# ANALYSIS OF CONSUMER AWARENESS AND PREFERENCES FOR FORTIFIED SUGAR IN KENYA

**A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Agricultural and Applied Economics**

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## Declaration and approval

**Declaration**

**This thesis is my original work and has not been presented for examination in any other university.**

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**Dedication**

*To my parents, Ephraim and Rose, for teaching me the construct of life and hard work, to my fiancée, Rachel and my daughter Rosebella, for the new dawn in my life. To my brothers, Dave and Sam, and sisters, Winnie, Tausi, Ephy and Saline, for your cooperation, understanding and kindness during this study that made it easier for me to concentrate.*

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To my creator, for good health, wisdom and knowledge He imparted in me, and enabled me to continue with this work in His glory.

**Table of Contents**

**List of Tables**

**List of Figures**

**List of acronyms**

| | |
|---|---|
| CE | Choice Experiment |
| CM | Choice Modeling |
| CS | Compensating Surplus |
| CVM | Contingent Valuation Method |
| COFEK | Consumer Federation of Kenya |
| FAO | Food and Agricultural Organization |
| GoK | Government of Kenya |
| IFIC | International Food Information Council |
| IFPRI | International Food Policy Research Institute |
| IIA | Independence of Irrelevant Alternatives |
| IVACG | International Vitamin A Consultant Group |
| KNFFA | Kenya National Food Fortification Alliance |
| MNL | Multinomial Logit |
| OLS | Ordinary Least Squares |
| RP | Revealed Preference |
| RPL | Random Parameter Logit |
| SLL | Simulated Log-Likelihood |
| SP | Stated Preference |
| UNICEF | United Nations Children's Fund |
| UN SCN | United Nation's Standing Committee on Nutrition |
| VA | Vitamin A |
| VAD | Vitamin A Deficiency |
| WHO | World Health Organization |
| WTP | Willingness to Pay |

**Abstract**

Food fortification is considered as an important strategy to address micronutrient malnutrition, which is a key challenge in most developing countries. In Kenya, the National Food Security and Nutrition Policy focus on pilot efforts on food fortification. However, lack of empirical information on consumers' awareness and preferences for fortified foods remains the barrier to the uptake of fortified foods. This study assessed the consumers' awareness and analyzed their preferences for fortified sugar. Awareness was assessed using binary logit model while the preferences were determined through a choice experiment survey and random parameter logit (RPL) model. The study used primary data from a random sample of 350 consumers in Nairobi County (a completely urban setup), and Kakamega County (a relatively rural setup). The study found that about 55% of the households were aware of fortified sugar and that awareness levels were statistically higher for urban consumers. Results from binary logit regression showed that age of consumers, purchasing from supermarket, reading newspaper, living in urban area as well as having a child below the age of five years, were the significant factors influencing consumers' awareness of fortified sugar. The RPL results indicated heterogeneous and high preferences for fortified sugar attributes particularly, for rural consumers. Further, an analysis of compensating surplus (CS) showed that different consumer segments were willing to pay a premium ranging from 77% to 300% (above the average price of current conventional sugar) for fortified sugar, suggesting that there is high potential for sugar fortification in Kenya. These findings offer useful insights for the development of preference-based sugar fortification programmes in Kenya. Moreover, the results would guide formulation of policies against micronutrient malnutrition in Kenya and other developing countries, with similar conditions.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background information

Food quality, safety and availability are globally considered important aspects for human development. These entail access to nutritious and balanced diet that comprises carbohydrates, proteins, roughages, vitamins and minerals. Good nutrition is a prerequisite for human health and labour productivity (Caballero, 2003). Carbohydrates and proteins provide energy and build the body tissues respectively. On the other hand, roughages facilitate digestion of food, thus prevent constipation. Food quality is often conceptualized in the context of food energy or calorie intake. However, it is increasingly recognized that a large segment of the world's population especially in developing countries, consume food that is deficient in some micronutrients (WHO, 2007). Micronutrients (vitamins and minerals) are responsible for regulating various metabolic pathways and strengthen bones and teeth (FAO, 2002).

Micronutrient malnutrition is a widespread and serious problem, especially in developing countries, resulting in high economic and human costs (WHO, 2008). This is primarily caused by insufficient vitamin and mineral intake among the poor, whose diets are often dominated by starchy staple foods like maize or rice, and lack diversity due to low purchasing power or awareness (Kimenju et al., 2005). Due to their higher physiological requirements, women and children are the most affected. Generally, micronutrient deficiencies afflict more than 2 billion people globally, the majority of whom reside in developing countries (WHO, 2006). These nutritional shortfalls can impede physical and cognitive development, especially in children and reduce overall health levels. Consequently, the potential for widespread micronutrient deficiencies to impede human and economic development has received increased attention in recent policy literature and debates (Schwab, 2011).

Among the nutritional deficiencies, lack of sufficient amount of vitamin A, iron, iodine and zinc has the greatest impact on public health (see for example, Faber et al., 2002; Kimenju et al., 2005; WHO, 2006 and Meenakshi et al., 2010). The prevalence of three major micronutrient deficiencies is reported in Table 1. Vitamin A deficiency (VAD) is a major

problem that is not necessarily limited to specific groups of people or isolated communities. 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. For instance, 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 vitamin A (Sommer and West Jr., 1996).

Table1: Prevalence of the three major micronutrient deficiencies by WHO region

| **WHO region** | **(a) Iron deficiency (**total population**)** | **(b) Insufficient Iodine intake (**total population**)** | **(c) VAD (**pre-school children**)** |
|---|---|---|---|
| | **% of total** | **% of total** | **% of total** |
| Africa | 46 | 43 | 49 |
| Americas | 19 | 10 | 20 |
| South-East Asia | 57 | 40 | 69 |
| Europe | 10 | 57 | No Data |
| Eastern Mediterranean | 45 | 54 | 22 |
| Western Pacific | 38 | 24 | 27 |
| **Total** | **37** | **35** | **42** |

**Notes: (a)** based on the proportion of the population with haemoglobin concentrations below established cut-off levels. **(b)** Based on the proportion of the population with urinary iodine <100µg/l. **(c)** Based on the proportion of the population with clinical eye signs and/or serum retinol ≤0.70µmol/l. Source: WHO, 2006.

Vitamin A is mainly obtained from animal sources in the form of retinol. Other sources include dark-green-leafy vegetables, yellow and orange non-citrus fruits in the form of pro-vitamin-A carotenoids. Vitamin A from plant sources is less easily absorbed and utilized by the human body (less Bio-available) than the vitamin A coming from animal products (Kimenju et al., 2005). Since vitamin A from plant sources is usually found in large amounts in only a few fruits and vegetables, many of which are highly seasonal, low income populations may suffer from VAD unless VA is available in processed foods such as sugar, oils, and staples (Ruel, 2001).

Several approaches have been developed to reduce VAD worldwide. In many developing countries, supplements are provided to children through vitamin A capsules, typically every six months. These capsules contain retinol, which is stored in the liver from where it is slowly

released, in sufficient quantity to sustain vitamin A requirements for four to six months (dela Cuadra, 2000). Supplementation is generally considered cost effective (IVACG, 2003), although the costs and the number of children reached are influenced by the transport infrastructure. In Kenya, 90% of children between 6 to 59-months-old are reported to have received at least one dose of vitamin A in 2001 (UN SCN, 2004). However, UNICEF reported that the coverage of such vitamin A supplementation programmes usually stagnate at 58%, with high annual fluctuations. Moreover, children only receive one dose at the vaccination time, while they may need one every six months. Children older than nine months who have already received immunization can only receive the VA supplement either when they are sick and the mother takes them to a health clinic, or if the mother takes them to the clinic for the recommended monthly check-up (UNICEF, 2007).

An alternative to supplementation is dietary diversity, by creating awareness about the problem in affected communities and increasing use of foods that have relatively high levels of pro-vitamin A from home gardens and other sources. The promotion of such crops has been shown to have an impact on reducing VAD among children in South Africa, for example (Faber et al., 2002). Unfortunately, availability of appropriate food crops is often inhibited by resources available to the households and seasonality of fruits and vegetables; suffice to mention that, as an example; vitamin A intake of preschool children from low-income rural households in Kenya has been shown to differ significantly between the lean and the postharvest months (Kigutha et al., 1995).

The third method of reducing VAD is through biofortification, or breeding food crops with increased micronutrient content. Given the high number of people with micronutrient deficiencies, and the large amounts of staples the poor eat, biofortification has the potential to help many people at limited cost, as indicated by the good returns in vitamin A-biofortified maize for Kenya and Ethiopia (Meenakshi et al., 2010). However, biofortification is likely to increase the content of pro-vitamin A-carotenoids in maize, which, because of their chemical structure, will give it yellow to orange colour (Rodriguez-Amaya and Kimura, 2004). Furthermore, most of the maize for human consumption in Eastern Africa is white, largely for historical reasons (WHO, 2008; De Groote et al., 2010). This is likely to hinder the success of such biofortification programmes in Kenya.

The fourth approach is to enrich processed foods such as sugar with pro-vitamin A carotenoids through food fortification. According to the Food and Agricultural Organization of the United Nations (FAO), fortification entails "the practice of deliberately increasing the content of an essential micronutrient, such as vitamins and minerals, in a food irrespective of whether the nutrients were originally in the food before processing or not, so as to improve the nutritional quality of the food supply and to provide a public health benefit with minimal risk to health", (FAO, 2002; WHO, 2006; 2008).

Trials conducted in the Philippines have revealed that fortification of monosodium glutamate with vitamin A produces positive effects on reduction of child mortality, and improving growth and haemoglobin levels in children (Mihilal et al., 1988). Later studies with preschool-aged children, who consumed 27g of vitamin A-fortified margarine per day for a period of 6 months, reported a reduction in the prevalence of low serum retinol concentrations from 26% to 10% (Solon et al., 1996). Wheat flour fortified with vitamin A and fed as buns to Philippines' schoolchildren for 30 weeks had the effect of halving the number that had low liver stores of the vitamin (Solon et al., 2000).

The food selected for fortification should be affordable and consumed by the majority in the target population for successful fortification programmes (WHO, 2006). This ensures that larger segments of the target populations are covered. Refined table sugar (sucrose) is consumed by a large population in Kenya, hence a suitable avenue for fortification. Sugar fortification appears relatively feasible because the target population do not need to alter or adapt a new or costly distribution system. Indeed, sugar fortification only requires the existence of a well-established sugar production and marketing system. This allows for the uniform addition of vitamin A as well as monitoring of its content (UNICEF, 2007).

Fortification of sugar with vitamin A is possibly one of the safest, and relatively cost-effective interventions to prevent and control VAD (dela Cuadra, 2000). Moreover, food fortification is credited for contributing to reducing deficiency diseases hence its potential in promoting growth, mental health and good vision especially among children in developing countries. The approach is safe, can be introduced quickly, and can reach majority of the target population (WHO, 2008). If consumed on a regular basis, fortified foods can help to maintain body stores of nutrients more efficiently and more effectively than will intermittent supplements. Fortified foods are also better at lowering the risk of the multiple deficiencies

that can result from seasonal deficits in the food supply or a poor quality diet. This is an important advantage to growing children who need a sustained supply of micronutrients for growth and development. And to women of fertile age who need to enter periods of pregnancy and lactation with adequate nutrient stores. Fortification can be an important way of increasing the content of vitamins in breast milk and thus reducing the need for supplementation in postpartum women and infants (WHO, 2006)

Recent reports suggest that food fortification could be a cost-effective strategy to addressing micronutrient malnutrition in developing countries (for details, see for example, IVACG, 2003; WHO, 2006). Further, among other advantages, food fortification doesn't require people to change their eating habits, thus the "target" population continues to eat the food chosen as a "vehicle" which, once fortified, becomes a good source of the micronutrient. (Qaim et al., 2007). However, food fortification is just gaining momentum in Kenya, and thus relatively little empirical information is known about its actual implication.

### 1.2 The research problem

Industrialized countries have fortified foods with vitamins and minerals for several decades (Layton and Brown, 1998; Park et al., 2001; Bishai and Nalubola, 2002; Schwab, 2011). Fortification is credited with the successful control of deficiencies of vitamins A and D, several B vitamins, Iodine and Iron in those populations. In Africa, Asia and Latin America, fortification is increasingly recognized as a cost-effective strategy that, when combined with other interventions, can control micronutrient deficiencies. Considering its potential, several countries have initiated large scale fortification programmes, especially on staples like maize and rice as well as processed products including sugar, salt, milk and edible oils. In the case of sugar, known fortification initiatives in Africa have been undertaken extensively in Zambia and South-Africa. In Kenya fortified foods exist for salt, edible oils and flour, while the levels of VAD are almost 70% and 33% for children and women of reproductive age, respectively (KNFFA, 2011). However, sugar fortification only began recently, at a pilot level by Mumias Sugar Company, and there is relatively limited information on its acceptance among consumers in general, and specific segments of the population (children and women).

Generally, there is vast literature on consumers' acceptance or rejection of fortified foods in other parts of the world (see for example, Layton and Brown, 1998; Park et al., 2001; Bishai and Nalubola, 2002; McCluskey et al., 2003; Kim and Boyd, 2004; Jan et al., 2006; Lusk et al., 2006; Schwab, 2011). Most of these studies found that consumers' attitudes are positive, although many consumers claim that they would purchase fortified foods only at a price discount. These studies, however, are based on the developed country context and in most cases where food fortification has already been commercialized. The literature on food fortification in developing countries is still scanty and none has ever addressed the case of sugar fortification (see for example, Latham et al., 2001; van Stuijvenberg et al., 2001; Curtis et al., 2004; Qaim et al., 2007; Krishna and Qaim, 2008; Meenakshi et al., 2010). However, findings of a recent study suggests that consumers in developing countries tend to readily accept fortified foods than their counterparts in developed countries, due to widespread malnutrition among the poor households and the recognition that fortification can contribute to the reduction of micronutrient deficiencies (Qaim et al., 2007). This study seeks to build on the foregoing literature by analyzing consumers' awareness and preferences for fortified sugar in Kenya.

Currently, only a few studies in Kenya have assessed consumer preferences for enriched foods either through fortification or bio-fortification, (see for example, Kimenju et al., 2005; Kimenju and De Groote, 2008; and De Groote et al., 2010). However, these studies are mainly based on rural set ups, and none has studied consumer awareness and preferences for fortified sugar. Therefore, a significant knowledge gap worthy of empirical investigation emanates particularly regarding how awareness and preferences compares between rural and urban sugar consumers. Understanding the Kenyan consumers' awareness and preferences for fortified sugar provides useful insights on the potential of the Kenyan market for fortified foods. The study offers useful information for addressing VAD problems (and other micronutrient deficiencies) among the Kenyan population.

### 1.3 Objectives of the study

The purpose of this study was to analyze consumers' awareness and preferences for Vitamin A-fortified sugar in Kenya. The specific objectives were:

**a)** To assess consumers' awareness of fortified sugar among rural and urban consumers.

**b)** To analyze consumers' preferences for fortified sugar.

### 1.4 Research hypotheses

Two hypotheses were tested in this study, each corresponding to a specific objective.

**Hypothesis 1:** There is no difference in the levels of awareness of fortified sugar between rural and urban sugar consumers.

There are vast literature on how demographic factors may affect consumers' preference or even their willingness to pay for enriched foods (see for example, Nayga and Capps 1999; Maynard and Franklin, 2003), but limited literature explicitly explains how awareness vary along rural-urban axis (i.e. net sugar-consumption in urban versus consumption-production nexus in rural setup). Providing insights on this is one of the contributions to literature from this study. It may be argued that urban dwellers are more aware of sugar fortification compared to rural dwellers, perhaps due to modern lifestyles that promote their exposure to information. On the other hand, rural dwellers could also be more aware because of their nearness to sugar-fortification points as well as their interests in sugarcane production as farmers (for example, in western Kenya where farmers grows sugarcane and sell to Mumias sugar company that does fortification). This hypothesis was therefore empirical and worthy of investigation.

**Hypothesis 2:** Consumers do not prefer for fortified sugar

This hypothesis was informed by the findings of some previous studies which have revealed that consumers may not prefer fortified food products due to changes in sensory characteristics (for example, colour and taste), as well as price. A consumer preference study for taste, convenience and nutritional content in Frankfurt, Germany, revealed that some consumers valued taste and colour more highly than nutritional content while purchasing food, at least for certain products (Harris, 1997).

In the current study, table sugar, a major product consumed in Kenya, is used to undertake a preference study. Preference evaluation of vitamin A-fortification has not previously been tested using sugar in the country. Owing to the chemical structure of vitamin A-fortificant, the taste and colour of fortified sugar may change (Rodriguez-Amaya and Kimura, 2004), and consumers generally do not prefer such changes in sensory characteristics in food

commodities (Smale and Jayne, 2003). It was therefore, hypothesized in this study that sugar consumers in Kenya would prefer conventional sugar to fortified sugar.

### 1.5 Justification of the study

The study provides important information on acceptability of fortification in general, and fortified sugar, in particular, by the Kenyan consumers. This is regarded as important to both agricultural sector and food industries in Kenya, as it provide avenues for value addition. It will also benefit many stakeholders involved, including: Sugar processing companies may use this information to make decisions on whether or not to produce fortified sugar, depending on consumer preferences. This would enable them to become consumer-driven sugar producers; the Kenyan and other Sub-Sahara African governments could use this information to make informed decisions regarding programmes to reduce micronutrient malnutrition in their countries, specifically VAD, especially among the population groups that largely consume sugar; the Kenyan government and other Sub-Sahara governments could also use this information to make informed decisions regarding the adoption of mandatory or voluntary fortification programmes in their countries; sugar traders and retailers could use this information, depending on the level of preferences, to make a decision on whether or not to stock fortified sugar and other enriched food products in general.

This study can also assist organizations undertaking projects on food quality and safety in Kenya and Africa, such as, Kenya National Food Fortification Alliance (KNFFA), Harvest plus and International Food Policy Research Institute (IFPRI), with relevant literature on sugar fortification. For example, this study contributes immensely to achieving the Government of Kenya's (GoK) National Food Security and Nutrition Policy and Strategy that has formed the National Fortification Programme 2011-2014, with the main objective of: "Ensuring that all Kenyans throughout their life enjoy at all times safe food in sufficient quantity and quality to satisfy their nutritional needs for optimal health." The programme has included Food Fortification as an important strategy for addressing national food and nutrition security, and specifically aims to reduce, by one third; the prevalence of iron deficiency anaemia and vitamin A deficiency in children under 5 and women of reproductive age (i.e., from 74% to 49% and 84% to 54%), respectively within the project life (KNFFA, 2011).

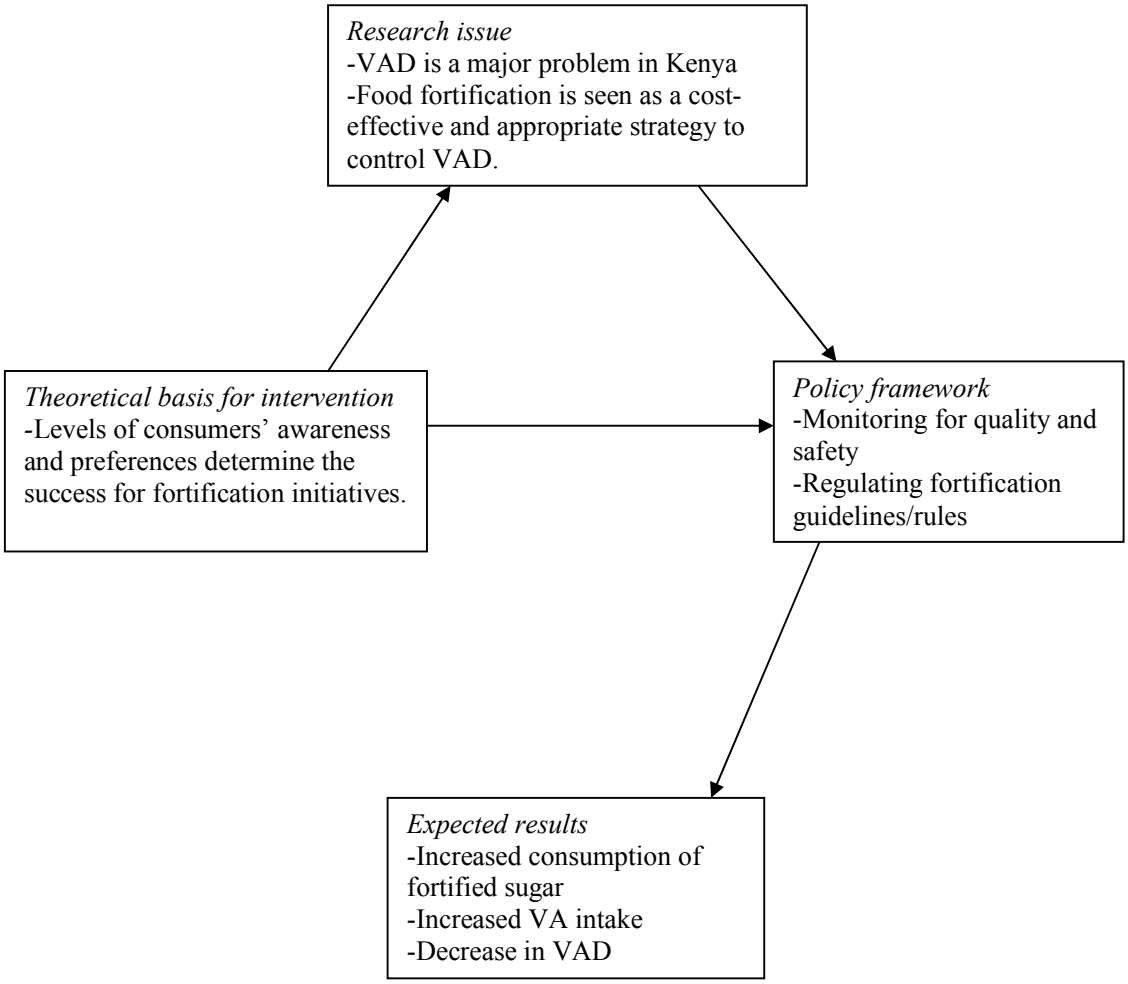
Regarding the academic and research arena, the study contributes immensely to the scant literature on industrial food fortification in Kenya and other developing countries. It compares consumer awareness and preferences along the rural-urban axis, which is quite insightful. The special attention given to young children and expectant mothers, who are the most vulnerable to the effects of VAD, makes it more relevant for subsequent studies. Furthermore, the study employs a choice based approach that enables the tradeoffs between the desired and undesired attributes of the product (fortified sugar), before the consumer decides to purchase. This is important in understanding the implied attribute ranking.

### 1.6 Study area

Two counties, Nairobi and Kakamega were purposively selected for this study. There is need to compare preferences and awareness for fortified sugar along the rural-urban axis to enable development of targeted fortification programmes. This is achieved by the choice of the two counties. Nairobi being the capital city is the most populated county in Kenya. According to 2009 national population census, the population of Nairobi County was estimated at 3.1 million people and possibly, has the highest number of sugar consumers in the country. Furthermore, the diversity in terms of demographic, cultural, and socioeconomic characteristics makes Nairobi a better representative county, of the whole country.

Kakamega County, with a population of 1.66 million people (2009 census) was selected because it is where sugar fortification has been initiated in the country by Mumias Sugar Company, and it is expected that most occupants have prior information regarding sugar fortification. This is because the majority of the employees, who usually purchase fortified sugar directly from the company welfare-shops at reduced prices, reside within the County. Consumers in Kakamega County are also farmers, who produce sugarcane and sell to the Mumias sugar company that undertakes fortification. These aspects are thus expected to influence the nature of preferences for sugar fortification differently compared to consumers in Nairobi County (main consumer zone without production). Furthermore, Western region of Kenya is among the regions with high prevalence of VAD, owing to cereal and sugarcane dominance in the region resulting in limited dietary diversity (De Groote et al., 2010). As a result, the greater proportion of diets in these areas consists majorly of starchy staple foods with little micronutrients (limited nutritional diversity).

### 1.7 Conceptual framework




Insufficient intake of micronutrients (minerals and vitamins) leads to conditions (body disorders) with enormous economic implications. This is because the efforts to control/reduce these conditions call for huge financial burden. Among the alternatives touted as effective in this control, food fortification reign supreme. However, the success of efforts to fortify foods such as sugar, are limited to the levels of consumer awareness and preferences for such products. Furthermore, consumers' trust in institutions and organizations undertaking fortification programmes also plays a big role. Careful consideration of these factors could result into formulation of widely accepted fortification programmes, hence increased consumption of fortified foods (sugar in this case). This is expected to reduce the problem of VAD, as the uptake of VA in the consumers' diets improves substantially.

### 1.8 Organization of the thesis

This thesis is organized into two papers. The first paper (Chapter two) addresses the first objective of the study. The paper specifically: i) explores the awareness levels of sugar consumers of fortified sugar and compares these levels between rural and urban consumers; ii) employs the binary logit model to assess the factors that influences consumers' awareness.

Consumer awareness is expected to vary significantly between the rural and urban sugar consumers owing to the differences in cultural, socio-economic and demographic characteristics that define rural and urban-setups. This can be examined in terms of net sugar consumption nexus in urban versus the consumption-production nexus that is synonymous with the rural setup. Binary logit model has been forwarded in recent literature as the most suitable for these kinds of analysis due to the fact that awareness is a discrete variable. Binary logit model is therefore used in this study to determine the probability of a consumer being aware of sugar fortification, and to test the stated hypothesis.

The second paper (Chapter three) addresses the second objective of the study. It analyzes the consumers' preferences for fortified sugar and the resulting trade-offs among the identified attributes. The paper specifically: i) examines consumers' preferences for the fortified sugar attributes; and, ii) ranks these attributes according to preferences and explores the preference heterogeneity inherent in sugar consumers. The paper applies stated preference approach, specifically choice experiment, to elicit the preferences for the various attributes of fortified sugar. A random parameter logit (RPL) is estimated to account for the preference heterogeneity among the consumers as well as their rankings of the attributes.

**References**


Bishai, D. and Nalubola, R., (2002). The history of food fortification in the United States: Its relevance for current fortification efforts in developing countries. *Economic Development and Cultural Change*, 51(1): 37 – 53.

Caballero, B., (2003). Original Communication, Fortification, Supplementation, and Nutrient Balance. *European Journal of Clinical Nutrition*, 57(1): 76-78

Curtis, K., McCluskey, J. and Wahl, T., (2004). Consumer acceptance of genetically modified food products in the developing world. *AgBioforum,* 7(1): 70 – 75.

De Groote, H., Kimenju, S. and Morawetz, U., (2010a). Estimating consumer willingness-to-pay for food quality with experimental auctions: the case of yellow versus fortified maize meal in Kenya. *Agricultural Economics,* 42(1): 1-16.

dela Cuadra, C., (2000). The Philippine micronutrient supplementation programme. *Food Nutrition.* Bull, 21(4): 512-514.

Faber, M., Phungula, M., Venter, S., Dhansay, M. and Spinnler, B., (2002). Home gardens focusing on the production of yellow and dark green leafy vegetables increase the serum-retinol concentration of 2-5-year-old children in South Africa. AMJ Clinic, *Nutrition*. 76(1) 1048-1054.

FAO, (2002). The State of food insecurity in the World. Food Insecurity: When people must live with hunger and fear starvation. Food and Agricultural Organization of the United Nations, Rome.

Harris, M., (1997). The Impact of Food Product Characteristics on Consumer Purchasing Behaviour: The Case of Frankfurters. *Journal of Food Distribution Research*, 30 (1), 92-97.

IVACG, (2003). Improving the vitamin A Status of Populations. Report of the XXI International Vitamin A consultant Group Meeting, International Vitamin A Consultant Group (IVACG), Washington, DC.

Jan, M., Fu, T. and Huang, L., (2007). A conjoint / logit analysis of consumers' responses to genetically modified 'tofu' in Taiwan. *Agricultural Economics*, 58(1): 330 – 347.

Kenya National Food Fortification Alliance (KNFFA), 2011. The PSI/Kenya's Food Fortification Social Marketing and Communication Project 2011-2013. www.gainhealth.org/programs [last accessed 22 June 2013]

Kigutha, H., Van Staveren, W., Veerman, W. and Hautvast, J., (1995). Child malnutrition in poor smallholder households in rural Kenya: An in-depth situation analysis. *European Journal of Clinical Nutrition*, 49(9): 691-702.

Kimenju, S. and De Groote, H., (2008). Consumer willingness to pay for genetically modified food in Kenya. *Agricultural Economics*, 38(1): 35 – 46.

Kimenju, S., Ulrich C. and De Groote, H. (2005). Comparing Contingent Valuation method, Choice Experiment and Experimental Auctions in soliciting consumer preference for maize in Western Kenya: Preliminary results

Kim, R. and Boyd, M., (2004). Japanese consumer attitudes and decision-making with regard to GM food products: Analysis using structural equation modeling (SEM). *Paper presented at 8th International Consortium on Agricultural Biotechnology Research (ICABR) Conference*, Ravello.

Krishna, V. and Qaim, M., (2008). Consumer attitudes towards GM Food and pesticide residues in India. *Review of Agricultural Economics*, 30(1): 233 – 251.

Latham, M., Ash, D., Ndossi, G., Mehansho, H. and Tatala, S., (2001). Micronutrient dietary supplements-a new fourth approach. *Archives of American Nutrition,* 51(1): 37-41.

Layton, D., and Brown, G., (1998). Application of stated preference methods to a public good: *Issue for discussion*. Washington, DC.

Lusk, L., Traill, B., House, O., Valli, C., Jaeger, S., Moore, M. and Morrow, B., (2006). Comparative advantage in demand: Experimental evidence of preferences for genetically modified food in the United States and European Union. *Agricultural Economics*, 57(1): 1 -21.

Maynard, J. and Franklin, T., (2003). Functional Foods as a Value-Added Strategy: The Commercial Potential of 'Cancer-Fighting' Dairy Products. *Review of Agricultural Economics,* 25(2): 316-331.

McCluskey, J., Ouchi, H., Crimsrud, K. and Wahl, T., (2003). Consumer response to genetically modified food products in Japan. *Agricultural and Resource Economics Review*, 32(1): 222 -231.

Meenakshi, J., Johnson, J., Manyong, V., Gonzalez, C., Garcia, J., Meng, E., De Groote, H., Javelosa, J., Yanggen, D., Naher, F., (2010). How cost-effective is biofortification in combating micronutrient malnutrition? An ex-ante assessment. *World Dev*. 38(1): 64-75.

Muhilal, P., Idjradinata, Y. and Karyadi, D., (1988). Vitamin A-fortified monosodium glutamate and health, growth, and survival of children: a controlled field trial. *American Journal of Clinical Nutrition*, 48(1):1271–1276.

Nayga, M. and Capps, O., (1999). US Consumers' Perceptions of the Importance of Following the US Dietary Guidelines. *Food policy,* 24(1): 553-564.

Park, K., McDonald, A., Hanson, A. and Yetley, A., (2001). History of cereal-grain product fortification in the United States. *Nutrition Today*, 36(3): 124-149.

Qaim, M., Stain, J. and Meenakshi, J., (2007). Economics of bio-fortification. *Agricultural Economics*, 37(1): 119 -133.

Rodriguez-Amaya, B., Kimura, M., (2004). Harvest plus Handbook for Carotenoids Analysis. International Food Policy Research Institute [IFPRI].

Ruel, T., (2001). Can Food-Based Strategies Help Reduce Vitamin A and Iron Deficiencies? *International Food Policy Research Institute (IFPRI)*.

Schwab, B., (2011) Nutrition, Education and development: The case of Vitamin D milk. Selected paper prepared for presentation at the Agricultural and Applied Economics Association's 2011 AAEA and NAREA Joint annual meeting, Pittsburgh, Pennsylvania.

Smale, M., Jayne, T. (2003). Maize in Eastern and Southern Africa "Seeds" of Success in Retrospect. *EPTD Discussion paper*. No. 97, IFPRI, Washington, DC.

Solon, F., Latham, M., West, P., Williamson, D., Nano, T. and Sommer, A., (2000). Efficacy of a vitamin A-fortified wheat-flour bun on the vitamin A status of Philippines' school-children. *American Journal of Clinical Nutrition,* 72(1):738-744.

Sommer, A., and West Jr., K., (1996). Vitamin A Deficiency: Health, Survival, and Vision. New York. Oxford University Press.

UNICEF, (2007). Vitamin A Supplementation: A decade of progress. Global overview on progress and limitations of ongoing vitamin A supplementation programs. The United Nations Children's Fund.

UN SCN, (2004). 5th Report on the World Nutrition Situation: Nutrition for Improved Development Outcomes. United Nation's Standing Committee on Nutrition, Geneva, Switzerland.

van Stuijvenberg, E., Dhansay, M. and Faber, M., (2001). Long-term evaluation of a micronutrient-fortified biscuit used for addressing micronutrient deficiencies in primary school children. *Public Health Nutrition*, 4(1):1201–1209.

West Jr., K. and I. Darnton-Hill, (2001). Vitamin A deficiency. Nutrition and Health in Developing Countries. *M. W. Bloem. Totowa, NJ, Humana Press***:** 267–306.

WHO, (2007). Preventing and controlling micronutrient deficiencies in populations affected by an emergency. World Health Organization, Geneva.

WHO, (2006). Guidelines on Food fortification with Micronutrients. World Health Organization, Geneva.

# CHAPTER TWO

## CONSUMER AWARENESS OF SUGAR FORTIFICATION IN KENYA

### 2.1 Introduction

Fortification of foods with micronutrients is a technologically and economically effective intervention to promote micronutrient intake by the targeted audience (West Jr. and Darnton-Hill, 2001). In some instances, food producers choose to fortify foods voluntarily; in others, governments enforce mandatory fortification. Mandatory fortification programmes can be assured through legislation and enforcement with little or no change in the knowledge and behaviour of the targeted population. However, high consumer' awareness, which can be transformed into effective demand is a critical element required for successful voluntary food fortification programmes (Mahgoub et al., 2007).

Food fortification has a long history of use in industrialized countries for the successful control of deficiencies of vitamins A and D, several B vitamins (thiamine, riboflavin and niacin), iodine and iron. Salt iodization was introduced in the early 1920s in both Switzerland (Burgi et al., 1990) and the United States of America (Marine and Kimball, 1920) and has since expanded progressively all over the world to the extent that iodized salt is now used in most countries. From the early 1940s onwards, the fortification of cereal products with thiamine, riboflavin and niacin became common practice. Furthermore, margarine was fortified with vitamin A in Denmark and milk with vitamin D in the United States (Schwab, 2011). Foods for young children were fortified with iron, a practice which has substantially reduced the risk of iron-deficiency anaemia in this age group. In more recent years, folic acid fortification of wheat has become widespread in the America, a strategy adopted by Canada and the United States and about 20 Latin American countries (WHO, 2006).

In the less industrialized countries, fortification has become an increasingly attractive option in recent years (Birol et al, 2011). In Kenya, salt iodization started on a voluntary basis in 1970's, and became mandatory in 1992, and has become a well established programme. However, the effort to extend the fortification agenda to other nutrients and foods did not fare so well. Given the success of the relatively long-running programme to fortify sugar with vitamin A in Central America, where the prevalence of vitamin A deficiency has been reduced considerably, similar initiatives are being attempted in other parts of the world. The

first sugar fortification experience in sub-Saharan Africa is taking place in Zambia, and if successful could be emulated elsewhere (Darnton-Hill and Nalubola, 2002, WHO, 2008).

Fortification of sugar with vitamin A is a strategy that has been used extensively throughout Central America. Starting in Guatemala in 1974, and extending to other countries in the region in subsequent years, this programme reduced the prevalence of low serum retinol values – from 27% in 1965 to 9% in 1977 (Arroyave et al., 1981). The authors also provided evidence to suggest that sugar fortification substantially increases the concentration of vitamin A in breast milk. When the programme was temporarily discontinued in parts of the region, the prevalence of low serum retinol again increased. Vitamin A fortification of sugar is, however, still ongoing in Guatemala.

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 could enable consumers defend themselves 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. Mahgoub et al. (2007) notes that only informed consumers that are aware of their rights and responsibilities can protect themselves from exploitation and prejudice, and are therefore, an asset to the society.

Consumer awareness plays an important role in establishing a healthy economic environment where consumers are informed and protected, while businesses are accountable to their clients (Nair, 2012). This benefits both individuals and society. From individual point of view awareness enhances critical thinking, improves life skills and self confidence. This is particularly useful when new products are introduced in the market and consumers are called upon to make informed judgement (whether to purchase and consume them or otherwise). Moreover, consumer awareness benefits the society by promoting satisfaction and informed public debates, creating realistic expectations that enhances economic stability.

The awareness levels of Kenyan sugar consumers regarding VA sugar fortification and its nutritional importance might pose a barrier to acceptance of fortified sugar. Consumers are

the sole determinants of the success of industrial food fortification initiatives through their purchases. The potential for sugar fortification programme therefore, relies solely on the level of consumers' awareness. However, there is a dearth of knowledge on consumer awareness regarding sugar fortification and its usefulness. Efforts should thus be directed towards understanding what information is available to consumers and ways of improving it.

Another challenge is that the level of consumer awareness in Kenya also varies from region to region depending on the level of social information of the people. A study by De Groote at al., (2010) in western and eastern parts of the country, found that awareness levels were, indeed varied. While over 80% of the respondents in western parts were aware of yellow versus fortified maize meal, only 30% were aware in the eastern parts. This variability has significant implication in terms of developing programmes aimed at improving consumer awareness. The earlier study was however, based in a relatively rural context. More insights are needed to understand how awareness varies along the rural-urban context to enable design of targeted-information dissemination programmes.

Moon and Balasubramanian (2002) examined the effect of knowledge and awareness of health benefits of soy protein on consumer decisions to purchase and their consumption intensity. They demonstrated that perception of health benefits, taste, and convenience are the main attributes that affect the decision to buy soy-based products. The decision of how much to consume is affected by perceptions and knowledge of health benefits and the convenience of food preparation. Huston and Finke (2003) examined the role of awareness in healthy diet choices. The decision to eat a healthy diet often involves subversion of other food characteristics (e.g., flavour, price, or convenience) in favour of health benefits. The motivation to choose a more healthy diet depends on the parameters which guide any investment decision. More importantly, the opportunity cost of realized present utility for added nutrients will influence investment in future health and well-being through activities such as diet choice, exercise and medical care. Awareness of all these factors forms important basis of the individual choices.

Paulsen (1999) showed that certain consumers are willing to pay more for enriched foods if they are aware of the associated health benefits. In contrast, the survey conducted by Jonas and Beckmann (1998) suggested that consumers expected the price of enriched foods to be the same as that of conventional foods. No additional price for the claimed health effects was

seen to be justified. They also found that taste and price are of greater importance than the product's health benefits. Many consumers' perceived enriched foods to be unnatural or impure because of added nutrients used to meet the claim of health benefits; thus these consumers expressed strong reluctance toward enrichment and fortification of foods. These studies concluded that increasing the knowledge of these consumers on the benefits of food enrichment would be important, hence supported the central role of consumer awareness in the acceptance of fortified foods.

In Kenya, consumer responses towards food nutritional enrichment have gained importance due to the increase in the production of nutritionally enhanced foods, both bio-fortified and industrially-fortified. A few surveys have been conducted to evaluate consumer knowledge, awareness, and responses toward food enrichment (Kimenju et al., 2005; Kimenju et al., 2008; and De Groote et al., 2010). These studies emphasised the need for increased consumer education regarding nutritionally enhanced foods as the results indicated that most of the respondents were unaware of the functions and advantages of food nutritional enhancement. Findings from Kimenju et al. (2005) indicated that public concerns and fear of food enrichment are progressively growing and suggested that consumer education on the functions, advantages, and safety issues of food bio-fortification, as well as label declarations and control programmes, are necessary in order to prevent misunderstandings regarding enhancing nutritional value of foods.

Recently, Kenyan mass media covered debates on the adverse health effects of food enrichments, but with lacking scientific data (KNFFA, 2011). Consumers may adopt misleading information emanating from such negative debates without discretion if they have low dietary awareness-making them more sceptical to food fortification. Therefore, this study examined the awareness levels of consumers to vitamin-A fortified sugar and assessed whether dwelling place (rural or urban) and food demand and consumption characteristics had any effect on the level of sugar fortification awareness observed. The study specifically; i) explored awareness of sugar fortification and compared the levels of awareness between rural and urban sugar consumers; ii) assessed the socioeconomic and food demand characteristics that influences consumer awareness of fortified sugar. It was hypothesised that rural and urban sugar consumers have the same levels of awareness regarding fortified sugar.

The study employed household consumer survey data and a binomial logistic regression model. The findings from the study provide insights regarding consumer-knowledge and are expected to offer policymakers and other stakeholders in Kenya with a better understanding of household sugar fortification awareness issues. It thus has the potential to influence policy development and can serve to guide strategies for micronutrient promotion and food enrichment education programmes in the country.

## 2.2. Methodology

### 2.2.1. Sampling and data collection

The target population included households residing in the County of Nairobi (which hosts the capital city) and Kakamega (which lies to the western region of Kenya). The survey was implemented through face-to-face interviews conducted in March and April 2013. This method of data collection was preferred because the respondents' concerns and questions could be addressed at hand by the interviewers, and further clarifications given instantly. Personal interviews also guaranteed higher response rate and made the use of visual aids, for example, illustration cards (Figure 1) as well as assisting respondents when necessary possible. This method was also instrumental in ensuring that only members of the household who are primary food shoppers answered the questionnaire.

The sample was drawn using a multistage sampling procedure, and stratified into rural and urban consumers, with Nairobi County representing urban and Kakamega representing rural setup. Multistage sampling method was used in this study because the listing of all sugar consumers in the study areas was not available. Moreover, the anticipated consumption diversity within the study areas in terms of dietary requirements, socioeconomic and sugar demand characteristics rendered the method most appropriate (Lohr, 1999). A great majority of sugar consumers in Kakamega County are sugarcane producers. In contrast, while some Nairobi households may produce sugarcane in their rural farms, the great majority are net sugar consumers. The inclusion of both rural and urban consumers in this study is intended to begin examining the awareness expressed by sugar consumers across the spectrum of producer-consumption in the rural areas and net-consumption in urban setup.

The two counties were divided into smaller administrative units called districts. To ensure greater sample representation within the selected counties, all districts were considered. Specifically, in Kakamega County all the six major districts were included in the survey, except Lugari district, due to its peripheral location. The districts selected included; Mumias, Matungu, Butere, Kabras and Kakamega (Shinyalu, Malava and Lurambi). The same selection criteria were applied in Nairobi County where all the districts except Westlands district, where the pretest survey was carried out, were included. Within each district, 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 each district. A total of thirty sub-locations were selected, with Kakamega County, due to its vast geographical diversity and size, taking up larger share of the selected sub-locations at eighteen (sampling proportionate to size).

Within the sub-locations, smaller units (Villages in Kakamega and Estates in Nairobi) were randomly selected, which formed the secondary sampling units. The primary sampling units were the households, supermarkets and clinics, from which primary household sugar-shopper (respondent) was drawn using a systematic random sampling criterion. More importantly, to select an household, a cross-sampling method was used; that is, a cross "X" was drawn on the village map and every nth household ('n' equals five and ten where households were scattered/far apart and congested, respectively) along the "X" with a random start was interviewed (Birol et al., 2011). Where the targeted respondent was unavailable or uninterested in participating, the next randomly selected household on the list was chosen to ensure that the desired sample size was realized. Employing sampling proportionate to size criterion, a total sample size of 360 sugar consumers was targeted (190 in Nairobi County and 170 in Kakamega County). This was within the project budget, time constraints and reviewed literature regarding consumer preference studies. The overall response rate was high (97.2 percent; 350 households), largely due to the face-to-face nature of the survey.

The study collected three types of data concerning consumers' purchasing behavior. Respondents were first asked about their frequency of sugar consumption (daily, weekly etc.), quantity of sugar consumed in a typical month as well as preferred sugar-purchase outlets (kiosk, retail shop or supermarket). They were also required to rate five product characteristics – price, taste, nutrition, brand, and additional health ingredients – according to level of importance in influencing their food purchase. The rating for each characteristic was

based on a five-point likert scale, including; not at all important (1), somewhat important (2), moderately important (3), fairly important (4), and very important (5). The survey elicited additional data on consumers' awareness of sugar fortification, knowledge of vitamin A and trust in organizations handling regulation and control of production, sale and release of the aforementioned product (see appendix 1).

Second, the enumerators collected social, demographic, and economic information on the households, including the age, education, income, household size (composition) and characteristics of the sugar purchase decision-maker(s) and other members of the household. The third data type consisted of the responses to the preferences for fortified sugar that is discussed in detail in the next chapter. The surveys were conducted by six enumerators specially hired and trained, and supervised by the researcher. Data was collected during daytime in Kakamega and on weekends, and weekday afternoons when a member of the selected target household would most likely be at home in Nairobi. Each questionnaire took an average of one hour to administer and each enumerator managed to complete about five questionnaires per day.

### 2.2.2. Model specification

A binary (binomial) logit model was applied to investigate determinants of consumers' probability to be aware of fortified sugar. The awareness of fortified sugar can be modelled as a choice between two alternatives: aware or not aware. The binary random variable $Y_i$ takes the value of 1 if the consumer is aware and zero otherwise.

$$Y_i = \begin{cases} 1\ if\ aware \\ 0\ otherwise \end{cases}$$

The dependent variable is discrete which therefore, renders the employment of binary logit model most appropriate. The probability that individual *i* is aware can be modelled following McFadden (1974) and Greene (1993):

$$\text{prob}\left[y_{ij} = 1\right] = \frac{\exp \beta' X_i}{1+\exp \beta' X_i} = \Lambda(\beta' X) \qquad 1$$

The subscripts $i$ and $j$ denote consumer and consumer awareness (1=aware, 0=otherwise), respectively. Equation (1) is the reduced form of the binomial logit model, where the $x_i$ is the row vector of explanatory variables (both socioeconomic and food demand characteristics) for the $_i$th consumer and the non-observed $\varepsilon$'s accounts for errors in perception and measurements. The errors are assumed to follow a distribution of logistic probability with a density function:

$$F'(\beta' X_i) = \Lambda(\beta' X_i)[1 - \Lambda(\beta' X_i)] \quad 2$$

The probability that individual $i$ is aware is estimated empirically as:

$$\Pr[\mathrm{Yi} = 1] = \mathrm{X_i}\beta_\mathrm{i} + \varepsilon_\mathrm{i} \quad 3$$

$X$ is a vector of socioeconomic and food demand characteristics that are posited to influence consumers' awareness of sugar fortification; $\beta_i$ is a vector of parameters to be estimated, while $\varepsilon_i$ is the statistical random term specific to individual sugar consumer.

Additionally, marginal effects were estimated (on the pooled sample), to measure instantaneous effects of changes in any explanatory variable on the predicted probability of being aware, while holding other explanatory variables constant. The marginal effects are computed as (Anderson and Newell, 2003):

$$\beta_m = \left[\frac{\partial(\beta_i X_i + \varepsilon_i)}{\partial \beta_i X_i}\right]\beta_i \quad \text{For continuous independent variables} \quad 4$$

$$\text{And } \beta_m = P_r[Y_i = 1] - P_r[Y_i = 0] \quad \text{for variables coded as dummies} \quad 5$$

The binary logit model and marginal effects were estimated using LIMDEP version 8/ NLOGIT version 3.0 software (Greene, 2002), descriptive statistics analyzed using the statistical package STATA, version 10, and the t-test for equality of means between rural and urban parameters estimated using SPSS for windows, version 16.

### 2.3. Results and discussions

#### 2.3.1. Characteristics of the respondents and their households

Group statistics shows that 46% of the rural consumers and 63% of the urban consumers are aware of VA fortified sugar. The independent sample test for the means of awareness levels for urban and rural consumers' (t-test for equality of means) allows rejection of the null hypothesis that the mean awareness estimates for urban and rural consumers are equal, at 5% significance level (i.e. the generated *p value* = 0.002 is less than the *significance level / critical value* = 0.05 or 5%). The decision rule is therefore to reject the null hypothesis and conclude that awareness levels are not equal, as shown in Table 2.0. Specifically, the group statistics indicate that urban consumers have statistically higher levels of awareness on fortified sugar than rural consumers.

Table 2.0: Independent sample test (t-test for equality of means)

| | Levene's test for Equality of variances | | t-test for equality of means | | |
|---|---|---|---|---|---|
| | F | Sig. | t | Sig. (2-tailed) | Mean difference |
| AWARE OF VA | 8.75 | 0.003 | -3.12 | 0.002 | -0.17 |
| BUY IN SUPERMARKET | 420.25 | 0.000 | -10.51 | 0.000 | -0.46 |
| READ NEWSPAPER | 54.89 | 0.000 | -5.16 | 0.000 | -0.26 |
| MARITAL STATUS | 15.24 | 0.000 | -1.91 | 0.057 | -0.07 |
| AGE | 13.42 | 0.000 | 2.18 | 0.030 | 2.47 |
| GENDER | 1.69 | 0.194 | 0.67 | 0.501 | 0.04 |
| YEARS OF EDUCATION | 9.45 | 0.002 | -7.35 | 0.000 | -2.51 |
| INFANTS PRESENT | 21.67 | 0.000 | -6.81 | 0.000 | -18535 |

***Notes:*** Equal variances assumed. Degree of freedom is 348.

The socioeconomic characteristics of the sample are presented in Table 2.1. More female respondents (54.9%) answered than males (45.1%) 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 preparation and purchase decisions and therefore, should be targeted for nutrition

information programmes. Respondents' average age is 35.05 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).

Table 2.1: Socioeconomic characteristics of the respondents

| **Variable** | **Kakamega** N = 162 | **Nairobi** N= 188 | **Pooled** N = 350 |
|---|---|---|---|
| Average age of respondent (years) | 36.4(12.2) | 33.9(9.0) | 35.1(10.6) |
| Average household income (Kshs) | 23700(18898) | 43300(34058) | 34200(29698) |
| Average household size | 5.1(2.7) | 3.1(1.6) | 4.0(2.2) |
| Average Years of schooling completed | 10.6(3.6) | 13.1(2.8) | 11.9(3.4) |
| Level of education (%) | | | |
| Primary | 30.9 | 12.2 | 20.9 |
| Secondary | 40.1 | 30.9 | 35.1 |
| College/Diploma | 19.8 | 37.8 | 29.4 |
| Bachelor degree | 6.8 | 14.4 | 10.9 |
| Other (MSc, PhD) | 0 | 4.8 | 2.6 |
| Gender of respondent (% Female) | 56.8 | 53.2 | 54.9 |
| Aware of VA fortified sugar (% Yes) | 46.3 | 62.8 | 55.1 |
| Have consume fortified sugar (% Yes) | 29.0 | 38.8 | 34.3 |
| Heard of fortification before this interview (% Yes) | 79.0 | 82.4 | 80.9 |
| Household has at least one member below 5 yrs (% Yes) | 58.6 | 55.3 | 56.9 |
| Frequency of consuming sugar (% Daily) | 97.5 | 99.5 | 98.6 |
| A member of an organization/ group (% Yes) | 85.1 | 77.2 | 81.4 |
| Usually read labels while buying sugar (% Yes) | 31.5 | 49 | 40.8 |

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

The mean number of years of formal education of the respondents is 11.91, with approximately 13.5% of the respondents having a university education (at least bachelor degree). The average household size in the sample is 4.0. The average monthly household

income was approximately Kenya shillings (Kshs) 34,200. These figures (for education and income) are relatively higher compared to those reported by other studies in Kenya (see for example, Kimenju et al., 2005; Adolwa et al., 2012) Therefore, respondents are expected to have high levels of awareness since education and income should translate to increased information. According to Adolwa et al., (2012), the high level of education is important to nutrition information dissemination as it enhances grasp. The study also gave special attention to expectant and lactating women, given that children and pregnant women are the most vulnerable to VAD (KNFFA, 2011).

In general, only a third (34%) of the respondents was found to have consumed fortified sugar, even though 55% and 80% of the respondents were aware of sugar fortification specifically, and food fortification in general, respectively. This indicate that majority of consumers do not read the labels on a regular basis. In fact, the results reveal that only 41% of the respondents usually read labels. The implication is that labeling food products as fortified could promote awareness regarding food fortification with just a small proportion. Approximately 57% of the households had children younger than 5 years while 19% had elderly occupants-above 50years. These two segments are the most vulnerable to the effects of VAD and their inclusion significantly improves the policy relevance of the study.

With regard to frequency of sugar consumption, almost all the respondents (98%) 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, 2008). Rural consumers acquire about 67% of their food fortification information from the media (i.e. radio, television and newspaper), while only 9% from observation and purchase. Whereas in the urban areas the contribution of media drops to 55% while that of observation and purchase rises to about 26%. Therefore, dissemination of nutritional information through the media would be more effective in the rural areas. Urban areas would require the use of other avenues such as internet options, mobile phones and even organized displays at the supermarkets.

More so, majority of urban consumers purchase sugar from supermarkets and would acquire significant information from such displays. The results show that only 8% of the rural

consumers usually purchase sugar from the supermarket while about 70% purchase from kiosk. This trend is reversed in urban areas where 54% of consumers frequent supermarkets with only 37% usually purchase sugar from the kiosk (as reported in table 2.2). Therefore, it is consistent that urban consumers get about 26% of food information during purchase activities because most of them purchase food items from the supermarket, where goods are well displayed and more information given through proper labeling (see for example, Weatherspoon and Reardon, 2003).

Table 2.2: Consumer purchase behaviour

| | | | | | |
|---|---|---|---|---|---|
| Source of food fortification information (%) | | | | | |
| | Observation | Purchase | Seminars | Media | Internet |
| Kakamega | 2.5 | 6.8 | 2.5 | 66.7 | 0.5 |
| Nairobi | 9.6 | 16.5 | 0.5 | 54.8 | 1.6 |
| Pooled | 6.3 | 12.0 | 1.4 | 60.3 | 0.9 |
| Frequency of reading labels during purchase (%) | | | | | |
| | Never | Rarely | Occasionally | Often | Always |
| Kakamega | 29.6 | 12.3 | 26.5 | 22.2 | 9.3 |
| Nairobi | 8.5 | 27.1 | 15.4 | 43.1 | 5.9 |
| Pooled | 18.3 | 20.3 | 20.6 | 33.4 | 7.4 |
| Frequency of purchase Supermarket (%) | | | | | |
| | Never | Rarely | Sometimes | Often | Always |
| Kakamega | 39.5 | 30.9 | 21.6 | 7.4 | 0.6 |
| Nairobi | 2.1 | 21.7 | 21.9 | 37.2 | 17.0 |
| Pooled | 19.4 | 26.0 | 21.7 | 23.4 | 9.4 |

| | | | | |
|---|---|---|---|---|
| Ranking factors influencing sugar purchase decisions (% Respondents) | | | | |
| Taste/Flavour | Price | Nutritional Information | Brand Name | Additional health Information |
| 91 | 88 | 70 | 65 | 45 |

To determine the most important factors that influence purchase decisions, consumers were asked to rate five product characteristics – price, taste/flavor/colour, nutritional information,

brand name and additional health ingredients' information, for example, fortification label, on their purchase decision– according to their level of importance prior to purchasing sugar, using a Likert scale ranging from not at all important (1) to very important (5). Following Gonzalez et al. (2010), the definition of the ''most important factor'' was based on the number of consumers responding to the top (4–5) scale levels, that is, fairly important and very important, as reported in Table 2.2. On average, taste/flavor/colour (91%), price (88%), and nutrition (65%) are the most important consumption factors, brand name ranked fourth at (65%) while an additional health ingredient was ranked last at (45%). This suggests that price and sensory characteristics (measured as taste/flavor/colour) are ranked higher than nutrition, by the majority of sugar consumers' in Kenya. These results compares to those reported by (Harris, 1997), and indicate that some consumers may not accept nutritious (fortified) foods if changes occurs to the sensory characteristics regardless of their awareness levels.

### 2.3.2. Determinants of consumers' awareness of fortified sugar

Table 2.3 shows the factors hypothesized to influence consumers' awareness of fortified sugar that were selected for the binary logit regression.

Table 2.3: Description of variables in the binary logit model

| Variable | Description of the variable | Expected sign |
|---|---|---|
| PSUPER | Purchase from supermarket (1=Yes, 0=No) | + |
| RNEWSPA | Read newspaper (1=Yes, 0=No) | + |
| MSTATUS | Marital status of respondent (1=Married, 0=Not married) | + |
| AGE | Years of the respondent | ± |
| GENDER | Sex of respondent (1=Female, 0=Male) | ± |
| REGION | Location of respondent (1 =Urban, 0=Rural) | + |
| EDUCYRS | Formal years of schooling | + |
| INFMEM | Household has at least one member below 5yrs (1=Yes, 0=No) | + |

Following Neven and Reardon (2004), frequent purchase from supermarket is expected to increase consumers' awareness regarding fortified sugar. 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. Furthermore, most supermarkets put

up leading posters as well as footpath guides that lead the prospective consumers' towards food stalls, especially when new products are available in the shelves (market). On the same note, reading newspaper frequently is expected to increase consumer awareness through provision of food information.

Media is the most important source of food nutrition information and fortification awareness. As reported in Table 2.2, 60% of the respondents acquire food information from the media (using pooled sample). Specifically, Radio is used by 91% of the respondents while 70% of them use Television in most cases. These two media sources therefore, offer little variability in terms of consumer-usage and were consequently excluded from the regression model. Newspaper (used by 43% in urban & 34% in rural areas) was included in the regression model to represent media.

The effect of age and gender on consumer awareness is empirical (Adesina and Baidu-Forson, 1995). The authors argued that older consumers may be expected to be more aware of sugar fortification due to their precision as well as accumulated experience in shopping activities. On the other hand younger consumers' may also be more aware of food fortification since they are more exposed to numerous modern technology-based channels of information dissemination, including mobile phones, facebook and other internet-based information channels (see for example, Okello et al., 2009; Nair, 2012). Concerning gender, male households may be more aware of food fortification due to their exclusive control of household resources, including information (Kaliba et al., 2000). However, women may also be more aware of food fortification programmes due to their responsibility for food purchase and preparation in most African households.

Households in formal marriage arrangements are also expected to be more aware of sugar fortification initiatives. This is because the study considers 'marriage' as a formal organization with an established structure of information flow, comparable to that of membership to a formal group that increases sharing of information among its members. Consumers from urban are postulated to be more aware of sugar fortification programmes as compared to counterparts dwelling in rural areas. The expectation is informed by the findings of Lupin and Rodriguez, (2012), who reported that neighborhoods around the city used different fresh potato channels from those used by other consumers in Argentina. These

authors attributed these differences to information levels within the cities among other factors. The two studies are similar in that both are based in the developing country context where urban areas has more developed information and purchasing infrastructure.

Households with infant-members are expected to have high levels of awareness (Birol et al., 2011). This is because these households frequent public clinics where the government has an ongoing programme on vitamin A supplementation, and where they are the prime targets (De Groote et al., 2010). Other than provision of vitamin A supplementation in form of capsules, the programme also entails education on nutrition where food enrichment comes in handy. These households therefore, acquire more information regarding nutritional value of foods and are expected to be more aware of VA-sugar fortification programme.

Suitability of the above selected factors for econometric analysis was tested for multicollinearity. This was tested using the variance inflation factors (VIF), which was computed for each of the consumer characteristics reported in table 2.4. 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 (see for example, Long, 1997; Otieno, 2013). The VIF for each factor is calculated as:

$$VIF_i = \frac{1}{1- R_i^2} \qquad 6$$

Table 2.4: Variance inflation factors for the regressors

| Variable | VIF |
|---|---|
| PSUPER | 1.92 |
| RNEWSPA | 1.72 |
| MSTATUS | 1.39 |
| AGE | 1.39 |
| GENDER | 1.38 |
| REGION | 1.23 |
| EDUCYRS | 1.15 |
| INFMEM | 1.04 |

Where $R_i^2$ is the $R^2$ of the artificial regression with the $i^{th}$ independent variable as a 'dependent' variable. The mean VIF was 1.40 with individual VIF ranging from 1.04 to 1.92

indicating absence of multicollinearity. Maddala (2000), suggested that variables with VIF<5 have no multicollinearity; hence they were selected for inclusion in the binary logit regression.

The results of determinants of consumers' awareness of sugar fortification in Kenya are presented in table 2.5. Both parameter estimates for coefficients and marginal effects from the binary logit model are shown. The significance of chi square, log-likelihood function and McFadden pseudo $R^2$ shows that logit regression model is fit for the analysis.

Among the regressors, age of consumers, purchasing from supermarket, reading newspaper, living in urban area as well as having a child below the age of five years, are the significant factors that influence consumers' awareness of sugar fortification, while marital status and years of formal education had insignificant effect. Whereas the coefficient values explain the probable influence of each regressor on awareness generally, the marginal effects measure the actual effect of instantaneous changes in each of the explanatory variables on consumers' awareness levels (Greene, 1993; Anderson and Newell, 2003).

Age of consumers negatively and significantly influence consumers' awareness of sugar fortification. The result implies that younger age group consumes sugar and is more likely to be aware of sugar fortification. The marginal effect results shows that an increase in age of the sugar consumer by one year reduces the probability of being aware of sugar fortification by 1%. The explanation could be that older consumers precisely shop for what they are used to since they are conservative in nature, as observed by Adesina and Baidu-Forson (1995). Moreover, the information has gone digital in Kenya due to technological advancement so that even food advertisers seek new avenues so as to keep track with the changing times (see for example, 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 favour in these new avenues which may explain their high level of awareness.

Table 2.5: Binary logit estimates of determinants of consumer awareness of fortified sugar

| Variable | Kakamega | Nairobi | Pooled | Marginal Effects |
|---|---|---|---|---|
| PSUPER | 0.223 | 4.535*** | 2.955*** | 0.512*** |
| | (0.675) | (0.699) | (0.451) | (0.053) |
| RNEWSPER | 1.186** | 2.342*** | 1.597*** | 0.322*** |
| | (0.432) | (0.565) | (0.319) | (0.06) |
| MSTATUS | - 0.543 | 0.295 | - 0.01 | - 0.022 |
| | (0.553) | (0.748) | (0.401) | (0.093) |
| AGE | - 0.025** | - 0.058** | - 0.03** | - 0.008** |
| | (0.011) | (0.024) | (0.01) | (0.002) |
| GENDER | - 0.639** | 0.36 | - 0.31 | - 0.076 |
| | (0.338) | (0.521) | (0.27) | (0.068) |
| REGION | _ | _ | 0.499* | 0.105* |
| | | | (0.305) | (0.078) |
| EDUCYRS | 0.043 | - 0.048 | - 0.038 | - 0.004 |
| | (0.042) | (0.724) | (0.033) | (0.008) |
| INFMEM | 0.773** | 0.465 | 0.681** | 0.159** |
| | (0.343) | (0.536) | (0.278) | (0.063) |
| Log-likelihood | - 98.72 | - 51.13 | - 166.0 | |
| Pseudo-$R^2$ | 0.11 | 0.58 | 0.31 | |
| $\chi^2$ (ρ- value) | 26.25(0.02) | 145.98(0.0000) | 149.48(0.0000) | |
| N (respondents) | 162 | 188 | 350 | |

***Notes***: Standard errors in parentheses; statistical significance levels: ***1%; **5%; *10%. Marginal effects are calculated for the pooled sample only.

The influence of media on sugar fortification awareness in this study is represented by reading newspaper. The results indicate that reading newspaper positively affects awareness of sugar fortification. Specifically, the marginal effect shows that reading newspaper instantaneously increases the probability of the consumer being aware of sugar fortification by 32.2%. The newspaper purposes to provide information including food as well as technology advertisement to the readers thus increasing their knowledge (for example, the

daily nation newspaper every Wednesday has a section on nutrition, entitled 'all about food', in the $DN_2$-Daily Kenya Living Magazine).

Consumers whose major sugar purchase outlet is the supermarket have higher probability of being aware 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 being aware of sugar fortification by 51.2%. In fact, this study finds purchasing from a supermarket the major determinant of consumer awareness of sugar fortification followed by reading newspaper. 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. Other than proper display of goods, supermarkets also offer shopping choices and ambiance through skilful and attractive arrangement of goods; advertise through posters, billboards and even media. All these aspects promote consumer awareness and are less synonymous with other purchase outlets (see, Neven and Reardon, 2004; Weatherspoon, and Reardon, 2003, for details).

According to Knight et al. (2003), larger sections of urban consumers may feel less pressured to seek discounted prices generally offered by retailers and, in addition, may not experience the subsistence type of living associated with kiosk outlets; that is, daily shopping for small individual food items. Furthermore, to shop at other outlets would not be in keeping with the image associated with a certain socio-economic standing. This contrasts with the experiences of those respondents in the rural areas, who, because of poverty and low income, are forced to seek the best value for their shilling from small shops that break goods in smaller quantities.

Households with some members below the age of 5years are also likely to be aware of sugar fortification with vitamin A. This is because more information regarding nutrition and nutritious foods, which is the sole aim and target of food fortification, is provided to them when they visit the public clinics (IVACG, 2003). The result from this study is in tandem with this expectation as it reveals that having a preschool child in the house increases consumers' probability of being aware of sugar fortification by 15.9%. These results concur with those of Birol (2011). Furthermore, availability vitamin A supplementation programme

(for instance, by the government) increases the awareness levels of these households, since they are the prime target of vitamin A supplementation programme (KNFFA, 2011).

Geographic region also positively and significantly affects the probability of being aware of sugar fortification. Specifically, residing in an urban region increases the probability of being aware by about 50%. These results corroborates the findings of De Groote et al. (2010) that consumers' proximity to urban areas increased awareness and preference for yellow versus fortified maize. The marginal effect shows that an instant migration from rural area to an urban area increases the probability of consumer awareness by 10.5%. This can be attributed to a number of factors including, increase in information infrastructure and sources in urban areas as well as increase in the number of supermarkets that increases the frequency of purchasing from these purchase outlets (major determinant of consumer awareness).

The effect of gender is insignificant for urban consumers' awareness; perhaps suggesting uniform access to information by male and female in the urban areas. However, the effect of gender is negative and significant for the rural consumers. The result shows that female consumers in the rural areas are on average 64% less aware of sugar fortification than the males. This can be attributed to the fact that males usually dominate the household resources, which includes information (Kaliba et al., 2000). The result contradicts the findings of Adesope et al., (2010), who found that female consumers in northern Nigeria were more likely to be aware of safety labels in sugar, a fact which the authors attributed to their roles regarding food purchase and preparation. In Kenya, this study has established that majority of female consumers in the rural areas purchase sugar from retail shops and kiosks. Such outlets offer little information to these consumers so that their awareness levels are still low regardless of their greater roles in terms of food purchase and preparation. Moreover, such outlets usually repackage sugar into smaller-unlabelled packets, reducing chances of consumer awareness/information (Knight et al., 2003).

### 2.4. Conclusions and policy implications

This study applied a binomial (binary) logit model to investigate the awareness levels of consumers regarding sugar fortification. The socioeconomic and food demand characteristics that might influence consumers' awareness regarding sugar fortification in Kenya were also identified. The study contributes useful insights in food policy development; food nutritional

enrichment programmes; consumer education programmes and necessary infrastructure for ultimate uptake of such nutritional enhancement technologies by the consumers.

This study found that consumers' awareness of sugar fortification in the study areas was moderate for urban but relatively lower for rural consumers. Consequently, the null hypothesis that the awareness levels are equal for urban and rural consumers was rejected. The study also established the fact that purchasing sugar from supermarket, age of the consumer, reading newspaper, location in urban area and household having infant member(s) significantly influences consumer's awareness of sugar fortification. In addition, marital status and the years of formal education of the consumers' had insignificant influence on the level of consumer awareness, contrasting the prior expectation of the study.

Results showed that purchasing sugar from supermarket outlets positively and significantly influence consumers' awareness on fortified sugar. This was quite useful to all stakeholders involved in fortified sugar production, marketing and distribution. It implied consumers are able to improve their knowledge from organized display of goods (able to read). Coupled with the relatively high levels of education noted (high school education on average), consumers could as well benefits from proper labelling. Therefore, promoting purchase infrastructure, particularly in the rural areas would impact positively on the consumers' awareness levels. A case in point would be for the stakeholders to promote private investment in modern purchase outlets in rural areas.

Societal groups such as women groups, churches and other non-profit organizations can be used to supplement media sources, in disseminating information. In addition, mobile phones (via short message service) should be considered, since there is evidence of its wider use in literature. Finally, younger generation (whose access to media and phones is low), can also be targeted for nutritional information in schools. The study suggests introduction of nutrition education as well as formation of nutrition/dietary clubs in both primary and secondary schools. Further research is required to understand the link between consumers' awareness and their attitudes for fortified foods. This would enable designing of consumer-based food fortification programmes and could increase the acceptance rates of consumers.

**References**


Adesina, A. and Baidu-Forson, J., (1995). Farmer's Perceptions and adoption of new agricultural technology: evidence from analysis in Burkina Faso and Guinea, West Africa. *Journal of Agricultural Economics,* 13(1): 1-9.

Adesope, A., Awoyemy, T., Falusi, O. and Omonono, T. (2010). Willingness to pay for safety label on sugar and vegetable oil among households in south-Western Nigeria. *Agricultural and Social Research*, 10(1): 156-167.

Adolwa, S., Okoth, F., Mulwa, R., Esilaba, O., Mairura, F. and Nambiro, E., (2012). Analysis of Communication and Dissemination Channels Influencing the Adoption of Integrated Soil Fertility Management in Western Kenya, *Journal of Agricultural Education and Extension*, 18(1): 71-86.

Anderson, S. and Newell, R., (2003). Simplified marginal effects in discrete choice models. *Econometrics Letters,* 81(3): 321-326

Arroyave, G., Aguilar, R., Flores, M. and Guzman, A., (1981). Evaluation of sugar fortification with vitamin A at the national level. Washington, DC, Pan American Health Organization, (Scientific publication No. 384).

Bailey, A., (2005). *Consumer Awareness and Use of Product Review Websites.* Available at: http://jiad.org/article71. [Accessed 14 July 2013]

Birol, E., D., Asare-Marfo, B., Karandikar, and Roy, D., (2011). A latent Class Approach to Investigating Farmer Demand for Bio-fortified Staple food crops in Developing Countries: The Case of High-iron Pearl Millet in Maharashtra, India*. Harvest plus Working Paper*.

Burgi, H., Supersaxo, Z. and Selz, B., (1990). Iodine deficiency diseases in Switzerland one hundred years after Theodor Kocher's survey: a historical review with some new goitre prevalence data. *Acts Endocrinological*, 123(2): 577–590.

De Groote, H., Kimenju, S. and Morawetz, U., (2010). Estimating consumer willingness-to-pay for food quality with experimental auctions: the case of yellow versus fortified maize meal in Kenya. *Agricultural Economics,* 42(1): 1-16.

Greene, W., (1993). *Econometric Analysis* (3rd Ed.) New York, NY: Macmillan Publishing Company.

Greene, W., (2002). LIMDEP version 8.0/Nlogit version 3.0. *Econometric Modeling Guide.* Plainview, NY: Econometric Software.

Harris, M., (1997). The Impact of Food Product Characteristics on Consumer Purchasing Behaviour: The Case of Frankfurters. *Journal of Food Distribution Research*, 30 (1): 92-97.

Huston, S. and Finke, M., (2003). Diet Choice and the Role of Time Preference. *The Journal of Consumer Affairs, 37(1): 143-160.*

IVACG, (2003). Improving the vitamin A Status of Populations. Report of the XXI International Vitamin A consultant Group Meeting, International Vitamin A Consultant Group (IVACG), Washington, DC.

Jonas, M. and Beckmann, S., (1998). Functional Foods: Consumer Perceptions in Denmark and England. *MAAP Working Paper, No. 55,* MAPP, Aarhus, Denmark.

Kaliba, M., Verkuijl, H., Mwangi, W., Byamungu, A., Anadajayasekeram, P., and Moshi, J., (2000). Adoption of maize production technologies in intermediate and lowlands of Tanzania. *Journal of Agricultural Economics,* 32(1): 35-47.

Kenya National Food Fortification Alliance (KNFFA), 2011. The PSI/Kenya's Food Fortification Social Marketing and Communication Project, 2011-2013. www.gainhealth.org/programs [last accessed 22 June 2013]

Kimenju, S. and De Groote, H., (2008). Consumer willingness to pay for genetically modified food in Kenya. *Agricultural Economics*, 38(1): 35 – 46.

Kimenju, S., Morawetz, U. and De Groote, H. (2005). Comparing Contingent Valuation method, Choice Experiment and Experimental Auctions in soliciting consumer preference for maize in Western Kenya: Preliminary results.

Knight, P., Jackson, J., Bain, B. and Eldemire-Sheare, D., (2003). Household food safety awareness of selected urban consumers in Jamaica. *International Journal of Food Sciences and Nutrition,* 54(3): 309-320.

Lohr, S., (1999). *Sampling: Design and analysis.* Cincinnati, OH: Duxbury Press.

Long, J., (1997). *Regression models for categorical and limited dependent variables.* Thousand Oaks, CA: Sage Publications.

Lupin, B. and Rodriguez, M., (2012). Quality attributes and socio-economic factors affecting channel choices when buying fresh potatoes in Argentina. Selected Poster Prepared for Presentation at the International Association of Agricultural Economics [IAAE] Triennial Conference, *Foz do Iguacu*, Brazil, 18-24, August

Maddala, G. S., (2000). *Introduction to Econometrics* (3rd edition). New Jersey: Prentice-Hall Inc.

Mahgoub, S., Lesoli, P. and Gobotswang, K., (2007). Awareness and Use of Nutrition Information of Food Packages among Consumers in Maseru (Lesotho). *African Journal of Food Agriculture Nutrition and Development,* 7(6): 1-8.

Marine, D. and Kimball, P., (1920). Prevention of simple goitre in man. *Archives of Internal Medicine*, 25(1): 661–672.

McFadden, D., (1974). Conditional logit analysis of qualitative choice behaviour. *In Frontiers in Economics, ed. P. Zerembka.* New York: Academic Press.

Moon, W. and Balasubramanian, K., (2004). Public Attitudes towards Agro-biotechnology: The Mediating Role of Risk Perceptions on the Impact of Trust, Awareness, and Outrage. *Review of Agricultural Economics,* 26(2): 186-208.

Nair, I., (2012). Assessment of Consumer Awareness amongst Undergraduate Students of Thane District (India)-A Case Study. *International Journal of Science and Research,* 2(5): 1-7.

Neven, D. and Reardon, T., (2004). The rise of Kenyan Supermarkets and evolution of their horticulture procurement systems. *Development Policy Review,* 22(6): 669-699.

Okello, J., Okello, R. and Ofwona-Adera, E., (2009). Awareness and use of mobile phones by smallholder farmers in Kenya. In Blessing Maumbe (Ed). *E-Agriculture and E-Government for Global Policy Development: Implications and Future Directions.*

Otieno, D., (2013). Market and Non-market Factors Influencing farmers' Adoption of Improved Beef cattle in Arid and Semi-arid Areas of Kenya. *Journal of Agricultural Science,* 5(1): 32-46.

Paulsen, J., (1999). Danish consumers' attitudes towards functional foods. MAPP working paper, 62, Aarhus School of Business www.mapp.asb.dk/wppdf/wp62.pdf.

Schwab, B., (2011). Nutrition, Education and development: The case of Vitamin D milk. Selected paper prepared for presentation at the Agricultural and Applied Economics Association's 2011 AAEA and NAREA Joint annual meeting, Pittsburgh, Pennsylvania.

Weatherspoon, D. and Reardon, T., (2003).The rise of supermarkets in Africa: Implications for agri-food systems and the rural poor. *Development Policy Review,* 21(3): 333-355.

WHO, (2008). Micronutrient deficiency information system. World Health Organization, Geneva.

WHO, (2006). Guidelines on Food Fortification with Micronutrients. World Health Organization, Geneva.

# CHAPTER THREE

# ASSESMENT OF CONSUMER PREFERENCES FOR FORTIFIED SUGAR IN KENYA

## 3.1. Introduction

Industrial food fortification-the practice of increasing the content of an essential micronutrient, such as vitamins and minerals, in a food irrespective of whether the nutrients were originally in the food before processing or not—could prove to be an essential strategy for combating vitamin-A deficiency (VAD) in Kenya, which has high rates of micronutrient malnutrition. Over 70% of children and 33% of women of childbirth age in Kenya, for example, 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 (Gonzalez et al., 2010).

Vitamin-A (VA) is mainly obtained from animal sources in the form of retinol that are usually expensive and out of reach of most households. Other sources include a few leafy vegetables and fruits in the form of pro-vitamin-A carotenoids. These are less easily absorbed and utilized by the human body (less Bio-available) than the VA coming from animal products (Kimenju et al., 2005). Since VA from plant sources is usually found in large amounts in only a few fruits and vegetables, many of which are highly seasonal, low income populations may suffer from VAD unless VA is available in processed foods such as sugar, oils, and staples (Ruel, 2001). Moreover, young children and the elderly, who bears the greatest burden of VAD, may not be physiologically able to acquire VA directly from plants or animal sources.

This suggests that there is need to improve the quality of the diet of the vulnerable in Kenya, in terms of VA content, in order to ensure better nutritional outcomes. Fortification of foods with minerals and vitamins is the most effective and least expensive method of eliminating micronutrient deficiencies. Among other advantages, food fortification is commercially viable as it retains the original nutrients and taste of food, and indeed provides the additional nutrients; cost effective as the cost to the government is minimal since the main responsibility

for fortification has to be shouldered by the industry and do not require any change in dietary habits of consumers (WHO, 2006; Meenakshi et al. 2010).

In recent years, many food manufacturers have developed and marketed fortified foods in response to increasing consumer concern and interest in the link between diet and health (Hasler et al., 2004). However, the market for these foods in developing countries remains relatively small as prices for these products are generally higher than conventional foods (Childs, 1997). The main characteristic of fortified foods is the health benefit from one or more added micronutrients that may help prevent certain deficiency diseases. It is thus expected that, particular groups of people will likely be more interested in and willing to pay premium prices for these food products.

While studies have been carried out on preferences for food and its nutritive value (especially genetically modified foods), no study in Kenya has empirically analyzed consumers' preferences for fortified sugar. This study aims to fill this gap in knowledge by; i) determining consumers' preferences for the fortified sugar-attributes; and, ii) ranking these attributes according to preferences. Furthermore, preference heterogeneity among sugar consumers as well as the trade-offs between different fortified sugar-attributes will be explored using a choice modeling approach, specifically choice experiment. It is hypothesized that consumers' in Kenya have insignificant preferences for fortified sugar, given that efforts to fortify food products in Kenya, other than salt (iodized), has yielded limited success. The results can be useful for better understanding the acceptance of fortified sugar as well as the potential for food fortification in Kenya. This will also allow assessment of the possibility of using food fortification to reduce the impacts of micronutrient deficiency in developing countries.

### 3.1.1. Approaches to economic valuation of preferences

Revealed preference (RP) and stated preference (SP) methods are the two main approaches that have been commonly used in the economic valuation of market and nonmarket goods (Garrod and Willis, 1999). The RP approaches, comprising the travel-cost and hedonic pricing methods, are used to evaluate product demand by examining purchases of related goods in the private market place. This approach is appropriate when a market exists for

those goods, in which case the data are obtained from actual market behaviour or based on actual choices made in observable situations.

The SP approaches, including the contingent valuation method (CVM) and choice modeling (CM) measure how people value goods through explicit questions seeking to achieve the valuation of hypothetical situations. SP data are collected by presenting hypothetical scenarios to respondents and asking for their preferences (not observed). The basic idea is that relative important scales on different product attributes can be derived on the basis of responses to such hypothetical questions (Bates, 1988). Although responses from the SP approach may not be valid for forecasting actual behaviour due to their unknown bias and error properties, such responses often contain useful information on trade-offs among attributes. In particular, SP data provides useful information when new products or attributes are introduced, in which cases RP data is not yet available (Morikawa et al., 2002).

Ben-Akiva et al. (1991) and Adamowicz et al. (1994), enumerated the advantages of the SP, as compared to the RP approaches. First, the SP approach can be applied to elicit preferences for non-existing attributes and alternatives. Also, by employing appropriate design procedure, the SP approach may not encounter the problem of multicollinearity among attributes. Though RP data are observed from real behaviour, it suffers from the fact that not all quality attributes can be included in the model because of collinearity problems (Morikawa et al., 2002).

CVM is an approach that asks respondents to state their maximum willingness to pay (WTP) for a hypothetical change in an environmental or economic good or service (Mitchell and Carson 1989; Hanley et al., 2001). It is the most widely used approach within SP methods. CVM has been considerably criticized in literature. Some of the most serious criticism involves its often-poor implementation as people may not be aware of or able to articulate their preferences (Whittington, 2002); *ethical protest* as respondents may refuse to 'play the game' due to ethical objection to the underlying utilitarian model. This implies, for example, unwillingness to pay in principle to stop soil erosion (Hanley et al., 2001); *anchoring effects* (when respondents base their responses on a feature of the scenario-leading to some form of a hypothetical bias); and *yea saying* as respondents are faced with 'all or nothing' design (when respondents too easily accept the proposed payment without regard for their ability to pay).

Also, the values of WTP estimates could be sensitive to the size of anticipated change in the hypothesized good (*sensitive to scope*) due to lack of or weak natural internal scope test (Hanley et al., 2001).

Interest in CM has risen in part as a response to the problems of CVM. In general CVM and CM differ mainly in that the latter allows the practitioner to estimate values for multiple attributes of a product and their tradeoffs simultaneously, while CVM can only analyze one combination of attributes at a time (Merino-Castello, 2003). The basic foundations lie in Lancastrian microeconomics in which individuals derive utility from characteristics or attributes of a good (Lancaster 1966); and in random utility models/theory (RUM/RUT), in which utility has a deterministic and probabilistic component (McFadden, 1973; Manski, 1977). Utility is considered to be unobservable (to the researcher), i.e., a random variable, which can be measured as a probability that rational consumers make choices of goods from which they obtain the highest utility in any given choice set. The randomness arises from the effects of unobserved attributes and taste heterogeneity, salient individual characteristics and measurement errors.

In CM approaches, individual preferences are elicited by asking respondents to rank the options presented to them, to score them or to choose their most preferred. Accordingly, these different ways of eliciting preferences corresponds to the different variants of CM surveys. There are four main CM variants including: contingent rankings, contingent ratings, choice experiments (CE) and paired comparisons. The CM literature posits that these methods differ in the quality of information they generate, their degrees of complexity and the consistencies of their WTP estimates to the welfare theory (see for example, Hanley et al., 2001). The authors concluded that even though CE poses some degree of complexity, (particularly at the design level), it produces the most consistent welfare estimates among the four CM techniques.

CE offer a promising new way forward in the field of choice valuation. The approach is based on the notion that attributes of a good can be used to understand the general trade-offs which an individual is willing to make. This is in contrast to CVM that focuses on a specific situation (specific change in the good) and elicits a response unique to this case. CE enables estimation of trade-offs and values of individual components or attributes of a good, rather than only the value of the "whole" good as in CVM. Furthermore, CE provides an

opportunity to obtain more information from a relatively smaller sample size through repeated responses from the same respondent, on a panel of choice tasks. They are practical from a policy and management perspective because the information they provide can be used in the design of multidimensional policies (Hanley et al., 2001).

### 3.1.2. Applications of choice experiments

The CE technique was originally applied in environmental economics (Adamowicz et al., 1994), but has gained popularity in other disciplines including, marketing, transportation, and psychology literatures in recent years. CE has been applied through a series of questions with more than two alternatives, to estimate individual preferences over attributes of an environmental issue, including the design of agri-environment schemes, wilderness area, recreation restrictions, forest industry employment, tourism and changes to provincial income tax (see for example, Hensher, 1991; Adamowicz et al., 1998; Hanley et al., 1998; Hearne and Salinas, 2002; Massimiliano, 2003; Ruto and Garrod, 2009). The technique has also been extensively employed in Kenya to explore various aspects related to indigenous cattle service provision and policy issues. These include livestock marketing in Kenya's rangelands, valuing animal genetic resources, identifying preferences for local cattle traits as well as preferences for Disease-Free Zones (see for example, Ruto et al., 2008; Ruto, 2009; Otieno et al., (2011).

The application of CE has also extended to agribusiness research, as firms are increasingly becoming interested in producing and selling differentiated goods and services with values not currently established in well-functioning markets. Towards this end, CE has been used to examine the importance of different product attributes including price, marbling and tenderness, use of growth hormones and GM foods, and changes in sensory characteristics in consumer purchasing decisions. It has also been employed to elicit consumers' preferences for different food products' attributes, including labeling, added nutritional value (e.g. fortification) and price, in a hypothetical market (see for example, Lusk and Fox, 2000; Kimenju et al, 2005; Gonzalez et al., 2010; Birol et al. 2011).

Although CE reduces the cognitive tasks to the respondents' posed by other choice-based methods, it is still problematic to the analyst in terms of the complex nature of the statistical/

experimental design required; and the selection of appropriate attributes and levels. Care was taken to ensure that alternative choices in the experimental design are just sufficient to enable the respondents' select their preferred options without compromising their cognitive abilities. The implied ranking of attributes is also dependent on the experimental design used, and accompanying materials. To overcome these weaknesses, choice tasks were reduced from the initial six to four through an efficient design procedure, to reduce cognitive burden to the respondents. Additionally, attributes and their levels ware contextually validated through a focused group discussion (FGD) and CE-experts consultations.

### 3.2. Methodology

#### 3.2.1. Theoretical framework

A discrete choice model is chosen to examine how consumers value fortified sugar and make trade-offs among its attributes. This model allows the linkage of individual consumer demand to underlying attributes of fortified sugar (Anderson et al., 1992). It provides an ideal framework for describing demands for differentiated products, since it deals explicitly with a population of heterogeneous consumers who make mutually exclusive choices from a set of substitutable sugar-attributes. The model starts from the underlying assumption that each consumer chooses a single option that yields the greatest utility (McFadden, 1973; Ben-Akiva and Lerman, 1993). Utility is only known by the consumers and cannot be observed directly by researchers. Researchers only observe certain attributes of alternatives available to consumers and some consumer characteristics. If researchers make assumptions about the distribution from which the taste parameters are drawn, they will be able to forecast demand by modeling the probability of purchase (Anderson et al., 1992).

The random utility model (RUM) represents the fundamental approach for the econometric analysis of consumer choice within a discrete choice multi-dimensional environment. It is based on the hypothesis that individuals make choices according to attributes of alternatives along with some degree of randomness (McFadden, 1973; Adamowicz et al., 1994). The model suggests that consumer's utility is represented by two components, a deterministic and a random component. The deterministic component is a function of observable product attributes, following Lancaster's characteristic theory that recognized how consumers select among different food attributes when choosing diets (Lancaster, 1966). The deterministic

portion of consumer's utility can be modeled as a function of these product attributes. Consumers assign a value to each product attribute, sum these values for each product, and select the product that has the highest total value. The random component captures variations in choices due to within- and between-individual variance, omitted variables, and measurement errors (Bates, 1988). Various discrete models that can be applied to analyze CE data are discussed in section 3.2.3.

### 3.2.2. Choice experiment design

In a CE, individuals are asked to choose their preferred alternative from several options in a choice set, and they are usually asked to respond to a sequence of such choices. Each alternative (e.g., fortified sugar alternative 1, 2, and 3) is described with a number of attributes or characteristics (e.g., levels of vitamin A, colour, labeled as fortified, gift pack, source of vitamin A), where the levels of the attributes change from one alternative to the other (e.g., level of vitamin A; 5, 10, 15). A monetary attribute is included as part of attributes presented to respondents. Thus, when individuals make their choices, they implicitly make trade-offs between the levels of the attributes in the different alternatives presented in a choice set (Alpízar and Martinson, 2003).

#### 3.2.2.1. Definition of attributes and their levels

A starting point involved reviewing literature on the attributes and attribute levels used in previous studies and their importance in the fortified sugar-choice decisions. This is a key step in a CE. The design procedure relies "on the accuracy and completeness of the characteristics and features used to describe the situation". The attributes were expected to affect respondents' choices. Additionally, the selection of attributes was guided by their policy relevance and their ability to be amenable to policy changes in response to consumer preferences (for details see, Batsell and Louviere, 1991; Bliemer and Rose, 2010).

There are two types of attributes namely, compulsory and optional attributes. The compulsory ones are those that must be observed for the fortification programme to be feasible. These compulsory features are also necessary to enforce public policy on fortification, and include monitoring for safety and quality of fortified sugar, use of non-poisonous fortificant (vitamin

A additive) as well as regulation of the type of sugar fortification programme to be adopted. The optional features offer consumers some choice and are the ones that enter the CE design. In the present study, six voluntary attributes were identified for the CE design. These are; labeling the product as fortified, level of vitamin-A, source of vitamin A, provision of gift pack, colour of fortified sugar and price. The identification process involved review of relevant literature, expert's consultations and focused group discussions.

Table 3.1: Attributes included in sugar-fortification CE-design

| Sugar fortification attribute | Definition of attributes | Attribute levels |
|---|---|---|
| Source of vitamin A | Whether vitamin A added is obtained from natural or artificial sources. | Natural<br>Artificial |
| Level of vitamin A (mg / kg) | Nutrition attribute (vitamin A levels sufficient for human health according to WHO guidelines) | 5<br>10<br>15 |
| Labeling | Marketing attribute (whether sugar is labeled as fortified or not) | Yes<br>No |
| Gift pack | Marketing attribute (whether fortified sugar has a complementary / supplementary gift or not) | Yes<br>No |
| Colour | Consumption attribute (colour of fortified sugar). | White<br>Brown<br>Yellowish |
| Price | Monetary attribute (price of 1 kilogram of fortified sugar in Kenya shillings within 50% of the current price/ status quo) | 120<br>150<br>180 |

Focus group discussion (FGD) was conducted with stakeholders to find an easily understandable definition of what nutrition value (in this case level of vitamin A) is, and how consumption of VA could improve health. In the CE, the sugar alternatives contained varying levels of VA. These were: 5; 10; 15; with the 5 and 15-value indicating minimum and maximum levels of VA allowed by nutrition experts to be added in sugar during fortification respectively (WHO, 2006). Based on previous studies that used CE to estimate preferences for nutritional attributes (see for example, Gonzalez et al., 2010; Meenakshi et al., 2010;

Birol et al, 2011), it was expected that consumers' would prefer the fortified sugar with high level of VA.

In the CE, the gift pack attribute was defined as "packaging the fortified sugar with a complementary commodity, or otherwise, as a gift (e.g., tea leaves, cocoa, coffee, etc), to induce consumers into purchasing this commodity". The levels used for this attribute are whether the gift pack is included or not. The aim of including this attribute into the CE-design is to test whether certain sugar consumers would need incentives to purchase fortified sugar, but with little knowledge regarding their response to this initiative. Therefore, there were no *a priori* expectations on consumers' preferences for this attribute.

According to the results of a study by Adesope et al. (2010), packaging, and labeling were thought to be very important marketing traits by the highest proportion of consumers. The difference in proportions for these two traits was not statistically significant. During FGD for this study, labeling was adopted as the marketing attribute that got valued vis-à-vis other traits in the CE. The reason being that the sugar in Kenya is already differentiated in terms of packaging and fortification would have added no value in terms of packaging, which rule out any trade-offs between other attributes and packaging. Moreover, it was envisaged that 'labeling sugar as fortified' would distinguish fortified sugar from conventional sugar, draw consumers' attention, increase their awareness and motivate them to purchase the product.

Birol et al., (2011) reported that taste and colour are the consumption traits that are regarded as very important by majority of consumers. Since it would be difficult to describe taste in this hypothetical context, the colour of fortified sugar was preferred. Colour was easier to describe with the help of digital technology that allowed generation of sugar-pictures in yellowish, brown, and white colours (see Figure 1). This qualitative attribute with three levels was coded as two dummies (brown and yellowish-coloured sugar,) with white-coloured sugar as the base level. Moreover, vitamin A fortification is likely to result from an increased content of pro-vitamin A-carotenoids, which, because of their chemical structure, will give fortified sugar a yellowish colour (Rodriguez-Amaya and Kimura, 2004). Smale and Jayne (2003) reported that consumers do not prefer such changes to the sensory characteristics in the food they consume. This is considered a concern for the acceptance of fortified sugar. Therefore, it was expected *a priori* that consumers' would require discounts to accept yellowish colour.

Figure 1: Illustration of colour attribute (yellowish, brown, and white)


Source: Author's survey card

Finally, it is important to identify the welfare interaction effect between the attributes (see for example, Bliemer and Rose, 2010). As such, it was necessary to include price as the monetary attribute. This attribute was included in order to estimate consumers' willingness to pay (WTP) a premium for other attributes, i.e., level of vitamin A, source of vitamin A, gift pack, labeling and colour. The levels of the price attribute were derived from the prices of the sugar currently available in the Kenyan market (see for example, Birol et al., 2011) and included a mean price of Kenya shillings (Kshs) 120. The selected prices of Kshs 150 and 180 respectively (per kilogram of sugar), is consistent with the allowable levels that could be set within 50 % around the mean price level (Gonzalez et al., 2010). *Ceteris paribus*, it was expected that consumers prefer sugar alternatives with lower prices.

### 3.2.2.2. Experimental design

A CE design was developed by obtaining the optimal combinations of attributes and attribute-levels. The main design issue was to maximize the efficiency of the survey to extract information from the respondents. Each answer to a choice set provided additional information for the statistical model, so that eventually the preferences for different levels of the attributes were individually identified (Bliemer and Rose, 2010).

The FGD recommended three levels each for three of the six fortified sugar attributes, and two levels each for the remaining three attributes. These chosen attributes and their levels produced a full factorial orthogonal main-effects design of 108 ($3^3 * 2^3 = 108$) possible fortified sugar alternatives (see Adamowicz et al., 1994 for details on experimental designs). The full factorial design was, in general, very large and not tractable in a CE (Huber and Zwerina, 1996). Therefore, a subset of all possible combinations was chosen, following optimality and design efficiency criteria, and then the choice sets were constructed.

In CE, design techniques used for linear models were popular in the past. Orthogonality in particular has often been used as the main component of an efficient design. More recently, researchers in marketing have developed design techniques based on 'D-optimal' criteria for nonlinear models in a CE context (Huber and Zwerina, 1996). A design is said to be 'D-efficient' or 'D-optimal' if it has a sufficiently low 'D-error' or yields data that enable estimation of parameters with low standard errors (Kuhfeld, 2005).

Bliemer and Rose (2010) noted that efficient designs generally increases sampling efficiency (reduces sampling size hence cost effective). Therefore, design efficiency implies sampling efficiency. To capture full information across the entire consumer diversity, at a reasonable sample size (considering costs constraints), an efficient criterion was adopted. Specifically, the study focused on maximizing the 'D-optimality' in two stages. In the first stage, a conventional fractional factorial orthogonal design generated from the attributes was selected and applied in a preliminary survey of 42 sugar consumers to obtain prior coefficients. The second stage involved using the 'priors' (from first stage) to generate an efficient design, whose application could estimate both main effects and interaction effects (for details see for example, Otieno, 2011).

The design had a relatively good level of D-optimality (i.e. D-efficiency measure of 86%). In addition, the design had good utility balance (i.e. a B-estimate of 85%)-surpassing the minimum threshold (B-estimate of 70%), which signals the fact that none of the alternatives in the choice options had any significant dominance. Worthwhile to mention is that most CE-designs rarely achieve good D-efficiency, utility balance and orthogonality simultaneously (Huber and Zwerina, 1996). Furthermore, A-efficiency of 77% implied that the variance matrix generated reliable estimates (Kuhfeld, 2005). The efficiency procedure in the NGENE

(Choice Metrics, 2009) statistical software was applied to produce the design (see appendix 2 for comprehensive CE-design syntax).

The final design had 24 paired choice sets that were randomly blocked into six profiles of four choice tasks. Respondents were randomly assigned to one of the six profiles. Each choice task consisted of two alternatives (A and B) and neither option, which was the *status quo.* When making choices, respondents were asked to consider only the attributes presented in the choice tasks and to treat each choice task independently (for example, choice tasks involving higher prices never implied better quality than others and *vice versa*). An example of a choice set/card presented to respondents is shown in Figure 2 (see Appendix 3 for the entire choice sets).

Figure 2: Example of fortified sugar choice set

| | Sugar type A | Sugar type B | Neither type A or type B |
|---|---|---|---|
| Source of vitamin A | Artificial | Natural | |
| Level of vitamin A | 10 | 10 | |
| Labeling | Labeled | Not labeled | |
| Gift Pack | No gift pack | Has gift pack | |
| Colour | White | Yellowish | |
| Price | 120 | 180 | |
| Which ONE would you prefer? | | | |

### 3.2.2.3. Data and the experimental context

As already discussed in chapter two, the choice sets were part of a larger questionnaire that included an initial set of questions related to the respondents' general characteristics such as knowledge of sugar fortification and their consumption habits or frequencies (see appendix 1). The questionnaire provided an introductory text to explain the dynamics of the interview as well as screening for suitable respondents. The choice sets contained different attribute-alternatives and the respondents were required to choose the preferred alternative, with regard to the relative importance assigned to them. Coloured cards (Figure 1) were used to illustrate the colour attribute so as to aid the presentation of the three colour-levels (yellowish, brown

and white). The last section of the questionnaire collected data on demographic and socio-economic characteristics, such as income level, household size, employment status, education level and age.

The survey team (the author and six trained enumerators) conducted a pilot survey to fine-tune the questionnaire, which explored the cognitive complexity of the task and helped determine the adequate number of choice sets. First, a qualitative study was conducted using FGD and included sugar consumers, traders, actors involved in the marketing and distribution of sugar, nutrition-experts, public health officials and representatives from sugar-producers. The discussions were designed to obtain information about respondent's perception and knowledge on consumer profile, the importance assigned to this product in the market and the challenges in consumption of fortified sugar. Furthermore, the group discussions validated the attributes that were included in the choice sets, as well as their levels. This was followed by, a pre-test (preliminary) survey on 42 randomly sampled households in the selected study sites. The preliminary survey revealed that respondent could comfortably handle four choice sets since they got tired by the fifth exercise. Consequently, the initial six choice sets were reduced to four. The pilot survey was carried out as if it were the actual survey, in order to mimic all the conditions that would be faced.

Prior to asking respondents to make their choices among three sugar alternatives (A, B, or the baseline option) in the four consecutive choice sets, well-trained enumerators explained the attributes, their levels, and the choice exercise slowly and clearly (see appendix 4). The enumerators asked respondents if they understood the attributes, their levels, and the choice exercise. They repeated these definitions and instructions as many times as needed and reminded the respondents that there were no wrong or right answers, and that only their honest opinion was being sought.

Enumerators also reminded the respondents' that even though the choices they were going to make were hypothetical in nature, they were expected to think carefully about them, as if they were actually going to buy the sugar they selected in each choice set. The respondents' were further reminded to consider their budget constraints, the kind of sugar they consume and they would like to consume, before making their choices. In addition, the respondents were also reminded that even though their choices were hypothetical (that is, even though they

were not expected to buy the sugar alternative they selected), it was likely that the results of this study would inform delivery of certain types of fortified sugar in their shops. This rigorous reminder was intended to reduce the hypothetical bias that is inherent in SP studies.

The FGD also defined the relevant population and the sampling strategy. The group discussions revealed that data collection during daytime in Nairobi County would be unattainable given that most households leave their houses in the morning, for work related ventures and go back in the evenings. Therefore, to ensure that only the household, who shoulder the responsibility for food purchase, and not the house help, is interviewed, the enumerators conducted the surveys on the afternoons and over the weekends, when household heads were likely to be available. Again, for sampling strategy, research team conducted interviews only in Kiswahili, to promote uniform interpretation of the questions, since the group discussions revealed its wider use among the Kenyan population.

### 3.2.3. Model specification

Following McFadden (1973), Ben-Akiva and Lerman (1993) and Adamowicz et al. (1998), the $n^{th}$ consumer is faced with discrete choices between a conventional sugar and fortified sugar, given various attributes presented in each choice set (see section 3.2.3.1, for the attributes). Each choice alternative offers some utility that comprises two components:

$$U_{nj} = V_{nj} + \varepsilon_{nj} = \text{alternative } 1, 2, 3, \text{and } 4 \qquad (1.1)$$

Where $U_{nj}$ is the $n^{th}$ consumer's utility when choosing alternative $j$; $V_{nj}$ is the deterministic component of the utility function based on product attributes for alternative $j$; $\varepsilon_{nj}$ is the stochastic component of the utility function. The $n^{th}$ consumer will choose alternative $j$ if $U_{nj} > U_{nl}$ for all $l \neq j$. The probability that the $n^{th}$ consumer chooses alternative j is given by;

$$Lnj = \text{prob}\{j \text{ is chosen}\} = \text{prob}\{Vnj + \varepsilon nj \geq Vnl + \varepsilon nl \text{ ; for all } l \in Cn\} \qquad (1.2)$$

Where $C_n$ is the set of all possible alternatives for the $n^{th}$ consumer

Assuming that the observable utility component ($V_{nj}$) is a linear function of perceived product attributes ($x$) and there are $k$ attributes for each alternative, then the functional form of this utility component is given as

$$V_{nj} = \sum_{k=1}^{K} \beta_k \, X_{njk} = \beta' X_{njk}$$

K= attributes 1 up to 6. (1.3)

Where $X_{njk}$ is the $k^{th}$ attribute value for the $j^{th}$ alternative for the $n^{th}$ consumer and $\beta_k$ represents the coefficient to be estimated which represents the value the consumer places on that particular attribute. The probability that individual *n* chooses alternative *j* becomes;

$$L_{nj} = \frac{\exp(\beta' X_{njk})}{\sum_l \exp(\beta' X_{nlk})} \quad (1.4)$$

Parameters in this model can be estimated using numerical methods such as Newton's or the maximum likelihood estimate (Batsell and Louviere, 1991; Greene, 2000).

The conditional logit model is a standard multinomial logit (MNL) model that analyzes discrete choice data and it can be derived from utility maximization. However, this model does not accommodate preference heterogeneity among consumers. The coefficients of variables that enter the model are assumed to be the same for all people, implying that different people with the same observed characteristics have the same values (i.e., attribute valuation) for each factor entering the model. It also imposes a restrictive assumption, independence of irrelevant alternatives (IIA) (Ben-Akiva and Lerman, 1993).

The IIA assumption states that the ratio of the probability for any two alternatives is independent of the existence and attributes of any other alternatives or it does not depend on irrelevant alternatives. A change in the attribute of one alternative changes the probabilities of the other alternatives proportionately such that the ratios of probabilities remain the same. In other words, it is assumed that the errors are independently distributed across alternatives. Furthermore, the conditional logit model assumes that unobserved factors are independent in situations with repeated choices for each decision maker. This substitution pattern can be unrealistic in many settings (Brownstone and Train, 1999).

A random-parameter logit model (RPL), also called a mixed logit model, does not exhibit the restrictive IIA property and explicitly accounts for correlation in unobserved utility over repeated choices by each respondent. It allows the parameter associated with each observed

variable to vary across consumers (Train, 1998). The RPL model is a highly flexible and relaxes the three limitations of multinomial logit models by allowing for random taste variation and hence explicitly accounting for heterogeneity in preferences; unrestricted substitution patterns; and dependence across a panel of repeated choices made by the same respondent, which captures correlation in unobserved factors that affect individual utility. The RPL is also not subject to the strong assumption of IIA (Hausman and McFadden, 1984) inherent in the standard MNL.

The specification for a RPL model is similar to a MNL model, except that the coefficients are varied across the population rather than being fixed (Train, 1998). Each respondent is presented with a series of T = 4 choices. In each choice set, a respondent faces a choice between J = 2 alternatives (including a baseline option). Thus, the three alternatives that the respondent faces in a particular choice set comprise two sugar fortification policy options described in terms of key design attributes (colour, level of vitamin A, source of vitamin A, gift pack, labeling and price) and the neither option in which sugar is not fortified. The attributes of alternative j in choice occasion t faced by respondent n are collectively labeled as vector $X_{jnt}$. Following Train (1998), the utility obtained by individual n from alternative j in choice situation t is expressed as:

$$U_{jnt} = \beta_n X_{jnt} + \varepsilon_{jnt} \quad (1.5)$$

Where the coefficient vector for each respondent βn is unobserved and varies in the population with a density function f(βn/θ), whereby θ are the parameters of this distribution. $\varepsilon_{jnt}$ is an unobserved random term assumed to be identically independently distributed type I extreme value. Conditional on βn, the probability that individual n chooses alternative j in choice situation t is given by the standard MNL model:

$$L_{jnt}(\beta_n) = \frac{\exp(\beta n\, Xjnt)}{\sum_{j\in C} \exp(\beta n Xjnt)} \quad (1.6)$$

Let *j(n,t)* denote the alternative chosen by individual *n* in choice situation *t*. The probability of individual *n's* observed sequence of choices (conditional on βn) is simply the product of the standard MNL model assuming that the individual tastes, βn, do not vary over choice situations in repeated choice tasks (although are assumed heterogeneous over individuals):

$$G_n(\beta_n) = \prod_t L_{jnt}(\beta_n) \quad (1.7)$$

The unconditional probability for the sequence of choices made by individual n is expressed as:

$$P_n(\theta) = \int Gn\,(\beta n)\, f\,(\beta n \,/\, \theta)\, d\beta n \quad (1.8)$$

Two sets of parameters are noteworthy in this expression: $\beta n$ is a vector of parameters specific to individual *n* (representing the individual's tastes, which vary between respondents) and $\theta$ are parameters that describe the distribution of the individual specific estimates (such as the mean and covariance of $\beta n$). The objective in RPL is to estimate the $\theta$. This is usually done through simulation of the choice probability [because the integral in equation (1.8) cannot be computed analytically due to the lack of a closed mathematical form]. The log-likelihood function is specified as:

$$LL\,(\theta) = \sum n \ln Pn\,(\theta). \quad (1.9)$$

The $P_n(\theta)$ is approximated by a summation over randomly chosen values of $\beta_n$. For a selected value of the parameters $\theta$, a value of $\beta_n$ is drawn from its distribution and $G_n(\beta_n)$, i.e. the product of the standard MNL model, is computed. Repeated calculations are done for several draws and the average of the $G_n(\beta_n)$ is considered as the approximate choice probability:

$$SPn\,(\theta) = \left(\frac{1}{R}\right) \sum_{r=1}^{R} G_n\,(\beta n^{r/\theta}) \quad (2.0)$$

Where $R$ is the number of draws of $\beta_n$, $\beta_n^{r/\theta}$ is the $r^{th}$ draw from $f(\beta_n/\theta)$ and $SP_n$ is the simulated probability of individual n's sequence of choices. Following Train (2003), the simulation were based on Halton intelligent draws, which has been shown to yield more accurate results compared with independent random draws. Up to 100 Halton draws were used in the simulations. The simulated log-likelihood function is constructed as:

$$SLL\,(\theta) = \sum_n ln\,(SPn\,(\theta)). \quad (2.1)$$

The estimated parameters are those that maximize SLL (θ). Trade-offs between fortified sugar attributes and money, i.e. the marginal willingness to pay (WTP), was computed as (Hanemann, 1984):

$$\text{WTP} = -1\text{x}(\frac{\beta_k}{\beta_p}). \qquad (2.2)$$

Where $\beta_k$ is the estimated coefficient for an attribute level in the choice set and $\beta_p$ is the marginal utility of income given by the coefficient of the consumer's purchase behaviour (price attribute). The marginal WTP (implicit price) for a discrete change in an attribute provides a measure of the relative importance that respondents attach to attributes within the fortification design. Finally, the overall WTP or the compensating surplus (CS) welfare measure was obtained for three different sugar fortification policy scenarios associated with multiple changes in attribute levels as Hanemann (1984):

$$\text{CS} = \frac{-1}{\beta_p}(\text{V1} - \text{V0}) \qquad (2.3)$$

Where $V_1$ represents the value of the indirect utility associated with attributes of the sugar fortification scenario under consideration, whereas $V_0$ is the indirect utility of the baseline scenario of no fortification of sugar. In this study the RPL parameters were estimated using LIMDEP version 8.0/NLOGIT 3.0, econometric software (Greene, 2002).

The variables used in the analysis of fortified sugar as well as how they were coded are given in table 3.2. All the indicated utility parameters (variables) entered the model as random parameters assuming normal distribution, except the price attribute that was specified as fixed in order to facilitate the estimation of WTP, by eliminating the risk of obtaining extreme negative and positive trade-off values (Train, 1998).

Table 3.2: Variables used in the preference analysis

| Variable | Description |
|---|---|
| NATURAL | Source of vitamin A used is natural (1= yes; 0= otherwise) |
| MIN | Minimum level of vitamin A added – 5ml/kg (1= yes; 0=otherwise) |
| MAX | Maximum level of vitamin A added - 15ml/kg (1= yes; 0= otherwise) |
| LABEL | Sugar packet is labeled as fortified (1= yes; 0= otherwise) |
| GIFT | Gif- pack is provided (1= yes; 0= otherwise) |
| BROWN | Colour of fortified sugar is brown (1= yes; 0= otherwise) |
| YELLOWISH | Colour of fortified sugar is yellowish (1= yes; 0= otherwise) |
| PRICE | Cost of purchasing1kg of fortified sugar (120, 150 or 180) |

### 3.3. Results and discussions

The survey team conducted a total of 360 interviews, collecting 1400 complete observations (each respondent answered four choice sets). A total of 350 respondents (97.2 percent) completely answered the questionnaire. Thus, the econometric model included all the 1400 observations, a solid base for the results.

In the questionnaire, respondents faced two generic fortified sugar alternatives, described by six attributes shown in Table 3.2. The maximum likelihood estimates for the RPL models, estimated for the rural, urban and pooled samples are reported in Table 3.3. The models were estimated using maximum simulated likelihood procedures in NLOGIT 3.0 econometric software utilizing 100 Halton draws for the simulations. In all the three samples, the coefficient for price enters with the expected negative sign.

As expected, given the extensive involvement of consumers in FGD and subsequent CE-experts consultations, all variables are statistically significant at below the 1% level ($p < 0.0001$), with the exception of brown colour, which is significant at the 10% level. This means that all variables are relevant and contributed to explaining the behaviour of consumers when confronted with the choices. All coefficients have the expected signs. In this type of probabilistic model, the estimated coefficients are only interpreted in terms of sign, context and significance (not magnitude).

On the pooled sample, the log-likelihood ratio test rejects the null hypothesis that the coefficient estimates (for the fortified sugar attributes) are equal to zero at less than 1% significance level ($\chi^2 = 1130.76$: $p < 0.0001$). Therefore, the null hypothesis that consumers have insignificant preferences for fortified sugar is rejected. Sugar consumers in the two counties have positive preferences for fortified sugar as compared to conventional sugar (referred to herein as *status quo*).

Table 3.3: RPL estimates for fortified sugar attributes

| Variable | Kakamega | Nairobi | Pooled |
|---|---|---|---|
| NATURAL | 2.61 (0.53)*** | 2.22 (0.28)*** | 2.41 (0.31)*** |
| MIN | 2.46 (0.55)*** | 2.41 (0.41)*** | 2.54 (0.35)*** |
| MAX | 2.10 (0.53)*** | 1.62 (0.35)*** | 1.87 (0.32)*** |
| LABEL | 1.59 (0.33)*** | 2.22 (0.26)*** | 1.89 (0.20)*** |
| GIFT | 1.22 (0.3)*** | 1.93 (0.24)*** | 1.59 (0.19)*** |
| BROWN | 2.46 (1.35)* | 30.9 (0.001) | 3.62 (1.86)* |
| YELLOWISH | - 1.31 (0.38)*** | - 1.61 (0.29)*** | - 1.50 (0.25)*** |
| PRICE | - 0.008 (0.003)** | - 0. 01 (0.002)*** | - 0.01 (0.002)*** |
| Standard deviations of parameter distribution | | | |
| sdNATURAL | 1.95 (0.48)*** | 0.68 (0.28)** | 1.31 (0.24)*** |
| sdMIN | 2.78 (0.75)*** | 2.22 (0.48)*** | 2.49 (0.44)*** |
| sdMAX | 0.18 (0.38) | 0.04 (0.29) | 0.13 (0.26) |
| sdLABEL | 1.12 (0.49)** | 0.83 (0.33)** | 0.98 (0.29)*** |
| sdGIFT | 0.76 (0.39)** | 0.55 (0.29)** | 0.54 (0.39)* |
| sdBROWN | 0.39 (2.55) | 0.001 (0.01) | 0.70 (2.56) |
| sdYELLOWISH | 0.50 (0.50) | 0.18 (0.39) | 0.25 (0.24)* |
| Log-likelihood | - 448.34 | - 506.96 | - 972.68 |
| Pseudo-$R^2$ | 0.37 | 0.39 | 0.37 |
| $\chi^2$ (ρ- value) | 527.13(0.0000) | 638.38(0.0000) | 1130.76(0.0000) |
| *n* (respondents) | 162 | 188 | 350 |
| *n* (choices) | 648 | 752 | 1400 |

**Notes:** Statistical significance levels: *** 1%; ** 5%; * 10%. Corresponding standard errors are shown in parentheses.

Consumers' on average prefer minimum rather than maximum level of VA, when compared to medium level. This may be explained by the fact that consumers in developing countries still show lack of confidence in food nutritional enhancements; a finding which corroborates the observations of Onyango and Nayga, (2004). However, it contradicts De Groote et al., (2010)'s findings where it was noted that Kenyan consumers were willing to pay significant premiums for yellow versus fortified maize. Suffice to note here that the preference pattern for fortified sugar is bound to differ from maize/cereals due to variations in targeted consumer segments. The results also indicate that consumers have a positive preference for the gift pack attribute, which is rational and consistent with the choice axioms of completeness and transitivity. As expected, they also prefer natural source of VA to artificial source. As mentioned previously, this attribute was exclusively described in the CE to prevent consumers' from perceiving 'artificial source' of VA negatively.

The estimated coefficient for yellowish colour is negative, as expected, and highly significant. This indicates that even though consumers generally express positive preferences for sugar fortification/food enrichment, they are still skeptical of the potential changes to the sensory characteristics including colour and taste (Adesope et al., 2010; De Groote et al., 2010 and Gonzalez et al., 2010). But, consistent with the previous studies, the preferences for food fortification programmes are higher than the dislikes of such changes in the sensory features so that fortified foods are still acceptable to the consumers. The coefficient for labeling sugar as fortified is positive and higher for urban areas compared to rural areas.

Following Train (2003), the random parameters of the RPL model further identify the distribution of individual taste preferences in the population. For example, for a normally distributed parameter, which has a positive (negative) mean estimate, the share of respondents who have a positive (negative) view of that attribute can be calculated. Considering attributes with statistically significant standard deviation estimates, 96.7% of the respondents have positive views (3.3% with negative views) regarding natural source of vitamin A-attribute. The majority (97%) of respondents value labeling sugar as fortified attribute positively, while all the respondents (100%) value yellow colour negatively relative to white colour. There are 84.6% of respondents who value minimum level of VA positively relative to medium value, indicating greater preferences for minimum level of VA, relative to medium level. Clearly the respondents have different percentages of positive views (ranging

from 84.6% to 100%) for the listed attributes, indicating different degrees of heterogeneity in consumers' responses to these attributes (see appendix 5).

The standard deviations of all the random coefficients, except for maximum level of VA and brown colour, are highly statistically significant indicating that these coefficients are indeed heterogeneous in the population. The implication is that the preferences for these attributes are influenced by other factors not included in the model. The preference-heterogeneity observed confirms suitability of the RPL model in the analysis. All the models for different regions, as well as the pooled sample exhibit good explanatory power (Pseudo $R^2$ of between 37% and 39%), which fit in the acceptable range noted by Domenic and McFadden (1975), for a discrete choice model.

The negative sign and significance of the price coefficient enables estimation of marginal rate of substitution (MRS) between the fortified sugar attributes and money. Specifically, MRS can be interpreted as the marginal willingness to pay (WTP) for a change in each attribute (Hanemann 1984). Because the impact of each attribute is not predetermined, the marginal WTP values can either be positive or negative. In the CE, the monetary attribute was described in terms of price for purchasing fortified sugar. Following the application of Ruto and Garrod (2009), positive values indicate the price that consumers would be willing to pay, trade-off or forgo in order to acquire desirable attributes. Conversely, negative values indicate the discount consumers would demand in return for accepting less desirable attributes.

Table 3.4 reports the implicit prices (marginal WTP values), for each of the fortified sugar attributes estimated using the Wald procedure (Delta method) in LIMDEP 9.0/ NLOGIT 4.0 (see appendix six for the formula used). For comparisons purposes, estimates were calculated for urban and rural setup as well as the pooled sample. The WTP results shows the relative importance assigned to each fortified sugar attribute by the consumers. In the pooled sample, consumers are willing to pay between Kshs 159 and Kshs 277 per kilogram for natural source of vitamin A; Kshs 173 to Kshs 289 for minimum level of vitamin A; Kshs 119 to Kshs 221 for maximum level of vitamin A; Kshs 132 to Kshs 212 for sugar to be labeled as fortified; Kshs 110 to Kshs 180 for provision of gift pack. These results compares favorably to those of De Groote, et al., (2010). They also found that Kenya consumers were willing to pay a premium of 24% for yellow biofortified maize, but were demanding a discount of 11% to accept the yellow colour.

Table 3.4: Marginal WTP estimates for fortified sugar-attributes (Kshs)

| | Marginal WTP (95% confidence interval) | | |
|---|---|---|---|
| Variable | Kakamega | Nairobi | Pooled |
| NATURAL | 340.0 | 161.8 | 218.9 |
| | (135.5 to 580.4) | (118.7 to 204.9) | (159.1 to 277.1) |
| MIN | 319.8 | 175.6 | 230.9 |
| | (143.6 to 496.0) | (125.8 to 225.5) | (173.2 to 288.6) |
| MAX | 273.2 | 117.6 | 170.0 |
| | (104.3 to 442.1) | (76.7 to 158.5) | (118.6 to 221.4) |
| LABEL | 206.6 | 162.3 | 172.0 |
| | (95.9 to 317.2) | (121.5 to 201.1) | (131.9 to 212.0) |
| GIFT | 158.8 | 140.6 | 144.7 |
| | (68.4 to 249.1) | (104.7 to 176.5) | (109.7 to 179.8) |
| BROWN | 320.2 | 2249* | 329.0 |
| | (- 61.2 to 701.7) | | (- 15.7 to 673.8) |
| YELLOWISH | - 169.9 | - 117 3 | - 136.8 |
| | (- 296.4 to – 43.4) | (- 164.9 to – 69.7) | (- 187.5 to - 86.0) |

**Notes**: All the marginal WTP estimates are significant below the 1% level, except for brown colour attribute. * Completely insignificant.

In the present case, consumers are demanding a discount of between Kshs 188 to Kshs 86 for yellowish colour in fortified sugar. The clear indication is that consumers generally prefer interventions that improve nutritional value of their food without changing its sensory characteristics. On the basis of the WTP values, consumers' ranking of preferences is: minimum level of vitamin A; natural source of vitamin A; labeling sugar as fortified; maximum level of vitamin A; and provision of gift pack.

On average, rural consumers are willing to pay more for all the attributes (except labeling) than urban consumers, indicating that preferences for fortified sugar attributes are higher in rural areas. This could be due to the high poverty levels in the rural areas which limit diversity in their diets, and so the rural consumers consider food fortification as an alternative of acquiring important micronutrients, as reported by (Faber et al., 2002). However, the rural

consumers are more skeptical to changes in sensory characteristics of sugar as they demand higher discount (Kshs 170) to accept yellowish colour, compared to Kshs 117 demanded by urban consumers. These results suggest the need for changing dietary education programmes, especially in the rural areas where consumers indicated high preferences for sugar fortification, while at the same time are highly skeptical of the potential changes to the conventional sugar that they currently consume. Use of mobile phones and targeting village groups (for example, informal women groups), could be a better alternative to blanket use of media, which are dominated by one gender. Dietary/nutrition education can also be introduced in schools. This would culminate in the formation of dietary clubs that would promote acquisition of nutritional information by the students (youth in society).

Preference heterogeneity between the two regions is not only reflected in significant differences in the WTP estimates, but also in attribute ranking. Whereas rural consumers rank natural source of vitamin A the most important attribute in the sugar fortification programme, the urban consumers rank level of vitamin A on top with higher preference for 'minimum level' over 'maximum level' of vitamin A. Rural consumers are willing to pay more for gift pack implying that they need more incentives and enticement to purchase fortified sugar than urban consumers. This may reflect the differences in current access to 'sale on offer' promotions that are skewed in favour of urban consumers' who are accessible to large supermarket outlets, which are synonymous with such promotions.

The bi-annual survey conducted by International Food Information Council (IFIC) 2002, suggest that several demographic factors such as age, gender, education, marital status, and health contribute to certain targets for fortified foods. Sugar fortification programme is thus expected to target specific consumer-categories, particularly young children, lactating mothers and the elderly, who have heavy VA-dietary requirement (WHO, 2006). It therefore appears more insightful and appealing to policy practice to design implementable fortification scenarios according to VA-dietary requirements and food consumption habits for the various consumer segments in the society. The study identified three consumer segments, namely; category 1: Mothers with young children (aged below 5 years); category 2: Middle aged consumers (aged between 6-50 years); and category 3: The elderly (above 50 years).

The evidence provided suggests that mothers with young children require higher levels of VA for their physiological needs. Therefore this category (category 1) has minimum level of VA

that comes from natural sources, given that the digestive structures of infants may not be well adapted to artificial additives. Minimum level of VA is preferred to maximum level for this category to avoid toxication (WHO, 2006) as young children are expected to consume fortified sugar (in beverages) more frequently. Moreover the group is likely to prefer yellowish to white colour given that most ration for infants are usually coloured. The category is also likely to prefer gifts included in their targeting package as young children are thought to be attracted to presents (that may include play toys). In this regard, gift pack attribute is primed for this consumer-segment.

For category two (middle aged group), minimum level of VA from artificial source and yellowish in colour would be appealing. This is due to their greater exposure to dietary diversity compared to the first category (see for example, Faber et al., 2002). Compared to the elderly, middle aged group usually adopt new ventures with much ease, and may not mind whether VA comes from natural or artificial source. Their flashy habits and curiosity, as noted by Wojcicki and Heyman (2012), would most likely enable them prefer yellowish colour. The elderly (category three) is provided with artificial source of VA with no gift pack since they are expected to be conservative and particular in their shopping decisions. Their accumulated shopping experience would also enable them appreciate the need for nutritious food additives such as VA. Maximum level of VA is also included in the package given their relatively higher physiological needs compared to the middle category.

To find the compensating surplus (CS) associated with each of the above scenarios the difference between the welfare measures under the *status quo* (no sugar fortification) and the three policy scenarios were calculated using equation 2.3. The estimates of CS for the three scenarios are reported in Table 3.5. For comparisons, CS estimates are calculated for all three models (Kakamega, Nairobi and pooled sample) and the three target scenarios.

Table 3.5: Attribute levels and compensating surplus (CS) for fortified sugar policy scenarios (in shillings)

| | Attribute | | | | | | | CS in the target consumer segment | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Category | Natural source of VA | Artificial source of VA | Min level of VA | Max level of VA | Labeled | Gift pack | Colour yellow; brown; white | Kakamega | Nairobi | Pooled |
| 1 | ✓ | | ✓ | | ✓ | ✓ | ✓ | 649.7 | 589.6 | 629.7 |
| | | | | | | | | (75.8) | (59.2) | (63.9) |
| 2 | | ✓ | ✓ | | ✓ | | ✓ | 356.5 | 219.6 | 266.1 |
| | | | | | | | | (92.4) | (28.7) | (31.3) |
| 3 | | ✓ | | ✓ | ✓ | | ✓ | 499.8 | 268.7 | 342 |
| | | | | | | | | (127.7) | (48.3) | (38.5) |

***Notes:*** Standard errors are in parentheses. All CS estimates are significant at 1% level or better.
✓ Indicates that the attribute is present in a scenario at non-zero level

The CS estimates for all the three scenarios are positive, implying that consumers prefer a change from conventional sugar (*status quo*) to fortified sugar. Mothers with infants (category 1) have the highest CS (Kshs 629 or a premium of about 300%). This is approximately three times that of middle aged category, whose CS is Kshs 266, approximately a 77% premium over the *status quo*. The CS for the elderly is Kshs 342- approximately a 128% premium from the *status quo.* Generally, mothers with infants are provided with the VA-capsule supplements while visiting clinics (KNFFA, 2011) and may have taken sugar fortification as an alternative to the former programme that suffers coverage challenges, hence their higher CS. Furthermore, this category faces narrow dietary diversity due to food availability and biological complexities, most of which can be solved through sugar fortification. Given that middle aged group has other options of obtaining VA other than food fortification, coupled with the fact that their VA-dietary needs are much lower than that of categories1 and 3, it is consistent that their CS is lower than that of the other two categories.

That mothers' with children are willing to pay a premium that is approximately three times that of middle aged group for VA-fortified sugar appears exaggerated, but plausible. Young children are more physiologically active and bear the greatest impacts of VAD (WHO, 2006). These results corroborate those of Gonzalez et al., (2010), who found that Brazilian consumers were willing to pay a premium of 160% for VA-attribute alone in bio-fortified cassava (and households with children was a significant determinant of the WTP). These are very important findings for food fortification programmes in Kenya (and other developing countries) since consumers still have to make a decision whether to consume fortified or conventional foods. Food fortification produces more enriched products that come at a cost- which consumers are indeed willing to pay.

However, this does not mean that fortified sugar should be sold at such high prices. This study did not purpose to determine the appropriate price mark-up for fortified sugar, but rather its preferences. Therefore, these results should be interpreted only in terms of preferences rather than possible price mark-ups. Stakeholders such as KNFFA should therefore, harness these high preferences for VA-fortified sugar with targeted nutritional education programmes, in the wake of negative public debates regarding food fortification. This hold true at least in the present situation, where the public sugar fortification debates are dominated by perceived technological risks and concerns.

The possible sources of preference heterogeneity were further investigated by introducing interactions between the mean estimate of the random utility parameters and consumer characteristics in the RPL model estimated on the three sample sets. After extensive testing of various interactions with consumer factors collected in the survey, the interactions that best fit the model were included according to Train (2003) and Hensher et al. (2005). These included the model that interact mean preference for minimum level of VA and yellowish colour with the two covariates (i.e. gender and household with young children). The variables were coded as: 'GENYEL' to denote for the interaction between the colour attribute (specifically yellowish colour), with the gender of the respondent. And 'INFMIN' to represent the interaction between minimum levels of VA attribute, with the household having young children.

The results are reported in Table 3.6. The top part of the table reports estimates of mean taste or preference in the population (has been discussed in Table 3.3), and the bottom part contains estimates of standard deviations of parameter distributions. The middle part of the table reports the effect of the interaction-variables on the preferences for fortified sugar attributes. These results compares favourably with those reported in Table 3.3. The McFadden Pseudo-$R^2$ marginally improves, particularly for Kakamega County, while the Log-likelihood function reduces (in absolute terms), for all the three models/samples in Table 3.6. These facts imply that the interactions included improve the model's overall fit.

The interactions between having a young child and minimum level of VA are positive and significant for Kakamega and Pooled data, but insignificant for Nairobi sample. The results show that having a young child (aged below 5 years), shifts the mean household preference for minimum level of VA by 162%. This finding is consistent with the results from some micronutrient fortification literature (see for example, Gonzalez et al., 2010; Birol et al., 2011), who found that household with young children had relatively higher preferences for nutritional attributes. However, this result is still surprising as it was expected that those households with young children would prefer maximum rather than minimum level of VA. The reason could be to avoid VA-toxication to young children who are expected to consume fortified sugar frequently through the beverages.

Table 3.6: Sources of preference heterogeneity

| Variable | Kakamega | Nairobi | Pooled |
|---|---|---|---|
| | Random parameters in utility functions | | |
| NATURAL | 2.31 (0.39)*** | 2.23 (0.28)*** | 2.38 (0.31)*** |
| MIN | 1.38 (0.53)** | 2.16 (0.49)*** | 1.89 (0.38)*** |
| MAX | 1.85 (0.43)*** | 2.62 (0.35)*** | 1.83 (0.32)*** |
| LABEL | 1.48 (0.26)*** | 2.22 (0.26)*** | 1.87 (0.21)*** |
| GIFT | 1.09 (0.23)*** | 1.93 (0.24)*** | 1.57 (0.19)*** |
| BROWN | 2.48 (1.09)* | 30.9 (0.001) | 3.67 (2.01)* |
| YELLOWISH | - 1.52 (0.40)*** | - 1.62 (0.33)*** | - 1.67 (0.30)*** |
| PRICE | - 0.007 (0.002)** | - 0. 01 (0.002)*** | - 0.01 (0.002)*** |
| | Non-random parameters in utility functions | | |
| GENYEL | 0.67(0.37)* | - 0.01(0.30) | 0.33(0.24) |
| INFMIN | 1.62(0.53)** | 0.42(0.48) | 1.05(0.38)** |
| | Derived standard deviations of parameter distributions | | |
| sdNATURAL | 1.65 (0.35)*** | 0.69 (0.28)** | 1.29 (0.24)*** |
| sdMIN | 2.18 (0.53)*** | 2.22 (0.48)*** | 2.40 (0.44)*** |
| sdMAX | 0.02 (0.37) | 0.03 (0.29) | 0.10 (0.25) |
| sdLABEL | 0.76 (0.45)* | 0.84 (0.32)** | 0.94 (0.30)*** |
| sdGIFT | 0.51 (0.35) | 0.54 (0.30)* | 0.50 (0.45) |
| sdBROWN | 0.13 (2.23) | 0.001 (0.01) | 0.78 (2.75) |
| sdYELLOWISH | 0.25 (0.48) | 0.17 (0.39) | 0.23 (0.24) |
| Log-likelihood | - 441.71 | - 506.57 | - 967.35 |
| Pseudo-$R^2$ | 0.38 | 0.39 | 0.37 |
| *n* (respondents) | 162 | 188 | 350 |
| *n* (choices) | 648 | 752 | 1400 |

**Notes:** Statistical significance levels: *** 1%; ** 5%; * 10%. Corresponding standard errors are shown in parentheses.

The interaction between gender of the household and the yellowish colour shifts the preference for yellowish colour in fortified sugar by 67%, among the rural household. Since females were given the value of one in the dummy coding, the interpretation is that female sugar consumers in rural areas are therefore, likely to demand relatively less discounts to accept yellowish colour in fortified sugar, compared to male counterparts. In the urban areas, the interaction between the dummy variable for gender and yellowish colour attribute is negative, but not significant. This indicates the knowledge of gender roles that could be high in urban areas due to high information levels compared to rural areas. This result also reveals that resources are not highly dominated by either gender (some sort of gender parity in urban areas) as opposed to the rural areas where resources including information services are dominated by the male gender (Kaliba et al., 2000).

The study has identified gender of the household as well as having a young child in the household as significant sources of preference heterogeneity in consumers' preferences for the two attributes (source of vitamin A and yellowish colour). However, the derived standard deviations of parameter distributions for natural source of VA, minimum level of VA as well as that of labeling sugar as fortified attributes, are still highly statistically significant. This indicate that the heterogeneity in the preferences for these attributes is caused by factors other than the socioeconomic characteristics included in the model.

### 3.4. Conclusions and policy implications

The growing market for enriched foods, especially fortified industrial products, provides a potential opportunity to improve the health of Kenyans and enable the development of a new value-added food sector. With the growing interest among consumers in the link between diet and health, and the credence nature of the nutritive attributes in fortified sugar, VA plays a key role in consumers' choices. The analysis employed the choice experiment method to investigate the preferences of Kenyan consumers' for fortified sugar attributes considered to be most important, including; Source of VA, Level of VA, Labeling sugar as fortified, whether gift pack is provided or not, Colour and Price.

Results showed that these attributes are important in describing fortified sugar since all were significant and with the expected sign. The consumers were willing to pay a positive premium for all the attributes, except yellowish colour that all the consumers were

demanding price discounts to accept. Heterogeneity in consumer preferences for these attributes was evidence from higher preferences shown by rural consumers than urban consumers regarding all the attributes. Also, while using monetary attribute as normalizing factor, rural consumers ranked source of VA as the most important attribute, contrary to urban consumers who's most important attribute was level of VA.

The results suggest that care must be taken while designing acceptable sugar fortification programmes in Kenya given that price and sensory characteristics such as colour and taste, compete with the nutritional attribute (VA), for consumer choice. In fact, the results reveal that consumers still value price and changes in sensory attributes highly compared to nutritional attribute when faced with a choice between fortified and conventional sugar. This was clear when all the respondents showed negative preference for colour change from white/brown to yellowish. Major stakeholders, including KNFFA and the sugar producing companies should therefore, develop targeted awareness programmes to promote nutritional information among the consumers.

Concerning the need to target specific segment of the population with varied VA dietary requirements, the study also derived policy options for mothers with infants, middle aged group and the elderly. The middle aged group had the lowest CS and was willing to pay a 77% premium for fortified sugar. The elderly category was willing to pay a premium of 128%, while the CS for mothers with infants was approximately 300% of the current price. These findings support a strong preference for fortified sugar, among all segments of the society. The results suggest the possibility of differentiated sugar production targeting different consumer segments. The positive CS values indicate that sugar producing companies with capacities of producing fortified sugar; have a niche in the Kenyan market, with greater potential of increasing their market share.

Whereas these premiums seam relatively high, they are not unrealistic, given that VAD and related health problems are widespread in Kenya (De Groote at al., 2010; KNFFA, 2011). That lactating mothers and their children have higher CS is also consistent given their heavy VA dietary requirements; and given that they are the main target of VA fortification programmes. These results bode well for development of food fortification in Kenya. They are also consistent with earlier findings from developing countries showing that food

enrichment with direct consumer benefits are valued positively, despite the skepticism towards the imminent changes in sensory features such as taste and colour.

Worthwhile to note is that this analysis has been based on stated preference data, with unknown magnitude of hypothetical bias. There also exists a possibility that responses in a hypothetical market setting may reveal little about how respondents would behave in a real market. Therefore, the high WTP figures should be interpreted as high preferences, instead. In any case, sugar fortification, as any other food fortification programme, usually target and benefit the poor and cannot be sold at such high premiums. The WTP analysis should not be misinterpreted as a strategy to develop a feasible price mark-up for sugar fortification, but rather as a tool to better understand consumer preferences. Moreover, the prices for sugar were constantly changing (varying) in the study areas during the survey, and this could have affected the WTP estimates.

The finding of this study is that Kenyan consumers prefers VA-fortified sugar and highly appreciates the nutritional benefits evident in the top ranking of nutritional attributes by both urban and rural consumers. In order to promote consumption of fortified sugar however, VA-fortificant that result to changes in sensory quality of sugar such as colour should be avoided. Packaging fortified sugar with a 'gift pack' would promote its up-take, especially among mothers with infants. While nutritional education, particularly regarding the need for dietary change are encouraged, not only through the media, but also other avenues such as mobile phones and introduction of dietary education in schools.

Future research should focus on ways of combating other micronutrient deficiencies with equally negative impacts on human health and productivity. Iron in particular, causes high economic loss especially to women. And therefore requires urgent redress in a similar manner. Policy scenarios were constructed based on dietary requirements-that was profiled using age of consumers. Understanding how preferences vary along 'societal classes' would also be important. Therefore, categorizing consumers on the basis of household income or even occupation would offer additional insight. Following the high preferences noted, cost benefit analysis (CBA) should be conducted to understand the actual welfare implication of sugar fortification in Kenya. Finally, this study was limited to sugar in the shelves and did not investigate the retention of VA beyond the shelves (i.e., the amount of VA retained when fortified sugar is put to its various uses), further studies should consider these aspects.

**References**


Adamowicz, W., Boxall, P., Williams, M. and Louviere, J., (1998). Stated Preference Approaches for Measuring Passive Use Values: Choice Experiments and Contingent Valuation. *American Journal of Agricultural Economics*, 80(3): 64-75.

Adamowicz, W., Louviere, J. and Williams, M., (1994). Combining Revealed and Stated Preference Methods for Valuing Environmental Amenities. *Journal of Environmental* Economics *and Management*, 26(1): 271-292.

Adesope, A., Awoyemy, T., Falusi, O. and Omonono, T., (2010). Willingness to pay for safety label on sugar and vegetable oil among households in south-Western Nigeria. *Agricultural and Social Research*, 10(1): 156-167.

Alpizar, F. and Martinson, P., (2003). Using Choice Experiment for Non-market Valuation. *Economics Issues*, 8(1): 83-110.

Anderson, P., De Palma, A. and Thisse, F., (1992). Discrete Choice Theory of product Differentiation, *Cambridge, MA: The MIT Press.*

Bates, J., (1988). Econometrics Issues in Stated Preference Analysis. *Journal of Transport Economics and Policy,* 22(1): 59-69.

Batsell, R. and Louviere, J., (1991) Experimental Analysis of Choice. *Marketing Letters*, 2(3): 199-214.

Ben-Akiva, M. and Lerman, R., (1993). *Discrete Choice Analysis: Theory an Application to Travel Demand,* Cambridge, MA: The MIT Press.

Ben-Akiva, M., T. Morikawa and Shiroishi, F., (1991). Analysis of the Reliability of Preference Ranking Data. *Journal of Business Research,* 23(1): 253-268.

Birol, E., Asare-Marfo, D., Karandikar, B. and Roy, D., (2011). A latent Class Approach to Investigating Farmer Demand for Bio-fortified Staple food crops in Developing Countries: The Case of High-iron Pearl Millet in Maharashtra, India. *Harvest plus Working Paper*.

Bliemer, C., and Rose, J., (2010). Construction of Experimental Designs for Mixed Logit Models Allowing for Correlation across Choice Observations. *Transportation Research Part B*, 44(1): 720-734.

Brownston, D. and Train, K., (1999). Forecasting New Product Penetration with Flexible Substitution Pattern. *Journal of Economics,* 89(3): 109-129.

Childs, M. and Poryzees, H., (1997). Foods that Help Prevent Disease: Consumer attitudes and Public Policy Implications. *Journal of Consumer Marketing, 14 (6): 433-447*

Choice Metrics. *Ngene 1.0 User Manual and Reference Guide, the Cutting Edge in Experimental Design* (2009).

De Groote, H., S. Kimenju, and Morawetz, U., (2010a). Estimating consumer willingness-to-pay for food quality with experimental auctions: the case of yellow versus fortified maize meal in Kenya. *Agricultural Economics.* 42(1): 1-16.

Faber, M., Phungula, M., Venter, S., Dhansay, M,. Spinnler, B., (2002). Home gardens focusing on the production of yellow and dark green leafy vegetables increase the serum-retinol concentration of 2-5-year-old children in South Africa. AMJ Clinic, *Nutrition*. 76(1): 1048-1054.

Garrod, G. and Kenneth, W., (1999*). Economic Valuation of the Environment*. Northampton, MA: Edward Elgar.

Greene, W., (2000), *Econometric Analysis,* Upper Saddle River, NJ: Prentice Hall.

Greene, W., (2002), LIMDEP version 8.0/Nlogit version 3.0. *Econometric Modeling Guide.* Plainview, NY: Econometric Software.

Gonzalez, C., Johnson, N. and Qaim, M., (2010). Consumer Acceptance of Second Generation GM Foods: The Case of Bio-fortified Cassava in the North East of Brazil. *Journal of Agricultural economics.* 42(1): 1-18

Hanemann, W. M., (1984). 'Welfare evaluations in contingent valuation experiments with discrete responses', *American Journal of Agricultural Economics,* 66(2): 332–341.

Hanley, N., Mourato, S. and Wright, R., (2001). Choice Modeling Approaches: A superior Alternative for Environmental Valuation? *Economic Surveys*, 15(3): 435-462.

Hasler, M., Abby, B. and Cynthia, T., (2004). Position of the American Dietetic association: Functional Foods. *American Dietetic Association*, 104 (5): 814-826.

Hausman, J. And McFadden, D., (1984). Specification Tests for the Multinomial Logit Model. *Econometrics,* 52(2): 1219-1240.

Hearne, R. And Salinas, Z., (2002). The use of Choice Experiments in the Analysis of Tourist of Preferences for Ecotourism Development in Costa Rica. *Journal of Environmental management,* 65(1): 153-163.

Hensher, A., (1991). The Use of Discrete Choice Models in the Determination of Community Choices in Public Issue Impacting on Business Decision Making. *Journal of Business Research,* 23(1): 299-309.

Huber, J., and Zwerina, K., (1996). The importance of utility balance in efficient designs. *Journal of Market Research*, 33(1): 307-317.

International Food Information Council (IFIC), 2002. Functional Foods: Attitudinal Research. http://ific.org

Kenya National Food Fortification Alliance (KNFFA), 2011. The PSI/Kenya's Food Fortification Social Marketing and Communication Project 2011-2013. www.gainhealth.org/programs [last accessed 22 June 2013].

Kimenju, S. and De Groote, H., (2008). Consumer willingness to pay for genetically modified food in Kenya. *Agricultural Economics*, 38(1): 35 – 46.

Kimenju, S., Morawetz, U. and De Groote, H. (2005). Comparing Contingent Valuation method, Choice Experiment and Experimental Auctions in soliciting consumer preference for maize in Western Kenya: Preliminary results.

Kuhfeld, Warren F. (2005). Experimental Design, Efficiency, Coding, and Choice Designs. in *Marketing Research Methods in SAS: Experimental Design, Choice, Conjoint, and Graphical Techniques*. Eds. TS-694, Cary, NC: SAS Institute.

Lancaster, K., (1966). A New Approach to Consumer Theory. *Journal of Political Economy*, 74(1): 132-157.

Lusk, J. And Fox, J., (2000). Consumer Valuation of Beef Ribeye Steak Attributes. Paper presented at the AAEA meeting, Tampa, FL.

Manski, C., (1977). The Structure of Random Utility Models: *Theory and Decision*, 8(1): 229-254.

Meenakshi, J., Johnson, J., Manyong, V., Gonzalez, C., Garcia, J., Meng, E., De Groote, H., Javelosa, J., Yanggen, D., Naher, F., (2010). How cost-effective is biofortification in combating micronutrient malnutrition? *World Dev*. 38(1): 64-75.

McFadden, D., (1973). Conditional Logit Analysis of Qualitative Choice Behaviour in Zarembka (ed.), *Frontiers of Econometrics,* New York: Academic Press, 105-142.

McFadden, D., (2001). Economic Choices. *American Economic Review*, 91(3): 351-378.

McFadden, D., (1986). The Choice Theory Approach to Market Research, Marketing Science, 5(4): 275-297.

Merino-Castello, A., (2003), Eliciting Consumer Preferences using Stated Preference Discrete Choice Models: Contingent Ranking versus Choice Experiment. Department of Economics and Business, Pompeu Fabra University, Barcelona, Spain. http://ww.econ.upf.edu/doc/papers/downloads/705.pdf

Mitchell, R. and Carson, R., (1989). Using Surveys to Value Public Goods: The Contingent Valuation Method. Washington, DC.

Morikawa, T., Ben-Akiva, M. and McFadden D., (2002). Discrete Choice Models Incorporating Revealed Preferences and Psychometric Data. *Econometric Models in Marketing*, 16(1): 29-55.

Onyango, B. and Nayga, R., (2004). Consumer acceptance of nutritionally enhanced genetically modified food: Relevance of gene transfer technology. *Journal of Agricultural and Resource Economics,* 29(3): 567-583.

Otieno, D., (2011). Economic analysis of beef cattle farmers' technical efficiency and willingness to comply with Disease Free Zones in Kenya. Ph. D Thesis, Newcastle University. https://theses.ncl.ac.uk/dspace/bitstream/10443/1248/1/Otieno.pdf

Otieno, D., Ruto, E., Hubbard, L., (2011). Cattle Farmers' Preferences for Disease-Free Zones in Kenya: An Application of the Choice Experiment Method. *Journal of Agricultural Economics*, 62(1): 207-224.

Rodriguez-Amaya, B., Kimura, M., (2004). Harvest plus Handbook for Carotenoids Analysis. International Food Policy Research Institute [IFPRI].

Ruto, E. and Garrod, G., (2009). Investigating farmers' preferences for the design of agri-environment schemes, a choice experiment approach. *Journal of Environmental Planning and Management,* 52(1): 631-647.

Ruto, E., Garrod, G. and Scarpa, R., (2008). Valuing animal genetic resources: a choice modeling application to indigenous cattle in Kenya. *Agricultural economics,* 38(1): 89-98.

Smale, M., Jayne, T. (2003). Maize in Eastern and Southern Africa "Seeds" of Success in Retrospect. *EPTD Discussion paper*. No. 97, IFPRI, Washington, DC.

Train, K., (1998). Recreation Demand Models with Taste Differences over People. *Land Economics*, 74 (2): 230-239.

Train, K., (2003). Discrete Choice Methods with Simulation (New York: Cambridge University Press).

West Jr., P. and Darnton-Hill, I., (2001). Vitamin A deficiency. Nutrition and Health in Developing Countries. *M. W. Bloem. Totowa, NJ, Humana Press***:** 267–306.

Whittington, D., (2002). Improving the Performance of Contingent Valuation Studies in Developing Countries. *Environmental and Resource Economics*: 22(1): 323-67.

Wojcicki, J. and Heyman, M., (2012). Adolescent nutrition awareness and use of food labels: Results from the national nutritional health and examination survey. Available at http://www.biomedcentral.com/1471-2431/12/55 [accessed 15 July 2013]

# CHAPTER FOUR

# SUMMARY, CONCLUSIONS AND POLICY IMPLICATIONS

## 4.1 Summary

That micronutrient deficiencies continue to haunt the developing world cannot be gainsaid. Micronutrient malnutrition have a debilitating effect on health, leading to onset of several diseases and disabilities causing not only distress but economic loss to an individual, his household and the country (WHO, 2006; KNFFA, 2011). Micronutrient deficiencies have a profound impact on the socioeconomic fabric of the affected areas. The African countries, especially sub-Sahara region, have large sections of population suffering from micronutrient deficiencies. In Kenya, the problems are quite acute particularly in relation to VA. The resulting human suffering and economic losses could be totally avoided if the right strategies of addressing the menace are followed.

Fortification of foods with minerals and vitamins is the most effective and least expensive method of eliminating micronutrient deficiencies. 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 ones, started fortifying foods at least many years back. It is commercially viable as it retains the original nutrients and taste of food, and indeed provides the additional nutrients; cost effective and do not require consumers to change their consumption behaviour.

As a result, the interest in industrial food fortification has escalated and the food industry is focused on developing food products that promote good health by adding required micronutrients. The food manufacturing companies are positioning themselves to benefit from the increasing opportunities in the rapidly-growing field of diet and health linkage (evidence from the increasing number of fortified food products in the country e.g. Mumias VA-fortified sugar, wheat flour, maize flour (e.g. Hostess, Jogoo, Pembe, and Pendana, are fortified with various vitamins, including VA and minerals), a number of edible oils among other products. In this regard, major resources are being committed to food fortification innovation and production, although, considerable uncertainties still exist regarding public awareness, perceptions and preferences for these products. Therefore, understanding

consumer purchase behaviour and decisions will be important if the impact of fortified foods on public health is to be realized.

The study aimed to explore consumers' awareness and preferences for fortified sugar. The thesis is organized into two research papers each addressing one specific research goal. The specific objectives were: (1) assessment of consumer awareness regarding fortified sugar (2) analysis of consumers' preferences for fortified sugar. To accomplish these objectives, survey data was collected from 350 randomly selected participants within two consumption regions (counties) of Kenya; Kakamega in a relatively rural part of the country, and Nairobi, the urban area that also hosts the capital city. The survey procedure consisted of three major stages namely: FGD; the pre-test survey and the actual survey. A binary logit regression analysis was used to evaluate the effect of different explanatory variables, including demographics, on the awareness of fortified sugar, while the RPL was applied to determine the preferences for fortified sugar attributes.

The first paper explored consumers' awareness of fortified sugar in the study areas and compared the awareness levels between rural and urban households. In addition, the paper investigated the socioeconomic and food purchase decisions that affected the levels of awareness. The results showed that awareness levels for urban consumers were statistically higher than that of rural consumers. Urban consumers were found to prefer supermarkets as their purchase outlets, while majority of rural households frequently purchased sugar from kiosks that normally offer them sugar in small quantities (repackage). Regarding purchase decisions, consumers relatively rated sensory changes and price higher than nutritional content of sugar. Therefore, the paper observed that consumers may not prefer nutritionally enhanced products if prices and quality is not controlled, regardless of their levels of nutritional awareness.

Majority of consumers in the study areas were found to consume sugar daily (in some cases more than once). This is an important finding regarding suitability of fortifying sugar-that is justified in terms of frequency of consumption, rather than quantities consumed. Furthermore, KNFFA reports that sugar is consumed by majority (80%) of households. The study therefore qualified table sugar (sucrose), appropriate for micronutrient fortification in Kenya, especially mass fortification programmes. Regarding the factors affecting consumer awareness for fortified sugar, the binary logit estimates indicated that; age of consumers,

purchasing sugar from the supermarket, reading of newspaper, living in urban area and having a young child below the age of five in the household, significantly affected awareness levels.

The second paper determined consumers' preferences for fortified sugar in Kenya by eliciting the relative importance assigned to each fortified sugar attribute. Further, the preference heterogeneity inherent in sugar consumers was assessed and the possible sources of this heterogeneity in preferences investigated. The RPL results showed high and significant preferences for all the fortified sugar attributes. Despite their relatively low levels of awareness, rural consumers were found to have higher preferences for fortified sugar attributes compared to urban consumers. However, a quick conclusion that awareness levels have no effects on preferences for fortified sugar can be misleading. The research team provided detailed information to the respondents' prior to making choices during the survey. This could have brought all the prospective respondents on the same level of information regarding fortified sugar.

Applying the monetary attribute as a normalizing factor the study ranked the attributes of fortified sugar based on their WTP estimates. Whereas rural consumers ranked natural source of VA the most important attribute in the sugar fortification programme, the urban consumers ranked level of VA on top with higher preference for minimum level over maximum level of VA. Rural consumers were willing to pay more for gift pack implying that they needed more incentives and enticement to purchase fortified sugar than urban counterparts. However, both rural and urban consumers were demanding price discounts to accept yellowish colour in fortified sugar.

Considering attributes with statistically significant standard deviation estimates; majority of the respondents showed positive views regarding natural source of VA and labeling sugar as fortified. However, consumers showed no variability in their dislike of yellowish colour attribute, as all the respondents expressed negative preference. These inherent preferences variability offer profound challenges to stakeholders involved in production, marketing and regulation of fortified sugar. A simple solution may lie in understanding dietary requirements and consumption patterns and behaviour of different segments of sugar consumers. This enables targeted production and distribution of this product to a specific consumer segment.

To this end the study derived three policy scenarios by profiling sugar consumers on the basis of VA dietary requirements. This involved categorizing consumers into three age groups. These were; mothers with infants (aged below 5 years), middle aged group and the elderly. Mothers with infants and the elderly were thought to be relatively conserved in their preferences for artificial food additives. However, the middle aged group was postulated to easily adopt such new ventures due to exposure and influence from peers. The compensating surplus (CS) estimates for all the three scenarios were positive, implying that consumers preferred a change from conventional sugar (*status quo*) to fortified sugar. Mothers with young children had the highest CS (above three times that of the middle aged group), followed by the elderly group. While these CS figures were relatively high considering the fact that the target populations are relatively poor, they should be interpreted only within the context, to mean high preferences and not price markups.

### 4.2 Conclusions and policy implications

The fact that purchasing sugar from the supermarket drastically increased awareness levels of consumers' was particularly important to all stakeholders. On the face value it reiterated the need to improve purchase infrastructure in areas with low levels of awareness, specifically, rural areas. Deeply it revealed that sugar consumers are reasonably learned (able to read labels), so they benefited from proper display of goods (demonstration effect) at the supermarkets. To capitalize on the reading ability of the respondents, the study suggested proper labeling of fortified food products. Indicating the aspired health benefits from the added elements is regarded useful, while reiterating safety measures could allay fears inherent in consumers regarding food additives. These measures are geared towards promoting consumers' acceptance and use of fortified foods.

Generally, the findings of this study are important to fortified food manufacturers and marketers as well as government bodies that are interested in designing effective fortification programmes such as KNFFA and sugar companies (fortified sugar producers). A number of factors including price and taste are competing with nutrition as determinants of what product the consumer decides to purchase. The results indicated that consumers' value sensory characteristics (taste/colour) and price, more than the nutritional aspects while purchasing sugar. Furthermore, consumers were demanding price discounts to accept sensory-changes in sugar that they consume. KNFFA should therefore, oversee the development of fortification

programmes that are affordable and also maintains the sensory characteristics of the chosen food, to increase their public appeal. Proper monitoring by the relevant regulatory bodies (e.g. KEBS) is required to ensure safety and compliance.

Despite the skepticism about sensory changes in fortified sugar, particularly yellowish colour, consumers still showed positive preferences for fortified sugar. This implies that sensitization programmes that are geared toward these factors may be effective in helping consumers move towards required dietary change. The associated finding, however, that these factors have a different effect on the decision to pay (preferences), and the decision of how much to pay, implies that there is more to learn about the consumer. This is an important area for further research, specifically for the fortified food marketer. There is need to determine what tradeoffs consumers go through while making decision of what premium to pay for these foods.

Targeting sampling particularly, of mothers with young children at the clinics enhanced the policy relevance of the study in addressing VA-food fortification. This group is the prime target for VA fortification programmes; because they bear a relatively heavier burden of VAD, hence have higher VA-requirements. Stratifying the sampling strategy along the rural-urban nexus provided more insights in comparing awareness and preferences of sugar consumers. Recommended policy options should therefore be directed accordingly. These two perspectives are often missing in such studies; thus, the present study offers some novelty in the area of VA sugar fortification in Kenya and food fortification in general, in a developing country context.

### 4.3 Contributions to knowledge

The study contributes immensely to the scant literature regarding the application of CE for modelling preferences for sugar (food) fortification in Kenya. It is one of the few applications in the literature involving the use of more recent and robust software to obtain an efficient CE design, especially in agribusiness related survey in the country. CE enabled breaking fortified sugar in terms of its attributes so that preferences for each attribute were analyzed separately. Therefore, the study not only revealed that Kenyan consumers' prefer fortified sugar, but also revealed the fortified sugar attributes that they prefer most (i.e. the attributes consumers like in fortified sugar and attributes they dislike was revealed from the analysis of CE data).

The study has hypothetically produced fortified sugar for a specific consumer group, based on dietary needs. Formulating policy scenarios based on age for specific consumer segment in the society is important for targeted sugar production in Kenya. The CS results for the three consumer-segments were positive indicating that consumers preferred a change from current situation (conventional sugar) to fortified sugar. Therefore, sugar producing companies with capacities to invest in production of VA-fortified sugar have an edge in the market. This is because these companies would create a market niche, in the face of revealed high preferences for fortified sugar, hence increase their market share.

### 4.4 Suggestions for further research

In overall, this study has contributed to further understanding of the fortified sugar consumer especially, concerning comparison of awareness levels and preferences, between urban and rural consumers. However, the findings that rural consumers' had relatively low levels of awareness, but higher preferences for fortified sugar attributes, compared to urban consumers who had higher levels of awareness, requires further investigation. The link between consumers' acceptance of fortified foods and levels of awareness is very important. Acceptance problems may result from inadequate awareness, especially in the face of negative debates on the perceived risks of food additives, fuelled by pressure groups such as consumer federation of Kenya (COFEK). Therefore, successful fortification programmes can only thrive on objective public food debates anchored on balanced flow of nutrition information.

Sugar fortification programme involves intensive investment that requires additional costs that indeed, consumers have shown, through their high preferences, that they are willing to pay. Further research are therefore, needed to understand the welfare implication of sugar fortification in Kenya. Specifically, cost benefit analysis (CBA) should be carried out to enable the stakeholders in the sugar industry make informed decisions regarding sugar fortification. A case in point is the decision of whether vitamin A sugar fortification programme should be carried out under; voluntary or mandatory basis. Additionally, preferences for other food enrichment technologies and modifications (e.g., GM) could also be addressed in a similar manner.

## APPENDICES

### Appendix 1: Household survey questionnaire

**UNIVERSITY OF NAIROBI**

**ANALISYS OF CONSUMERS' AWARENESS AND PREFERENCES FOR FORTIFIED SUGAR IN KENYA**

**SURVEY QUESTIONNAIRE, MARCH-APRIL 2013**

**INTRODUCTION**

This survey is being conducted by researchers from the Department of Agricultural Economics at the University of Nairobi. The purpose of the survey is to understand consumer awareness and preferences for fortified sugar (nutritional value added sugar) in order to improve the Nutrition Policy in Kenya. Respondents for this survey shall be sugar consumers who are at least 21 years old. Respondents will be randomly interviewed at different points including Households, Supermarkets and Clinics. The survey will be done in Nairobi and Kakamega counties and will involve about 360 respondents.

Your responses and opinions will be treated with utmost confidentiality and will only be used for policy making. If you have any question please contact Mr. Kennedy Pambo (kennedypambo@gmail.com, 0723787934).

The survey interview will require about an hour to complete.

I now request your permission to begin the interview.

*Screening questions:*

1. Do you or your household normally consume sugar?

Yes ☐ No ☐

2. Are you one of the primary food (sugar) shoppers in your household?

Yes ☐ No ☐

*Respondents that answer YES to both questions should proceed with the survey. Those answering NO should **exit** from the survey*

*NOTE: There is no wrong or right answer, simply express your opinion!!*
*PART A*

IDENTIFICATION

Interviewer's name..... Date of interview.....

Village/Estate..... Sub-location..... Location.....

Division..... District..... County.....

Point of interview: (1- Residential area, 2- Supermarket, 3- Clinic, 4- Roadside 5- Other [specify.....])

## SECTION 1: FORTIFICATION AWARENESS AND SUGAR CONSUMPTION PATTERN

### Section 1(a): Sugar consumption habits and purchasing patterns

**1**. How frequently do you and your household consume sugar in either tea, porridge, Mandazi, etc.? (1= Daily, 2= Weekly, 3= Monthly)
**2**. What size of sugar do you usually purchase? .....

**3**. What is the **main** use the sugar you normally purchase? [1= Tea, 2= Cakes, 3= Mandazi, 4= Porridge]
**4**. Approximately how much sugar does your household usually consume in a typical month in the last 1 year? .....kilograms
**5**. Which brand of sugar do you prefer the **most** and **why? *Brand*** **(**1= Sony, 2= Mumias, 3= Nzoia, 4= Chemelil, 5= Other.....**)**
***Reason***.....
**6**. How frequently does your household purchase from the following outlets?

| | | **1** (Never at all) | **2** (Rarely) | **3** (Sometimes) | **4** (Often) | **5** (Always) |
|---|---|---|---|---|---|---|
| **(i)** | Supermarket | | | | | |
| **(ii)** | Retail store | | | | | |
| **(iii)** | Kiosk/ open-air market | | | | | |
| **(iv)** | Other (specify) | | | | | |

**7**. Which of the following beverages do you normally use sugar for? [1= Tea, 2= Coffee, 3= Cocoa, 4= other (specify.....)]
**8**. How many ***times a day*** does you normally take your preferred beverage? (1= Once, 2= Twice,3= Three times daily, 4= other.....)

**9**. How important are the following factors in influencing your sugar purchasing decisions:

| | | **1** (Not at all important) | **2** (Somewhat Important) | **3** (Moderately Important) | **4** (Fairly Important) | **5** (Very Important) |
|---|---|---|---|---|---|---|
| **(i)** | Nutritional information | | | | | |
| **(ii)** | Price | | | | | |
| **(iii)** | Taste or flavour & Colour | | | | | |
| **(iv)** | Brand name | | | | | |
| **(v)** | Additional health Ingredients (e.g. added vitamins and minerals) | | | | | |

**10**. How often do you normally read labels when you purchase sugar?

| **Never** | **Rarely** | **Occasionally** | **Often** | **Nearly Always** |
|---|---|---|---|---|
| | | | | |

***Skip Q11 if the response to Q10 is Never or Rarely.***

**11**. How important are these aspects to you in a sugar package label?

| | | **1** (Not at all Important) | **2** (Somewhat Important) | **3** (Moderately Important) | **4** (Fairly Important) | **5** (Very Important) |
|---|---|---|---|---|---|---|
| **(i)** | Brand name | | | | | |
| **(ii)** | Size | | | | | |
| **(iii)** | Ingredients (Nutritional Information) | | | | | |
| **(iv)** | Manufacturer's identity | | | | | |
| **(v)** | Date of manufacturing & expiry | | | | | |
| **(vi)** | Location of manufacturing | | | | | |
| **(vii)** | Recipe /preparation or use | | | | | |
| **(viii)** | Quality inspection label | | | | | |
| **(ix)** | Storage instruction | | | | | |
| **(x)** | Fortified or non-fortified label | | | | | |

**12**. Do you normally seek prior information **regarding the aspects on question 9**, before making food purchasing decisions? [1= Yes, 0= No]

**13**. Do you get information about food and nutrition from the following sources? [1 = Yes, 0 = No] If Yes, how frequently (daily, weekly, monthly, annually, biannually)?

| | **Source** | **Yes/No** | **Frequency** |
|---|---|---|---|
| **(i)** | Food advertisements (Billboards, Posters) | | |
| **(ii)** | Media (Radio, T.V, Newspaper, etc) | | |
| **(iii)** | Public seminars | | |
| **(iv)** | Family and Friends | | |
| **(v)** | Healthcare professionals | | |
| **(vi)** | Other, please specify | | |

**Section 1(b): Consumer Perception and Awareness of Fortified Sugar**

**14**. Have you ever heard of vitamin A? [1 = Yes, 0 = No]

**15**. What do you think is the impact of vitamin A **deficiency** on human health? ……

**16**. Have you heard of the term food fortification before this interview? [1= Yes, 0= No]
**17**. If YES, what was your main source of information? (Through 1= Observation, 2= Purchase, 3= Meetings/seminars, 4= Radio, 5= Television, 6= Newspaper, 7= Internet options e.g. face-book, twitter, 8= other…….)
**18**. Do you know any fortified (*nutritionally enhanced*) food product in the country? [1= Yes, 0= No]
**19**. If YES, do you **trust** that these food products are really fortified? [1= Yes, 0= No]
**20**. Are you **aware of vitamin-A fortified sugar**? [1 = Yes, 0 = No]
**21**. If YES, have you consumed it? [1 = Yes, 0 = No, 2= don't know]
**22**. If NO, what is the reason?.....
**23**. If YES, how did it taste? [1=Very Poor, 2= Poor, 3= Fair, 4= Good, 5= Very Good]
**24**. Do you consume fortified sugar regularly? [1 = Yes, 0 = No]
**25**. If NO, what could be the main reason? (1= Not available, 2= Not Safe, 3 Not aware of it, 4= Do not trust producers 5= other……..
**26**. If YES, what would be your motivation to consume fortified sugar? (**Tick all that apply).**

| | | |
|---|---|---|
| **(i)** | To keep healthy lifestyle | |
| **(ii)** | To gain vitamin A | |
| **(iii)** | Influenced by other family members/Friends | |
| **(1v)** | I don't know | |

***PART B:*** **CHOICE EXPERIMENT**
Now I am going to show you cards containing examples of these different types of sugar, based on different combination of the attributes below:

| **Attribute** | **Description** | **Levels** |
|---|---|---|
| Source of vitamin A | Whether vitamin A added is obtained from natural or artificial sources | Natural<br>Artificial |
| Level of vitamin A (mg / kg) | Vitamin A levels sufficient for human health according to international health guidelines | 5<br>10<br>15 |
| Labeling | Whether sugar is labeled to be fortified or not | Yes<br>No |
| Gift pack | Whether fortified sugar has a complementary / supplementary gift or not (e.g., Tea leaves, Cocoa, Coffee, margarine etc). | Yes<br>No |
| Colour | Colour of sugar | White<br>Brown<br>Yellowish |
| Price | Price of 1 kg of sugar with a variance of within 15% | 120 (current price)<br>150<br>180 |

Please indicate your purchase decision between the sugar-types given below;
*[Randomly selected cards shown]*

**Validation Questions on Choice Experiment Responses**

**27**. How sure are you about the choices you made in the sugar options (types)? [1= Very sure, 0= Not sure]

**28**. Were you considering and comparing all attributes before you made a choice? [1= Yes, 0= No]

**29**. Were there specific attributes you were looking for in each choice option before you made each decision? [1= Yes, 0= No]. If **yes**, list the selected attributes;

……

**30**. Were there specific attributes that you ignored in each choice option before you made your choices? [1= Yes, 0= No]. If **yes**, list the selected attributes;

……

**31**. Is there any other factor that influenced your responses to the choice experiment questions besides the information given? [1= Yes, 0= No] If yes, please specify

……

***PART C:*** **CONSUMER CHARACTERISTICS AND DEMOGRAPHICS**

**32**. Indicate how the statements below best describe you and your household;

| | **1 (Never)** | **2 (Rarely)** | **3 (Not sure)** | **4 (Often)** | **5 (Always)** |
|---|---|---|---|---|---|
| Read newspaper/magazine articles on food safety | | | | | |
| Listen to radio discussion programmes about food safety | | | | | |
| Watch television/cable programmes on food safety | | | | | |

**33**. Marital status of the respondent: [1= Single, 0= Married]
**34**. Please indicate your age in years ……..
**35**. Please indicate your occupation .....
**36**. Gender of the respondent: [1= Female, 0= Male]
**37**. Region from which the respondent reside: [1= Rural, 0= Urban]

**38**. Excluding yourself, how many members of your household are in the following age groups?

| | | **Males** | **Females** |
|---|---|---|---|
| **(i)** | Pre-school children – less than 5 years | | |
| **(ii)** | School children - 5 -15 years | | |
| **(iii)** | Adults - 16-50 years | | |
| **(iv)** | Elderly - Above 50 years | | |

**39**. Please indicate your highest level of education attained

| | **Education Category** | **Tick Category** | **Years of completed schooling** |
|---|---|---|---|
| **(i)** | Primary School | | |
| **(ii)** | High / Secondary School | | |
| **(iii)** | Some College or Diploma | | |
| **(iv)** | Bachelor Degree | | |
| **(v)** | other, specify | | |

**40**. What is your household monthly income?

| **Income Category (KSHS)** | **Tick Category** | **Gross Household Income** |
|---|---|---|
| Less than 10,000 | | |
| 10,001 – 20,000 | | |
| 20,001 – 40,000 | | |
| 40,001 – 75,000 | | |
| 75,001 – 100,000 | | |
| 100,001 – 200,000 | | |
| Above 200,000 | | |

**41**. Are you a member in some non-profit organization? (Community based organization, Women group, village group, Church group, Cooperative society, School committee, CDF, etc.) [1= Yes 0= No]

**Thank you for your participation.**

**Appendix 2: NGENE choice experiment design syntax**

*a) Orthogonal design for preliminary survey*

```
Design
; alts = alt1, alt2
; rows = 36
; block = 6
; orth = sim
; model:

U(alt1)=b0+b1*x1[0,1]+b2*x2[0,1,2]+b3*x3[0,1]+b4*x4[0,1]+b5*x5[0,1,2]
+b6*x6[0,1,2]/

U(alt2) =  b1*x1  +b2*x2  +b3*x3  +b4*x4  +b5*x5  +b6*x6$
```

*b) Efficient design for final survey*

Attributes are listed in this order:
X1 = Type or source of Vitamin A
X2 = Level of vitamin A
X3 = whether labeled or not
X4 = Gift or no gift
X5 = Colour
X6 = Price

**a) <u>Syntax</u>**

```
Design
;alts = alt1, alt2
;rows = 24
;block = 6
;eff = (mnl,d)
;model:
U(alt1)=b1[0.978]*x1[0,1]+b2[0.505]*x2[0,1,2]+b3[0.901]*x3[0,1]+b4[0.753]*x4[0,1]+b5[
0.356]*x5[0,1,2]+b6[-0.004]*x6[0,1,2]/

U(alt2) = b * x1 +  b2 * x2 +  b3 * x3   +  b4 * x4  +  b5 * x5   + b6 * x6$
```

**b*) <u>Efficiency measures</u>***

D-error = 0.1399 [D-efficiency or D-optimality measure is 0.861 or 86%]
A-error = 0.230 [A-efficiency measure is 77%]
B-estimate = 84.85%
S-estimate = 17148.75

**Appendix 3: List of all choice sets used in the CE Survey**

**Profile One**

*Scenario 1*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 5 | 15 | |
| **Labelling** | Yes | No | |
| **Gift pack** | Yes | N | |
| **Colour** | Yellowish | White | |
| **Price** | 150 | 150 | |
| **Which ONE would you prefer?** | | | |

*Scenario 2*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 15 | 5 | |
| **Labelling** | No | Yes | |
| **Gift pack** | Yes | No | |
| **Colour** | Brown | Brown | |
| **Price** | 150 | 150 | |
| **Which ONE would you prefer?** | | | |

*Scenario 3*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 10 | 10 | |
| **Labelling** | No | Yes | |
| **Gift pack** | Yes | No | |
| **Colour** | Brown | Brown | |
| **Price** | 150 | 150 | |
| **Which ONE would you prefer?** | | | |

*Scenario 4*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 5 | 15 | |
| **Labelling** | No | Yes | |
| **Gift pack** | No | Yes | |
| **Colour** | White | Yellowish | |
| **Price** | 120 | 180 | |
| **Which ONE would you prefer?** | | | |

**Profile Two**

*Scenario 1*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 15 | 10 | |
| **Labelling** | Yes | No | |
| **Gift pack** | No | Yes | |
| **Colour** | Brown | Brown | |
| **Price** | 180 | 120 | |
| **Which ONE would you prefer?** | | | |

*Scenario 2*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 10 | 10 | |
| **Labelling** | Yes | No | |
| **Gift pack** | No | Yes | |
| **Colour** | Brown | Brown | |
| **Price** | 150 | 150 | |
| **Which ONE would you prefer?** | | | |

*Scenario 3*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 5 | 15 | |
| **Labelling** | Yes | No | |
| **Gift pack** | No | Yes | |
| **Colour** | Yellowish | White | |
| **Price** | 180 | 120 | |
| **Which ONE would you prefer?** | | | |

*Scenario 4*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 5 | 15 | |
| **Labelling** | No | Yes | |
| **Gift pack** | Yes | No | |
| **Colour** | White | Yellowish | |
| **Price** | 180 | 120 | |
| **Which ONE would you prefer?** | | | |

**Profile Three**

*Scenario 1*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 15 | 5 | |
| **Labelling** | No | Yes | |
| **Gift pack** | Yes | No | |
| **Colour** | Yellowish | White | |
| **Price** | 150 | 150 | |
| **Which ONE would you prefer?** | | | |

*Scenario 2*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 10 | 10 | |
| **Labelling** | Yes | No | |
| **Gift pack** | No | Yes | |
| **Colour** | White | Yellowish | |
| **Price** | 120 | 180 | |
| **Which ONE would you prefer?** | | | |

*Scenario 3*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 15 | 5 | |
| **Labelling** | No | Yes | |
| **Gift pack** | No | Yes | |
| **Colour** | White | Yellowish | |
| **Price** | 120 | 180 | |
| **Which ONE would you prefer?** | | | |

*Scenario 4*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 10 | 5 | |
| **Labelling** | Yes | No | |
| **Gift pack** | Yes | No | |
| **Colour** | Yellowish | White | |
| **Price** | 120 | 180 | |
| **Which ONE would you prefer?** | | | |

**Profile Four**

*Scenario 1*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 10 | 10 | |
| **Labelling** | Yes | No | |
| **Gift pack** | No | Yes | |
| **Colour** | White | Yellowish | |
| **Price** | 120 | 180 | |
| **Which ONE would you prefer?** | | | |

*Scenario 2*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 5 | 15 | |
| **Labelling** | No | Yes | |
| **Gift pack** | No | Yes | |
| **Colour** | Yellowish | White | |
| **Price** | 120 | 180 | |
| **Which ONE would you prefer?** | | | |

*Scenario 3*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 15 | 5 | |
| **Labelling** | Yes | No | |
| **Gift pack** | No | Yes | |
| **Colour** | Brown | Brown | |
| **Price** | 180 | 120 | |
| **Which ONE would you prefer?** | | | |

*Scenario 4*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 15 | 5 | |
| **Labelling** | No | Yes | |
| **Gift pack** | Yes | No | |
| **Colour** | White | Yellowish | |
| **Price** | 180 | 120 | |
| **Which ONE would you prefer?** | | | |

**Profile Five**

*Scenario 1*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 10 | 10 | |
| **Labelling** | Yes | No | |
| **Gift pack** | No | Yes | |
| **Colour** | Brown | Brown | |
| **Price** | 180 | 120 | |
| **Which ONE would you prefer?** | | | |

*Scenario 2*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 15 | 5 | |
| **Labelling** | Yes | No | |
| **Gift pack** | Yes | No | |
| **Colour** | Yellowish | White | |
| **Price** | 120 | 180 | |
| **Which ONE would you prefer?** | | | |

*Scenario 3*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 5 | 15 | |
| **Labelling** | No | Yes | |
| **Gift pack** | Yes | No | |
| **Colour** | Yellowish | White | |
| **Price** | 150 | 150 | |
| **Which ONE would you prefer?** | | | |

*Scenario 4*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 15 | 5 | |
| **Labelling** | Yes | No | |
| **Gift pack** | Yes | No | |
| **Colour** | Brown | Brown | |
| **Price** | 180 | 120 | |
| **Which ONE would you prefer?** | | | |

**Profile Six**

*Scenario 1*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 10 | 10 | |
| **Labelling** | No | Yes | |
| **Gift pack** | Yes | No | |
| **Colour** | White | Yellowish | |
| **Price** | 120 | 180 | |
| **Which ONE would you prefer?** | | | |

*Scenario 2*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 10 | 10 | |
| **Labelling** | Yes | No | |
| **Gift pack** | Yes | No | |
| **Colour** | White | Yellowish | |
| **Price** | 150 | 150 | |
| **Which ONE would you prefer?** | | | |

*Scenario 3*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Natural | Artificial | |
| **Level of vitamin A** | 5 | 15 | |
| **Labelling** | No | Yes | |
| **Gift pack** | No | Yes | |
| **Colour** | Yellowish | White | |
| **Price** | 180 | 120 | |
| **Which ONE would you prefer?** | | | |

*Scenario 4*

| | Sugar type A | Sugar type B | Neither |
|---|---|---|---|
| **Source of vitamin A** | Artificial | Natural | |
| **Level of vitamin A** | 5 | 15 | |
| **Labelling** | No | Yes | |
| **Gift pack** | No | Yes | |
| **Colour** | Brown | Brown | |
| **Price** | 150 | 150 | |
| **Which ONE would you prefer?** | | | |

**Appendix 4: Figures of respondents undertaking CE survey in Kakamega County.**

**Appendix 5: Respondents' heterogeneous preferences.**

| Variable | Positive percentage | Negative percentage |
|---|---|---|
| NATURAL | 96.7 | 3.3 |
| MIN | 84.6 | 15.4 |
| MAX | 99.9 | 0.1 |
| LABEL | 97.3 | 2.7 |
| GIFT | 99.8 | 0.2 |
| BROWN | 100 | 0 |
| YELLOWISH | 0 | 100 |

**Appendix 6: Formula for calculating the range of WTP estimates**

$$mean\ WTP \pm 95\%\ CI\ \times standard\ error$$

*Where, CI is the Confidence Interval*

**Appendix 7: FGD checklist questionnaire**

FOCUSED GROUP DISCUSSION QUESTIONNAIRE
MARCH 22, 2013 (AT SHAURI MOYO BAPTIST CHURCH, NAIROBI)

The purpose of the focus group discussion is to obtain preliminary insights on knowledge of food fortification as well as consumption issues that are relevant to choice experiment design procedure.

**Checklist for discussion**

1. Are you aware of fortified food products? Have you consumed any? If No, why?
2. Where do you normally purchase sugar? (Supermarket, Kiosk, Retail shop, etc)
3. How do you use the sugar you normally purchase? [1= Tea, 2= Cakes, 3= Porridge]
4. How much do you pay to purchase 1 kg of sugar? What should it cost?
5. How important are the following aspects when you buy sugar? [1. Price 2. Colour 3. Brand name 4. Packaging 5. Fortified and non-fortified label 6. Quality inspection label]
6. How is vitamin A important to human life? What are its sources?
7. Should vitamin A be made available to consumers through food fortification?
8. What role should government play to ensure the accessibility of VA to the public?
9. Do you consume fortified sugar frequently? Give reasons;
10. In your opinion, how should consumption of fortified foods (sugar) be enhanced?
11. Consider the attributes of fortified sugar as described below:

| **Attribute** | **Description** | **Possible Levels** |
|---|---|---|
| Source of vitamin A | Whether vitamin A added is obtained from natural or artificial sources | Natural<br>Artificial |
| Level of vitamin A (mg / kg) | Amount of vitamin A added following WHO guidelines | 0<br>5<br>15 |
| Labelling | Whether sugar is labelled fortified or not | Yes<br>No |
| Gift pack | Whether fortified sugar has a complementary / supplementary gift or not (e.g., Tea leaves, Cocoa, Coffee, margarine etc). | Yes<br>No |
| Colour | Colour of sugar | White<br>Brown<br>Yellowish-orange |
| Price | Price of 1 kg of sugar with a variance of within 15% | 110<br>120 (current price)<br>140 |

Do these attributes adequately describe fortified sugar?

***Participants' at the FGD***



***Thank you for participating***

**Appendix 8: Random parameter logit (RPL) commands**

a) Parameters for fortified sugar attributes

```
Sample; all$
--> RPLOGIT; Lhs=CHOICES
   ;CHOICES=1,2,3
   ;Rhs=NATURAL,MIN,MAX,LABEL,GIFT,BROWN,YELLOW,PRICE
   ;FCN=NATURAL(N),
        MIN(N),
        MAX(N),
        LABEL(N),
        GIFT(N),
        BROWN(N),
        YELLOW(N),
        PRICE(C)
   ;pds=4
   ;halton
   ;pts=100
```

b) WTP estimates (WALD Procedure in NLOGIT 4)

```
WALD; Labels=b1,
                b2,
                b3,
                b4,
                b5,
                b6,
                b7,
                b8,
                sd_b1,
                sd_b2,
                sd_b3,
                sd_b4,
                sd_b5,
                sd_b6,
                sd_b7,
```

```
            Fix_b8,
      ;start=b
      ;Var=Varb
      ;Fn1=-1*(b1/b8)
      ;Fn2=-1*(b2/b8)
      ;Fn3=-1*(b3/b8)
      ;Fn4=-1*(b4/b8)
      ;Fn5=-1*(b5/b8)
      ;Fn6=-1*(b6/b8)
      ;Fn7=-1*(b7/b8)$
```

C). Compensating Surplus (CS)

```
   WALD; Labels=b1,
            b2,
            b3,
            b4,
            b5,
            b6,
            b7,
            b8,
            sd_b1,
            sd_b2,
            sd_b3,
            sd_b4,
            sd_b5,
            sd_b6,
            sd_b7,
            Fx_b8
      ;start=b
      ;Var=Varb
      ;Fn1=(-1/b8)*(b1*1+b2*1+b3*0+b4*1+b5*1+b6*0+b7*1)
      ;Fn2=(-1/b8)*(b1*0+b2*1+b3*0+b4*1+b5*0+b6*0+b7*1)
      ;Fn3=(-1/b8)*(b1*0+b2*0+b3*1+b4*1+b5*0+b6*0+b7*0)$
```

*Source: adapted from Greene (2007).*

**Appendix 9: Binary logit commands**

a) Parameters of Awareness Regressors

```
Logit;Lhs=AWAREVA
;Rhs=PURSUPER,RNEWSPA,MASTATUS,AGE,GENDER,REGION,EDUCYRS,
INFANTME$
```

b) Marginal Effects

```
LOGIT; Lhs = dependent variable
;Rhs = regressors
;Marginal effects$
```