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EDIBLE INSECTS PURCHASE DECISION AND INTENTION TO REDUCE MEAT FOR THEIR CONSUMPTION: EVIDENCE FROM ABEOKUTA, OGUN STATE, NIGERIA

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Abstract
Motivated by the need to gain understanding of how consumers in developing countries situate within the counter-space of food consumption and environment-friendly society, this study examined factors that can potentially influence consumer's decision to purchase edible insects, and intention to trade-off meat for insect consumption in Abeokuta, Nigeria. Multistage sampling technique was employed to select households from whom data were collected using questionnaire. Descriptive statistics and logit regression model were used as tools for data analysis. The average age of the respondents was approximately 35 years, with the majority (62.3%) of them unaware of the environmental benefits of edible insects. On the average, household head spent ₦120.78 per month on edible insects. The logit regression analysis revealed education ($p<0.05$); awareness about health/nutritional benefits ($p<0.05$) of edible insects as important determinants of purchase decisions and behavioural intention towards reducing meat for consumption of edible insects. The implications of these findings are that the health and nutritional awareness benefits of edible insects and access to formal education are also crucial for edible insect's consumption. Improved access to formal education and awareness about the health and nutritional benefits of edible insects are thus suggested to stimulate consumption of edible insects.

Keywords: *Sustainable diets, Edible insects, Consumers, Awareness, Behavioural intention*

Introduction

As the world population increases, consumer preference for high quality animal protein is increasing, and even faster than that of plant protein. l proteins are obtained from meat from cattle, small ruminant animals, poultry, fish and other sources. As demand for animal protein rises, the production of livestock to meet with this demand also increases. Livestock production poses enormous challenges to the ecosystem. According to Steinfeld et al. (2006), livestock rearing is responsible for 18 percent of greenhouse gas emissions (CO_2 equivalent), a higher share than the transport sector. Livestock waste (urine and manure) also contributes to environmental pollution (e.g. ammonia) that can lead to nitrification and soil acidification (Aarnink et al., 1995). 'Excessive' meat production and consumption have been increasingly criticized for their potential negative impacts on the natural environment (Odegard et al., 2014; de Vries et al., 2010) and human health (Micha et al., 2013).

Thus, the interconnection between consumer demand and production (supply) added to the impact of increasing livestock production on the environment and health has made increased demand for meat detrimental to human and environmental health. There are many ways to reduce the effects that livestock production poses to the ecosystem. Some of the ways suggested by researchers include use of better quality feed and feed balancing to lower enteric and manure emissions, improved breeding and animal health, manure management practices, improvements in energy use efficiency along supply chains (Beusen et al., 2008; Gerber et al., 2013; Herrero et al., 2013; Elser et al., 2014), and changes in dietary patterns. Dietary change entails persuading consumers to modify their diets towards foods whose production are much more environmentally friendly or sustainable. As noted by FAO (2010), a shift towards sustainable diets may be a veritable pathway for curbing the environmental problem caused by production of animal protein. Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. With respect to proteins of animal origin, such foods (alternative protein sources) many include seaweed, duckweed and rapeseed (Vander Spiegel et al., 2013), cultured meat (Post, 2013) and insects (Van Huis et al., 2013). Edible insects may provide a valuable future source of food (FAO, 2013). Consumption of edible insects has been identified as a form of sustainable diet, with nutritional, health and environmental protection benefits (Verbecke, 2015).
Edible insects can be produced with less environmental impact than livestock. Less land area is needed for production and they have great potential in the reduction of greenhouse gas and ammonia emissions (Oonincx et al., 2010). They have high feed conversion efficiency (Van Huis, 2013) and have potential to be grown on organic by-products of which 1.3 billion tons is produced globally per annum (FAO, 2011). Fasoranti and Ajiboye (1993) identified and examined the socio-cultural factors influencing the consumption of edible insects[1] in Kwara State, Nigeria. However, in spite of the identified benefits of edible insects' consumption over meat consumption, little is known about consumers' factors influencing consumption of edible insects and or whether they intend to trade-off meat for inclusion of edible in their diets. Therefore, a more holistic food system approach to addressing the ecosystem health should examine what factors influence consumption of foods that pose less challenges to the environment, or whether consumers intend to bias consumption away from more environmental unfriendly foods to more environmentally sustainable alternatives such as edible insects. Besides the motivation for sustainable environment, such studies can stimulate consumer's awareness about the nutritional benefits of consuming such environmentally friendly foods and projects opportunities for potential producers, marketers and other actors along the value or supply chains of the products. Specifically, the study seeks to respondent's awareness of the environmental and nutritional benefits of edible insects, drivers of purchase decision, and potential influencers of consumers' intention to reduce meat in order to accommodate edible insects in their diets.

[1] Species of insects such as: termites, grasshoppers, caterpillars and crickets.

Hypotheses

It is hypothesised that socioeconomic characteristics of consumers and awareness about the nutrition/health benefit of edible insects have no significant influence on decision to consume edible insect or intention to reduce meat for its consumption.

Materials and Methods

Study Area

The study was carried out in Abeokuta South local government area (LGA) of Ogun State. Abeokuta is situated about 100km north of Lagos and 70km south-west of Ibadan. The LGA of Abeokuta south is divided into six Community development committee Areas namely-Egba Agbeyin, Egba Eku Titun, Lisabi Idi-Aba, Egbadotun Saraki Ilupeju, Egba Eku 1 and Egba Aarin. There are further subdivisions of development associations in each of the Community development committee Areas. The inhabitants of the Local government are civil servants, business persons, artisans, and those primarily engaged in farming.

Sampling and Collection of Data

This study employed a multi stage sampling procedure to select 160 respondents. In the first stage of the sampling procedure, four (4) Areas Community development committee (ACDCs) were randomly selected from the six (6) ACDC in Abeokuta south local government. The second stage involved the selection of five (5) community development associations (CDAs) from each ACDC to make a total of 20 CDAs. The final stage was the random selection of 8 households in each CDA. This gave a total of 160 households. Questionnaires were administered mainly to household heads. However, where the households head could not provide adequate information, the spouse and other adult members who could provide reliable information were asked to supply information. Out of the 160-questionnaires administered, only 154 were useful for analysis. The questions asked include, among others, socioeconomic characteristics, awareness about edible insects, whether respondents had eaten insect before, and whether they intend to reduce meat in order to consume insects.

Analytical Techniques

Descriptive statistics were used to summarise the socio-economic characteristics of the household heads while logit model was used to examine factors influencing purchase decision on edible insects as well as influencers of their intention to reduce meat for edible insects.

Specification of the logit model begins generally by assuming that edible insects' purchase decision takes on values of either one or zero, such that:

$$y = \begin{cases} 1 & \text{with probability } p \\ 0 & \text{with probability } 1-p \end{cases}$$

where p is the probability that a consumer's edible insect purchase decision is observed, and $1-p$ if otherwise. Specifically, the edible insects' purchase decision model is specified as below:

$$\text{Prob}\,(y_i = 1|\mathbf{x}) = \ln\frac{p}{1-p} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} \ldots\ldots\ldots (1)$$

Where from equation 1, $y_i = 1$ implies that the household head did purchase edible insect and zero if otherwise.

Similarly, the logit model indicating the household head's intention to reduce meat for edible insects' consumption is specified below in equation 2:

$$\text{Prob}\,(V_i = 1|\mathbf{x}) = \ln\frac{p}{1-p} = \alpha_0 + \alpha_1 x_1 + \alpha_2 x_2 + \alpha_3 x_3 + \alpha_4 x_4 + \alpha_5 x_5 + \alpha_6 x_6 + \alpha_7 x_7 + \alpha_8 x_8 + \alpha_9 x_9 + \alpha_{10} x_{10} + \alpha_{11} x_{11} \ldots\ldots (2)$$

With V=1 implying that the respondents indicated intention to reduce meat in order to accommodate edible insects in their diets, and zero if otherwise. β and α are parameters to be estimated. The regressors in the two logit regression models are:

x_1 = Sex of household head (1, if male, 0 otherwise)

x_2 = Age of household head (years)

x_3 = Marital status of household head (1, if married, 0 otherwise)

x_4 = Occupation of household head (1, civil servant, 0 otherwise)

x_5 = Educational level of household head (years of schooling)

x_6 = Household size (No of people)

x_7= Household Income (Naira)

x_8 = Eaten insects before (1 if household head has eaten insect before, otherwise 0)

x_9 = Availability (1 if availability of insect in the market is a factor driving consumption, otherwise 0)

x_{10} = Environmental concerns (1 if household head indicates that concern for environmental health induces food consumption, 0 otherwise)

x_{11} = Health or nutritional benefits (1 if household head is aware of the nutritional/health benefits of edible insects, 0 otherwise)

Results and Discussion

Socioeconomic Characteristics of the Household Heads

The distribution of the socioeconomic characteristics of the household heads are shown in Table 1. Approximately 66.9% of household heads were females while 33.1% were males. The average age of the household heads is approximately 35 years. With larger percentage (43.5%) of them below 31 years of age. As for marital status, 30.5% of the household heads were single while 47.4% were married. The mean income of the household heads was 82525.97 Naira; with greater proportion of them earning between 21000 and 40000 Naira per month. The majority (72.7%) of the household heads have 4 to 6 persons as members of household. Most (71.4%) of the household heads had tertiary education and this is expected to enhance consumption decisions. This is in line with Oladunni and Aduba (2014) who found over 70% of the respondents to have one form of education or the other. Greater proportion (43.5%) of the household heads were civil servants, following by 38.3% who were into private businesses.

Table 1: Socioeconomic Characteristics of the Household Heads

Socioeconomic characteristics	Frequency	Percentage
Sex		
Male	51	33.1
Female	103	66.9
Total	154	100
Marital status		
Single	47	30.5
Married	73	47.4
Widow/Divorced	34	22.1
Total	154	100
Age		
Less than 31 years	67	43.5
31-45 years	57	37
46 - 60 years	29	18.8
61 and above	1	0.6
Total	154	100
Monthly Income		
<=₦20000	22	14.3
₦21000- ₦40000	52	33.8
₦41000 - ₦60000	30	19.5
₦61000 - ₦80000	13	8.4
Above ₦80000	37	24.0
Total	154	100
Household size		
1 to 3	20	13
4 to 6	112	72.7
7 to 9	20	13
Above 10	2	1.3
Total	154	100
Educational level		
No formal education	6	3.9
Primary	8	5.2
Secondary	30	19.5
Tertiary	110	71.4
Total	154	100
Awareness nutrition/health benefits of edible insects		
Aware	62	37.7
Not aware	92	62.3
Total	**154**	**100**

Source: Field survey, 2016

Monthly Expenditure on Edible Insects

The descriptive statistics presented in Table 2 points to the low rate of edible insects' consumption among the sampled respondents. Evidence of this was shown in the fact that most of the household heads (about 75 percent) reported zero consumption-expenditure incurred per month on edible insects. This could be attributed to the respondents' low level of awareness of the nutritional and health benefits of edible insects' consumption reported in table 1 above.

Table 2: Monthly Expenditure on Edible Insects

Expenditure (Naira)	Frequency	Percentage
Less than 200	9	5.84
200 – 399	18	11.69
400-599	2	1.30
600 and above	10	6.49
Nil	115	74.68
Total	154	100.00
Mean	120.78 (339.68)	

Figures in parenthesis is the standard deviation

Factors Affecting Purchase Decision on Edible Insects

Presented in Table 3 are results of the factors affecting decision to purchase edible insect. The pseudo log likelihood value (-66.049) of which the associated chi-square of value (25.55) is statistically significant at ($p<0.01$) establishes the overall significant of the model. Meaning that all the explanatory variable exerts joint significant influence on the likelihood of purchasing edible insects. Factors with significantly positive influence on decision to purchase edible insects are age of household head ($p<0.05$), awareness of the nutritional/health benefits ($p<0.1$), and previous consumption experience ($p<0.01$) of edible insects. With respect to the marginal effects associated with the variables, a year increase in the age of the household head is expected to increase the likelihood of purchase of edible insects by 0.006 point`. Senhui et al. (2003) noted that when people become old they tend to be more conscious of their health and nutrition such that their preference for protein sources other than meat (especially red meat) increases. Based on the marginal effect estimates, persons who have consumed edible insects before and those aware of the nutritional benefits of consuming edible insects have higher probability of approximately 0.21 point and 0.11 point of purchasing edible insects respectively compared to their counterparts. The coefficient of education is negative and statistically significant, meaning that an additional year of formal educational attainment may depress the likelihood of purchasing edible insect for consumption by 0.012 (1.2 percent) point. Higher formal education gains may induce reluctance to admitting perceived indigenous habits (Illgner and Nel 2000) which possibly may include eating of insects. Schösler et al., (2012) noted that higher educational levels have no influence on intention to consume insects in the study area. The negative coefficient of the marital status also implies that married household heads in the study area have lower chance (approximately 9 percent) of purchasing edible insects. The results show that concerns for the possible environment benefits associated with edible insects is unlikely to substantially increase the likelihood of purchasing edible insects.

Table 3: Factors Influence Purchase Decision on Edible Insects

Variables	Coefficient	Z-value	P>|z|	Marginal effect
Sex of household head	-0.2865	-0.6600	0.5060	-0.0322
Age of household head	**0.0535	2.3900	0.0170	0.0058
Marital status	*-0.8245	-1.8400	0.0660	-0.0887
Occupation	0.5502	1.1800	0.2380	0.0637
Educational level	**-0.1132	-2.2100	0.0270	-0.0123
Household size	-0.2237	-1.5900	0.1120	-0.0242
Household income	-0.0026	-0.8800	0.3810	-0.0003
Eaten insects before	***1.8329	2.9700	0.0030	0.2073
Availability	0.3851	0.7700	0.4400	0.0402
Environmental concerns	-0.7127	-1.2700	0.2030	-0.0826
Nutritional/health benefits	*0.9047	1.7000	0.0890	0.1070
Constant	-1.2051	-1.0200	0.3070	
Log Pseudo likelihood =	- 66.049			
Wald Chi-square =	25.55			
Prob>Chi-square =	0.008			
Pseudo R-square =	0.2421			

*Source: Field survey, 2016. Note: **, ** and *** imply that coefficients are significant at 10%, 5% and 1% level of significance respectively.*

Factors Influencing Intention to reduce meat for edible insects' consumption

The results of factors influencing willingness to reduce meat for edible insect consumption is presented in Table 4. The pseudo log likelihood value (-84.73) of which the associated chi-square of value (26.06) is statistically significant at ($p<0.01$) suggests that all the explanatory variables in the model exert joint significant influence on the likelihood of reducing meat to accommodate edible insects in their diets. Whereas, availability of edible insects and awareness about their nutrition/health benefits ($p<0.01$) both have positive and statistical significant effects on intention to reduce meat for consumption of edible insects. Specifically, market availability of edible insect will significantly increase the consumers' intention to reduce meat in their diets to accommodate more edible insects' consumption. Concerns for sustainable environments have paltry influence. Years of formal educational attainment exerts negatively significant effect on intention of consumers to reduce meat consumption for edible insects' consumption. An additional year of formal education attained will lower consumers' intention to reduce meat for edible insects' consumption by 0.1 percent. This finding indicates that higher educational gains (years of schooling) is unlikely to positively stimulate reduction of meat for edible insects in consumer diets. This may occur especially if consumers bias consumption in favour of other animal proteins (such as fish). The foregoing suggests that while efforts may be geared towards production of edible insects, awareness about their nutritional/health and environmental benefits should be promoted to persuade people towards consumption, and achieve some reduction in the quantity of meat currently being consumed to accommodate them (edible insects) in their diets.

Table 4: Factors Influence Intention to Reduce Meat for Edible Insects' Consumption

Variables	Coefficient	Z-value	P>|z|	Marginal effect
Sex of household head	-0.170	-0.430	0.668	-0.034
Age of household head	0.012	0.650	0.517	0.002
Marital status	0.102	0.260	0.794	0.020
Civil servant	0.541	1.380	0.168	0.112
Educational level	**-0.006	-2.250	0.024	-0.001
Household size	0.014	0.130	0.899	0.003
Household income	0.003	1.450	0.148	0.001
Eaten insects before	-0.257	-0.570	0.568	-0.051
Availability	***1.339	3.190	0.001	0.244
Environmental concerns	0.012	0.030	0.978	0.002
Nutritional/health benefits	*0.807	1.830	0.067	0.167
Constant	-2.786	-3.080	0.002	
Log Pseudo likelihood =	-84.725			
Wald Chi-square =	26. 06			
Prob>Chi-square =	0.006			
Pseudo R-square =	0.106			

*Source: Field survey, 2016. Note: *, ** and *** imply that coefficients are significant at 10%, 5% and 1% level of significance respectively.*

Conclusion

This study was conducted to examine the factors influencing consumers' decision to purchase edible insects and their intension to trade-off meat to consume edible insects. We found that consumers concern for environmental health has insignificant effects on decision to purchase edible insects or reduce meat for consumption. Consumers who have experienced insects' consumption and those that are aware of the nutritional and health benefits are more likely to purchase edible insects or reduce meat for its consumption in their diets. Availability of edible insects is another important determinant of respondents' decision to reduce meat for edible insects' consumption. In order to improve consumers' purchase decisions on edible insects, there should be creation of public awareness about the nutritional, health and environmental benefits of edible insects' consumption.

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