Hedonic Analysis of Edible Winged Termites Prices in Kenya

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Abstract

This paper determines consumers' socioeconomic, institutional and termites' characteristics influencing the determination of Edible Winged Termites (EWT) market prices in Kenya. The multistage sampling procedure was used to select 384 rural and urban consumers who were interviewed using a pre-tested semi-structured questionnaire. Data were analyzed using Hedonic price analysis model. Results indicate that consumers' willingness to pay was influenced by off-farm activities and place of residence for raw, fried, sun-dried and blanched; kiosk for raw, fried and sun-dried; time taken walking to nearest market for fried, sun-dried and blanched; education, income, group membership and culture for fried and sun-dried; age and producers for raw; nutritional officer for fried and termites attributes for sun-dried. This study concludes that: consumers' participation in off-farm income generating activities and place of residence are the major determinants of EWT market price variations. The study recommends enhancement of EWT value addition to attract higher market prices hence profits.

Keywords: Edible winged termites, Willingness to Pay, Rural, Urban, Hedonic price model.

1. Introduction

The World increased human population growth, urbanization and incomes have resulted in high food demand, specifically animal-based proteins (FAO, 2013). The increased household incomes and consumer awareness of importance of sustainable food consumption habits have led to exponential growth in edible insects demand (Alemu *et al*., 2017a). With the current food market trends, markets have been split into smaller niches due to socioeconomic changes and simple commodity markets transformed to highly differentiated markets so as to meet consumer preferences for product attributes (Ehiakpor *et al*., 2017). Edible insects are one of the simple commodities that in recent years have been highly differentiated to meet consumer preferences (Alemu *et al*., 2017b). To cope with these trends food-chain actors are making efforts to gather all available data on product differentiation (Satimanon and Weatherspoon, 2010). There is a need of understanding how the market prices of raw, fried, sun-dried and blanched EWT respond to these changes.

Edible insects' value chain has been subsistent in Kenya (Alemu *et al*. 2017a), but there is developing trend in Western Kenya to commercialize it, particularly for EWT, with increasing consumer awareness on its nutritional benefits. There has been increasing demand for the termites with some consumers indicating greater willingness to pay premium prices. However, there is limited empirical evidence on raw, fried, sun-dried and blanched EWT market price determinants. The earlier studies on evaluation of WTP (Satimanon and Weatherspoon 2010; Bett *et al*., 2011; Pambo *et al*., 2015; Ehiakpor *et al*., 2017)considered other food products like eggs, live indigenous chicken, fortified sugar and rice respectively but not edible insects. Although Alemu *et al*. (2015), evaluated consumers WTP for whole and processed EWT, they used the Contingent Valuation model that has a weakness of biasness in results.

This paper uniquely contributes to the body of literature on marketing of edible insects in several ways. First, this study looks at the combination of consumers socioeconomic, institutional and termite characteristics in determination of market prices of raw, fried, sun-dried and blanched Edible Winged Termites. While prior studies on consumers' WTP (Satimanon and Weatherspoon, 2010; Gebrezgabher *et al*., 2015) concentrated on the product attributes and ignored the consumers socioeconomic and institutional characteristics that significantly contribute to the determination of market prices. Secondly, prior studies (Alemu *et al*., 2015; Gebrezgabher *et al*., 2015) used the contingent valuation (CV) model that is a stated preference method to investigate WTP. The CV method only reflects consumers' intentions but not their actual actions in terms of purchasing behavior where consumers can over estimate the price premiums hence their WTP (Satimanon and Weatherspoon, 2010). This paper uses the hedonic price analysis model that is a revealed preference method which is able to capture consumers' actual purchases and thus give a more accurate description of the WTP.

Third, while scanner data have been used for hedonic price analysis models, this study uses primary data

collected from rural and urban households. This study provides empirical evidence on how consumers socioeconomic and institutional and product characteristics influence market price determination of EWT in rural and urban consumers to cater for spatial heterogeneity in the population. Findings from this study could be important in informing policy formulation and implementation on edible insects' value chain commercialization by determining the optimal characteristics and prices without ignoring the consumer side.

The next section gives the materials and methods used, while chapter 3 presents empirical results and discussions. The last section provides conclusions.

2. Materials and Methods

2.1 Study area and sampling design

The study was conducted in Kimilili Sub-County, which is one of the nine Sub-Counties of Bungoma County. The study area was purposively selected for its high population density, cosmopolitan population and emergence of EWT commercialization. Therefore using an exploratory research design, the study area would provide insights into aspects of marketing the termites. According to GoK (2013), Kimilili Sub-County is the most densely populated in Bungoma County with a population of 150,074 persons (Males 73,011 and females 77,063) thus a density of 828 persons per square kilometer. It is further pointed out in GoK (2013) that, high unemployment level, food insecurity due to dependency on rain-fed agriculture and high poverty and inequality levels are a challenge in Kimilili Sub-County. GoK (2013) proposed that: diversification of food production and encouraging self-employment should be promoted to enhance food security and poverty alleviation.

Termites are harvested, consumed and sold year-round in the Sub-County. Most collections are in rural areas by women and children. Termites are sold in both rural and urban markets in different forms that are raw, blanched, fried and sun-dried. Agribusiness is an investment opportunity to be explored in Kimilili Sub-County (GoK 2013). The termites' value chain enhancement could be of great importance to the Sub-County residents. The target population of this study was the residents of Kimilili Sub-County where multistage sampling procedure was used. In the first stage, Kimilili Sub-County was purposively selected because it is among the Sub-Counties in Western Kenya where agribusiness on termites is developing. In the second stage, two of the four County assembly wards were selected purposively. Kimilili ward residents represented urban consumers while Kamukuywa ward residents represented rural consumers. Based on information from the Ward Ministry of agriculture office, Kimilili Township Sub-Location from Kimilili ward and Nabikoto sub-location from Kamukuywa ward were selected. Simple random sampling technique was used to select 192 respondents from each Sub-Location leading to a total of 384 respondents.

Data were collected in December 2016 using a semi-structured pre-tested questionnaire administered through face-to-face interviews by trained enumerators. The questionnaire contained information on consumers' socioeconomic, institutional and termite characteristics as well as prices. The coded data were managed using Stata 12 (Stata Corp 2011) computer program. The dependent variables were natural logs of the prices of raw, blanched, fried and sun-dried EWT.

2.2 Analytical framework

2.2.1 Hedonic price analysis model

Hedonic price analysis model was used to determine the consumers socioeconomic, institutional and termite characteristics that influence EWT market price variations. The contingent valuation (CV) model could be used instead. However, CV requires joint consumption of goods within a group and models the whole system of demand and supply (Satimanon and Weatherspoon, 2010). For this study Hedonic price model has an advantage over contingent valuation: does not require joint consumption of EWT within a group thus inverse demand of specific form of EWT consumption can be estimated individually. Hedonic price model decomposes the price of a product into separate factors that determine it (Lancaster, 1966). According to Rosen (1974), the observed market price of a differentiated product is a composite of the coefficients of its embedded characteristics but the characteristics of buyers and sellers are excluded. However, most studies have found that product prices are as well related to the characteristics of buyers or sellers (Bett *et al*., 2011; Alemu *et al*., 2015; Pambo *et al*.,2015; Alemu *et al*., 2017a;Alemu *et al*., 2017b).This study therefore hypothesizes that the consumers' socioeconomic, institutional and EWT characteristics explain the variations in market prices of EWT.

This analysis adopts hedonic pricing and regression analysis to estimate the value of specific attributes of edible winged termites from within the bundled price. The regression analysis treats the price as a function of various attributes. The general implicit function is expressed as:

$$P_i(X) = Q^i(X_1, X_2, \ldots X_n, Z) + \varepsilon_i \tag{1}$$

Where; P_i is the price of the product i in the market (EWT), X_1, $X_2 \ldots X_n$ are product attributes, and Z are the buyer or seller characteristics. The variable Z can be omitted from the function if there are no existing differences between the buyers or sellers (Rosen, 1974).

The above function then takes the following empirical multiple regression models' derived short form:

$$InP_i = \alpha + \sum_{i=1} \beta_1 X_1 + \beta_2 X_2 + \ldots \beta_n X_n + nZ + \varepsilon_i \tag{2}$$

Where; $In\,P_i$ is the market value or price for EWT which is log transformed, Xs are the product attributes β_s and are elasticities that measure the proportional change in prices caused by proportional changes in characteristics. Z are characteristics of the sellers or buyers including other relevant market characteristics, while a is the constant effect and ε_i the homoskedastic error term with zero mean. The variables used in the model are presented in Table 1. To obtain the parameters the model was estimated using STATA.

The second step of the hedonic regression analysis estimates the willingness to pay of households which additionally accounts for households having different socioeconomic characteristics. The willingness to pay function therefore becomes:

$$p_i = W(X_1, X_2, \ldots \ldots X_n, Z) \tag{3}$$

Where; p_i is the price of termites, W is the willingness to pay, $X_1 + X_2 \ldots \ldots X_n$ termites attributes and a vector (Z) which denotes consumer characteristics.

3. Results and Discussion

3.1 Descriptive results

Table 1. Descriptive statistics of socioeconomic and institutional characteristics

Variable	Description	Rural dwellers	Urban dwellers	
Continuous variables		**Mean**	**Mean**	*t* – value
Age	Years	45.313	42.771	1.914*
Years spent in formal education	Years	11.568	15.281	-9.199***
children below 5 years	Number	1.922	0.781	6.584***
Monthly income	KES	19015.630	35604.170	-9.101***
Time taken walking to nearest market	Minutes	24.313	8.115	27.205***
Price of raw edible winged termites	KES	27.941	49.568	-42.774***
Price of fried edible winged termites	KES	84.012	149.796	-37.001***
Price of sun-dried edible winged termites	KES	84.321	150.000	-37.552***
Price of blanched edible winged termites	KES	50.971	80.000	-30.862***
EWT consumed in a year	kilograms	10.309	4.785	9.426***
Termite attributes	Score	0.057	-0.057	1.132
Convenience	Score	0.105	-0.105	2.541**
Culture	Score	0.067	-0.067	1.444

Categorical variables		Percentage	Percentage	χ^2value
Gender	Female	78.646	68.750	4.850**
	Male	21.354	31.250	
Off-farm activity	No	25.521	2.083	44.325***
	Yes	74.479	97.917	
Native	No	44.794	45.313	0.011
	Yes	55.208	54.688	
Kiosk	No	79.688	55.729	25.203***
	Yes	20.313	44.271	
Producer	No	40.625	79.688	61.115***
	Yes	59.375	20.313	
Nutrition/ Health officer	No	79.688	24.479	117.245***
	Yes	20.313	75.521	
Agricultural extension officer	No	32.813	82.292	96.205***
	Yes	67.188	17.708	

Note: ***, **, *Significant at 1%, 5% and 10%, respectively.

t -test was used to determine significant differences in continuous variables, between rural and urban dwellers.

χ^2 -was used to determine relationships in categorical variables, between rural and urban dwellers.

Descriptive and summary statistics for rural and urban dwellers varied (Table 1). On average rural respondents were significantly elderly and less educated compared to urban respondents. Rural respondents had a significantly higher number of children below 5years within their households than urban respondents. Urban respondents had significantly higher monthly incomes and paid higher price than rural respondents. While significantly more urban respondents participated in off-farm activities, more rural respondents were female and natives. On average significantly more urban consumers bought edible winged termites from kiosks while more rural consumers bought from producers. It took rural respondents significantly more minutes walking to the nearest market than urban respondents. While significantly more urban respondents got their food security information from nutritional officers, more rural respondents got it from agricultural extension officers.

3.2 Econometric results

Table 2 presents hedonic price model results. The adjusted R-squared were 0.880, 0.826, 0.828 and 0.634 for raw, fried, sun-dried and blanched EWT models respectively indicating the percentage of market price variability explained by the empirical models. The F test values were significant at 1% for all models implying that the independent variables as a set significantly affect the dependent variable.

Results indicate that age of the consumer had a significant and negative effect on the market price of raw EWT at 10%. Generally the elderly were unlikely to pay higher prices for raw EWT in both rural and urban markets. Probably, the consumers view raw EWT consumption as a childhood practice and move away from it as they get older. The elderly could be in possession of knowledge on collection of raw EWT or might have seen no value added to raw EWT that warrantee the higher price. This finding corroborates that reported by Alemu *et al*. (2017a) where older consumers were less likely to pay higher prices for whole and processed termites than the young. However, elderly consumers were more willing to pay premium prices for local rice than younger consumers in Upper East Region, Ghana (Ehiakpor *et al*., 2017).

Education is significant at 10%. There is a negative and significant relationship between the variation in price of fried and sun-dried EWT and education of the consumer. These are the most common and available forms. Probably, as consumers advanced in education they adopted western eating habits and abandoned their traditional local diets like EWT making the more educated unwilling to pay high prices. Similar finding was reported by Ehiakpor *et al*. (2017) where, more educated consumers were unwilling to pay for local rice but paid higher prices for imported perfumed and polished rice. Moreover they could not wish their friends to see them consume the local rice. Furthermore, more educated consumers would less likely pay a premium price for fresh tilapia (Gebrezgabher *et al*., 2015). Contrary to this finding, Hussain *et al*. (2016) reported that, highly educated

consumers understand and appreciate the health implications of their diets thus more willing to pay higher prices for healthy products than the less educated.

Table 2. Determinants of raw, fried, sun dried and blanched EWT prices.

EWT form	Raw		Fried		Sundried		Blanched	
Variable	Coef.	S.E	Coef.	S.E	Coef.	S.E	Coef.	S.E
Consumers' socioeconomic characteristics								
Age	-0.001*	0.001	0.000	0.001	0.000	0.001	0.001	0.001
Gender	0.025	0.016	0.023	0.019	0.021	0.019	0.028	0.027
Education	0.002	0.002	-0.006*	0.003	-0.005*	0.003	-0.001	0.004
Chlbelow5	-0.012	0.009	-0.017	0.011	-0.017	0.011	-0.023	0.016
Ofarmacts	0.064**	0.025	0.096***	0.030	0.084***	0.030	0.071*	0.042
Income	0.023	0.016	0.039**	0.019	0.035*	0.019	0.012	0.026
Native	0.014	0.016	-0.023	0.019	-0.022	0.019	-0.034	0.027
Residence	0.548***	0.025	0.569***	0.030	0.561***	0.030	0.450***	0.041
Consumers' institutional characteristics								
Groupmem	0.016	0.015	-0.039**	0.018	-0.040**	0.018	-0.034	0.025
Timarket	0.005	0.001	0.004***	0.002	0.004**	0.002	0.004*	0.002
Kiosk	0.063***	0.023	0.060**	0.028	0.047*	0.028	0.056	0.038
Producers	0.092***	0.024	-0.004	0.030	-0.014	0.029	-0.007	0.040
Agritens	-0.023	0.023	0.013	0.029	0.015	0.028	0.007	0.039
Nutficer	0.007	0.025	0.053*	0.031	0.049	0.031	0.040	0.042
Edible winged termite characteristics								
Termats	-0.130	0.121	0.204	0.126	0.220*	0.124	0.035	0.191
Convenience	-0.030	0.048	0.041	0.054	0.049	0.053	0.004	0.080
Culture	0.006	0.009	0.018*	0.010	0.017*	0.010	0.018	0.014
Constant	3.070***	0.147	3.839***	0.179	3.906***	0.177	3.654***	0.243
Number of obs	274		309		309		279	
F(17)	119.140		86.760		88.250		29.380	
Prob > F	0.000		0.000		0.000		0.000	
R-squared	0.888		0.835		0.838		0.657	
Adj R-squared	0.880		0.826		0.828		0.634	
Root MSE	0.110		0.141		0.138		0.184	

Note: ***, **, *Significant at 1%, 5% and 10%, respectively.

Consumer participation in off-farm income generating activities has a positive and significant effect at 5%, 1%, 1% and 10% for raw, fried, sundried and blanched EWT respectively. This implies that, consumer who participated in off-farm income generating activities were more willing to pay price premiums for raw, fried, sundried and blanched EWT than those who did not participate. Off-farm activities could have improved access to nutritional information on EWT and provided supplementary income which increased disposable income that made consumers more willing to pay higher prices for EWT. This finding is not surprising as in their study on willingness to pay Alemu *et al*. (2015), found formally employed consumers more willing to pay higher prices for whole and processed termites than those who only practiced farming or fishing.

Income was significant at 5% and 10% for fried and sun-dried EWT respectively. Consumers who earn higher incomes would pay higher prices for fried and sundried EWT than those who earn lower income. This finding

could be expected because increase in income increases the consumers' purchasing power. The fried and sundried forms do not require any further on-farm processing before consumption they are ready to eat. The social class based on income could explain this purchase behavior as high income earners could have associated the other forms that could require further processing to lower income class. Similar finding was reported by Pambo *et al*. (2015) where, willingness to pay for fortified sugar increase with increase in consumer income. Moreover in their study on consumers' willingness to pay for whole and processed termites Alemu *et al*. (2015) found out that, higher income earners were more willing to pay prices premiums than lower income earners. However, high income earners were less likely to pay higher prices for local rice in Ghana than low income earners (Ehiakpor *et al*., 2017).

There is a positive and significant variation in prices of raw, fried, sundried and blanched EWT and the consumers' location of residence at 1%. Urban consumers would pay higher prices for raw, fried, sundried and blanched EWT than rural consumers. This could be attributed to the transaction costs involved in moving EWT from rural to urban areas as most collections are majorly in rural areas. Moreover the supply is higher in rural markets than in urban markets where the demand is high.   Prices in urban markets would therefore respond to supply rather than demand. Bett *et al*. (2011) found out that, urban consumers paid higher prices for indigenous chicken than rural consumers due to the higher transaction cost of moving live chicken from production areas in the rural to urban markets. Similarly, urban consumers were more likely to pay higher prices for whole and processed termites than rural consumers (Alemu *et al*., 2015). Furthermore, urban consumers were more willing to pay higher prices for buns fortified with cricket flour than rural consumers (Alemu *et al*., 2017b).

Group membership has a significant negative effect on the market prices of fried and sundried EWT at 5%. Consumers who were members of food security groups were unwilling to pay premium prices for fried and sundried EWT. Group membership allows consumers to learn from each other, share and exchange current nutritional information and knowledge at lower costs.   Members could have acquired knowledge about a cheaper source of animal protein that was equivalent to or superior than EWT making them unwilling to pay higher prices for fried and sundried EWT. Probably from the group meetings the consumers learnt on how to do value addition to EWT thus could prefer collecting and value adding at a lower price than pay premiums for already fried and sundried EWT. Similar finding was reported by Balogh *et al*. (2016) where, consumers who were group members were less willing to pay price premiums for mangalitza salami but preferred to pay more for fresh pork.

Distance to the nearest market measured as time taken walking to the nearest market of the consumer positively and significantly influenced the market prices of fried, sundried and blanched EWT. Consumers who took long walking to the market could be more willing to pay higher prices for fried, sundried and blanched EWT when they get to the market and reduce the number of times they go to the market to save on their time. Longer distance to markets constrains access to food commodities due to high transportation costs (Gido *et al*., 2016). Moreover, Bett *et al*. (2011) in their study on hedonic pricing of indigenous chicken reported that, transport and other transaction costs were included in market prices and passed to consumers making them pay higher prices.

Kiosk was significant at 1%, 5% and 10% for raw, fried and sun-dried EWT respectively. Consumers who had kiosks as their most preferred retail outlet would pay higher market prices for raw, fried and sundried EWT. Kiosks are many in number, found in rural and urban areas even some along the roadsides. These combined with their reliability, could have increased the consumers' willingness to pay for raw, fried and sun-dried EWT. Satimanon and Weatherspoon (2010) found a positive and significant relationship between price variation of eggs and kiosk retail outlet. Similarly, most consumers preferred to buy EWT from kiosks than supermarkets and paid premiums for them in kiosks but none of them could be willing to pay for them in supermarkets or open air markets (Alemu *et al*., 2015; Alemu *et al*., 2017a).

Producers had a significant positive effect at 1% on the market price of raw EWT. This implies that consumers who bought EWT from producers would pay higher market prices for raw EWT. This finding could be attributed to EWT collection by producers from rural areas and consumers' awareness of it hence reluctant to pay for the raw form in other retail outlets due to uncertainty about quality and freshness. Most consumers have confidence in producer retail outlet, associate them with quality assurances and are willing to pay premium prices there (Alemu *et al*., 2017a). Furthermore, consumers tend to trust and prefer local producers for speciality food goods because of their quality consciousness and belief in promoting local producer outlets (Balogh *et al*., 2016).

Nutritional officer was significant at 10%. Having food and nutritional information provided by nutritional officers positively and significantly affected the market price of fried EWT. This finding could be attributed to consumer trust in the information source; food and nutritional information given by nutritional specialists. Based

on the information about nutritional value of EWT consumers have they would pay higher prices for fried EWT. Insect based food consumers prefer and respond quickly to official recommendation like health and nutritional officers (Alemu *et al.*, 2017a). However, Alemu *et al.* (2015) found termite consumers trusting information from friends and relatives than from health officials and media.

Termite attributes was significant at 10%. Termite attributes had a positive and significant influence on the price of sundried EWT. The sun-dried EWT could be having most of the important attributes that consumers were seeking making them more willing to pay price premiums. This finding could be expected as most consumers are increasingly getting aware of the nutritional, ecological and economic importance of using edible insects as food. Perceived product attributes is an important factor for any food product purchase. According to Alemu *et al.* (2015), consumers pay higher prices for food with attributes they consider important like high nutritional value and naturalness. Furthermore, high nutritional value, perceived naturalness and ecological concern positively influenced prices of cricket flour buns (Alemu *et al.*, 2017b). Satimanon and Weatherspoon (2010) in their study of hedonic pricing of eggs found desirable egg characteristics as most significant price variation determinant.

Culture was significant at 10%. Consumers with higher value for their culture would pay higher prices for fried and sundried EWT than those with lower value for their culture. Fried and sundried EWT are traditionally given as wedding prizes to signify long-term food security. Probably, the consumers associated EWT consumption with habits and heritages passed from one generation to another that generated the price premiums for fried and sun-dried EWT. This finding corroborates that reported by Balogh *et al.* (2016) where, consumers' culture positively influenced their willingness to pay for traditional food products. Sea caught shrimp was preferred to cultured shrimp because consumers believed that, sea caught shrimp was culturally appropriate, healthier, natural and of superior quality so paid premiums for it (Suthamathy, 2012).

4. Conclusion

The consumers' willingness to pay for raw, fried, sun-dried and blanched edible winged termites is positively affected by participation in off-farm income activities and place of residence. This implies that, marketers aiming to maximize their profits can target the consumers residing in urban areas and those participating in off farm income generating activities. Results from this study provide marketers with information on factors influencing price variations of different EWT consumption forms and the magnitude of WTP associated with each form that can inform price policy formulation. This study recommends enhancement of EWT value addition in order to increase profits.

This study was limited to EWT that is seasonally collected and difficult to rear on farms. Therefore, further similar research can be conducted using crickets or grasshoppers that are easier to produce in commercial farms.

References

Alemu, M. H., Olsen, S. B., Vedel, S.E., Pambo, K. O. and Owino, V. O. (2015) Consumer acceptance and willingness to pay for edible insects as food in Kenya: the case of white winged termites. IFRO Working Paper 2015 / 10, Department of Food and Resource Economics (IFRO) University of Copenhagen, Denmark.

Alemu, M. H., Olsen, S. B., Vedel, S. E., Pambo, K. O., and Owino, V. O. (2017a) Combining product attributes with recommendation and shopping location attributes to assess consumer preferences for insect-based food products. *Food Quality and Preference*, 55, 45–57.

Alemu, M. H., Olsen, S. B., Vedel, S. E., Kinyuru, J. N. and Pambo, K. O. (2017b) Can insects increase food security in developing countries? An analysis of Kenyan consumer preferences and demand for cricket flour buns. *Food Security*, 9: 471-484.

Balogh, P., Békési, D., Gorton, M., Popp, J. and Lengyel, P. (2016) Consumer willingness to pay for traditional food products. *Food Policy*, 61:176–184.

Bett, H. K., Peters, K.J. and Bokelmann, W. (2011) Hedonic price analysis to guide in breeding and production of Indigenous chicken in Kenya. *Livestock Research for Rural Development* 23 (6) 2011.

Ehiakpor, S.D., Apumbora, J., Danso-Abbeam, G. and Adzawla, W. (2017) Households' preference for local rice in the Upper East Region, Ghana. Hindawi Advances in Agriculture Volume 2017, Article ID 1812975, 9 pages

FAO, (2013) Edible insects: Future prospects for food and feed security. FAO forestry paper 171, Rome, Italy.

Gebrezgabher, S. A., Amewu, A. and Amoah, A. (2015) Consumer preference and willingness to pay for fish farmed in treated wastewater in Ghana. International Water Management Institute, PMB CT 112, Cantonments, Accra, Ghana.

Gido, O.E., Ayuya, I.O., Owuor, G. and Bokelmann, W. (2016) Consumer's choice of retail outlets for African indigenous vegetables: Empirical evidence among rural and urban households in Kenya. *Cogent Food and Agriculture*, 2(1):1-14.

Government of Kenya, (2013) First Bungoma County Integrated Development Plan 2013 - 2017.

Hussain, I., Rahman, S., Zaheer. A. and Saleem, S. (2016) Integrating Factors Influencing Consumers Halal Products Purchase: Application of Theory of Reasoned Action, *Journal of International Food and Agribusiness Marketing*, 28:1, 35-58

Lancaster, K. J. (1966) A New Approach to Consumer Theory. *The Journal of Political Economy*.74: 132-157.

Lensvelt, E. and SteenBekkers, L. (2014) Exploring Consumer Acceptance of Entomophagy: A Survey and Experiment in Australia and the Netherlands. *Ecology of Food and Nutrition*, 53, 543-561.

Pambo, O. K., Otieno, J. D. and Okello, J. J. (2015) Willingness-to-pay for sugar fortification in Western Kenya. Selected Paper prepared for presentation at the 2015 Agricultural and Applied Economics Association and Western Agricultural Economics Association Annual Meeting, San Francisco, CA, July 26-28.

Rosen S (1974) Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition. *The Journal of Political Economy*, 82: 34-55.

Satimanon, T. and Weatherspoon, D. (2010) Hedonic Analysis of Sustainable Food Products. *International Food and Agribusiness Management Review*, 13(4), 57-74.

Suthamathy, N.(2012) Hedonic price analysis of shrimp: Quality Factors influencing Market price of Shrimp in Nha Trang, Vietnam. Master Thesis in Fisheries and Aquaculture Management and Economics(30 ECTS). The Norwegian College of Fishery Science University of Tromso, Norway and Nha Trang.