Peanut Paste/ Butter Consumption Frequency in the Republic of Uganda: Count Data Model Approach

Padmanand Madhavan Nambiar and Wojciech J. Florkowski

Author Contact Information

Padmanand Madhavan Nambiar, Graduate Student

University of Georgia,

306 Conner Hall,

Athens, GA 30602

Wojciech J. Florkowski, Professor

University of Georgia, Griffin Campus

1109 Experiment Street

Griffin, GA 30223-1797

E-mail: wojciech@uga.edu

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Abstract

Peanut paste/butter consumption frequency in the Republic of Uganda is analyzed using household survey data. Estimation results from Zero-inflated Binomial regression conclude that education, household location, color of peanut paste, etc. are important. The ordinal logistic results conclude that peanut paste/butter consumption with vegetables is the most preferred option.

Key Words: Peanut-paste/butter, consumption frequency,Republic of Uganda,Zero-inflated

Negative Binomial, Socioeconomic, Vitamin A fortification,household survey

JEL Classifications: Q12, Q13

Introduction

Uganda, popularly called “The Pearl of Africa” is an East African nation with agriculture as the main occupation of the rural people, who constitute about 85% of the total population. Uganda is divided into four regions comprising 112 districts, with about 18 different ethnic groups. The capital of Uganda is Kampala, which is situated in the central region and inhabited by 5% of the total population. In 2009, around 37.7% of the people were below the international poverty line of US $1.25/day (World Data Bank, 2012). This situation along with limited access to nutritious foods (FANTA, 2010) adversely affects the well being of children and adults. One of the consequences is the deficiency of micronutrients in the diet, including vitamin A. As per the World Bank report (2009), 28% of preschool children and 23% of pregnant women are found to be deficient in vitamin A. Consumption of foods fortified with vitamin A is considered one of the ways to reduce this deficiency. An earlier study examined the potential of sugar for vitamin A fortification (Kawuma, 2002) and another one analyzed the varietal preferences for orange-fleshed sweet potato, which was used to fight vitamin A deficiency problems (Yanggen and Nagujja, 2006).

Another food that also has the potential to be used for vitamin A fortification is peanut. Peanuts are widely consumed in Uganda in various forms. They are a good source of protein, some vitamins, fiber and antioxidants. Some of the common forms of peanut consumption are peanut butter and paste. A danger associated with peanut consumption is the presence of poisonous aflatoxins, and this presence is very common in Uganda (Kaaya and Warren, 2005). In order to gain information about the feasibility of vitamin A fortification and also the extent of aflatoxin contamination, the spread of peanut consumption among the population and the factors responsible for this spread are to be analyzed. This study proposes to examine various factors

that influence peanut paste/ butter consumption frequency in Ugandan households. Another objective is to assess factors that influence various forms in which peanut paste/butter is consumed. Households in this sample consume peanut paste/butter along with vegetables, meat, bread or other foods. Some earlier studies (Sarkar et al., 1994; Jubert et al., 2009) have concluded that chlorophyll and chlorophyllin found in almost all green plant parts can reduce the consequences of aflatoxin incidence. The results from these analyses will be useful for creating consumer profiles with different consumption frequencies, which in turn will assist government and other agencies involved with actions intended to reduce vitamin A deficiency and also to reduce aflatoxin contamination.

Data

The dataset used for this analysis is from a household survey conducted in October, 2010, in 5 districts of the Republic of Uganda. These districts are Kampala, the capital city from central region, Gulu and Lira from northern region and Soroti and Mbale from the eastern region. A total of 1646 households were surveyed to collect information that is beneficial for the analysis of peanut paste/butter consumption frequency. Respondents provided information about various socioeconomic and demographic factors, peanut consumption frequencies and opinions and views about various attributes of peanut paste/butter.

The descriptive statistics of the variables used in these analyzes are given in Table 1. The dependent variable for peanut paste/butter consumption frequency is constructed based on the responses to the question “how often do you eat peanut paste/butter?” Responses are translated into number of times a respondent consumes peanut paste/butter in a month. The dependent variables for equations to analyze the factors affecting the form of consumption of peanut paste/butter (with a particular food) are the categorical responses to the questions that enquired

about the form of consumption. There are four dependent variables representing four forms of consumption and each with four categories (Table 1).

Explanatory variables used (Table 1) include gender of the household head and respondent, marital status, age, education and employment category of the respondent. Some household characteristics included are monthly household income, main source of this income, number of adults in the household, presence of children and children of 3 years or younger in the household, distance to the nearest shopping center, and location. A variable to indicate whether a household prepares peanut paste at home or not is also included. Another set of binary variables representing the importance of some attributes like color, taste, thickness and oil separation is employed to capture attitudes of respondents. Similarly, three categorical variables for capturing the frequency of problems, such as rancid taste, bad aroma and presence of foreign matters, experienced by the respondents are also constructed from the responses obtained during the survey.

About 71% of the household head are males; where as about 72% of the respondents are females. Age of the respondent is measured in years and the average is 35 years. Education has two levels and the respondents with base level “lower higher secondary or below” are compared with upper higher secondary or above. Employment status has three levels with others as the reference category. Self employment constitutes 37% of the sample of respondents, followed by permanent employment (13%), where as employment in other categories has the highest share (49%). Main sources of the household income are salary and trading, and the average monthly household income is 612291 Ugandan shillings. Average number of adults per household is 2.3 and more than 90% of the households have children. Average distance to the nearest shopping center is about 573 meters. About 52% of the households in the sample prepare peanut paste at

home. On an average, respondents attach importance to color (74%), taste (89%), thickness (81%) and no oil separation (61%) of the purchased peanut paste/butter, where as majority of respondents did not experienced problems such as rancid taste (70%), bad aroma (72%) and presence of foreign matters (55%).

All the socioeconomic variables and household characteristics used in this study are supported by either the economic theory or previous food consumption studies. The famous Engel curve explains the relationship between income and food expenditures. Gender, marital status, educational level, employment status, household composition and location of households are routinely employed in research studies that analyzed food consumption behaviors (for example, Reynolds, 1990; Nayga, 1995; Roos et al., 1998; Blisard et al., 2002; Ruel, Minot and Smith, 2005). Apart from these factors, various attributes of foods like color, taste, aroma, etc., are also employed by some previous such studies (Shutz et al., 1986; Glanz et al., 1998; Hinds et al., 2003). In Ghana, a West African country, age, education and various forms in which peanuts are consumed are found to affect the peanut consumption frequency (Jolly et al., 2008). The various product attributes are also found to be significant in explaining variations in peanut product consumption pattern (Jolly et al., 2002)

Model Development

Peanut paste/butter consumption frequency analysis

Since the consumption frequency is constructed as counts, a count data regression model would be the ideal choice for analyzing factors associated with variation in peanut paste/butter consumption frequency across households in the sample. There are different types of count data models like Poisson, negative binomial, etc., which are employed based on certain features of the distribution of count dependent variable.

Poisson Model

This is the simplest of the count data models, where the dependent variables is assumed to have a Poisson distribution, i.e., the probability of observing a specific count, y is,

$$\Pr(Y=y) = \frac{\lambda^{y} e^{-y}}{y!},$$

where, λ is the parameter which is the mean and variance of the distribution. From this, the conditional mean function is written as

$E[y_i|X_i] = \lambda_i = \exp(X_i' \beta)$,

where X_i is a vector of explanatory variables and β is a vector of associated coefficients. If we take the natural logarithm of both sides, this model can be estimated as a log-linear model. In Poisson model, the mean and variance of the distribution are assumed to be the same (equidispersion), a very restrictive assumption. A quick look at the descriptive statistics (Table 1) will clearly tell that in this sample, the variance (square of the standard deviation) is much higher than the mean. If the variance is higher than the mean, it is called overdispersion and if it is lower, underdispersion. If the equidispersion assumption fails, the estimated standard errors of the coefficients would be biased downwards, though the estimated coefficients would still be consistent. In the case of overdispersion of data, negative binomial model would be more appropriate.

Negative Binomial Model

Here, the count dependent variable is assumed to have a negative binomial distribution, which is written as

$$P(Y = y) = \left(\frac{r}{r + \lambda}\right)^{r} \frac{\Gamma(r + y)}{\Gamma(y + 1)\Gamma(r)} \left(\frac{\lambda}{r + \lambda}\right)^{y}$$

Here, the mean is λ, but the variance is $\lambda + \frac{\lambda^2}{r}$, where r is the dispersion parameter. With negative binomial regression model, we can predict the probabilities in addition to modeling the mean.

Another issue is the selectivity problem in count data models. This problem arises with excess number of zeros in the data. Here, out of the total 1638 households, 137 households reported zero consumption frequency per month. Though these zeroes are included in the usual negative binomial regression estimation, the process of zero origination does not distinguish between zeroes originated from two different processes. In this dataset, one type of zeroes is created because those households do not eat peanut paste/butter, and the second type because of consumption frequency that is less than once in a month. However, a Zero-inflated Negative Binomial regression model will be able to distinguish this difference and estimate the coefficients accordingly.

Zero-inflated Negative Binomial Model

This model has two parts, the first for distinguishing households that consume peanut paste/butter (even though less than once in a month, and therefore result in zeroes) from those that do not want to consume (certain zeroes). This estimation is done through a logit model. The second part is the Negative binomial regression. For both parts, separate regressors can be used.

For choosing between these models, different tests are available. To choose between Poisson and Negative binomial, first, both models are fitted to the data and then, a likelihood ratio test is performed to verify advantages, if any, of negative binomial model over Poisson model. A similar approach is adopted for making a choice between zero-inflated Poisson and zero-inflated Negative Binomial. A test called Vuong test is applied to identify advantages of

zero-inflated Negative Binomial over the usual Negative Binomial model. In this analysis all these tests are done before arriving at the final results.

Analysis of Different Forms of Peanut Paste/Butter consumption

Here, the dependent variables in four equations that are to be estimated assume more than two values. Therefore, a binary logistic regression is inadequate to model the equations. The ordinal logistic regression is an extension of the binary logistic regression that takes into account the ordering of responses used in this study. The four dependent variables are constructed based on a question asked, i.e., indicate the frequency of peanut paste/butter consumption along with vegetables, with meat or fish, with bread, and with other foods respectively. Responses are recorded in four categories, i.e., 1 for "almost never", 2 for "not often", 3 for often, and 4 for very often, resulting in four categories for each of the four dependent variables. The modeling of an event includes modeling of the following odds of Y takes a value of 1 or 2 or 3.

Y_1= prob(value=1)/ prob(value>1)

Y_2= prob(value=1 or 2)/ prob(value>2)

Y_3= prob(value=1 or 2 or 3)/ prob(value>3).

The fourth (last) category does not have odds, as the cumulative probability of having a value of 1, 2, 3 or 4, is one (Norusis, 2011).

The ordinal logistic model then takes the form of $Yi = \alpha_i - b_j x_j$, where $_i$ represents the number of categories not including the last one (here 1, 2 and 3) and $_j$ represents the explanatory variables. The explanatory variables are the same as in the count regression model, except for the attributes. If the coefficient for a particular explanatory variable has a positive sign, then the likelihood of higher categories are more likely to occur; but, if it is negative, lower categories are more likely to occur (given an increase in the value of that explanatory variable if it is

continuous or changing the value from zero to one, if it is a binary variable). The results are also interpreted based on the marginal effects and predicted probabilities.

Results

The likelihood ratio test for testing the overdispersion of the data is highly statistically significant (Chi2=1.1e+04; Pr>chi2 =0.0000). This implies that the data is overdispersed and a Poisson model, that assumes the data is equidispersed, is insufficient to provide correct estimates. Therefore, the Negative Binomial is the choice. However, the Vuong test results for verifying if the Zero-Inflated Negative Binomial is required, is also statistically significant (Z=2.27; Pr>Z=0.0117) at 0.05 significance level leading to the conclusion that Zero-Inflated Negative Binomial regression method is the best choice among these different models. Therefore, the results from the Zero-Inflated Binomial Regression are presented below.

Factors influencing peanut paste/butter consumption

Results from this regression are given in Table 2. The estimated coefficients can be interpreted by themselves or through the Incidence Rate Ratio (IRR). The IRR is an easier alternative which is similar to odds ratios from a logistic regression. The interpretation follows is based on the IRRs.

Only the distance to shopping center is statistically significant in the inflated part of the regression and it says that excessive zeroes (meaning the lack of consumption in a month) in peanut consumption frequency will be decreased by an increase in the distance to a shopping center. It can be deduced from this that such households do not prefer consuming peanut paste/butter frequently. Because, the result suggests that when shopping center becomes closer, they do not purchase peanut paste/butter, resulting in zero consumption and when shopping

center is farther, these households purchase peanut paste/butter more frequently than when shopping center is closer. The results from the count part of the model are given below.

The respondents with an education of upper higher secondary or higher level have peanut paste consumption 1.17 times more likely than those with a lower higher secondary or less education. It is more likely that those who obtained higher degrees will be aware of the nutritional value of peanuts. If the households have children of age 3 years or less, then the consumption frequency is tend to be lesser by 0.91 times than those without children under this category. A study by Toit et al. (2008) concludes that it may be possible to avoid peanut allergy, if infants are given peanut products at a very early stage. Those households that make peanut paste at home are 1.32 times more likely to have high consumption frequency than those that do not make peanut paste at home. This result is plausible, since there is an easy access to peanut paste. With regard to location of households, Gulu, Lira, Soroti and Mbale locations are more likely to have more consumption frequency than those households in Kampala, the capital city. This likelihood is more in Gulu (2.27 times), followed by Soroti (1.79 times), Lira (1.71 times) and Mbale (1.52 times). The respondents who consider color of the peanut to be important are more likely (1.23 times) to have increased consumption frequency than those who do not consider it to be important. According to Jolly et al. (2002), product attributes affect peanut consumption, and Schutz et al. (1986) concluded that sensory attributes are positively correlated with percent of food expenditures. Another very interesting result is that those households with respondents who are interested in consuming vitamin A fortified foods will be more likely (1.28 times more) to have higher consumption frequency than those with respondents who expressed no interest. As the vitamin A deficiency is high in pre-school children and pregnant women, peanut paste/butter can be a good choice for vitamin A fortification.

Factors influencing the frequency of peanut paste/butter consumption with different foods

The likelihood ratio tests show that all the four models are globally statistically significant with the rejection of the respective null models (Table 3). The low value of McFadden's pseudo R-square is not uncommon in cross sectional studies. Previous studies also report low values, for example, Brierley (2008) and Hank and Schaan (2008). Following are the results presented separately for each of the four equations. The results from these four estimations are given in Table 3.

Frequency of consumption with vegetables

The respondents with upper higher secondary education or more are less likely to consume peanut paste along with vegetables as frequently as those with lower higher secondary or less education. An increase in the number of adults reduces this frequency. The households that prepare peanut paste at home are more likely to have increased frequency than those which do not prepare peanut paste. Households located in Gulu, Lira, Soroti and Mbale are more likely to have greater frequency than those households in Kampala.

Frequency of consumption with meat or fish

An increase in age of the respondent decreases the likelihood of having peanut paste consumption along with meat or fish. This less frequency may be attributed to the generally low consumption by older people. Jolly et al. (2008) found that in Ghana older people tend to eat less peanut products than younger people. This may also be due to the avoidance of meat by older

people because of health reasons and the generally low consumption of meat among African countries (Speedy, 2003). Households with respondents engaged in self employment are more likely to have increased frequency than households with respondents in other jobs. Households that prepare peanut paste at home are more likely to consume peanut paste with meat or fish more frequently. Households in Gulu, Lira and Mbale have less likely to have more consumption frequency than those in Kampala.

Frequency of consumption with bread

Households with married respondents are less likely to have consumption frequency as those with single respondents. Respondents with permanent or self employment are more likely to have higher frequency than those in other jobs. Those who have upper higher secondary or more education have higher likelihood of having more frequency of consumption than those with lesser education. Total monthly income of the household increases the chances of a higher consumption frequency. Jolly et al. (2008) conclude that consumption of peanut paste with bread increases with an increase in income. If the main source of income is salary, then also this likelihood increases, where as if the income source is trading, the likelihood decreases. Increase in the number of adults increases the likelihood of having more consumption frequency. Increase in the distance to the nearest shopping center tends to increase the frequency more likely. This may be due to the highly perishable nature of vegetables, meat or fish that are bought from a distant shopping center, so that the households may have run out of this stock faster than the stock of bread. With regard to geographical locations, households in Gulu have higher likelihood, while those in Mbale and Soroti have less likelihood of having more peanut paste consumption frequency along with bread than households located in Kampala.

Frequency of consumption with other foods

If the household head is a male, then there is less likelihood of having more of this type of consumption. Households with permanently employed respondents are more likely to have increased frequency. Also, households with children are more likely to have increase frequency. Households that prepare peanut paste are more likely to consume peanut paste with other foods more often. Households located in Gulu are less likely, while those in Lira, Mbale and Soroti are more likely have increased frequency of consumption with other foods.

Discussion

The information obtained from the analysis of factors that influence peanut paste/butter consumption frequency in the Republic of Uganda will help the concerned policy makers with their policy formulations in at least two ways. It will assist the implementation programs intended to reduce aflatoxin intake through the consumption of peanut paste/butter, through the creation of profile of households that are likely to have more peanut paste consumption. For example, those households having respondents with upper higher secondary education and more, that prepare peanut paste at home, that are located in Gulu, Lira, Soroti and Mbale, households with respondents who consider the color of the peanut an important attribute or households with respondents who are interested in consuming vitamin A fortified foods are more likely to have higher peanut paste/butter consumption frequency. Educating those households about how to reduce the aflatoxin contamination in the peanut paste/butter they buy, or prepare at home will bring down the consequences of aflatoxin intake by this population segment. This becomes important, since some studies have concluded that peanut butter consumption is a risk factor in liver cancer incidence (Omer et al., 2000; Williams et al., 2004). At the same time, the result that households with children of 3 years or younger are more likely to have reduced consumption

is also worth considering, especially since there are studies that conclude that if infants are exposed to peanuts at a very early stage, then the incidence of peanut allergy may be reduced (Toit et al.. 2008).

The results from this analysis will also help in implementing programs that target the reduction of vitamin A deficiency among people, especially among pre-school children and pregnant women. Fortification of peanut paste/butter with vitamin A can be a good option; according to the results from this study, households with respondents who are interested in consuming vitamin A fortified foods have higher peanut paste/butter consumption. Interestingly, about 94% of the respondents in the survey sample are interested in consuming such foods.

Another objective of this study was to determine the factors that affect the consumption frequency of peanut paste/butter along with different types of foods, namely, vegetables, meat or fish, bread and other foods. Location of households is found to be the main factor that influences these various forms of consumption. In the case of consumption with bread, income, education and employment status also found to be important in explaining variations in the consumption frequency.

The probabilities of having a particular form of consumption frequency calculated at mean values of the explanatory variables are given in Table 4. The cumulative probabilities of consuming peanut paste/butter with a particular food “often” or “very often” are 0.78, 0.66, 0.45 and 0.61 in the case of vegetables, meat/fish, bread and other foods, respectively. The Figure 1 graphically represents these probabilities. As there are binary variables, probabilities are also calculated based on a hypothetical situation. The situation is : Respondents are from households with a male head and with a monthly income of 612290 Ugandan shillings; main source of income is salary; are 35 years old; are married; have permanent employment; have upper higher

secondary or more education; households prepare peanut paste at home; households have children; households are from Gulu city; respondents are interested in consuming vitamin A fortified foods. The probabilities have changed to 0.85, 0.62, 0.81 and 0.61 for vegetables, meat/fish, bread and other foods, respectively. The Figure 2 shows these probabilities graphically. The probability for higher consumption frequency with bread has increased to almost double.

The result from the equation that analyzed the frequency of peanut paste/butter consumption along with vegetables is worth pursuing from the standpoint of the reduction of aflatoxin consequences in the society. Some studies (Sarkar et al., 1994; Jubert et al., 2009) have concluded that chlorophyll and chlorophyllin content found in most green plant parts can reduce the consequences of aflatoxin contamination.

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Table 1. Descriptive Statistics of the Variables used

Variable	Mean	Std. Dev.	Min	Max	Description
Dependent					
Gnfreq	16.58688	17.23577	0	60	Consumption frequency per month
Pasteveg[a]	3.046163	0.8856548	1	4	Frequency of consumption of paste/butter with vegetables
Pastemeat[a]	2.825625	0.8997079	1	4	Frequency of consumption of paste/butter with meat or fish
Pastebread[a]	2.339825	1.108389	1	4	Frequency of consumption of paste/butter with bread
Pasteotherfood[a]	2.31745	0.9740503	1	4	Frequency of consumption of paste/butter with other foods
Independent					
Headgend	0.709599	0.4540854	0	1	Gender of the household head 1=male; 0=female
Age	35.33911	12.35561	17	89	Age of the respondent in years
Permanent	0.1342649	0.3410403	0	1	Permanent job
Self	0.3718104	0.483435	0	1	Self employed
Others	0. 4914945	0. 5000796	0	1	Other jobs*
Education	0. 345079	0. 4755385	0	1	1=upper secondary or above, 0 =otherwise
Soutrading	0.3013366	0.458978	0	1	Main source of income is trading
Sousalary	0.3037667	0.4600229	0	1	Main source of income is salary
Souother	0.3657351	0.4817821	0	1	Main source is others*
Totalincome	612291.3	1993446	1000	67000000	Total monthly household income in Ugandan Shillings
Adults	2.2930403	1.4136391	0	15	Number of adults in the household
Child	0.9157509	0.2778458	0	1	1 If the household has children and 0 otherwise
Child3	0.5486027	0.4977834	0	1	1 if there are children of 3 or less than 3 years of age
Shopdist	573.0996	1925.962	0	50000	Distance to the nearest shopping center in meters
Homepreppaste	0.5200765	0.4997561	0	1	Prepare peanut paste at home 1=yes; 0=no
Gulu	0.1215067	0.3268145	0	1	Residence in Gulu (=1)
Lira	0.1221142	0.3275172	0	1	Residence in Lira(=1)
Mbale	0.1215067	0.3268145	0	1	Residence in Mbale(=1)
Soroti	0.1172539	0.3218204	0	1	Residence in Soroti(=1)
Kampala	0.5152625	0.4999196	0	1	Residence in Kampala (=1)*
Color	0.744836	0.4360859	0	1	Importance of the color of paste/butter[b]
Thickness	0.8068044	0.3949251	0	1	Importance of the

					thickness/viscosity of paste/butter[b]
Oilseparation	0.6123937	0.487352	0	1	Importance of no oil separation from paste/butter[b]
Taste	0.8851762	0.3189061	0	1	Importance of taste of paste/butter[b]
Rancidtaste	0.6919806	0.4618149	0	1	Problem of rancid taste experienced with paste[c]
Badaroma	0.717497	0.4503535	0	1	Problem of bad aroma experienced with paste[c]
Foreignmatter	0.5492102	0.4977237	0	1	Problem of observing pieces of shells and other foreign matter in paste[c]
Vitaforti	0.9368165	0.2433666			1 if interested in consuming vitamin A fortified foods, 0 otherwise

[a] 1=almost never, 2=not often, 3=often, 4=very often; [b] 1=important, 2=not important;
[c] 1=not experienced, 0=experienced; * reference category

Table 2. Results from the Zero-Inflated Negative Binomial Regression

Independent variables	Consumption frequency	Incidence Rate Ratio (IRR)	Zero inflated	Incidence Rate Ratio (IRR)
Headgend	0.0745	1. 07735		
	(0.0554)			
Age	-0.000658	0.9993419		
	(0.00227)			
Permanent	0.127	1. 135246	0.807	0.8065871
	(0.0872)		(0.881)	
Self	-0.0458	0.9552008		
	(0.0558)			
Education	0.161**	1. 17527	-0.428	-0.4278832
	(0.0570)		(0.808)	
Soutrading	-0.0470	0.9540691		
	(0.0624)			
Sousalary	0.0289	1.029359		
	(0.0672)			
Totalinc	1.10e-08	1	-1.08e-08	-1.08e-08
	(1.20e-08)		(0.000000126)	
Adult	0.0105	1.010511		
	(0.0175)			
Child	0.0121	1.012181		
	(0.0129)			
Child3	-0.0905*	0.9134553	0.765	0.76479
	(0.0549)		(1.413)	
Shopdist	0.0000145	1.000015	-0.00711**	-0.0071**
	(0.0000135)		(0.00325)	
Homepreppaste	0.276***	1.318199		
	(0.0591)			
Gulu	0.822***	2.274832		
	(0.0889)			
Lira	0.535***	1.707327		
	(0.0870)			
Mbale	0.416***	1.516193		
	(0.0824)			
Soroti	0.582***	1.788722		
	(0.0861)			
Color	0.207***	1.230126	0.468	0.4675454
	(0.0598)		(1.116)	
Thickness	(0.0598)	1.001463		
	(0.0680)			
Oilseparation	-0.0328	0.9676857		
	(0.0533)			
Taste	0.0225	1.022795		
	(0.0852)			
Rancidtaste	-0.0572	0.9444372	0.153	0.1527432

	(0.0643)		(0.751)	
Badaroma	-0.104	0.9012152	-0.630	-0.6296264
	(0.0647)		(0.985)	
Foreignmatter	-0.0404	0.9604216		
	(0.0558)			
Vitaforti	0.248**	1.282005		
	(0.111)			
Wald chi2	460.09		Prob=0.000	

***, ** and * denote significant at 0.01, 0.05 and 0.1 level respectively

Table 3. Estimation results from the Ordinal Logistic Regression of four equations that explain variation in forms of consumption of peanut paste/butter

Dep var/ indep var	with vegetables	With meat or fish	With bread	With other foods
Headgend	-0.127	0.00640	0.172	-0.425***
	(0.145)	(0.137)	(0.140)	(0.138)
Married	0.118	0.103	-0.314**	0.169
	(0.143)	(0.136)	(0.140)	(0.136)
Age	0.000229	-0.0113***	-0.000880	-0.000115
	(0.00423)	(0.00409)	(0.00420)	(0.00416)
Permanent	-0.210	-0.0963	0.568***	0.407**
	(0.169)	(0.168)	(0.172)	(0.170)
Self	-0.0567	0.236**	0.235**	-0.0344
	(0.113)	(0.110)	(0.112)	(0.110)
Education	-0.372***	0.0742	0.389***	0.155
	(0.114)	(0.112)	(0.115)	(0.112)
Soutrading	-0.0254	-0.00644	-0.220*	0.166
	(0.127)	(0.123)	(0.125)	(0.124)
Sousalary	-0.115	0.147	0.343**	0.0349
	(0.136)	(0.134)	(0.135)	(0.135)
Totalinc	-1.63e-08	1.02e-08	0.000000127***	5.65e-09
	(2.09e-08)	(2.01e-08)	(3.38e-08)	(2.17e-08)
Adultdum	-0.756**	0.0667	0.675**	0.140
	(0.313)	(0.301)	(0.323)	(0.306)
Child	0.259	-0.0160	0.0253	0.491***
	(0.181)	(0.179)	(0.186)	(0.185)
Shopdist	-0.0000313	-0.0000134	0.0000455**	-0.00000443
	(0.0000232)	(0.0000301)	(0.0000224)	(0.0000265)
homepreppaste	0.966***	0.750***	0.0982	0.435***
	(0.124)	(0.119)	(0.117)	(0.113)
Gulu	0.842***	-0.762***	0.604***	0.102
	(0.184)	(0.173)	(0.174)	(0.171)
Lira	0.398**	-0.620***	-0.170	-0.590***
	(0.179)	(0.168)	(0.180)	(0.170)
Mbale	1.011***	-0.495***	-0.615***	0.422**
	(0.165)	(0.157)	(0.174)	(0.163)
Soroti	0.349**	0.255	-0.640***	0.429**
	(0.171)	(0.169)	(0.171)	(0.168)
Vitaforti	-0.148	0.226	-0.0703	0.537**
	(0.211)	(0.205)	(0.218)	(0.213)
Pseudo R2	0.0673	0.0249	0.0350	0.0263
LR chi2	250.39	95.70	136.66	103.48

***, ** and * denote significant at 0.01, 0.05 and 0.1 level respectively

Table 4. Predicted probabilities of a respondent falling into a category calculated at the mean values of explanatory variables

	Predicted probabilities of having peanut consumption with a particular food			
Category	Vegetables	Meat or fish	Bread	Other foods
1 = Almost never	0.05	0.07	0.3	0.24
2=Not often	0.17	0.27	0.25	0.33
3=Often	0.45	0.41	0.28	0.32
4 = Very often	0.33	0.25	0.17	0.11

Table 5. Predicted probabilities of a respondent falling into a category calculated based on hypothetical personal and household characteristics

	Predicted probabilities of having peanut consumption with a particular food			
Category	Vegetables	Meat or fish	Bread	Other foods
1 = Almost never	0.3121	0.0839	0.0738	0.1343
2=Not often	0.118	0.2967	0.1137	0.2563
3=Often	0.407	0.4056	0.2813	0.4024
4 = Very often	0.443	0.2138	0.5302	0.207

Situation: Respondents are from households with a male head and with a monthly income of 612290 Ugandan shillings; main source of income is salary; are 35 years old; are married; have permanent employment; have upper higher secondary or more education; households prepare peanut paste at home; households have children; households are from Gulu city; interested in consuming vitamin A fortified foods

Figure 1. Predicted probabilities (calculated at the mean values of explanatory variables) of having peanut consumption with a particular food

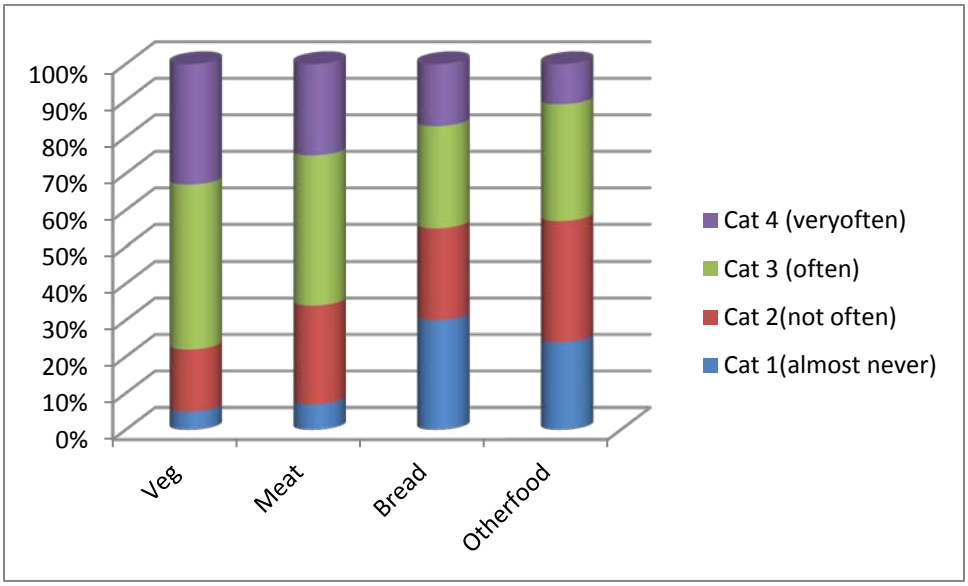

Figure 2. Predicted probabilities (calculated based on the hypothetical situation) of having peanut consumption with a particular food