume insect-based foods and whether targeted information about such foods can influence the consumption decisions. The study also uses nonneoclassical economic theory, namely the means-end chain theory, which is anchored on economic psychology literature, to qualitatively map out the structure of decision making related to consumption of insect-based foods.

## Theoretical framework

In the context of insect-based foods, the means-end chain (MEC) theory posits that an individual will consume foods from edible insects (in this case, the cricket-buns; means) to generate particular benefits that will ultimately serve to attain more abstract personal values (end) that the consumer

associates with the consequence (Barrena and Sánchez 2009). The theory argues that perceived self-relevant product *attributes* (A) lead to *consequences* (C) that 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 from a product (Arsil et al. 2014; Okello et al. 2013). These consequences can be direct, indirect, physiological, psychological, or sociological in nature (Lind 2007). For example, locally available crickets (an attribute) can be associated with proper/efficient utilization of local resources (first consequence), which then either creates employment opportunities or helps 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. That is, they translate individual needs into a socially acceptable format (Arsil et al. 2014; Lind 2007). They reflect inner motives associated, in our case, with consumption of cricket buns. Understanding such motives can help in the development of marketing strategies aimed at increasing consumption of such foods and hence the nutrition and health status of the community.

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' behavior according to 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. This technique is able to "bring to the surface" the personal values about a product that are usually hidden within an individual's mind (Reynolds and 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 subconscious mind of an individual (Barrena and Sánchez 2009; Lind 2007). It has been applied in an African context by Largerkvist, Okello, and Karanja (2015) and Okello et al. (2013).

## Empirical methods

### *Study area and sampling*

This study was part of a larger study by "GREEiNSECT" project that aims, among other things, to provide knowledge and technological solutions to establishment of small to large-scale insect production sectors in Kenya

through collaborative research between public and private institutions. The project targets five counties of Kenya: Kisumu, Siaya, Nairobi, Machakos, and Kiambu. Two counties, Siaya and Machakos (see figure 1 for geographical locations), were purposively selected for this study. The two counties have high levels of poverty and food insecurity (Alemu et al. 2017). They also differ in terms of experience and exposure to edible insects, with consumption of edible insects being a deeply rooted culture in Siaya county (Ayieko, Oriaro, and Nyambuga 2010).

The selection of participants was conducted as follows. First, four administrative locations were randomly sampled from each county, followed by random selection of one ward from each location. Next, three villages were randomly selected for the study from each ward. Within each village, a list of all households was generated with the help of village elders and verified for completeness and accuracy. Last, 18 households were randomly sampled from each village for the interview. This procedure yielded 432 participants who took part in the larger study. For the laddering interviews, a random subsample of all the study participants was involved. Specifically, from among the sampling households in each village, either two or three were

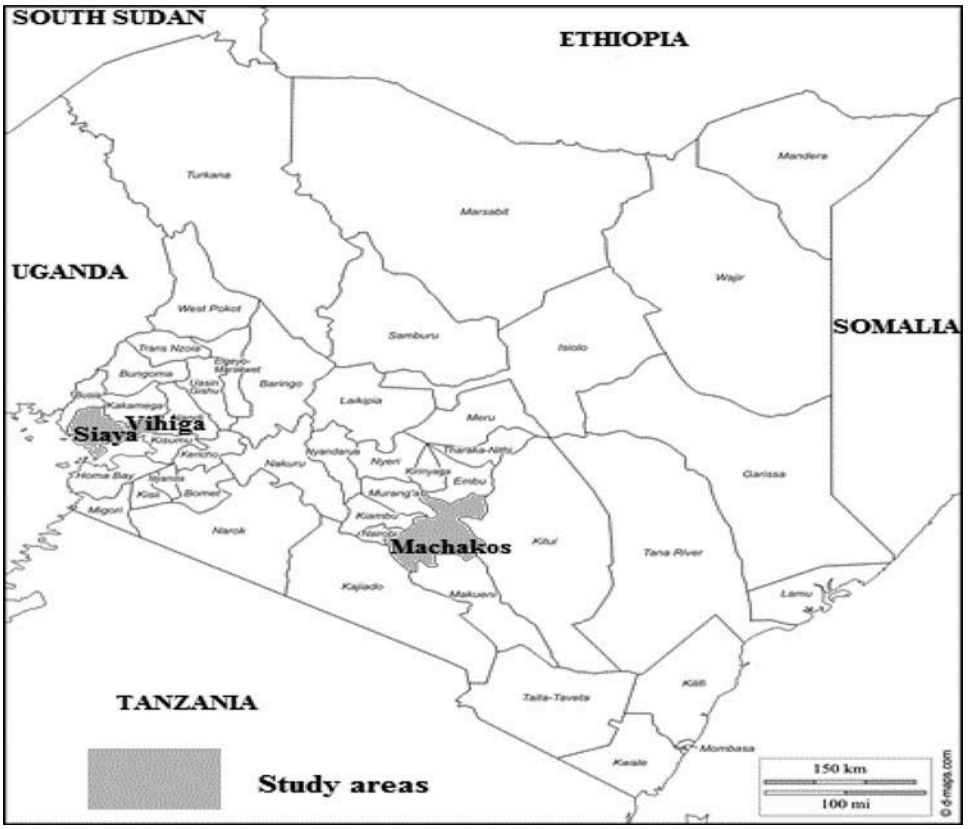


Figure 1. Geographical region in Kenya where the study was done (d-maps.com).

randomly selected (proportionate to size) for each of the treatment arms to take part in the laddering interviews, yielding a total of 54 participants. All the participants from one village were interviewed on the same day to reduce chances of respondents discussing the experiment. The socioeconomic characteristics of the participants are presented in table 1.

The sample sizes in each treatment arm/group, though small, compare favorably with those used by other MEC studies. For example, Okello et al. (2013) used the same sample size to investigate the role that farmers' personal values play in the decision to use organic manures and chemical fertilizers in Kenya; Schaefers (2013) used a sample of 14 participants to assess motivations for the use of car-sharing services in the United States; Crudge and Johnson (2007) used only six participants to explore mental models of users of search engines.

## 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

**Table 1.** Socioeconomic Characteristics of the Participants.

| | Control group | | Positive information group | | Negative information group | | |
|---|---|---|---|---|---|---|---|
| Variable | Mean | SD | Mean | SD | Mean | SD | Kruskal-Wallis[a] |
| Descriptive | | | | | | | |
| Household size | 4.88 | 1.99 | 4.44 | 1.67 | 4.62 | 1.71 | 0.165 |
| Participant's age | 48.06 | 13.82 | 46.31 | 12.44 | 40.94 | 11.89 | 0.067 |
| Household income (x 1,000)[b] | 264 | 288 | 268 | 283 | 262 | 287 | 0.451 |
| Frequencies | | | | | | | |
| | Proportion (%) | | Proportion (%) | | Proportion (%) | | |
| Gender (female) | 55.6 | | 55.6 | | 50 | | 0.056 |
| Have consumed insect of any kind | 94.4 | | 88.9 | | 88.9 | | 0.058 |
| Have consumed foods from insects | 16.7 | | 11.1 | | 11.1 | | 0.066 |
| Level of highest education | | | | | | | |
| Nonschool & incomplete primary | 22.2 | | 22.2 | | 11.2 | | 0.047 |
| Complete primary | 38.8 | | 33.3 | | 38.8 | | 0.121 |
| Complete secondary | 27.8 | | 27.8 | | 33.3 | | 0.071 |
| College (no university) | 5.6 | | 11.1 | | 11.1 | | 0.046 |
| University | 5,6 | | 5.6 | | 5.6 | | 0.912 |
| Marital status | | | | | | | |
| Married | 77.7 | | 83.3 | | 83.3 | | 0.055 |
| Single | 11.1 | | 11.1 | | 11.1 | | 0.931 |
| Cohabiting | 11.2 | | 5.6 | | 5.6 | | 0.981 |
| *n* | 16 | | 20 | | 18 | | |

[a]Hypothesis that the distribution of the variable is the same across the three groups.
[b]Sum of crop, livestock, and other income over the past 1 year in Kshs x 1,000 (Kshs 1 = $0.01 USD at the time of study).

Okello et al. (2013), soft laddering technique gives respondents more freedom by typically allowing them to trace their own mental models with little interruption and to follow as much as possible their 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 and Sánchez 2009).

The laddering interviews were conducted as part of a field experiment.[2] Each participant was interviewed separately at his or her home. The home environment was an appropriate setting for this study because it is where food preparation and eating mostly take place. Following Lind (2007), the study setting was kept as close to the real decision-making food consumption situation as possible for the participant to provide the most salient criteria in the laddering interviews. Field experiments followed the steps below.

In step 1, upon recruitment, the participant was asked for his or her informed consent to participate in the study. A consenting respondent was then randomly assigned to one of the three treatment groups. Group 1 (the control group) received only basic information on processing and safety features of cricket buns, whereas in addition to the processing and safety properties, group 2 (treatment 1: positive information group) received detailed information on nutrition, particularly proteins and other economic and environmental benefits of insect value chains. Group 3 (treatment 2: perceived negative information group) received information on perceived negative sensory differences between cricket buns and ordinary buns. Description of processing and safety features as basic information (control) was important because most participants were expected to have personal experiences with "fresh" crickets rather than "blended" cricket buns (Alemu et al. 2017; Pambo et al. 2016a). It was therefore necessary to inform participants about the change in form. Furthermore, information regarding safety properties and approval was included to enhance participation (reduce refusal). Safety concerns rank high among reasons given for rejection of insect-based foods (Hartmann and Siegrist 2016; Verbeke 2015), so it was vital to prevent perceived safety risks. This therefore meant that the interest in the potential of cricket buns could be considered as a base from which the contrast to benefits or shortcomings could be examined (Lagerkvist et al. 2016).

Processing information included details about the content of cricket buns as well as the baking procedure. The detailed information on benefits first termed mixing wheat flour and cricket powder as "enriching ordinary wheat flour" with proteins, then mentioned the nutritional and public health impact of proteins. Interest in alternative sources of "animal" proteins, including sustainability and environmental concerns of increased consumption of conventional meat as well as the potential livelihood opportunities from

[2]Ethical guidelines laid down in the Declaration of Helsinki were adhered to while conducting the field experiments, and all procedures involving human subjects were approved by the Kenyatta National Hospital/University of Nairobi – Ethical Review Committee (reference KNH-ERC/A/493; Protocol reference P609/09/2015).

cricket-buns' value chains were described. The information on perceived negative product sensory differences described the trade-offs between nutritional and sensory characteristics with reference to the ordinary buns. In addition to the verbal information, participants in each treatment were presented with a set of images specific to each treatment. The images used in each treatment were meant to reinforce meanings of the verbal information and to convey aspects related to production and product properties, safety considerations, improved health, food security, environmental care, and emotions. Details of the verbal narrative and images used are in the appendix. Images were included to stimulate deeper meanings such as emotions and abstract ideas, which are difficult to capture in traditional face-to-face interviews (Lagerkvist, Okello, and Karanja 2015).

In step 2, the enumerator handed a packet containing three cricket buns to the participant then read aloud general information to the participant. All participants received the general information.

In step 3, the enumerator read the treatment information (narrative) to the participant according to his or her treatment category. In addition to the verbal narrative, the participant was shown the set of images specific to the treatment.

In step 4, the respondent was requested to rinse his or her mouth with water in preparation for tasting of the cricket buns. He or she was then requested to take one cricket bun from the packet and taste two to three times (i.e., at least two bites).

In step 5, the experiment concluded and the participant was allowed to keep the remaining two buns for other family members to also taste after the experiment, as compensation for time devoted to the experiment.

The cricket buns were baked by professionally trained technical assistants at the Food Processing Workshop Unit of the Jomo Kenyatta University of Agriculture and Technology, Kenya, using a recipe adopted from Alemu et al. (2017). They were prepared by replacing 10% of the wheat flour with cricket powder and baking in a standard manner using ingredients shown in table 2. The buns were used in the field for 4 days. Although the buns were still suitable for consumption after the fourth day, they were discarded to mitigate the effects of potential variation in the properties of the products on peoples' mental models. During the field experiment, the research team (i.e., the lead researcher and five trained research assistants) evaluated 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.

**Table 2.** Formulation (recipe) of the cricket buns used for the field experiment.

| Amount of wheat flour (g) | Amount of cricket powder (g) | Baking fat (g) | Salt (g) | Sugar (g) | Yeast (g) | Acetic acid (ml) |
|---|---|---|---|---|---|---|
| 112.5 | 12.5 | 7.5 | 1.25 | 5 | 2.5 | 0.125 |

*Source*: Alemu et al. (2017).

Next, the interviewer started each laddering session by asking the respondent to consider (1) the information given regarding edible insects and products (see appendix), (2) the cricket bun just tasted and, (3) the remaining cricket buns on the plate, as suggested by Reynolds and Gutman (1988) and adopted by (Arsil et al. 2014; Lind 2007). 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 buns (you've just tasted) again?

From the response to this question, attributes (i.e., features/characteristics) that would make the respondent want to consume cricket 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 Lagerkvist, Okello, and Karanja (2015) 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 25–40 minutes.

### *Content analysis*

Data from laddering interviews were analyzed following Reynolds and Gutman (1988). The answers from the laddering interviews were classified according to whether they were attributes, consequences, or values. A set of summary codes was first developed by the research team to ensure that all the attributes, consequences, and values mentioned by the respondent were covered. The team was jointly trained in the use of laddering technique and MEC analysis to improve consistency during content analysis procedure (Arsil et al. 2014). MECanalyst 1.0.15 software was then used to analyze the coded data. This software produces mental maps 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 and 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 (MECs) into a hierarchical value map (HVM). The HVM in this case depicts the motivational decision structure of the respondents' decision to consume cricket buns (Grunert and Grunert 1995).

The next step in constructing HVMs was to identity a "cutoff level." As Reynolds and Gutman (1988) suggested, the "rule of thumb" for researchers is to try multiple cutoff 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). The HVMs for the current study were constructed using a cutoff level of 2, except the general one representing the whole sample, which had a cutoff level of 4.

## Results and discussion

### *The motivation of the households to consume foods from edible insects*

The general HVM (whole sample) is presented in figure 2. The respondents were motivated/demotivated to consume cricket buns by characteristics related to (1) the product (mainly sensory attributes) such as good taste, attractive color, nutritional content, low levels of sweetness (less sugary); (2) the personality (e.g., disgusting); and (3) 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" color of cricket buns "attractive." Only 17% of the respondents perceived the dark color as unattractive. One-third of the respondents rated the cricket buns on the lower side of the "sweetness" scale (less sugary). Surprisingly, they associated this with fitness benefits, namely, energizing or being strong. Still, 14% of the respondents rated cricket buns negatively as "disgusting."

The general HVM shows that sensory attributes of cricket 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., cricket 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 perceived cricket 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

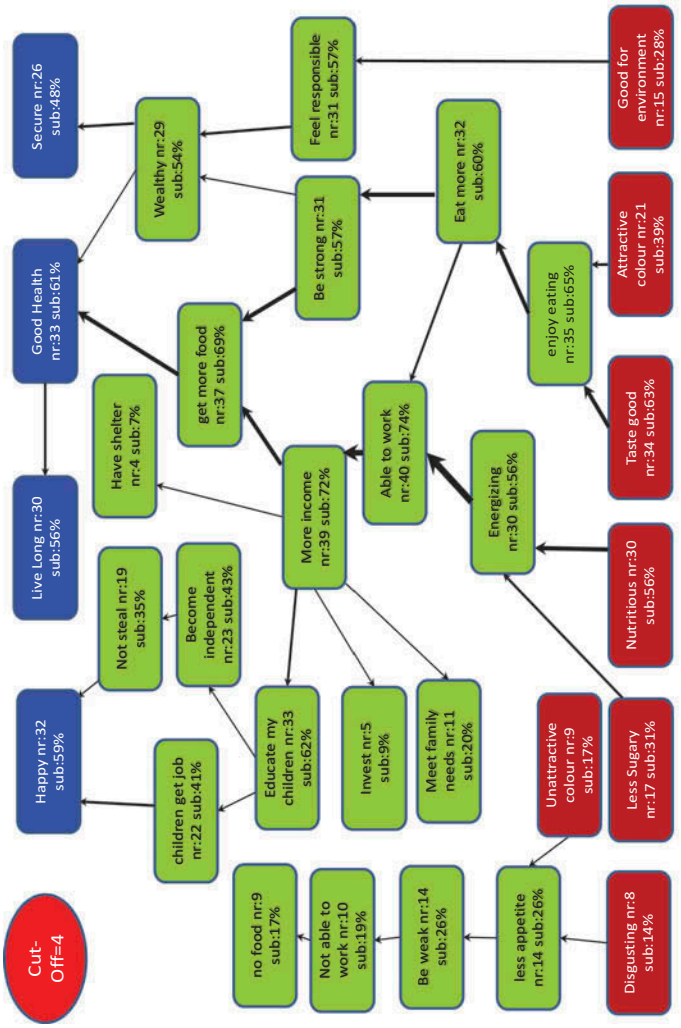


**Figure 2.** The hierarchical value map (HVM) for the whole sample: The general HVM.

with the value "happiness." Specifically, having "more money" is mentally linked to the ability to educate children to be morally upright (not thieves) or to being able to find jobs (hence becoming independent from parental support) and subsequently later supporting their parents instead.

Thus, the main reasons the laddering participants would consume cricket buns are good taste, perceived nutrition, and 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 meet other family needs. These benefits of consuming cricket buns in turn enable the participants to achieve four life goals (values): good health, long life, happiness, and food security.

### *The control group (general information group)*

The control group only received basic information regarding the processing of cricket buns and the safety considerations. The HVM for this group (figure 3) has four attributes contained in the general HVM, with the attributes "good for the environment" and "disgusting" completely missing. However, this HVM has two new attributes: "safe to eat" and "cheap to get."

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 general HVM was linked with good health. Participants in this group, it seems, realized that much sugar (sweetness) has negative health effects. Moreover, the information regarding the safety procedures undertaken during the processing of cricket 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 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 color" of cricket 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.

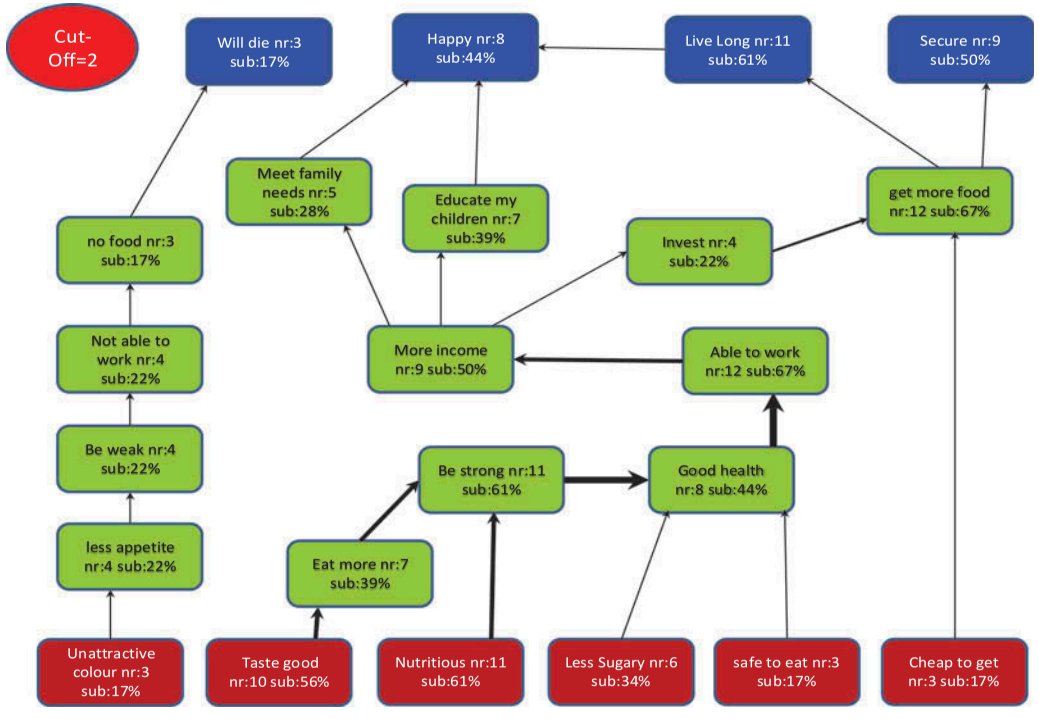


**Figure 3.** The hierarchical value map for the control: Basic information group.

### *Effect of positive information*

The HVM for the participants who received detailed information on nutritional, economic, and environmental benefits of insect value chains (figure 4) has all the attributes contained in the general HVM except "disgusting." Participants in this group were motivated to consume cricket buns, mostly by the attributes 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.

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 security." "Energizing" is also linked to "meeting family needs" and ultimately to the hedonistic value "good life." "Nutritious" attribute is 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" is also linked to the consequence "more income." Participants somehow understood caring for the 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 locally (within the study areas). However, 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 given regarding the benefits of edible insects (appendix). Therefore, the information treatment moderated 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 buns in the HVM for the positive information group. The attribute "good for the environment," which 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

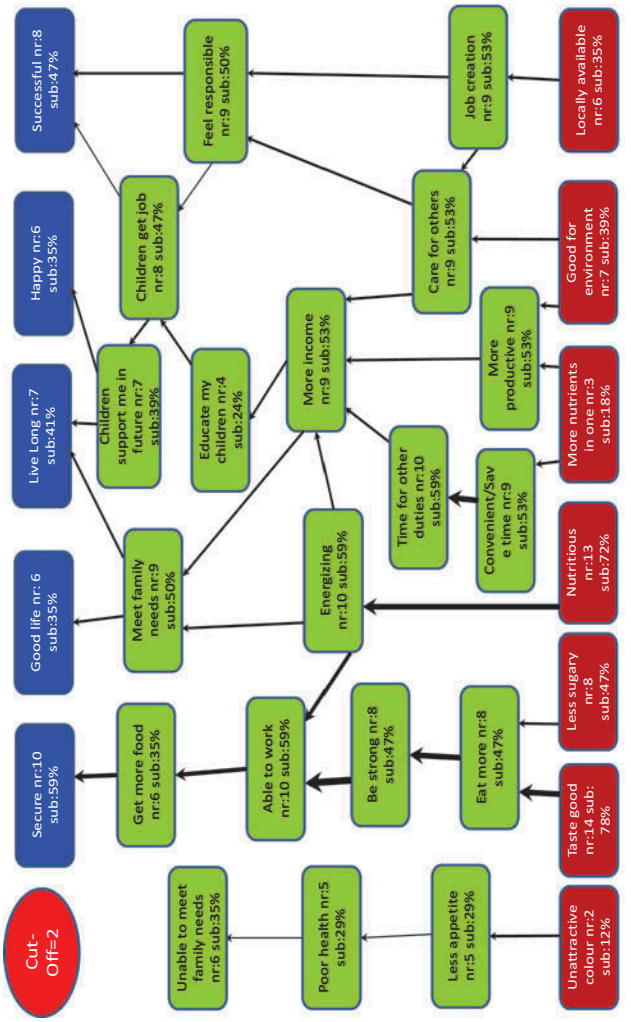


**Figure 4.** The hierarchical value map for Treatment 1: Positive information group.

caring for the environment on other people. This finding suggests that consuming cricket buns is mentally associated with positive environmental effects that accentuate the altruistic motives in the participants who are positively informed. Five unique consequences emerged: "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 buns because they wanted to become food secure, feel successful, and have good, healthy, and long lives.

### *Effect of perceived negative information*

Figure 5 presents the HVM for the group of participants who received information on perceived negative sensory differences between cricket buns and ordinary buns. This HVM is remarkably different from the previous ones. For example, four out of the seven attributes are negative: has chemicals (impure; 18%), disgusting (39%), hard to eat (18%), and unattractive color (22%). The positive attributes included good taste (56%), less sugary (39%), and nutritious (33%). Notably, the proportions of participants who associated cricket buns with these three positive attributes drastically dropped from the previous HVMs. Attributes for this group are related to either sensory or personality without any environmental element occurring. This suggests that the negative sensory information provided to this group influenced their perception of the buns, causing them to rate them less favorably than did 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 vices such as "stealing." However, a positive chain linking the positive attributes ("taste good," "nutritious," and "less sugary") to increased appetite, which enabled 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 the real product (i.e., tasting the cricket buns) counteracted the perceived negative messages given to this group. The findings corroborate those reported by Combris et al. (2009), that real product experiences can overshadow the sensory perceptions held in the mind of a consumer.

Several ladders in this HVM are terminal (not ending with a value) compared to the HVMs for positive-information and control groups. For example, four out of the seven chains end with terminal consequences (figure 5). Possibly, mental conflict occurred between the negative information provided through the narrative (appendix) and the formed perception (actual sensory feeling) based on

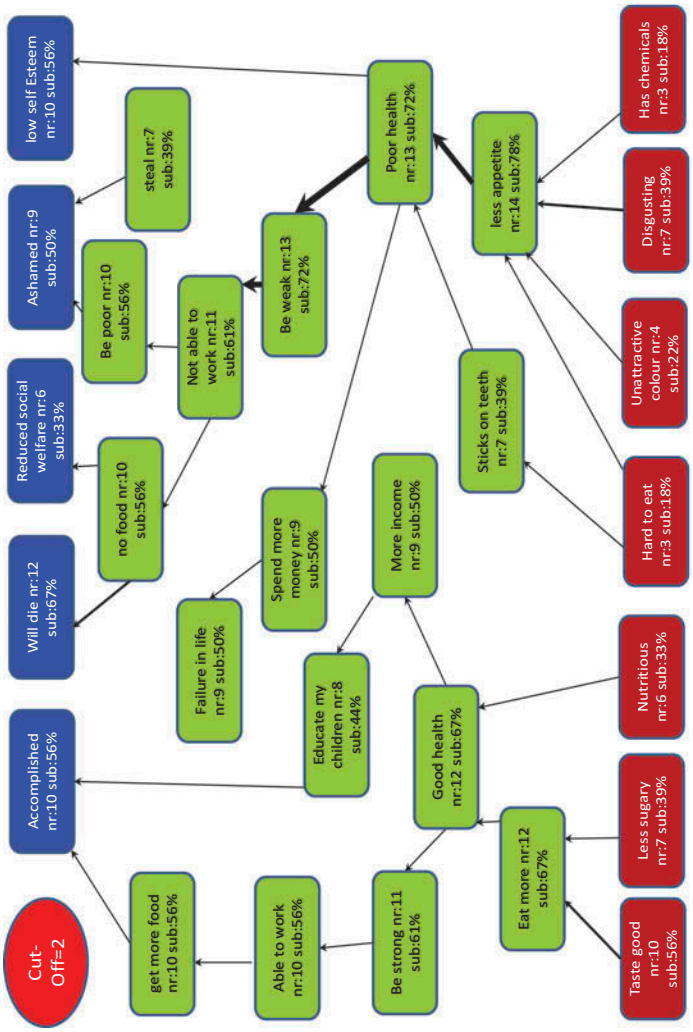


**Figure 5.** The hierarchical value map for Treatment 2: Negative information group.

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: "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. As in 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 buns reduce 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 the attribute "disgusting," which suggests that disgust of eating crickets conjures the feeling of shame. This group is therefore motivated to consume cricket buns so as to feel accomplished, to live (not to die), and to have high self-esteem, but they are likely to be deterred from eating the cricket buns by the shame that arises from the disgust of eating such buns.

## Summary, conclusion, and implications of the study

This study applied the laddering technique combined with the means-end chain theory to investigate consumers' mental models of foods from edible insects and the effect of differentiated information about such foods (cricket buns in this case) on consumers' mental models. The results indicate that the provision of information on benefits of edible insects and perceived negative aspects of processed insect-based foods influences participants' mental models. Participants were motivated/demotivated to consume cricket buns by characteristics that can be categorized into three groups: (1) the product (mostly sensory; e.g., taste, color, perceived nutritious, sweetness [sugary]); (2) personality (e.g., disgusting, product knowledge [e.g., more nutrients, cheap to get, locally available]); and (3) environment (e.g., good for the environment). These attributes reflect the kinds of information that participants received (i.e., information treatments moderated participants' mental models). These findings confirm the argument of Lensvelt and SteenBekkers (2014) that education of consumers (information) is key to changing their attitudes toward insect-based foods.

However, attributes that 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, Kimenju, and Morawetz (2010), which suggest 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 buns are less known and hitherto not consumed as food (Alemu et al. 2017). However, our results corroborate those reported by Pambo, Otieno, and Okello (2016b) that consumers may not prefer new foods if unfavorable changes occur to the sensory characteristics.

The control group, who received neither sensory nor nutritional information, still identified several sensory and personality-based attributes. Seemingly, the sensory experience of tasting the actual product (cricket buns) prior to the laddering interviews influenced them. But still, this group's HVM has an attribute "safe to eat" that was part of the basic information given. Despite the information treatment of the respondents in the three groups, participants still perceived cricket buns as tasty, nutritious, and less sugary. These findings suggest that the opportunity to taste cricket 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 (Lensvelt and SteenBekkers 2014; Pambo, Otieno, and Okello 2016b; Roininen, Arvola, and Lähteenmäki 2006), especially when participants have low family incomes (Arsil et al. 2014). The health aspect is corroborated by participants from all the three treatment groups in the current study. However, the price aspect is only implied by participants in the control group, who only received the basic information regarding cricket 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 by the price of such foods. Therefore, marketing information for novel food products should be designed along the identified goals (values/ends). These results therefore confirm the need for targeted consumer education as suggested by Lensvelt and SteenBekkers (2014), Looy, Dunkel, and Wood (2014), and Tan et al. (2015).

Regarding policy implications in the consumer domain, current results suggest that first, consumption of novel foods (such as cricket buns) can be influenced by the kind of information package consumers have/receive, which implies that consumer education on the benefits of such foods can enhance perception and consumption. 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 (such as cricket buns) are included as exhibits. For example, participants in the three groups found

cricket 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 such as cricket buns can be counteracted by the opportunity to taste actual products. Lensvelt and SteenBekkers (2014) questioned whether providing "targeted" information may not be necessary if households have an opportunity to try insect-based foods. Our results show that mental models (HVMs) were treatment specific and the real products simply moderated the information effect, hence were complementary.

Third, the results are in tandem with the medium and long-term growth policies in Kenya (e.g., Vision 2030), which consider farming as a business activity. For example, the consequence "more income" (i.e., profitability) is common to participants in all 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 depending on children getting education and good jobs, which should be facilitated by the benefits of making more money from insect value chains.

Finally, "more income" and "wealth" are among the most common consequences, indicating that the two are key consideration by participants regarding consumption of foods from edible insects. Nonetheless, deeper motivational reasons to consume cricket 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-buns marketers should use the themes generated by this study to design their campaign messages, especially those that will relate consumption of cricket buns with happiness, food security, good health, and long life. Insect-based foods are currently being promoted for their potential to improve (1) nutrition (good health), (2) economic benefits (profit/income), and (3) environmental care (responsibility). The current study 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.

## Limitations of the study

The study has some limitations that should be addressed by future research. First, the study used three information treatments only. Future research should investigate whether the findings (i.e., mental models) would be different if a fourth group were included and provided with information about both the

positive and perceived negative information. Second, when new food products (such as cricket buns) are introduced into a culture, they generally induce feelings of fear and refusal (rejections) called food neophobia (Alemu et al. 2017; Verbeke 2015). This study did not investigate how food neophobia could have affected the mental models presented in this study. Future research should therefore explore how food neophobia influences perceptions of cricket buns and the cognitive structure of the mental models.

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## Appendix

***Product information and images given/shown to each treatment group***

(Source: Authors' conceptualization)

*Control: General 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) and the Ministry of Health. 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 healthy 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.