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# Consumer Acceptance of Edible Insects for Non-Meat Protein in Western Kenya

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***Abstract***

The objective of this paper is twofold. First, the authors aim to assess acceptance of edible insects for food and as an alternative to conventional meat. Second, they employ a binary logistic regression modelling approach to determine the factors that influence consumer acceptance. The study exploits data from a consumer survey from western Kenya ($N$ = 234) conducted in October 2015. More than three quarters of the respondents accepted edible insects for food and as a possible alternative to meat. The study adopts a robust framework that captures a complex factor-evaluation process that consumers simultaneously goes through in order to accept or reject new food products when they become available. Consistent with this framework, the choice of edible insects for food was driven by many motives, including ones related to familiarity, convenience, social and environmental responsibility, economic incentives and barriers, and by factors related to one's own risk-attitude and altruistic concerns for the well-being of other value-chain actors. These results present great implications to policies targeting dietary interventions and the prospects of addressing environmental challenges through the household food choice.

***Key words***: Edible insects, meat alternative, binary logit, consumer acceptance.

## 1.0 Introduction

Present food production systems place a heavy burden on the environment (Hoek, 2010). Globally, residential sector (major base for food production systems) is responsible for about 50% of all environmental impacts of human activity (Hertwich et al., 2010). Kenya contributes approximately 0.11% of the global greenhouse-gas (GHG) emission (UNEP, 2012), with agricultural sector being responsible for about 56% of the total country's emissions (IPCC, 2006; OECD, 2013). Within the agricultural sector, livestock emissions account for approximately 30% of total emissions in Kenya. Decreasing the annual growth rate of conventional livestock (cows, goats, poultry, etc.), even by a small amount, from current rates of 1.3% to 1.0%, would reduce overall agricultural emissions in 2030 by 5% or 1.4 megatons (MacDonald, 2010; UNEP, 2012; OECD, 2013; GoK, 2013).

Food consumption is also remarkable in that it can be changed in structure only to some degree, but cannot be avoided because nutrition is one of the basic human needs (Urban et al., 2012). The dilemma is that with increasing population, urbanization and incomes, food consumption, particularly of protein origin such as meat, is expected to rise (FAO, 2013). Given that large volumes of plant protein is inefficiently converted to animal protein – meat, the impact on the environment will increase beyond those of GHG emissions (Van Huis and Vantomme, 2014). A number of dietary curtailments have been proposed that could reduce the environmental burden of increased meat consumption, including the substitution of conventional meat with the so-called Novel Protein Foods that includes edible insects. Edible insects can be used as alternative or additional source of animal protein (Lensvelt and Steenbekkers, 2014; Looy at al., 2014; Tan et al., 2015), which would have several advantages.

First of all edible insects are nutritious; they are a good source of protein, good fats, calcium, vitamins, and energy (FAO, 2010; Van Huis, 2013). Insects also have several benefits for the environment compared to other sources of protein. For example, insects intended as food emit fewer GHG than most conventional livestock and can be fed from organic waste streams (van Huis, 2013). Furthermore, various edible insects and products are already available in Kenya as shown in Table 1. These insects can be reared and multiplied easily in small spaces within a short period of time (FAO, 2013). Yen (2010), cited by Lensvelt and Steenbekkers (2014) noted that the use of insects as human food can thus result in a more energy-efficient food production and facilitate environmental conservation. Finally, insect-rearing and harvesting can offer livelihood opportunities for poor households since insect harvesting/rearing is a low-capital investment option (van Huis, 2013).

For the economic, social and environmental benefits of edible insects to be realized, consumers must accept them. Acceptance in this context implies that edible insects becomes a common component of general diets and that edible insects' value chains forms important livelihood opportunities among the targeted communities. The dearth of knowledge regarding consumer acceptance could pose a big challenge to such novel dietary interventions. The aim of this study, therefore, is to assess consumer acceptance of edible insects in Kenya and explore the factors that drive consumer choices on these foods. The study is among the few that assesses acceptance of edible insects and the potential for environmental conservation through a dietary intervention in Kenya.

## 2.0 Theoretical framework

Consumer acceptance is a broad concept; there is hardly any single theory that can conclusively explain why consumers do or do not accept a product (Lensvelt and Steenbekkers, 2014). Consumer acceptance can be used in different fields; in this study it is applied to the field of innovative food technologies and new food products, as described by Siegrist (2008). Insects as food among most Kenyans is a re-emerging food, although it is common to the communities that stays in the western side, particularly along the shores of Lake Victoria (Christensen et al., 2006; Ayieko et al., 2010). These communities have traditionally consumed insects presented in Table 1, and further processed others like termites, to form ingredients for fortifying porridge for babies (Kinyuru et al., 2013). Other than infant foods, these communities have also used edible insects as ingredients in the pilot production of wheat buns (Kinyuru et al., 2009), crackers, muffins, sausages and meat loaf (Ayieko et al., 2010). To them, insects are thus not just "one type of food" but a delicacy and an ingredient, as well (Lensvelt and Steenbekkers, 2014).

Table 1: Edible insects consumed in Kenya

| Insect (common name) | Region | Source |
|---|---|---|
| Grasshopper /Locusts | Western Kenya | Kinyuru et al. 2010; Ayieko et al. 2010 |
| Termites | Most parts of Kenya | Kinyuru et al. 2012; Ayieko et al. 2011 |
| Black ants | Lake Victoria region, Kenya | Ayieko et al. 2012 |
| Lake flies | Lake Victoria basin, Kenya | Ayieko et al. 2010; Ayieko and Oriaro, 2008 |
| Crickets | Most parts of Kenya | Christensen et al. 2006 |

Lensvelt and Steenbekkers (2014) noted that consumer acceptance of innovative food technologies and products largely depends on how they perceive these products. Hughner et al. (2007) reported that these perceptions forms consumer attitudes that ultimately shape their consumption behaviour (acceptance or rejection of edible insect in this case). Following Siegrist (2008); Urban et al., (2012); Waever and Lusk, (2014); Wollni and Fischer (2015), there are two main categories of factors that influence consumer perceptions and attitudes regarding new foods. These are: (1) food product variables and (2) food personality variables. These studies' theories forms the basis of the conceptual model used in the current study. In this study setting, the consumer, who may see foods from edible insects as a new (re-emerging), faces a portfolio-type-consumption decision problem (Wollni and Fischer, 2015). When foods from edible insects are available, the consumer decides whether to accept or reject them. The decision, as explained by Hughner et al. (2007), is not 'either-or' in nature, but the consumer simultaneously goes through complex factor-evaluation process.

Figure 1 represent a number of factors, falling within the two categories, which are expected to play a role in influencing consumer acceptance of entomophagy (consumption of insects). Regarding the first category (*food product variables*), variables like price, quality and taste of the product, perceived product risks, perceived naturalness of the product, benefits of the product and convenience applies. For the second category (*food personality variables*), we considered two sub-categories; one related to trust for institutions and the other related to cultural orientation, including past experience and traditions. We also considered care and responsibility for the environment.

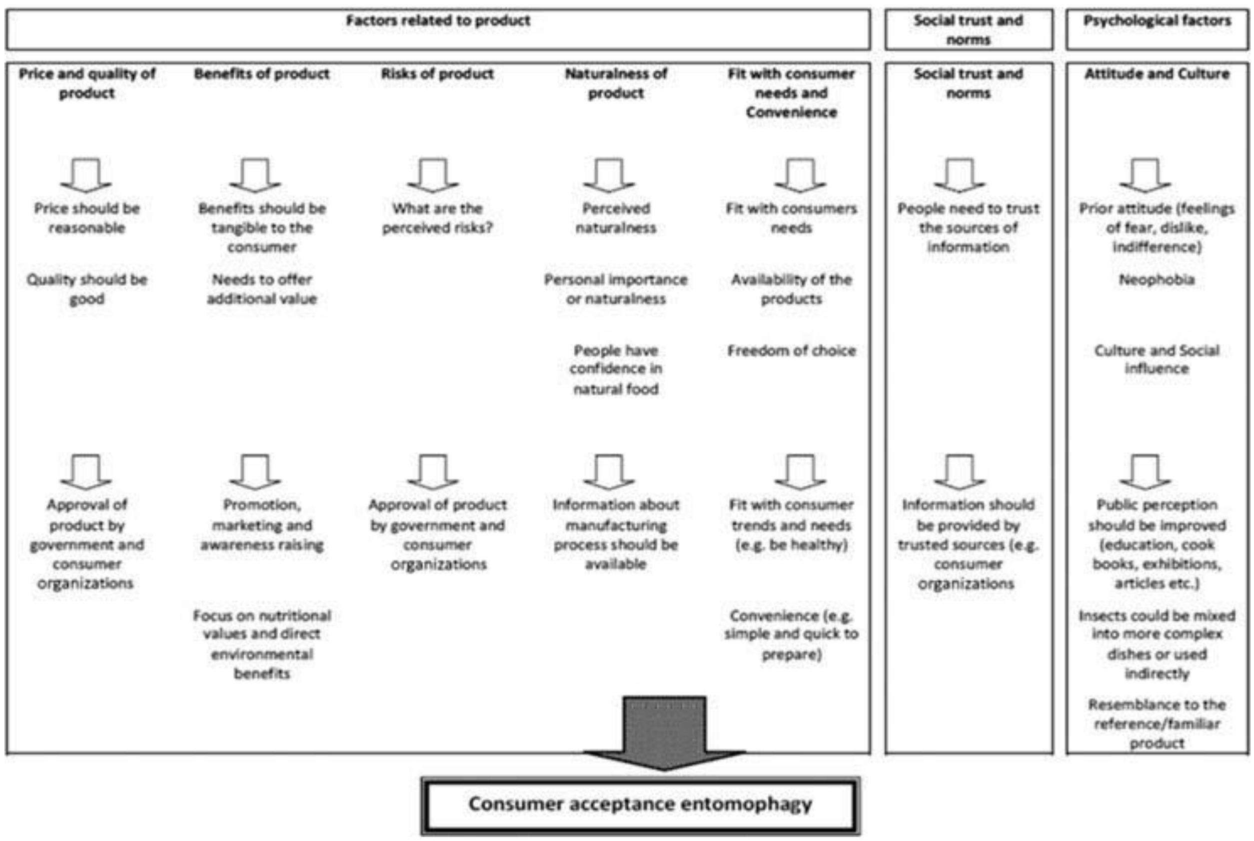


**Figure 1:** Conceptual model of consumer acceptance of entomophagy

(Source: Lensvelt and Steenbekkers, 2014)

The combination of price and quality (and even taste) is very important to consumers that edible insects are ‘reasonably’ priced (affordable). It also matters to consumers that these foods ‘taste good’ and are of good quality (Hoek, 2010). Tangible product benefits can increase consumer acceptance. However, consumers need to be aware of the benefits in order to increase the chance of them accepting edible insects (Siegrist, 2008). Other than own benefits, consumers may also derive benefits from other social issues, such as higher incomes for other value chain actors, including insect-farmers (Kikulwe et al., 2011). Recent studies found that respondents in both developed and developing countries derive benefits from knowing that others are employed; earn higher incomes, or have improved livelihood outcomes as a result of an innovation or a policy/programme change (Bergmann et al., 2008). In addition, most edible insect consumers in Kenya also gather these insects personally, as opposed to buying-implying that they are possibly edible insects' gatherers, themselves or farmers, should that opportunity arise. Whether due to altruistic reasons or self-interest, consumers may derive positive value from this attribute and so may perceive edible insects' positively.

The perceived risk of a product has a negative influence on consumers' perceptions (Siegrist, 2008). On the other hand, consumers generally seem to have a strong desire for natural foods, since they relate these with better looks and a better taste compared to foods containing additives or artificial ingredients (Lensvelt and Steenbekkers, 2014). Trust is a very important aspect for consumers when it comes to accepting a product, Wollni and Fischer (2015) found that consumers rely on trust to make their decision easier. Finally, convenience plays an important role when consumers have to decide whether to buy a certain food product or not. The product should, amongst other things, be easily accessible, easy to store, available for use when needed and be easy to cook. When trying to create consumer acceptance of a new food product it is also important that the product fits with the consumers' trends and needs (Hoek 2010). Personal values also plays significant role in shaping consumer behaviour (Wollni and Fischer, 2015). To some consumer category, price is rated as the most important criterion for making the food choice. We expected consumers who are predominantly guided by the price to be more disposed to rejecting foods from edible insects (especially if prices are higher) compared to consumers who are predominantly guided by quality, such as nutrition. Consumers who cares for environment and whose diets are diversified may easily accept edible insects for food.

## 3.0 Materials and Methods

### 3.1 Study area and data

Primary data was collected from Siaya and Vihiga counties in western region of Kenya using a semi-structured questionnaire. The communities living in these counties have traditionally consumed edible insects (Table 1). These counties have also hosted several interventions to promote foods from edible insects through pilot trials under "FlyingFoods", "INSFeed" and "GREEiNSECT" Projects (Ayieko et al., 2010; Kinyuru et al., 2013; Looy et al., 2014), hence suitable for this survey. The study areas are also uniquely suitable for this study because they host several emerging urban centres, including Bondo and Lwanda towns. Small towns in Kenya (less than 50,000 inhabitants) are of particular relevance because they accommodate 70% of the urban population, and the manifestation of lifestyle changes are less obvious and less well studied (KNBS, 2010; Rischke et al., 2014).

Within each county, two locations were randomly selected and two sub-locations selected from each location. Within each sub-location, villages were listed and a random sample ranging from three to five villages per sub-location was drawn based on the population size. From each village, a list of all the households was generated with the assistance of county administration officials, particularly the knowledgeable village elders, from which six households (on average) were selected. These households formed the primary sampling unit where the head or in his/her absence, any other adult member who normally participate in the household food purchase decisions was interviewed. Where the targeted respondent was unavailable or uninterested in participating, the next randomly selected household on the list was chosen. A total sample of 234 consumers were interviewed. This was within the project budget, time constraints and reviewed literature regarding consumer acceptance studies. The data was collected through face-to-face procedure in October, 2015, by four trained research assistants.

The questions were divided into three categories: (i) socioeconomic characteristics such as sex, age, income, number of children, frequency of consuming edible insects, knowledge of edible insects in Kenya (cricket, lake/may flies, and termites). (ii) Edible insects related factors such as price, quality, taste, appearance, naturalness/freshness and convenience. (iii) Factors related to care for the environment and personality, including dietary diversity, risk perceptions and trust. A 5-scale Likert index was used to measure these constructs. These were later transformed into Dummy variables following Gonzalez et al. (2010)'s proposition whereby responses to the top (4 & 5) scale levels were given the Dummy value for 1, and the responses to the bottom three scales (1, 2 & 3) given the 0 value. In order to assess the simultaneous effects of multiple factors on acceptance of edible insects for food, binomial modelling was achieved through a logit model specified following Greene (1993).

### 3.2 Empirical model

Acceptance of edible insects for food can be modelled as a choice between two alternatives: a consumer either accept or does not accept. The binary random variable $Y_i$ takes the value of 1 if the consumer accept and zero otherwise.

$$Y_\iota = \begin{cases} 1 \; if \; accept \\ 0 \; otherwise \end{cases}$$

The dependent variable is discrete which therefore, renders the employment of binary logit model most appropriate. The probability that individual *i* accept edible insects as food can be modelled following Greene (1993):

$$\text{prob}\left[\mathrm{y_{ij}} = 1\right] = \frac{\exp \beta\prime \mathrm{X_i}}{1+\exp \beta\prime \mathrm{X_i}} = \Lambda\,(\beta\text{'}\mathrm{X}) \qquad 1$$

The subscripts *i* and *j* denote consumer and consumer acceptance (1=accept, 0=otherwise), respectively. Equation (1) is the reduced form of the binomial logit model, where $x_i$ is the row vector of explanatory variables (*both food product variable, food personality variables and variables related to social and environmental responsibility*) for the $_i$th consumer and the non-observed *ε's* accounts for errors in measuring acceptance. The errors are assumed to follow a distribution of logistic probability with a density function:

$$F'(\beta' X_i) \;=\; \Lambda(\beta' X_i)[1 - \Lambda(\beta' X_i)] \qquad 2$$

The probability that individual *i* accept is estimated empirically as:

$$\Pr[\mathrm{Yi} \;=\; 1] \;=\; \mathrm{X_i}\beta_\mathrm{i} \;+\; \varepsilon_\mathrm{i} \qquad 3$$

*X* is a vector of variables related to edible insects (food product), consumer characteristics (food personality) and responsibility for the environment that are posited to drive consumer acceptance of edible insects for food; $\beta_i$ is a vector of parameters to be estimated, while $\varepsilon_i$ is the statistical random term specific to individual insect consumer (respondent).

Additionally, marginal effects were estimated to measure instantaneous effects of changes in any explanatory variable on the predicted probability of accepting edible insects for food, while holding other explanatory variables constant. The marginal effects are computed as (Anderson and Newell, 2003):

$$\beta_m = \left[\frac{\partial(\beta_i X_i + \varepsilon_i)}{\partial \beta_i X_i}\right]\beta_i \quad \text{for continuous independent variables} \qquad 4$$

*Or*

$$\beta_m = P_r[Y_i = 1] - P_r[Y_i = 0] \quad \text{for dummy-coded variables} \qquad 5$$

The data was analysed using SPSS Statistical Package for Windows, version 16.

## 4.0 Results and discussions

### 4.1 Characteristics of the respondents and their households

A total sample of 234 respondents answered the questionnaire and their socioeconomic characteristics are presented in Table 2. More female respondents (57%) answered than males because individuals in the study areas were selected based on availability and responsibility for food purchase in the household. The implication is that female members' shoulders heavy responsibility in terms of household food preparation decisions and therefore, should form a prime target for innovative food programmes. Respondents' average age was 42 years (varying from 18 to 65 years). Persons younger than 18 years were not selected for the interviews as it was assumed that they had less experience in food decisions and would give biased responses.

More than one half of the respondents showed concern for the environment with a reported willingness to participate in conservation practices. The wealth index was constructed from the total household-asset ownership and was taken as a better representation of the household's economic status compared to the self-reported level of income. Majority of the respondents (88%) had consumed at least some kinds of edible insects. This is not surprising since the study was conducted in the areas that are traditionally known to consume edible insects. However, the finding that only one quarter of the respondents had consumed foods having edible insects as ingredients suggest that more work are required to promote edible insects' value-chains in the region.

Table 1: Respondents' characteristics

| Variable | Sample statistics | |
|---|---|---|
| | Mean | SD |
| Age | 41.9 | 13.7 |
| Land size in acres | 2.3 | 2.2 |
| Household size | 5.9 | 2.8 |
| Number of children (<5 years) | 1.0 | 1.1 |
| Years of formal schooling | 9.3 | 3.8 |
| | Percent | |
| Gender (female) | 57 | |
| Care for the environment (yes) | 56 | |
| Household is wealthy (yes) | 51 | |
| Household has eaten some kind of edible insects (yes) | 88 | |
| Household has eaten foods from edible insects (yes) | 26 | |
| Household accepts edible insects as food (yes) | 73 | |

Participants in general had positive attitudes towards using edible insects for food. As Table 3 reports, the Likert scale mean scores for the three attitudinal statements were significantly higher than the 'neutral' value of 3 (*neither… nor…*). Following Tan et al. (2015), insects can be served in three different forms (see Figure 2 for illustrations). They can be served as 'whole' where the insects are fully visible; can be mixed with other foods where the insects are partly visible (covered); or insects can be processed and used as ingredients while preparing other foods (invisible).

| Visible | Covered | Invisible |
|---|---|---|
| Fried crickets With chilli & salt | Cricket with roasted peanuts | Butter cookies containing cricket powder |

**Figure 2**: Product descriptions for the three crickets' serving types
(Source: borrowed from Tan et al.,2015, with modifications)

Participants generally preffered consuming edible insects when visible compared to when invisible, *t(233) = 5.79*, *p < 0.001*. The reason could be due to the fact that most respondends were familiar with the visible serving type. These results contradicts others, particularly those from the developed world indicating that processing edible insects increases acceptance (see for example, Lensvelt and SteenBekkers, 2014; Looy at al., 2014). However, this finding should be taken with caution since the data was collected from regions where entomophagy is traditionaly inclined.

Table 3: Comparing attitudes on the three serving methods

| | N | Mean | SD | t | Sig. (two-tailed) |
|---|---|---|---|---|---|
| I would be more likely to eat edible insects if they were served visible | 234 | 4.06 | 1.49 | 10.81 | 0.000 |
| I would be more likely to eat edible insects if they were mixed with other foods | 234 | 3.21 | 1.65 | 1.89 | 0.049 |
| I would be more likely to eat edible insects if they were invisible | 234 | 3.49 | 1.77 | 4.21 | 0.000 |

It was very important to the respondents that foods from edible insects becomes affordable, available, taste good and of good quality. For example, the mean score of 4.76 for price on a 5-point Likert scale was significantly higher than the 'neutral' value of 3, *t(233) = 30.64*, *p < 0.001*. Participants did not only see edible insects as beneficial to themselves (t(233) = 23.26, *p < 0.001*), but also to other value-chain actors, including gatherers and transporters, t(233) = 55.*27*, *p < 0.001*. They also reported that consuming edible insects conserves environment in addition to promoting general health due to high nutrition. Regarding convenience (Table 4), participants generally considered edible insects as convenient foods, especially on ease of preparations and status. However, availability of edible insects remains a barrier to the acceptance of edible insects for food. This is due to the seasonality problem that currently characterise the entreprise (Christensen et al., 2006).

Table 4: General convenience of edible insects for food as perceived by respondents

| | N | Mean | SD | t | Sig. (two-tailed) |
|---|---|---|---|---|---|
| Edible insects are readily available for food | 234 | 2.36 | 1.77 | -5.51 | 0.000 |
| Foods from edible insects are easy to prepare | 234 | 4.59 | 0.98 | 24.85 | 0.000 |
| Preparing edible insects' foods fit my needs | 234 | 3.98 | 1.45 | 10.1 | 0.000 |
| Eating edible insects fit my status | 234 | 3.44 | 1.79 | 3.76 | 0.000 |

**4.2 Binary logistic regression for acceptance drivers**

Acceptance of edible insects for food and as an alternative to conventional meat was measured using the statement; "*If edible insects are readily available for food, I'm willing to accept them as alternative to meat*". A 5-point Likert scale was used to measure consumer responses and the outcome is presented in Table 5. Taking the top level responses (*partly agree & fully agree*) to represent acceptance, approximately three-quarters of the respondents were willing to accept edible insects as food and as an alternative to conventional meat.

Table 5: Frequency distribution for consumer acceptance of edible insects as an alternative to meat

| | Frequency | Percentage (%) |
|---|---|---|
| I fully disagree | 25 | 10.7 |
| I partly disagree | 34 | 14.5 |
| I neither agree nor disagree | 2 | 0.9 |
| I partly agree | 23 | 9.8 |
| I fully agree | 150 | 64.1 |
| Total (N) | 234 | 100 |

Following the framework described in Figure 1, factors hypothesised to influence consumer acceptance of edible insects for food and as an alternative to conventional meat are described in Table 6. Suitability of these factors for econometric analysis in this study was tested for multicollinearity. This was achieved using the variance inflation factors (VIF), which was computed for each of the consumer characteristics. The VIF computation involves estimation of ‘artificial’ ordinary least squares (OLS) regressions between each of the consumer characteristics as the ‘dependent’ variable with the rest as dependent variables (Long, 1997). The VIF for each factor is calculated as:

$$VIF_i = \frac{1}{1 - R_i^2} \qquad 6$$

Where $R_i^2$ is the $R^2$ of the artificial regression with the $i^{th}$ independent variable as a ‘dependent’ variable. The mean VIF was 1.62 with individual VIF ranging from 1.3 to 1.9 indicating absence of multicollinearity. Maddala (2000), suggested that variables with VIF<5 have no multicollinearity; hence they were selected for inclusion in the binary logit regression.

Table 6: Description of factors affecting acceptance of edible insects for food

| Variable | Description | Mean | SD | Min | Max |
|---|---|---|---|---|---|
| Age (AGE) | Age of the respondents in years | 41.88 | 13.99 | 18 | 65 |
| Education (EDUCATION) | Years of schooling completed | 9.31 | 3.86 | 0 | 20 |
| GENDER (Female) | | 0.57 | 0.50 | 0 | 1 |
| Household size (HH_NUM) | The number of people living in the household | 5.90 | 2.83 | 1 | 18 |
| Number of children (CHILD_NUM) | The number of children below 18 years old in the household | 1.76 | 1.85 | 0 | 7 |
| Eat edible insects (EAT_INSECTS) | 1 if the respondents has eaten any kind of edible insects | 0.88 | 0.54 | 0 | 1 |
| Care for environment (CARE_ENVI) | 1 if the respondent cares for the environment | 0.56 | 0.34 | 0 | 1 |
| Benefit (BENEFIT) | 1 if the respondent considers edible insects benefitial | 0.22 | 0.42 | 0 | 1 |
| Price experience (PRICE) | 1 if the respondent considers affordability important | 0.82 | 0.37 | 0 | 1 |
| Edible insects are risky (RISK_ATTITUDE)[1] | Scores are calculated for each individual based on the weights obtained from the PCA | -0.0034 | 1.43 | -4.42 | 1.82 |
| Convenience (CONVENIENCE) | Scores are calculated for each individual based on the weights obtained from the PCA | -0.0001 | 1.48 | -2.59 | 1.14 |
| Trust (TRUST) | 1 if the trust institutions concerned | 0.59 | 0.49 | 0 | 1 |

[1] We identified four attitudinal statements relevant to assess consumers' attitudes toward the convenience of using edible insects for food, and five statements to assess their risk attitudes. As is commonly done in the literature (e.g. Kikulwe et al. 2011), we analyzed the data using a principal component analysis (PCA) to identify components across attitudinal statements. The PCA results gave us two distinct components based on a linear weighted combination of the statements (Cronbach's alpha = 0.781). These are ‘risk-attitude’ and ‘convenience’.

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Table 7, present the results of binary logit regression model with the estimated logistic regression estimates (β), their standard errors (S.E.), significance levels (ρ) and marginal effects (Mxf). Among the regressors, socio-economic variables such as age of the respondents, gender, education and house-hold size, were not significant acceptance-drivers and are excluded from the Table. Whereas the coefficient values explain the probable influence of each regressor on consumer acceptance of edible insects for food, generally, the marginal effects measure the actual effect of instantaneous changes in each of the explanatory variables on consumers' acceptance (Greene, 1993; Anderson and Newell, 2003).

Households who had children below the age of 18 years readily accepted edible insects for food than those without. This could be due to the 'wild gathering' practice where edible insects are collected from the fields (wild) when in season, mostly by children (Christensen et al., 2006). Moreover, some mothers (within the study regions) dry and grind edible insects (termites) into flour and use it as a sprinkle in baby porridge, while in some cases these insects have been blended for complementary feeding with cereal grains i.e. to fortify traditional cereal grains, mostly for children (see for example, Kinyuru et al., 2012; FAO, 2013).

Table 7: Binary logistic estimation explaining consumers' acceptance of edible insects for food

| Variable | Estimate | S.E. | Sig. | Mxf. |
|---|---|---|---|---|
| CHILD_NUM | 0.855 | 0.512 | 0.054 | 0.011 |
| EAT_INSECTS | 1.961 | 0.681 | 0.000 | 0.199*** |
| CARE_ENVI | 0.66 | 0.501 | 0.011 | 0.066** |
| BENEFIT | 1.669 | 0.523 | 0.000 | 0.341*** |
| PRICE | -0.338 | 2.5 | 0.010 | -0.438** |
| RISK_ATTITUDE | -0.097 | 0.544 | 0.014 | -0.092** |
| CONVENIENCE | 1.271 | 0.59 | 0.003 | 0.012** |
| TRUST | 0.567 | 0.206 | 0.000 | 0.022*** |

**Notes:** S.E. implies Standard Error; Mxf. Implies marginal effects, while statistical significance level (only for Mfx.): ***1%; **5%; *10%. Goodness-of-fit statistics: _2Log likelihood statistic = 163.82; Likelihood ratio (12) = 138.10 ($p < 0.001$)

Participants who indicated familiarity with eating insects were more likely to accept edible insects for food than those who said they had never eaten any kind of insects. Results showed that having eaten edible insects before increased the probability of accepting edible insects by 167%. In fact, the marginal effects indicated that familiarity with entomophagy (practice of eating insects) instantaneously increased the probability of accepting edible insects for food by 20%. These results corroborate those reported by Verbeke (2015), that participants who indicated familiarity with the idea of eating insects were 2.6 times more likely to be ready to adopt insect- foods than those who said they had never heard about the eating of insects.

Significant effects of food choice motives can be produced by a person's convenience orientation and by the importance people attach to the environmental impact of food choice. When trying to assess consumer acceptance of a new food product it is also important to assess if the product fits with the consumers' trends, needs and status (Hoek 2010). These aspects were considered for the measurements of convenience constructs. Results showed that positive convenience-attitude i.e., a one-unit increase in the convenience orientation score was associated with 127% increase in the predicted odds of accepting edible insects for food. A one unit increase in the importance attached to the environmental impact of food choice (care for the environment) increased the probability of accepting edible insects for food by 6%.

Personal values also plays significant role in shaping consumer behaviour (Wollni and Fischer, 2015). To some consumer category, price is rated as the most important criterion for making food choices. Results showed that a one unit increase in expected price would instantaneously reduce the probability of accepting edible insects by 44%. Consumers are in general sensitive to product price and would readily accept interventions considered fairly priced. Consumers who showed trust in the government officials and institutions mandated to regulate, monitor and ensure safety and quality for food products (for example, public health officials, elected leaders, standards bodies, etc.) had their probability of accepting foods from edible insects increase by 57%, while perceived risks reduced the probability of accepting edible insects by approximately 10%.

**5.0 Conclusions**

Food production system involving edible insects could be one way of decreasing the environmental burden of food consumption. The choice of edible insects for food and as an alternative to conventional meat is driven by many motives, including ones related to familiarity with entomophagy, convenient with consumer needs, social and environmental responsibility, economic incentives and barriers, and by factors related to altruistic concerns for the well-being of other value-chain actors. These consumers have traditionally been interested in edible insects and entomophagy is well rooted in their culture. Despite this trend, surprisingly little is known whether these consumers would accept edible insects as a mainstream food and as an alternative to conventional meat. The studies that have focused on edible insects in the region to date have been mostly descriptive on issues related to efficacy, types of insects consumed and nutrient profiling. The present study has therefore, come at the right time.

Results show that consumers highly accepted edible insects for food and as alternative to conventional meat. Past behaviour as insect consumer, affordability, beneficial, personal trust, fitting with consumer needs as well as risk attitudes were significant acceptance drivers. However, socioeconomic characteristics were not significant drivers. This is an important result as it implies a need to better understand actual consumer motivations and life values that defines personality and behaviour. This finding suggest we can start to understand why, all too frequently, consumers appear to be knowledgeable about nutritional and health claim of some foods but they do not respond to them in the manner required.

The finding that product benefit and consumer trust in the institutions mandated to regulate and monitor food production significantly influence acceptance present a challenge for the food industry and public policy makers alike on two levels. First, the food industry must effectively communicate these benefits to consumers. The focus on benefit-information through labeling may largely continue to prove ineffective due to poor reading culture and difficulties in understanding these labels (Rischke et al., 2014). Therefore, an alternative public marketing policy, such as point of sale promotion, needs to be formulated. Here we align with Balcombe et al. (2015), who challenged the viability of increasing levels of nutrition literacy for the majority of the population. Second, regulatory framework should be formulated to facilitate monitoring edible insects' value chains to increase consumer confidence and trust, as well as enabling interested corporates to join edible insects' value-chains.

Another finding that consumers feel that availability of edible insects for food is among the barriers for acceptance is very important for policy. The implication is that there is demand for edible insects that food industry need to fill. Given the seasonality and unpredictability of wild collection of insects, artificial rearing becomes a reliable option. Thus, we can see merit in the development of regulatory framework replete with control and monitoring structures for the private sector to enter the value-chain and responsibly compete for market share. Perhaps a more surprising finding of the present study is the higher acceptance for edible insects served 'visible' than when incorporated as ingredients in other foods 'invisible'. Maybe this is because the respondents have traditionally consumed 'whole' insects (visible) and therefore, considers 'invisible' serving as new or even strange.

One limitation of this study is that it only involve participants who are already familiar with edible insects. Understanding consumer-acceptance from regions where entomophagy does not form part of tradition and culture would add novelty to these results, particularly with regard to levels of acceptance, preferred means of serving and the influence of socioeconomic characteristics.

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