What determines consumption of fortified foods in Kenya: the potential for micronutrient malnutrition control

Kennedy Otieno Pambo (corresponding author)

The National Treasury. P. O. Box 30007, Nairobi. Collaborating with the department of Agricultural Economics, University of Nairobi. Phone: 0723 787934, Email: kennedypambo@gmail.com, kenedy.pambo@treasury.go.ke

Dennis Opiyo olila

The National Treasury. P. O. Box 30007, Nairobi. Phone: 0720 633940, Email oliladennis@gmail.com

Abstract

Food fortification is considered as an important strategy for addressing micronutrient malnutrition that includes vitamin A, iron and zinc deficiency in most developing countries. Development efforts have thus focused on breeding for crops that have natural ability to produce through a process widely known as bio-fortification. In Kenya, these efforts are being complemented with push pilot fortification of foods. The recently enacted National Food Security and Nutrition Policy aims to encourage industrial fortification of widely consumed foods with essential micronutrients. Despite these efforts there is still very weak information on factors affecting consumption of fortified foods hence the dearth of knowledge regarding consumption levels and patterns. This study therefore assessed factors affecting consumption of fortified foods. It focuses on Vitamin A fortified sugar and uses data collected from rural and peri-urban areas of Kenya through a binary probit model to examine consumption drivers. The results showed that point of purchase, trust for stakeholders involved in fortification, consumer awareness and knowledge of the importance of vitamin A have significant effects on consumption of fortified foods. These findings offer useful insights for the development of nutrition policies in Kenya, and Africa at large. The study also augurs well with the theme 'Innovative Research and Technology for Global Development' on the premise of value addition, food technology and human health development.

1. Introduction

People feel hungry when their body's intake of protein, fat or carbohydrate is inadequate but not when their intake of equally important micronutrients, including vitamins and minerals, is insufficient. However, for divine health, these micronutrients are essential. Micronutrient deficiency is, therefore, often known as 'hidden hunger'. Worldwide, more than 2 billion people, almost one third of the world's population, suffer from hidden hunger (Meenakshi et al., 2010).

Micronutrient deficiencies have a debilitating effect on health, leading to onset of several diseases and disabilities causing not only distress but also economic loss to an individual, his family and the country (WHO, 2006). The deficiencies have a profound impact on the socio-economic fabric of a household and the country. The result is the increased difficulty to escape the poverty circle as economic status of more household worsen. The human suffering and the economic losses could be totally avoided if the right strategies are followed.

Among the nutritional deficiencies, lack of sufficient amount of vitamin A (VA) and iron has the greatest impact on public health in Kenya (KNFFA, 2011). For instance, vitamin A deficiency (VAD) is a major problem that is not necessarily limited to specific groups of people or isolated communities. It is one of the most frequently occurring forms of malnutrition in developing countries. An estimated 250,000 to 500,000 VA-deficient children go blind every year (West Jr. and Darnton-Hill, 2001). A part from acute eye symptoms, VAD also weakens the immune system, thus increasing the severity of infectious diseases and infant mortality rates. For adults, the severity of VAD is higher among pregnant and lactating women. In this regard, it is estimated that about 600,000 women die from childbirth-related complications each year, many of which could be reduced through better provision of VA (West Jr. and Darnton-Hill, 2001).

Among the alternative approaches to counter VAD, including VA-supplementation or dietary diversity, fortification of foods with minerals and vitamins is the most effective and least expensive method of eliminating micronutrient deficiencies (WHO, 2006). It is commercially viable. The cost to the government is minimal since the main responsibility for fortification has to be shouldered by the industry. The technology is proven since many countries particularly, developed countries, have been fortifying foods at least several years back. Fortified foods should be acceptable to people since they are not widely different in appearance and taste from conventional foods, do not require any change in dietary habits and have the added advantage of providing more nutritive value (Meenakshi et al., 2010).

The majority of people in Kenya are exposed to health disorders arising from micronutrient deficiencies. Deficiencies of the critical micronutrients (vitamin A and iron) have led to health disorders like anaemia, mental retardation, blindness, morbidity and high mortality. For example, over 70% of children and 33% of women of childbirth age in Kenya, suffer from the severity of infectious diseases and infant mortality rates while over 30% of children suffer from acute eye symptoms (West Jr. and Darnton-Hill, 2001; Meenakshi et al., 2010; KNFFA, 2011), which are the outcomes VAD. At the same time, as is the case in many developing countries, access to food supplements and animal food products-that supply vitamin A directly in form of retinol, is limited (Kimenju et al., 2005). These health problems have affected productivity and resulted in loss of national income. It is estimated that nearly 3% of the GDP is lost because of deficiencies of the two critical micronutrients (KNFFA, 2011).

Food enrichment with these important micronutrients through fortification offer great promise in the fight against micronutrient malnutrition. However, consumption of enriched foods remains the barrier to achieving such ambitious goal. Consumers must first consume fortified foods as vehicles of acquiring the added micronutrients. In this regard, the aim of this study is to investigate what determines consumption of fortified foods using fortified sugar as a case study. Specifically, a probit model is specified to analyze the factors with significant effect on consumption decisions regarding fortified sugar. The results would be useful in informing policies geared towards combating micronutrient malnutrition through value addition in processed foods.

2.0. Methodology

2.1. Sample design and data collection

The target population included households residing in Western and Central parts of Kenya-that includes the capital city of Nairobi. The survey was implemented through face-to-face interviews conducted in March and April 2013. This method of data collection was instrumental in ensuring that only members of the household who are primary food shoppers answered the questionnaire. The study regions were divided into smaller administrative units called sub-counties. Within each sub-county, a random sample of locations was drawn, from which a number of smaller administrative units (sub-location) were drawn, with regard to the distribution of consumers (population). Within the sub-locations, smaller units (Villages in rural

areas and Estates in peri-urban areas) were randomly selected. The primary sampling units were the households, supermarkets and clinics, from which primary household sugar-shopper's (respondent) was drawn using a systematic random sampling criterion. More importantly, to select the households, a cross-sampling method was used; that is, a cross "X" was drawn on the village map and every nth household along the "X" with a random start was interviewed (Birol et al., 2011). Employing sampling proportionate to size criterion, a total sample size of 350 sugar consumers was realized.

2.2. Probit Model

The econometric model used to identify factors that affect consumption of fortified foods can be modelled as two decisions: an individual either consumes fortified foods or not. The dependent variable in this case, consumption, is binary and takes the value of 1 if positive (an individual consumes) and 0 otherwise. The probit model can be specified following Greene (2003):

$$P\left(\alpha_1 = 0\right) = \phi\left(\frac{-\beta_\alpha^1 X_1}{\sigma}\right) \qquad\qquad 1$$

Where "α_1" is the dependent variable if individual i answered 1= positive (consumes fortified sugar) and 0= otherwise; "P" is a vector of respondent's consumption characteristics; "β"is a vector of coefficients and "ϕ" is the cumulative probability distribution.

The probability that individual i consume fortified sugar is estimated empirically as:

$$\Pr\left[Y_i = 1\right] = X_i \beta_i + \varepsilon_i \qquad\qquad 2$$

X_i is a vector of socioeconomic and food demand characteristics that are posited to influence consumption of fortified sugar; β_i is a vector of parameters to be estimated, while ε_i is the statistical random term specific to individual sugar consumer.

The binary logit and probit models are both based on latent regression. The only difference between the two functions is the different specification of the error term (ε_i). The error term is handled as standard normal distribution in the probit model but as a logistic distribution

in the binary logit model. The authors did not find any econometric premise of choosing between the two models and the results were also statistically similar. However, the results from probit model were more appealing.

Additionally, marginal effects were estimated to measure instantaneous effects of changes in any explanatory variable on the predicted probability of consuming fortified sugar, while holding other explanatory variables constant. The probit model and marginal effects, as well descriptive statistics, were estimated using the statistical package STATA, version 10.

2.3. Variables included in the model

Table I shows the description of variables that have been included in the probit model. Following Neven and Reardon (2004), frequent purchase from supermarket is expected to increase consumption of fortified foods. This is due to the additional information offered by these purchase outlets through skilful display of goods as well as frequent advertisement of products via numerous media. Individuals who seek nutritional information, either from family members, friends or any other media, are expected to have higher chances of consuming fortified foods. This is because inquiring from others is likely to increase knowledge regarding fortified foods in the same manner as reported in Pambo (2013). Additionally, respondents who trust organizations involved in fortification process including, companies that produce and distribute fortified foods as well as bodies involved in monitoring and control for safety, are also expected to have higher probabilities of uptake. The reason being that individuals are expected to reveal their confidence in fortified foods through their purchase decisions. More precisely, respondents who trust fortification process should show their confidence in fortified products through purchase.

The effect of age and gender on consumption of fortified foods is empirical (Adesina and Baidu-Forson, 1995). The rational is that older consumers may be expected to consume more fortified foods due to their accumulated experience in good nutrition. On the other hand younger consumers' may consume more fortified foods due to their exposure and tendency to embrace new technology with much ease (Nair, 2012). Concerning income, respondents with higher income are expected to have higher probability of consumption of fortified foods. This is

because food fortification is expected to come with an added cost to consumers so may be easily accepted by higher income earners.

Suitability of the above selected factors for econometric analysis was tested for multicollinearity using the variance inflation factors (VIF), which was computed for each of the consumer characteristics reported in Table I. The VIF computation involves estimation of 'artificial' ordinary least squares (OLS) regressions between each of the consumer characteristics as the 'dependent' variable with the rest as dependent variables (Long, 1997). The VIF for each factor is calculated as:

$$VIF_i = \frac{1}{1 - R_i^2} \qquad\qquad 3$$

Where R_i^2 is the R^2 of the artificial regression with the ith independent variable as a 'dependent' variable. The mean VIF was 1.41 with individual VIF ranging from 1.07 to 1.87 indicating absence of multicollinearity. Maddala (2000), suggested that variables with VIF<5 have no multicollinearity; hence they were selected for inclusion in the probit model.

3.0. Results and Discussions

3.1. Descriptive statistics

Table II presents the socioeconomic characteristics of the respondents. More female respondents (55%) answered than males because individuals in the study areas were selected based on availability and responsibility for food purchase in the household. The implication is that female members' shoulders heavy responsibility in terms of household food purchase decisions and therefore, should be targeted for nutrition information programmes. Respondents' average age is 35 years (varying from 18 to 85 years); persons younger than 18 years were not selected for the interviews as it was assumed that the younger sugar consumers had less experience in shopping and would give biased responses (De Groote et al., 2010).

In general, only a third of the sampled households was found to have consumed fortified sugar, even though 55% of the respondents were aware of sugar fortification. This calls for targeted efforts intended to increase consumption of fortified foods. In fact, the results reveal that

only 44% of the respondents seek nutritional information before purchasing food items. Efforts geared towards promoting sharing nutritional information, particularly among the households' should be considered, in order to promote uptake of nutritionally enhanced food items. With regard to frequency of sugar consumption, almost all the respondents consume sugar daily either in tea, porridge and other commodities (e.g. bread, cakes, biscuits, soft drinks, other beverages and confectionary products). This confirms the suitability of sugar as an avenue of fortification which is best, justified in terms of frequency of consumption by the target population rather than the quantity consumed by that population (WHO, 2006)

3.2. Factors Determining consumption of fortified foods

The results from the probit regression are presented in Table III. Both parameter estimates for coefficients and marginal effects from the binary probit model are shown. The significance of chi square, log-likelihood function and McFadden pseudo R^2 shows that probit regression model is fit for the analysis. Whereas the coefficient values explain the probable influence of each regressor on awareness generally, in this kind of probabilistic studies, the marginal effects measure the actual effect of instantaneous changes in each of the explanatory variables on consumption decisions (Anderson and Newell, 2003).

Age of consumers negatively and significantly influence consumption of fortified sugar. The result implies that younger age-group consumes sugar and is more likely to consume fortified sugar than older age-group. The marginal effect results shows that an increase in age of the sugar consumer by one year reduces the probability of consuming fortified sugar by 1%. Following Okello et al. (2009), internet options and mobile phone usage have provided the medium for the new advertisement opportunities that targets mostly technologically advanced consumers. The younger sugar consumers get favor in these new avenues which may explain their high level of consumption, given also that they are highly responsive to change.

The influence of income on consumption of fortified sugar in this study is negative, against the expectation. Since food fortification usually comes at a cost (above the normal price), and consumers have to dig deeper into their pockets to purchase such nutritionally enriched foods, it was expected ceteris paribus`, that higher income group would consume more (De Groote et al., 2010). The results however reveals that an increase in income reduces the

probability of consuming fortified sugar by 18%. The reason could be that the rich have got greater access to alternative sources of micronutrients including vitamin A so that to them, fortification adds no value.

Consumers whose major sugar purchase outlet is the supermarket have higher probability of consuming fortified foods than those who frequent other outlets such as retail stores, shops and open markets. This finding corroborates those reported in Lupin and Rodriguez (2012). The result shows that purchasing from a supermarket increases the probability of consuming fortified sugar by 55%. The marginal effect indicate that an instantaneous change from buying sugar from the kiosks or open air markets to buying from supermarket increases the probability of consuming fortified sugar by 20%. The reason for this lies in the 'demonstration effect' as consumers are able to see, read labels or even touch fortified sugar on display while purchasing from the supermarket (Neven and Reardon, 2004; Weatherspoon and Reardon, 2003).

Households who seek nutrition information either from peers' or other sources including media also have higher probability of consuming fortified foods. Results from this study indicate that seeking nutritional information prior to sugar purchase increases the probability of consuming fortified sugar by 67%. These results are important for nutrition policy in Kenya as it suggest the need to provide well designed and targeted nutritional information to shape the nutrition debates among the consumers. The rationale is that with informed debates (for example, the results from this study shows such debates improves the probability of consuming enriched foods), more fortified foods would be consumed rendering fortification process in Kenya a success.

Respondents who are bequeathed with the information regarding the importance of micronutrients in their diets will most likely consume fortified foods. This is because micronutrients such as vitamin A are very important aspects in promoting human health. The results shows that knowledge of the importance of vitamin A in diets increases the probability of consuming fortified sugar by 115%. The results are consistent with those of Gonzalez et al. (2010) who reported that farmers who knew the importance of vitamin A in their diets were more likely to adopt bio-fortified cassava in North Eastern Brazil.

Consumer trust for fortification process is important for acceptance and consumption of fortified foods. This includes the trust for the safety of fortified foods; trust for the companies involved in food fortification and distribution as well as the trust for the government departments

charged with the mandate of monitoring the quality and safety of fortified foods. Lack of trust would directly hinder consumption and therefore, it is crucial for the listed bodies to perform their mandate effectively, if the potential for food fortification is to be realized. The results from this study shows that consumers who trust sugar fortification process have higher probability of consuming fortified sugar. This is important for the bodies mandated to promote food fortification in Kenya, including the Kenya national food fortification alliance (KNFFA) to ensure that consumers' trust is not jeopardized by issues relating to quality and safety of fortified foods.

The results also shows that consumer's awareness of vitamin A fortification increase the consumption of fortified sugar by 193%. In fact consumer awareness is the factor with the largest effect on consumption of fortified sugar in this study. The marginal effect indicate that a unit increase in consumer awareness regarding sugar fortification process instantly increases the probability of the respondent to consume fortified sugar by 59%. Consumer awareness-the right of the consumers' to be aware of the products they purchase (Bailey, 2005), offers a considerable opportunity, to the realization of the apparent benefits of food fortification in the fight against micronutrient deficiency. According to Nair (2012), consumer awareness inculcates their responsibilities and balances the power between them and producers. Awareness is at the forefront of defence against fraud and deception that is rampant in the food industry, hence a powerful tool of progress in a society. It is important in enabling consumers make rational choices and informed decisions before spending money on any item.

4. Conclusions

In this paper we explores the factors that affect consumption of nutritionally enhanced (fortified) foods using a probit model on a sample of 350 sugar consumers. The results reveals that income and age of consumers, point of purchase, trust for fortification process, knowledge of the importance of micro-nutrients in the diet as well as awareness of fortification programmes, significantly influence the consumption of fortified foods. The findings clearly indicate that a high level of consumer trust and knowledge on the importance of vitamin A in the diet tends to exert a positive influence on fortified sugar consumption, while increase in age and income tend to have a negative effect.

While debates on the link between diet and health continue to gain momentum, the prospects for food fortification in combating micronutrient malnutrition takes precedence. However, a large gap remains in understanding the reaction of consumers towards fortified foods. On the continuum from scientific discovery to implementing mass fortification programmes, a renewed emphasis must be placed on the final determinant of the success of fortification programmes – the consumer. In this regard, developing commitments, and building institutional capacities at national and local level to deliver, manage, and monitor fortification programmes for safety as well as educating the consumer, would go a long way in building consumer trust thus hastening the uptake of fortified foods.

Until these gaps are filled (i.e. building consumers' trust, awareness and shaping informed nutritional debates through provision of dietary knowledge), micronutrient deficiencies, affecting more than a billion mothers and children in developing countries, will continue to take their toll, leaving in their wake an unacceptable burden of preventable morbidity and mortality, and lost opportunities for human, social, and economic development.

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Table I: Description of variables included in the probit model

Variable	Description of the variable	Expected sign
PURCHASEPOINT	Point of purchase (1 = supermarket, 0 = otherwise)	+
SEEKINFORMATION	Inquire from others before purchase (1 = Yes, 0 = No)	+
IMPORTANTVA	Knows the importance of VA in health (1 = Yes, 0 = No)	+
TRUSTFORTIFICATION	Faith in fortification stakeholders/bodies (1 = Yes, 0 = No)	+
AWAREVA	Aware of sugar fortification with VA (1 = Yes, 0 = No)	+
AGE	Years of living	±
GENDER	Sex of the respondent (1 = female, 0 = otherwise)	±
EDUCATION	Years of formal education	+
INCOME	Respondents income (high if above sample average)	+

Table II: Socioeconomic characteristics of the respondents

Variable	Average
Average age of respondent (years)	35.1(10.6)
Average household income (Kshs)	34200(29698)
Average household size	4.0(2.2)
Average Years of schooling	11.9(3.4)
Gender of respondent (% Female)	55
Aware of VA fortified sugar (% Yes)	55
Have consume fortified sugar (% Yes)	34
Supermarket is the main purchase point (% Yes)	38
Seek nutrition information prior to purchase (% Yes)	44
Know the importance of vitamin A in human health (% Yes)	50
Trust fortification process (% Yes)	65
Frequency of consuming sugar (% Daily)	98

* Standard deviations are in parentheses (for continuous variables).

Source: authors' survey, 2013

Table III. Probit estimates for determinant of consumption of fortified sugar

Variable	Coefficient	Marginal effect
PURCHASEPOINT	0.546** (0.216)	0.198** (0.078)
SEEKINFORMATION	0.671*** (0.186)	0.240*** (0.066)
IMPORTANTVA	1.145*** (0.187)	0.391*** (0.059)
TRUSTFORTIFICATION	0.441* (0.236)	0.151** (0.076)
AWAREVA	1.927*** (0.252)	0.589*** (0.055)
AGE	- 0.026*** (0.007)	- 0.009*** (0.002)
GENDER	- 0.258 (0.185)	- 0.092 (0.066)
EDUCATION	- 0.144 (0.028)	- 0.051 (0.009)
INCOME	- 0.176*** (0.217)	- 0.063*** (0.077)
Log-Likelihood	- 120.211	
Pseudo-R^2	0.54	
N (Respondents)	350	

Notes: Standard errors in parentheses; Significance levels: *** 1%, ** 5%, * 10%.

Source: authors' survey, 2013