Introduction

In the past, foods were primarily recognized for their essential nutrients for normal body activity and function. In recent years, however, consumers have begun to switch emphasis from mere satisfaction of hunger to the promising use of foods to promote well-being, of which prevention or reduction of risks of disease in cardinal (Niva, 2007). The growing consumers' interest in diet and health issues is connected to the increasing scientific evidences (and awareness) about the nexus between food, nutrition and health (Gil et al., 2000; Munene, 2006), advances in food science and technology, and changes in food regulations (Agriculture and Agri-Food Canada, 2009). Thus, encouraging consumption of food products known to have more health functions is important for maintaining the stock of people's health for productivity and national economic prosperity.

Studies have shown that a significant portion of non-communicable diseases stem from bad nutrition. For instance, dietary patterns are associated with increased risk of several chronic diseases such as coronary heart disease, cancer, stroke, diabetes, hypertension, overweight, and osteoporosis. It is estimated that healthier diets might prevent $71 billion per year in medical costs, lost productivity, and the value of premature deaths associated with these conditions (USDA/ERS, 1999). The global awareness of the role foods could play in enhancing human health has fuelled considerable public interest in the notion of functional foods (Munene, 2006). Although all foods are functional to some extent because they provide taste, aroma and nutritive value; foods are

Abstract: Although consumer demand for food products with more health functions has stimulated expansion of a number of food industries in the past years, not much is known about drivers of market participation and consumption of such foods in Africa, and Nigeria in particular. Consequently, the study examined factors influencing purchase decision and consumption-expenditure on garlic in South-West Nigeria. Descriptive statistics and the Heckman selection model were employed for data analysis. Results show that more than 70.0% of the respondent households became aware of the health benefits of garlic through media, friends/family and health workers, with more than 75.0% consuming garlic in raw and processed forms. The results of the Heckman selection model indicated that sex (p<0.05) and awareness of household head about the health benefits of garlic (p<0.01) substantially enhanced decisions to consume garlic while household income (p<0.01), household size (p<0.01), educational status (p<0.1) and occupation of the household head (p<0.1) significantly influenced consumption-expenditure. The study recommends public education programmes on the health benefits of garlic, efforts to enhance access to formal education and improvement in household income as strategies that could stimulate and raise garlic consumption. Our findings hold enormous implications for the sustainability of the garlic market in terms of research and product development as it relates to the forms in which consumers prefer to consume garlic and strategies for spreading knowledge about its health benefits in order to achieve greater demand in the country.

Keywords: Healthier foods, garlic, human health, Heckman Selection Model

1 Introduction

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now being studied intensively for additional physiological benefits.

In a more general sense, functional foods can be defined as foods that provide benefits beyond basic nutrition and that could play a role in reducing or minimizing the risk of certain diseases and other health conditions (IFICF, 2011). They could be natural foods (Brower, 1998) or food products from which one or more components have been added or removed, reducing the risk of disease (Diplock et al., 1999). Some examples of functional foods approved by European Food Safety Authority are fortified products such as non-alcoholic beverages fortified with vitamin A, dairy products containing Lactobacillus fermentum ME-3, enriched products such as eggs enriched in omega-3 and vitamin E, natural foods such as cereals like oat and barley which can be used as fermentable substrates for the growth of probiotic microorganism (Siro et al., 2008) and green tea and soy (Brower, 1998).

From the regulatory standpoint, and especially for the European Union, products are admitted as functional foods if they are labelled, and if the health/nutritional claims on their labels are guaranteed by law. The general principle at the European Union level is that claims on functional foods should be affirmed by generally accepted scientific data, non-misleading and pre-approved by EU regulatory agency. With these in perspective, a number of food products such as garlic are yet to be qualified as functional foods. Regardless of the ways in which functional foods are determined, what garlic products would appear to share as functions in common with some of the products established legislatively as functional foods are health promotion/reduction of disease risk factors and enhanced performance (both physically and mentally) (Gulati and Ottaway, 2006; Chanda et al., 2011), among others.

Garlic is a food item whose many health benefits are often understated. Even though not yet acclaimed globally as functional food, especially due to regulatory/legislative issues, the many health benefits of garlic have been documented. These include, among others, antimicrobial activity, anti-carcinogenic effects, antioxidant activity, ability to reduce cardiovascular diseases, improving immune functions, and anti-diabetic activity (Rahman, 2007). More specifically, garlic contains sulfide (Diallyl-sulfide, Diallyl-thiosulfinate, Allyl-methyl trisulfide), which may enhance detoxification of undesirable compounds, support maintenance of heart, immune and digestive health; prebiotics (Inulin, Fructo-oligosaccharides, Polydextrose), which support maintenance of digestive health and calcium absorption; as well as selenium, which neutralizes free radicals that may damage cells, and supports maintenance of immune and prostate health (IFICF, 2011; Rahman, 2007; Waladkhani and Clemens, 2008).

To promote consumption (and production) of healthier foods such as garlic, it is crucial to gain understanding of how it performs in the market. One of the ways to achieve this is by studying consumer behaviour regarding garlic. For example, drivers for purchase decisions, consumption-expenditure and preferred forms of consumption. Such empirical studies can provide useful information for food processing industries, and for developing marketing strategies to capture potential consumers in different segments of the population. While there have been a lot of studies on consumers’ behaviour towards consumption of functional foods or foods with more health functions, the majority of them are focused on countries such as the US, Canada, Finland, Australia, and Sweden (Verbecke, 2005; Buehrlen et al., 2005; Blandon, et al., 2007; Annunziata and Riccardo 2010; Özen et al., 2014; Vella et al., 2014), with less attention on the potential and emerging markets in Sub-Saharan Africa. In Nigeria for example, the work of Oyebade et al. (2013) on factors influencing willingness to consume plantain flour among youth is perhaps the only empirical study on the causal link between consumers’ demographic characteristics and their consumption behaviour towards foods with specific health functions in Nigeria. To the best of our knowledge, no attempt has been made to assess the influence of socioeconomic factors on garlic purchase decisions and its consumption among households in Nigeria. Consequently, the study seeks to contribute to the body of knowledge on the causal relationship between consumers’ idiosyncratic factors and market participation as well as consumption of foods with special health related functions, especially in the African context.

2 Theoretical/conceptual framework

The concept of household varies widely across cultures. Whichever way it is conceived, the key component in the definition of household is the identification of the decision-making unit, which devices the strategy pertaining to the generation of income and the use of this income. We approach this work from the collecting (income-pooling) household model. The income pooling hypothesis presumes incomes (resources) are pooled together and that the entire household maximizes a welfare function, which is essentially the utility function of the benevolent
household head. It further presumes that when there are divergences in preference between the key actors in household (usually husband and wife), a consensus is reached when making decision that bothers on the welfare of members (Quisumbing and McClafferty, 2006). For this study, our choice for the income-pooling model is based on two major reasons. First is the findings of Aromolaran (2010) on food calorie consumption, which appeared to challenge the popular wisdom in support of the non-income pooling (bargaining) model. He submitted that redistribution of income in favour of women relative to men would not lead to a significant increase in food calorie intake but that a gender-neutral increase in household total income would exact substantial positive influence on demand for high-quality food calorie sources in South-Western Nigeria. Although Angel-Urdinola and Wodon (2010) commented that increasing the contribution ability of women to household income leads to higher decision making-power for them within the household with the possibility of leading to higher investments in child human capital and poverty reduction, they cautioned that strong policy recommendations should not be drawn based on the limited and descriptive analysis in the study. This notwithstanding, this paper does not undermine the potential of intra-household resource allocation issues in household consumption decision.

Following Aromolaran (2004), household welfare function in the general setup of collective (income pooling) model can be defined as:

\[
U^h = \sum_{i=1}^{I} \Phi_i U_i
\]

Where; \(U^h\) is the welfare function of the household, \(U_i\) is utility function of individual member in the household, \(\Phi_i\) is the welfare weight associated with the utility function of each members of the household. It follows from the income pooling model that \(\Phi_i\) is fixed and does not change as the factors that influence resource control power (distributional factors) changes within the households; implying that the utility frontier of the household is unaffected by the distribution factors since the household acts as single decision making unit. Changes in income would only influence consumption via the Slutsky income effect (Aromolaran, 2004; Browning et al., 2006). In a situation where only one person, presumably the household head, takes decisions completely on behalf of the entire household, \(Q_i = [1, 0]\) corresponding to the unitary model.

The income pooling household model is consistent with the consumer demand theory. Since this work is a cross-sectional study, price is assumed to be identical for all households and the behavioural differences in food (garlic) consumption are sought via differences in household total income and household socio-demographic characteristics; leading to the specification of Engel’s curve defined as:

\[
C_i = g_i(X)
\]

Where \(X=(m,Z)\) with \(m\) representing total household income and \(Z\) as a vector of factors influencing consumption other than income and price. Although a number of studies, for example, Verbeke (2005), Mullie et al. (2009), Pasquale et al. (2011), Park and Park (2012), Stojanovic et al. (2013), Öyebade et al. (2013), Özen et al. (2014) and Sugandhi and Maheswari (2016) have reported some socio-demographic factors such as income, age, household size, marital status, occupation, education and sex of consumers as important determinants of consumption of healthier food products, less is known about drivers of consumers’ behaviour towards garlic consumption, especially in sub-Saharan African countries, including Nigeria. While some studies (Urala and Lahteenmaki, 2007; Dogan et al., 2011; Büyükkaragöz et al., 2014) reported significant influence of variables such as age, education, and income, others (Poulsen, 1999; Park and Park, 2012; Salleh et al., 2015) found weak or insignificant effects of one or more of the variables. The somewhat contradictory findings suggest that there should not be a universal generalisation of the influence of socio-demographic variables on consumption of healthier/functional foods. Whether household socioeconomic factors would exert different (or similar) effects on garlic market participation (purchase decision) and consumption-expenditure on garlic in Nigeria are examined in this study.

In empirical consumption studies, one of the frequently encountered problems is zero observations on the dependent variable, which relates to garlic consumption-expenditure (\(C_i\)) in this study; as well as difficulties to appropriately model the realized zeros. The common econometric tools of analysis are Tobit, Heckman, double hurdle and infrequency of purchase models. The observed zero expenditures may arise from different reasons. If the zeros are presumed to be due purely to economic constraints (income and price), the Tobit model is the most appropriate, as the realized zeros are the optimal choice (true corner solution) from utility maximization (Tobin, 1958). From the econometrics (modelling) perspective, it is presumed that every individual is a potential consumer (of garlic) such that the observed zeros and
the positive expenditures are taken to stem from the same stochastic process. This assumption is relaxed in the double-hurdle model, which allows the observed zeros and positive spending to be characterized by different stochastic processes. The observed zeros in the double hurdle model are presumed to arise either from true corners and non-participation, which can be due to non-availability of products, health concerns or other reasons (Cragg, 1971) apart from deliberate non-participation or self-selection. The infrequency of purchase model presumes that the observed zero expenditures are due to purchase infrequencies, and that the consumers reporting zero expenditures during the survey period actually consumed (the product) from what they had in the store. The observed zeros arise because the shelf-life or purchase cycle of the product is longer than the sampling period such that the households recording zero expenditures on commodity during the survey period would have purchased the product if the survey period had covered a longer period of time (Blundell and Meghir, 1987). This model is unable to handle cases of zero expenditures attributable to never purchase/deliberate non-consumption or self-selection. For this study, there are respondents who indicated they never consumed garlic and are unwilling to do so because of the somewhat unpleasant odour it leaves behind after consumption. Besides, all those who consume garlic reported positive expenditure during the survey period. This type of deliberate non-purchase behaviour (self-selection) is usually addressed using Heckman selection model (Heckman, 1979).

3 Methodology

3.1 The study area

The study was conducted in Badagry Local Government, Lagos State, Nigeria. The state is located in the South West part of the country and arguably the most economically important State of Nigeria. It is bounded on the North and East by Ogun State, in the West by Republic of Benin and in the south by the Atlantic Ocean. Available statistics indicates that as at 2006, the population of Lagos was 9,113,605 (National Population Commission (NPC), 2010) and the projected population as at 2015 was 13,123,000 (United Nations, 2015). Badagry Local Government is situated between Metropolitan Lagos and the border of Benin Republic at Seme. It is made up of several villages and towns with Aworis and Eguns as the major inhabitants. The major markets in the area include Agbalata and Ikoga markets. These markets are accessible to people from various parts of the state. Goods such as onions and garlic are among the food items that are traded in large quantities and are brought to the markets by middlemen who sell to retailers and consumers.

3.2 Sampling procedure and data collection

The data for this study were collected from 150 households in a cross sectional survey with the aid of a structured questionnaire which served as interview guide. First, ten (10) towns were randomly selected out of the existing towns in the Local Government Area. Thereafter, fifteen (15) houses were also randomly selected from each of the selected towns to make a total of 150 houses. While household data were mainly collected from a household head that was available for interview in each of the 150 houses, in cases where the household head was not at home, other adult members who could also supply reliable information were interviewed. The data collected include socio-economic characteristics of households, garlic consumption and expenditures, and awareness of, and sources of awareness about the health benefits of garlic.

3.3 Analytical techniques

3.3.0.1 Descriptive tools

Descriptive tools such as frequencies, tables and percentages were used to describe the socio-economic characteristics of the respondents, their knowledge about garlic and its health properties as well as information about its consumption.

3.3.0.2 Heckman Selection Model

Heckman selection model was used to determine both the factors influencing market participation (the decision to consume garlic) as well as the factors influencing consumption of garlic (intensity of participation). As mentioned earlier, some respondents indicated they have at no
time in the past consumed, and are unwilling to consume garlic mainly because of the residual odour it leaves in the mouth after consumption. This characteristic zero spending on garlic is therefore attributed to deliberate choices of the consumers (self-selection). These types of zero expenditures (non-consumption) can be handled with Heckman selection model using either the two-step estimator or the maximum likelihood estimator. Heckman model is a sample selection model which always involves two equations: (1) the selection/participation equation and (2), the consumption-expenditure (intensity of participation) equation. For this study, the selection equation \( y_i^* \) considers a portion of the households whose garlic consumption-expenditure is observed, as well as the mechanisms which defines the selection process while the intensity of participation equation \( C_i^* \) determines the consumption-expenditure on garlic (outcome variable) (Heckman, 1978, 1979). The two equations can be stated as follows:

Selection (Probit) equation:

\[
y_i^* = Z_i\gamma + u_i \quad (1)
\]

Where \( y_i^* \) is the latent variable that defines the rule as to whether a household would decide to consume garlic or not. \( Z_i \) is a vector of exogenous variables determining whether household will consume garlic or not. \( \gamma \) represents the coefficients associated with the repressors in \( Z \) including the constant term. \( u_i \) is the error term assumed to be the normal distribution which zero mean and unit variance. The observed participation \( y \) is linked with the latent participation \( y^* \) as follows:

\[
y = \begin{cases} 
1 & \text{if } y^* > 0 \\
0 & \text{otherwise}
\end{cases} \quad (2)
\]

The consumption-expenditure equation is stated as:

\[
C_i^* = X_i\beta + \varepsilon_i \quad (3)
\]

Where \( C_i^* \) is the latent consumption on garlic. \( X_i \) is a vector of explanatory variable, which may be the same as \( Z_i \). \( \beta \) represents the coefficients associated with the repressors in \( X \) including the constant term. The error term is represented by \( \varepsilon_i \) assumed to be normally distributed with zero mean and constant variance \( \sigma^2 \). The relationship between latent participation \( y^* \), the latent consumption \( C^* \) and the observed (consumption) expenditure on garlic \( C \) are as stated:

\[
C = \begin{cases} 
C^* & \text{if } y^* > 0 \\
- & \text{if } y^* \leq 0
\end{cases}
\quad (4)
\]

The error terms \( u_i \) and \( \varepsilon_i \) are assumed to be bivariate-normally distributed with mean zero and variance-covariance matrix specified as:

\[
\begin{bmatrix} 
1 & \rho \\
\rho & \sigma^2 
\end{bmatrix}
\]

Where \( \rho \) is a measure of correlation between the errors terms in the probit and consumption equations; \( \sigma^2 \) is the variance of the consumption equation. For the Heckman selection model, the dependent variable, which is the observed monthly expenditure (in Naira) on garlic \( C \), is transformed to its natural logarithmic form. The set of regressors in the probit/selection equation and the consumption-expenditure equation are described below:

\( X_1 = \text{Age category (31-45years)} \) (1 if household head belongs to the age group, 0 otherwise)

\( X_2 = \text{Age category (46-60years)} \) (1 if household head belongs to the age group, 0 if otherwise)

\( X_3 = \text{Sex of household head} \) (1 if male, 0 otherwise)

\( X_4 = \text{Marital status of household head} \) (1 if single, 0 otherwise)

\( X_5 = \text{Education} \) (1 if household head had a formal education, 0 otherwise)

\( X_6 = \text{Major occupation of the household head} \) (1 if civil servants/government workers, 0 otherwise)

\( X_7 = \text{Household monthly income in Naira} \) (Natural logarithm transformation)

\( X_8 = \text{Household size} \) (Natural logarithm transformation)

\( X_9 = \text{Awareness} \) (1 if respondent is aware about health benefits of garlic, 0 otherwise)

Having estimated the Heckman Model using the two-step and the full maximum likelihood approaches, the results of the full maximum likelihood approach appeared to provide stronger evidence of selection than that of the two-step estimation. Hence, the estimates of the full maximum likelihood approach are reported. Data analysis was performed using STATA (version 14) software.

2 Civil servant/government workers are generally expected to have a more stable source of income and are anticipated to have a fairly well-planned food budget than other household groups.

3 Awareness is excluded from the consumption equation (but included in the selection equation) in order to properly identify the consumption-expenditure equation from the selection. The variable satisfies the requisite conditions for exclusion.
4 Results and discussion

4.1 Socio-economic characteristics of respondents

Presented in Table 1 are the results of the socio-economic characteristics of the respondent households. The results revealed that the majority (70%) of the respondents were married and 56% of them were males. The average age of the respondents was 42.7 years; having an average household size of four (4) persons. The majority (73.6%) of the respondents had at least secondary school education, showing that the population is largely literate. Thus, the relatively highly level of education is expected to influence garlic consumption positively. The majority of the respondents were non-civil servants/government workers, and the average monthly income of the respondent households was N45 520 (see table 1). This translates to an average of N379.33 per person per day. This is barely above $1.25 poverty line, indicating the vulnerability of the households to poverty.

4.2 Respondents’ awareness and consumption pattern of garlic

Table 2 presents the results of respondents’ level of awareness and patterns of garlic consumption. Although all the respondents indicated they know garlic, approximately 78.7% are aware of its health properties while...
the remaining 22.3% are unaware. This result is similar to Vella et al. (2014) who reported that the majority of respondents (93.5%) were aware of health benefits/claims on functional foods but differ from Dogan et al. (2011) whose finding was approximately 40%. Approximately 88.7% of the respondents indicated that they actually consume garlic in their households. Most of the respondent households (48.7%) consume it more than twice a week, 16.6% consume it once a week, while about 11.3% do not consume it at all. The reasons given for that choice were garlic’s characteristic smell and residual odour, which they judged unpleasant. Most of the consumers (52.6%) acknowledged that they consume garlic in both the raw and processed form, 31.6% consume it only in its processed form (powdered form, garlic extracts) while 15.8% consume garlic only in its raw form. Furthermore, 42.1% of the consumer households spend a maximum of N=200 on garlic every month, while 45.8% spend between N=201 to N=600 on it, with an average monthly expenditure of approximately N=387, representing 0.85% of the average household monthly income.

### 4.3 Determinants of decision to consume garlic and consumption-expenditure on garlic

The first part of the Heckman selectivity model (probit model) as presented in Table 3 shows the results that were estimated to determine the factors influencing the probability of consuming garlic. The Chi-square value (4.17) associated with the likelihood ratio (LR) test of independence between the participation (probit) equation and consumption-expenditure equation is statistically significant (p<0.05), establishing evidence of correlation between the errors in the selection and consumption-expenditure equations. The implication of the finding is that Maximum likelihood estimator produces stronger evidence of selection, and that selection into the consumption-expenditure equation is not purely random. The sex of household head was also found to negatively influence the probability of consuming garlic (p<0.05), suggesting that an average household headed by a female has higher chance of consuming garlic than a male-headed household. In line with this present study, Ozen et al. (2012) reported significance influence of sex on consumers’

| Variables                              | Frequency | Percentage |
|----------------------------------------|-----------|------------|
| Do you consume it?                     | Yes       | 133        | 88.7      |
|                                       | No        | 17         | 11.3      |
| Frequency of Consumption               | Daily     | 10         | 6.7       |
|                                       | Twice a week | 19      | 12.7      |
|                                       | More than twice a week | 73 | 48.7      |
|                                       | Weekly    | 25         | 16.6      |
|                                       | Once a while | 6      | 4.0       |
|                                       | Never     | 17         | 11.3      |
| Awareness of Health benefits of Garlic?| Yes       | 118        | 78.7      |
|                                       | No        | 32         | 21.3      |
| Source of the Awareness about its Health Benefits | *Health practitioner | 27 | 18.0     |
|                                       | *Family and Friends | 30 | 30.0     |
|                                       | *Media    | 97         | 64.67     |
| Monthly expenditure on Garlic (N=133)  | ≤200      | 56         | 42.1      |
|                                       | 201-400   | 39         | 29.3      |
|                                       | 401-600   | 22         | 16.5      |
|                                       | 601-800   | 5          | 3.8       |
|                                       | 801-1000  | 7          | 5.3       |
|                                       | >1000     | 4          | 3.0       |

Mean expenditure # 386.8

Source: Field survey, 2015  Note: # = Naira (Nigerian currency), *=multiple responses
behavioural intention towards functional or healthier food products. Dogan et al. (2011) found that women (and especially younger ones) consumed more functional foods than the rest of the studied population. Awareness of the household head about the health benefits of garlic was found to have a significant (p<0.01) and positive influence on the decision to consume garlic. The implications of the result is that awareness about the health benefits of garlic is strongly linked to its purchase decision, so that households whose heads are aware are much more likely to consume it. Sugandhi and Maheswari (2016) respectively reported health benefit awareness as important factor that could stimulate people towards consumption of healthier (functional) foods. The coefficient of income
was negative but only statistically significant at 10%, indicating a somewhat weak influence of income on decision to consume garlic.

The second part of the Heckman selectivity model (Table 3) shows the factors influencing the consumption-expenditure on garlic by the households. Occupation of the household head exerted negative influence on expenditure on garlic, implying that households which are headed by non-civil servants/government workers would consume more garlic, all else equal. This finding has some implications for garlic marketing among the non-civil servant subset of the general population in Nigeria. The result showed that households headed by someone that had formal education would spend more on garlic. Dogan et al. (2011), Ozen et al. (2012) and Sugandhi and Maheswari (2016) are examples of studies that have reported significant influence of education on consumers’ behaviour towards consumption of functional or healthier food products. However, Salleh et al. (2015) found insignificant effect of education on consumption of functional foods.

Income of the household was found to be positively significant at 1%, implying that higher income could substantially raise expenditure on garlic. This is line with Mullie et al. (2009) and Dogan et al. (2011) who established a positive relationship between income and consumption of functional foods. The finding is, however, contrary to Park and Park (2012) who found a statistically insignificant relationship between income and consumption (intake) of food with special health functions. The coefficient of income is 0.732, meaning that a 1-percent increase in household monthly income is expected to increase monthly expenditure on garlic by approximately 0.732 percent. Household size was found to have significant effect on consumption of garlic, with an estimated coefficient 0.283; implying that a 1-percent increase in household size could result in extra monthly expenditure on garlic by 0.283 percent.

5 Conclusion

The study examined the influence of respondents’ awareness about the health benefits of garlic on its purchase decision and consumption-expenditure. The majority of the respondent households consume garlic in processed and raw forms with respondents obtaining information about the health benefits of garlic from media, families, friends and health workers. Awareness about the health benefit of garlic, household income, sex and occupation of the household head are factors with significant influence on garlic purchase decisions and consumption. Our findings hold important implications for marketing in terms of satisfying consumers regarding the forms in which they prefer to consume garlic. The non-civil servant subset of the population has higher demand for garlic and can be an important segment for garlic marketing activities. Public enlightenment/awareness programmes on the health benefits of garlic especially in work places, television, print media and other avenues where such information could be transmitted are crucial for stimulating garlic purchase decisions. Efforts to boost household incomes and encouragement of access to formal educational training are also advocated as strategies that could promote garlic consumption.

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