

**Level of knowledge, perceptions, and utilization of fortified maize flours
among women in Kibera, Nairobi**

Sarah Nyatuka Onsase-A510/60027/2013

BSc. Foods, Nutrition and Dietetics, Kenyatta University

**A Dissertation Submitted in Partial Fulfillment for the award of the Degree
of Master of Science in Applied Human Nutrition**

Department of Food Science, Nutrition and Technology

Faculty of Agriculture

University of Nairobi

2023

DECLARATION

I Sarah Nyatuka Onsase declare that this dissertation is my original work. To the best of my knowledge, this dissertation has not been submitted to any other University.

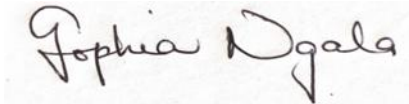


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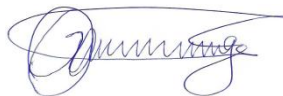
Dr. Sophia Ngala

Department of Food science, Nutrition and Technology, University of Nairobi

Signature Date 24/10/2023

Prof. George OokoAbong'

Department of Food science, Nutrition and Technology, University of Nairobi



Signature...

Date 24/10/2023

DEDICATION

I dedicate this work to my Husband Walter for his constant love, prayers, support and encouragement. To my children Angelo, Marissa, and Jr. for your cheerfulness patience and understanding.

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TABLE OF CONTENTS

DECLARATION	ii
DEDICATION	iii
ACKNOWLEDGMENTS	iv
LIST OF TABLES	ix
LIST OF FIGURES	xi
LIST OF ABBREVIATIONS	xii
OPERATIONAL TERMS	xiii
ABSTRACT	xiv
CHAPTER ONE: INTRODUCTION	1
1.0 Background to the Study	1
1.1 Statement of the problem	3
1.2 Justification	4
1.3 Aim.....	5
1.4 Purpose of the study	5
1.5 Objectives.....	6
1.5.1 Overall Objective	6
1.5.2 Specific objectives of the study	6
1.6 Research questions	6
CHAPTER TWO: LITERATURE REVIEW	7
2.0 Micronutrients	7
2.1 Micronutrients of Public health concern among women of reproductive age in Kenya.....	8
2.1.1 Folate.....	8
2.1.2 Iron	8
2.1.3 Niacin-Vitamin B3	10

2.1.4 Zinc	11
2.1.5 Vitamin B12	11
2.1.6 Vitamin A	11
2.1.7 Iodine.....	12
2.2 Micronutrient deficiency control interventions.....	12
2.2.1 Increasing diversity of food consumed.....	12
2.2.2 Supplementation.....	12
2.2.3 Fortification	13
2.3 History of food fortification in Kenya.....	14
CHAPTER THREE: MATERIALS AND METHODS	16
3.0 Study area.....	16
3.1 Study Design	17
3.2 Study Population	18
3.3 Sample size determination	18
3.4 Sampling procedure.....	19
3.4.1 Inclusion and Exclusion criteria	19
3.5 Data Collection.....	19
3.5.1 Data collection technique.....	19
3.5.2 Data collection instruments	20
3.6 Recruitment and training of research assistants	21
3.6.1 Recruitment.....	21
3.6.2 Training.....	21
3.7 Data Quality Assurance.....	22
3.8 Data management and analysis	22
3.9 Ethical Considerations.....	22
CHAPTER FOUR: RESULTS	23
4.0: Socio-economic and demographic characteristics of the respondents.....	23
4.1 Average Household Income by Source.....	25

4.2: Main sources of maize flour used in the Households of respondents	26
4.3: Households with study population utilizing fortified maize flour	27
4.6: Study respondents’ physiological status and utilization of fortified maize flour.....	28
4.4: Level of knowledge on fortified maize flours.....	29
4.5 Knowledge on fortified maize flour and utilization by study population	31
4.6: Perceptions of respondents on fortified maize flour	33
CHAPTER 5: DISCUSSION.....	35
5.0 Socio-economic and demographic characteristics of the respondents	35
5.1: The level of utilization of fortified maize flours among participants	35
5.2 The level of Knowledge on fortified maize flours among the participants.....	36
5.3 Study Respondents perceptions on fortified maize flours in Kibera.....	38
5.4 Conclusions and recommendations.....	39
REFERENCES	40
APPENDICES	44
APPENDIX 1: QUESTIONNAIRE.....	44
APPENDIX 2: TRAINING CURRICULUM.....	50

LIST OF TABLES

TABLE 1.1: MICRONUTRIENT DEFICIENCIES AMONG WOMEN OF REPRODUCTIVE AGE IN KENYA.....	2
TABLE 4.1: DISTRIBUTION OF THE RESPONDENTS' SOCIOECONOMIC AND DEMOGRAPHIC CHARACTERISTICS	24
TABLE 4.2: DISTRIBUTION OF RESPONDENTS PHYSIOLOGICAL STATUS AND UTILIZATION	28
TABLE 4.3: KNOWLEDGE OF FORTIFIED MAIZE FLOURS AND UTILIZATION BY RESPONDENTS.....	31
TABLE 4.4: KNOWLEDGE- FORTIFIED MAIZE FLOUR CAN REDUCE CHANCES OF BEARING CHILDREN WITH BIRTH DEFECTS AND UTILIZATION BY RESPONDENTS.....	31
TABLE 4.5: KNOWLEDGE- FORTIFIED FLOURS CAN IMPROVE WORK PRODUCTIVITY AND UTILIZATION BY RESPONDENTS (N=184)	32
TABLE 4.6: PERCEPTIONS OF THE RESPONDENTS EXPRESSED AS A PERCENTAGE (N=184).....	33

LIST OF FIGURES

FIGURE 1.1: MAP OF NAIROBI	17
FIGURE 1.2: HOUSEHOLD AVERAGE INCOME BY SOURCE	26
FIGURE 1.3: MAIN SOURCES OF MAIZE FLOUR USED IN THE HOUSEHOLDS OF STUDY POPULATION.	27
FIGURE 1.4: WOMEN PARTICIPANTS UTILIZING FORTIFIED MAIZE FLOUR.....	28
FIGURE 1.5: RESPONDENTS SOURCE OF INFORMATION ON FORTIFIED MAIZE FLOURS EXPRESSED AS A PERCENTAGE	30

LIST OF ABBREVIATIONS

ANC: Antenatal care

FAO: Food and Agriculture Organization

HIV: Human Immune-deficiency Virus

HHs: Households

IFAS: Iron-folic acid supplementation

KDHS:Kenya Demographic Health Survey

KNFFA: Kenya National Food Fortification Alliance

MI: Micronutrient Initiative

MOPHS: Ministry of Public Health and Sanitation

MOH: Ministry of Health

NCDS: Non-communicable Diseases

NTDS: Neural Tube defects

SPSS: Statistical Package for Social Sciences

UNICEF: United Nations Children’s Fund

WRA: Women of Reproductive Age

WHO: World Health Organization

OPERATIONAL TERMS

Commercial Fortified flours: Flours sold in retail markets that have additional micronutrients added to replace those that are lost during processing and to enhance existing nutrients.

Flour fortification: Means the addition of micronutrients to replace nutrients lost during processing or to enhance existing nutrients in flours.

Key players in the fortification program: this includes the government, donor agencies, food industry, local academic institutions, Kenya bureau of standards legislators (KEBS) and consumers.

Knowledge:Facts or information acquired through experience or education.

Lactating mothers: This includes all mothers with breastfeeding children less than 6 months.

Perceptions: This is the way respondents regard fortified maize flours.

Respondents:Women participants aged between 15-49 years (185 women in Kibera sub-location)

Utilization:use of the fortified maize flours as a source of food / nutrients

ABSTRACT

Food fortification has been prioritized by the Kenyan government in prevention of micronutrient deficiencies. However, despite the availability of the fortified maize flours, there was need to address the deficiency in literature on their level of utilization, knowledge and perceptions which remains a gap in the implementation of the fortification program. A cross-sectional study was conducted in Kibera sub-location to collect information on the flours from women participants using a structured questionnaire. About 185 participants were selected for the study, slightly more than half were between 20 and 29 years. The study results indicate that 46% of the respondents had heard about the fortified maize flours. More than half (54%) of the respondents accepted to have utilized the flours. About 39% of the respondents agreed to have the knowledge that the fortified flours can reduce the chance of bearing children with birth defects and 51.6% agreed that fortified flours can improve work productivity. Then 64% of the respondents perceived that the flour is expensive, 69% indicated that the flour is beneficial to health and 72% indicating that the flour has an appealing color. The Pearson's test of association showed that the respondents level of knowledge is likely to influence utilization of fortified maize flours. The results were significant at $P < 0.05$. In conclusion, the flours were acceptable to the participants but there is need to revitalize education, advocacy, and campaigns in informal settlements to increase the level of knowledge which was a barrier in utilization of fortified flours.

CHAPTER ONE: INTRODUCTION

1.0 Background to the Study

Vitamins and minerals are nutrients that the human body requires in small amounts for growth, development and to support the necessary body functions. The deficiency of these nutrients is also referred to as the ‘hidden hunger’, unlike macronutrients the deficit is not as pronounced and may take several signs and laboratory investigations to confirm. On the other hand, these nutrients are easily lost during agricultural production, storage, transportation, processing, and food preparation.

As stated in the Kenya Food Security and Nutrition policy, Micronutrient deficiencies are mainly caused by inadequate dietary intake. (KFSNP, 2012). This form of malnutrition is directly correlated with poverty. According to the 2011 National Micronutrient Survey in Kenya, the prevalence of anaemia in women who are pregnant and those who were not pregnant stands at 41.6% and 21.9% respectively as shown in Table 1.1 (KNMS, 2011) Though there is an improvement from the 1999 survey which had indicated a deficiency of 55.1% (pregnant women) and 47.9% (non-pregnant) it is still unacceptably high since maternal mortality rate was at 448 per 100,000 live births (Mwaniki et al,1999&KNBS and ICF Macro, 2010) whereas Infant and Child mortality rates are at 32 deaths and 41 deaths /1000 live births respectively (MOH,KNBSand ICF 2023).Food fortification has been emphasized as an important interventioninprevention of micronutrient malnutrition.In the past, the country

has had significant success in reduction of iodine deficiency due to salt iodization. As indicated in the KDHS 2008/09, 98% of the visited households had access to iodized salt (This is a nearly universal coverage) whereas the 1999 National micronutrient survey in Kenya showed that the rates of goitre in the country have reduced to as low as less than 6% (Mwaniki et al, 1999).

Folate fortification has been known to reduce the proportion of children born with congenital abnormalities like neural tube defects (NTDs). Folic acid was used in staple foods in south Africa from the year 2003, since its implementation the number born with of NTDs has been reduced by more than 30% (Sayed et al., 2008). This is an indication that the fortification program has a high coverage and has a high chance of eliminating micronutrient deficiencies in a population.

A report by Githuku from a longitudinal study done at Kijabe Hospital from 1998 to 2011 indicated a rise in the number of children born with Neural Tube Defects associated with folate deficiencies and in the recent `micronutrient survey in Kenya, the national prevalence of folate deficiency was 32.1% and 30.9% in pregnant and non-pregnant women respectively as shown in Table 1.1 (KNMS, 2011). Githuku's report recommended supplementation with folic acid from conception to the end of the first trimester and argued that an addition of food fortification to this intervention will reduce the incidence of Neural Tube Defects by 50-75% (Githuku, 2012).

TABLE 1.1: MICRONUTRIENT DEFICIENCIES AMONG WOMEN OF REPRODUCTIVE AGE IN KENYA

		ID	Anaemia	IDA	Vit A	Folate	Vit.B12	ZINC
Pregnant Women		<i>n=104</i>	<i>n=104</i>	<i>n=104</i>	<i>n=111</i>	<i>n=78</i>	<i>n=78</i>	<i>n=109</i>
	Rural	45.6	50.8	45.6	0.0	36	8.0	67
	Urban	20.9	29.5	20.9	14	25	7.1	70
	National	36.1	41.6	26.0	5.4	32.1	7.7	68.3
Non-Pregnant Women		<i>n=592</i>	<i>n=592</i>	<i>n=592</i>	<i>n=632</i>	<i>n=445</i>	<i>n=445</i>	<i>n=617</i>
	Rural	30.1	21.4	15.3	1.8	25.1	36.9	82.4
	Urban	17.9	21.2	13.2	0.4	40.6	30.7	82.3
	National	21.3	21.9	14	1.1	30.9	34.7	82.3

1.1 Statement of the problem

There are predominant micronutrient deficiencies among women of childbearing age in Kenya. Food fortification is practiced with the aim of reducing the prevalence of these deficiencies. Several studies have shown the efficacy of fortifying staples in reduction of these forms of malnutrition. The mandatory fortification of flours has increased the options of fortified products available in the Kenyan market. Maize flour has been used as a fortification vehicle because it is widely consumed by the population. The flours consumed are either processed commercially by industries or locally milled in posho-mills by consumers. The consumers' perceptions on these flours can negatively or positively influence the utilization of the product. Selection of an appropriate vehicle is therefore a critical step in successful fortification, this determines the acceptability of the fortified food. The desirable property of a good vehicle is that it should be consumed by the target group, be relatively low in cost, the fortificants should not make the appearance unappealing and the nutrients added should have a high bioavailability. Several studies have shown that increasing consumer awareness and knowledge on fortification can influence demand and utilization. The study area is an informal livelihood zone that signifies a

resource poor setting which has a high likelihood of micronutrient deficiencies. For successful elimination of these deficiencies, it is important for the vulnerable groups to utilize the fortified flours alongside other interventions. The top to bottom approach was used to implement the fortification program. It was therefore necessary to understand if the public is aware of the importance of the nutrients added, the level of utilization and the perceptions that could become a barrier in the demand of this fortified flour.

1.2 Justification

Food fortification has been prioritized by the Kenyan government as a vision 2030 flagship project and a high impact nutrition intervention in addressing micronutrient deficiencies (MOPHS, 2012). A community with high micronutrient deficiencies has a vicious cycle of poverty and under development due to decreased school, work performance and poor health associated with these deficiencies. Food fortification is sustainable, reaches more people, and is a cost-effective intervention in reducing the prevalence of micronutrient deficiencies among the at-risk groups. This intervention is therefore appropriate for the population living in informal settlements who are affected by poverty, food insecurity and high incidences of communicable diseases. Most of them cannot be able to diversify their diet due to lack of resources and therefore providing access to fortified foods becomes very critical in decreasing the deficit in micronutrient intake. In implementing this strategy, the government and its partners need to do periodic assessments of the population utilizing these foods in order to know the proportion that is reached with the fortification program. The concept of fortifying maize flour is new to the Kenyan population and is controlled and managed by the government and the food industries. Therefore, it was crucial to understand if the target group is aware what foods have been fortified and what benefits have been added to these flours and the perceptions (positive or negative) that

would influence the utilization. The scope of the study focused on women of the reproductive age (15-49 years) and therefore the sample was limited to women while excluding the other consumers of fortified maize flours. This was because of their known vulnerability to micronutrient deficiencies and target beneficiaries of many nutrition interventions

The final report will assist the sub-county and the county Government in addressing the gaps and strengthening the areas of focus on interventions that will reduce the prevalence micronutrient deficiencies. Researchers will be able to fill the gaps on existing knowledge, the utilization of fortified flours in urban slum areas, the existing knowledge, and perceptions of the target group on fortified maize flours. Policy makers will also benefit by using the information in reviewing the current policies on the National food fortification program thereby contributing towards addressing micronutrient deficiencies in the country. The manufacturing industries will benefit with information on the barriers that hinder utilization of the fortified flours. This will be important in reviewing their marketing strategies and addressing the raised concerns.

1.3 Aim

The aim of the study was to contribute to the knowledge on the implementation of the maize flour fortification as a means of alleviating and preventing micronutrient deficiencies.

1.4 Purpose of the study

The purpose of the study was to generate information that will inform the key players in the food fortification programme on the level of knowledge and perception on utilization of fortified maize flours.

1.5 Objectives

1.5.1 Overall Objective

The Overall objective of the study was to establish the level of knowledge, perceptions, and utilization of fortified maize flours among women of reproductive age in Kibra sub-county.

1.5.2 Specific objectives of the study

1. To assess the socio-economic and demographic characteristic of the respondents
2. To assess the level of knowledge and perception on fortified maize flours by the respondents
3. To determine the level of utilization of fortified maize flours among the respondents.

1.6 Research questions

The following questions were used to guide the study.

1. What is the level of utilization of fortified maize flours among the respondents?
2. Would the level of knowledge and perception of fortified maize flours affect utilization among the respondents?

CHAPTER TWO: LITERATURE REVIEW

2.0 Micronutrients

All micronutrients were discovered because of deficiency states occurring throughout the world e.g., Vitamin C. Treatment of micronutrient deficiencies was done using foods and then thereafter by chemical components. An example is scurvy which had killed many long sea sailors in the 19th and 20th century where James Lind conducted a clinical trial in Nutrition that led to the discovery of a vitamin C deficiency (Shekin, 2005). This trial led to the study of micronutrients, their chemical structures, functions, and food sources. Micronutrients are grouped into two, the Vitamins and minerals. Vitamins are further classified into Vitamin A, D, E, and K (fat soluble) while Vitamin C and vitamins B complex vitamins are water soluble. B complex comprises of thiamin, folic acid, riboflavin, niacin, biotin, pantothenic, inositol, and pyridoxine (Brown, et al, 2011). Micronutrient deficiencies occur when the body lacks one or more micronutrients. The most common deficiencies include iron, zinc, vitamins A, folate, vitamin B6, B12, C (Burgess et al, 2009). Populations that are prone to frequent infections and are those that are unable to provide adequate amounts of meat, fruits and vegetables have high deficiencies (Kusuke et al, 2011).

2.1 Micronutrients of Public health concern among women of reproductive age in Kenya

2.1.1 Folate

Folate is involved in the synthesis of DNA required growth of cells and conversion of vitamin B12 (Geissler and Powers, 2017). These are some of the effects of folate deficiency.

2.1.1.1 Neural tube defects

The three major types of NTDS are; Spina bifida, Anencephaly and Cephalocele (Brown, et al, 2011). The infant's brain and the spinal cord start to form even before a pregnancy is known (Geissler and Powers, 2017). Women should take Folic acid before they conceive and during the pregnancy period to avoid giving birth to children with NTDS. (Whitney and Rolfes, 2013).

2.1.1.2 Megaloblastic Anaemia and Congenital Birth defects

Lack of adequate intake of folate can cause megaloblastic anaemia. This is when red blood cells that are immature are released in the bone marrow. These cells are normally bigger in size and therefore cannot properly transport oxygen or pass in blood capillaries. The body then gets anaemia of folate deficiency (Whitney and Rolfes, 2013). In the recent studies cleft lip/ palate have been prevented with adequate folate intake through supplementation and fortification. (Whitney and Rolfes, 2013).

2.1.2 Iron

Iron is vital in many cell activities. It forms part of haemoglobin in red blood cells that transport oxygen in the body (Brown et al, 2011). Iron is also found in myoglobin of the muscle cells where it accepts, carries, and releases

oxygen(Brown et al, 2011). Iron helps the muscle, brain, and immune system to function properly (Whitney and Rolfes, 2013).WRArequire 18mgdaily (Whitney and Rolfes, 2013). This can be gotten from eating iron rich foods and fortified foods(Brown et al, 2011).Iron occurs in two forms, Heme ironfrom meats, poultry, and fish which the body absorbs easily (Whitney and Rolfes, 2013).Non-heme iron is found both plantsand animals but only 1-10% is taken up by the body. Iron in fortified foods is non-heme iron therefore should be eaten with enhancers to increase its absorption (Geissler and Powers, 2017). A high calcium content of some foodsinterferes with absorption of heme iron (Geissler and Powers, 2017). Phytatesand phenolic compounds in plantsalso reduce iron absorption(Whitney and Rolfes, 2013). Oxalates from vegetables like spinach also hinder iron absorption. (Geissler and Powers, 2017. Vitamin C is known as an iron absorption enhancer. It acts by reducing ferric iron to ferrous form that is easily absorbed(Geissler and Powers, 2017). Meat and fish have the ‘meat factor’ which means can enhance absorption of non-haem iron from other foods (Geissler and Powers, 2017). Iron deficiency has the following effects.

2.1.2.1 Iron deficiency anaemia

This refers to low concentration of haemoglobin in the body due to depletion of iron stores. Therefore, the body has red blood cells which are pale.The result of this is slow metabolism of energy in the cells that results in fatigue, weakness, headaches, apathy, and pallor. (Whitney and Rolfes, 2013). Women of reproductive age andthe Pregnant are more prone to iron deficiency due to repeated losses during menstruation and increased pregnancies needs respectively (Burgess et al, 2009).

2.1.2.2 Work productivity

Decreased oxygen supply to the tissues as result of reduced in haemoglobin levels limits the physical activity. (Geissler and Powers, 2017).

2.1.2.3 Cognitive function

Iron is important in the development of the child's brain. Studies have shown that lack of iron results to poor brain development in children that affects their performance in school. Once this happens in infancy it cannot be corrected therefore it affects cognitive function in adults later in life(Whitney and Rolfes, 2013).

2.1.3 Niacin-Vitamin B3

Niacin is important in the breakdown of glucose (Whitney and Rolfes, 2013) It also supports the health and integrity of the skin, nervous and digestive system. Niacin deficiency is characterized by dermatitis, diarrhea, and dementia (Brown, et al, 2011).It is predominant in a population consuming a low protein diet along with processed maize flours and hulled maize (muthokoi) as in the case with some of the Akamba community in Kenya. Some African countries which have a population that relies on maize as a primary source of food have experienced outbreaks of pellagra e.g., Malawi in 2017, (matapandeu et al, 2017). 70% of the niacin in maize is bound to complex carbohydrates and peptides making it unavailable for absorption. Tryptophan (amino acid) is made to niacin in the body but when one consumes high quantities of maize, interferes with this conversion because maize has a high content of leucine (Whitney and Rolfes, 2013). Therefore, food fortification has been used to eradicate these deficiencies.

2.1.4 Zinc

Zinc is used in DNA and RNA Metabolism, cell replication, maturation, gene expression and normal growth and development of the foetus. It is required in the proper functioning of the mammary glands. The production and secretion of breastmilk require adequate amounts of zinc (Geissler and Powers, 2017). In a pregnant woman zinc deficiency is likely to cause Preterm labour and miscarriages, prolonged labour, Retarded foetal growth, Low immunity for the mother and baby and negative effects on the mental ability of the child (Brown et al, 2011).

2.1.5 Vitamin B12

Vitamin B12 is an important contributor to the process of cell division. Its deficiency can lead to development of megaloblastic anaemia. (Bonnie. S et al, 1996) Women who are strict vegetarians and those who cannot access animal source foods are at a greater risk of the deficiency (Whitney and Rolfes, 2013).

2.1.6 Vitamin A

Vitamin A promotes the health of the epithelial tissues and skin. It is important in maintaining the body's immune system (Whitney and Rolfes, 2013). Consequences of vitamin A Deficiency include Severity of infectious diseases in children e.g., measles and diarrhoea, Night blindness, Xerophthalmia, Poor foetal growth and low birth weight infants (Burgess et al, 2009).

2.1.7 Iodine

Iodine is used in the synthesis of a metabolism-regulating substance called thyroxine (Geissler and Powers, 2017). The soil or environment determines the presence of iodine in food (Burgess et al, 2009). Reduced mental capacity is a consequence of great concern in iodine deficiency (Kennedy et al, 2003). Other deficiencies include Cretinism, brain damage, Hypothyroidism and Goiter (Burgess et al, 2009).

2.2 Micronutrient deficiency control interventions

2.2.1 Increasing diversity of food consumed.

This is increasing the amount and variety of micronutrient rich foods (Burgess et al, 2009). The poor are not able to achieve this due to lack of purchasing power. (WHO/FAO, 2006).

2.2.2 Supplementation

Supplementation is the intake of micronutrients in high doses, mostly through syrups, pills, capsules, tablets, liquids, or powders. WHO recommends that countries with high micronutrient deficiency levels especially pregnant women and children under 5 years should provide iron/folate and vitamin A supplements respectively (WHO/FAO, 2006). These supplements are at an additional cost to the countries which is not potentially sustainable. In addition, many countries including Kenya are struggling to address the issues of compliance among the recipients due to logistical challenges (Galloway et al, 2002).

In Kenya pregnant women attending antenatal clinics are given iron and folic acid supplements (MOPHS, 2008). In the MOH, plan of action for accelerating reduction of anaemia through iron and folic acid supplementation several challenges were highlighted, compliance, late start of antenatal care, stock-outs in health facilities and a weak implementation strategy (MOH,2012-2017).Other micronutrient supplementation strategies implemented in Kenya include Routine supplementation of Vitamin A to children aged less than five years in hospitals and health care centers. Children with Diarrhoea are also provided with Zinc according to National guidelines (MOPHS,2008).

2.2.3 Fortification

“This is the addition of one or more essential nutrients to a food whether it is normally contained in that food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups” (FAO, 1996). Food is fortified in four different ways.

2.2.3.1 Mass Fortification

This is where the government approves, guides, and regulates the fortificants added to foods(cereals, salt, sugar, flour, and oils)tobe consumed by its population. It is fortification of food that is consumed by the general population (Kusum W, 2019)

2.2.3.2 Targeted fortification

This is addition of micronutrients to foods provided to a particular population or sub-group who are at risk of micronutrient deficiencies in a specific periode.g.,complementary foods for children, food for school feeding programs, rations for pregnant and lactating women among others ((Kusum W, 2019).

2.2.3.3 Household /community fortification

This is use of micronutrients in form of powders or spreads that are added to complementary foods for young children at household level to improve their micronutrient intake (MOPHS, 2008).

2.2.3.4 Market-driven

Foods are fortified by manufacturers through business-oriented initiatives voluntarily, but the government puts in place regulatory measures on the premix. (Kusum W, 2019)

2.2.3.5 Bio-fortification

Bio-fortification is the genetic modification of plants to enhance their nutritional value and absorption of nutrients e.g., the orange-fleshed sweet potato from western, Kenya. (KFSNP, 2012).

2.3 History of food fortification in Kenya

The history of fortifying foods began in developed countries to prevent iron, iodine, Vitamin A, D and B-complex vitamin deficiencies. Salt iodization was introduced in Switzerland and United States of America in 1920s (WHO/FAO 2006). From 1940, cereals were fortified with thiamine, riboflavin and niacin which has since been implemented in many countries in the world. Some countries fortify margarine with vitamin A and milk with vitamin D. (WHO/FAO 2006). Most developing countries have now followed the trend and are increasingly fortifying most staple foods with micronutrients.

In Kenya, Salt iodization was passed by the Regulations of the Food, Drug and Chemical Substances (1978). These has been successfully implemented since then, with recommendable reduction of goiter to 6 % (Mwaniki et al, 1999). By

the year 2008, the government Fortification programme developed fortification Standards to regulate all the foods that were to be fortified in the country and while maize flour and sugar fortification and was being done voluntarily (MOPHS, 2012).

The government amended the Food, drug, and chemical substances act (1978) CAP 254 legal notice No. 62 to include mandatory fortification of flours and oils (MOPHS, 2012). In July 2015 it was amended to include standards for other fortification vehicles. (KNFSP, 2018-2022).

CHAPTER THREE: MATERIALS AND METHODS

3.0 Study area

The study was carried out in Nairobi city County, this is the capital city of the republic of Kenya. It comprises of 17 sub-counties as shown in the map, figure 1.1. Nairobi County is among the major urban areas in Kenya whereby there is increased urbanization and industrialization which has resulted to an increase in consumption of processed foods. The launch of the Food fortification project in Kenya and National campaign on food fortification was also done in Nairobi (MOPHS, 2012). The population of Nairobi has benefited from the public awareness campaign by the government on the importance of micronutrients, the food fortification logo, and the existence of fortified foods in the market through billboards, print and electronic media (MOPHS, 2012). Whereas Nairobi County residents have access to a variety of radio and TV stations with majority having access to either print or electronic media. About 4.3 million people reside in Nairobi (KNBS, 2019) according to Kuffer et al as quoted by Martin, 60% of the residents live in informal settlements (Martin K, 2023). Kibera sub-county was purposively selected because it is known to host the largest informal settlement in Nairobi. Some refer to it as the 'largest slum in Africa'. Kibera is known to have varied socio-economic and ethnic groups from the whole country due to rural-urban migration (Martin K, 2023). This sub-county is densely populated and has a population of low-income groups of individuals who are not producers of food but rather purchase flours from either millers, local shops, or supermarkets. It has a population of 185,777 people of which 94,199 are female 91,569 are male while 56,438 (61.6%) are women of reproductive age. It comprises the following administrative units (Figure 1.1).

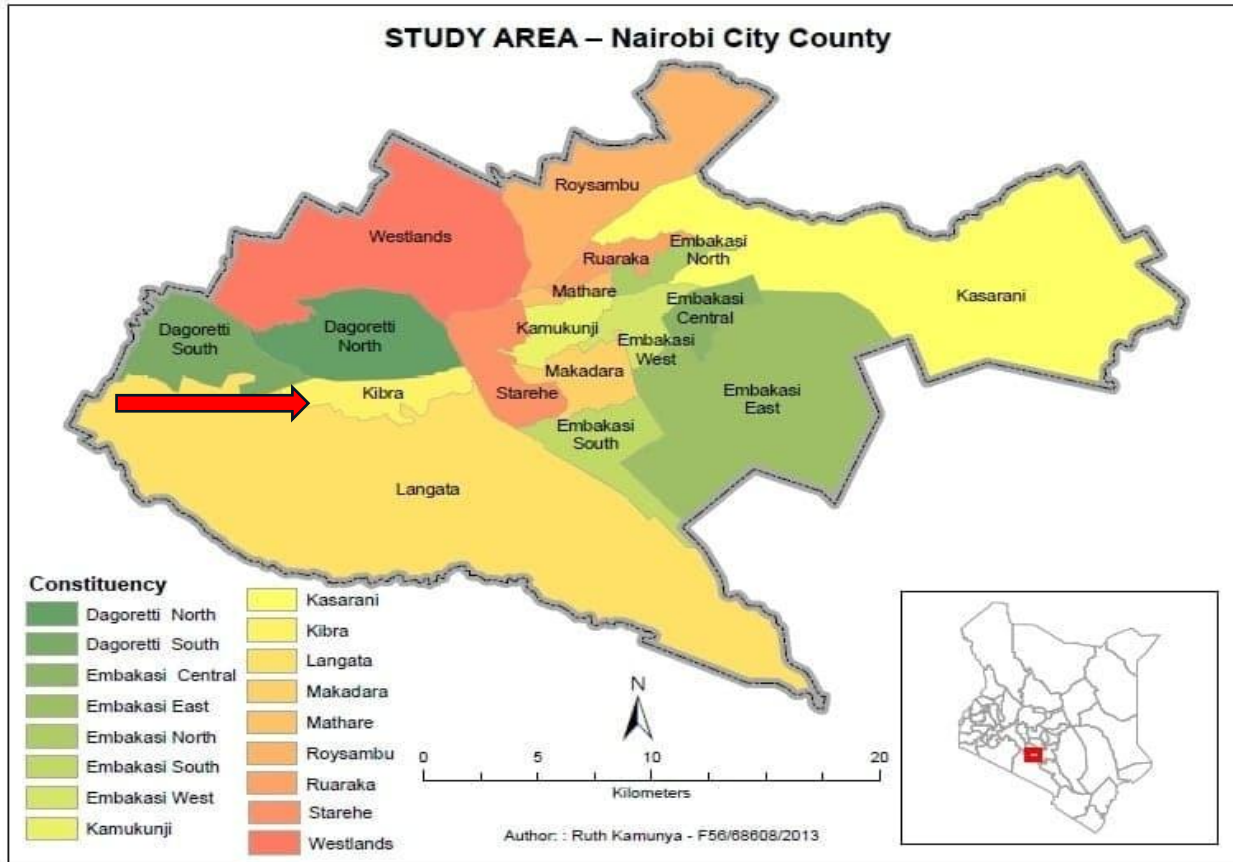


FIGURE 1.1: MAP OF NAIROBI

Source: Researchgate.net

3.1 Study Design

A cross sectional survey was done in Kibera sub-location whereby a semi structured Questionnaire was administered to participants to collect information on socio-economic and demographic characteristics, utilization of fortified maize flours, knowledge, and perceptions of fortified maize flours. This design was able to provide quantitative data which was used to establish the knowledge and utilization levels of the participants, the respondents' perceptions and enabled the description of variables using standard statistical methods. In addition, a further analysis was done to determine the association of independent variables

(knowledge and perceptions) and dependent variable (utilization of fortified maize flours).

3.2 Study Population

The target population included women aged between 15-49 Years. The sample was got from those residing in households within KibraSub- location. This target group was selected due to its vulnerability to micronutrient deficiencies especially during pregnancy and lactation.

3.3 Sample size determination

The respondents to be interviewed were determined using the Fischer (1991) formula

$$n = \frac{z^2 p(1-p)}{d^2}$$

d^2

Where: n is the sample size, z equals the standard normal deviate, usually set at 1.96 which corresponds to the 95 percent confidence level. d is the degree of accuracy desired, usually set at 0.05, p is the proportion in the target population with a certain characteristic (utilizing fortified maize flour) and $q = 1.0 - p$.

Assumptions: At 95% confidence level, an estimated population of women reproductive age utilizing fortified maize flours in KibraSub- County, Nairobi County is 87%. This estimate is used since it is the actual proportion in population known to be utilizing maize flours.(KNMS,2013) and a precision of 0.05 was used as shown below; ($p=0.87$)

Therefore $n = \frac{1.96^2 \times 0.87 \times 0.13}{0.05^2}$

0.0025

n=174

Adjusting a non-response rate of 5 %, the final calculated adjusted sample is **183**.

3.4 Sampling procedure

Kibra sub-county was selected through purposive sampling. This administrative unit has a population of 187, 777 people and 56,438 (61.6%) women of reproductive age. Within the sub-county a list of locations was drawn and Kibera location was randomly selected. Within the location Kibera sub-location was randomly selected to participate in the study. To get women aged 15-49 years, Purposive sampling was used to identify households with these participants.

3.4.1 Inclusion and Exclusion criteria

3.4.1.1 Inclusion criteria

This study included a sample of women of reproductive age (15-49 years) in Kibra sub-county who gave consent to be included in the study.

3.4.1.2 Exclusion criteria

Women of reproductive age who were sick and unable to respond to questions during the survey.

3.5 Data Collection

3.5.1 Data collection technique

Data collection was done through survey in which a semi-structured questionnaire was administered orally to the respondents. Questions were asked on social, demographic, and economic characteristic of the respondents, utilization, knowledge, and perceptions of respondents on fortified

flours. The mobile data collection system was used in data collection. The interview questions were put in the open data kit (ODK) in a logical sequence.

3.5.2 Data collection instruments

A semi-structured questionnaire was the key data collection instrument. It consisted of five sections. Responses in the questionnaire were assigned numerical values whereas closed ended questions with an anticipated yes answer were assigned 1 while No were assigned 0. The first section captured the socio-demographic characteristics of the respondents, section B contained information on utilization of the fortified flours, whereby the respondents were asked to state whether the maize flour utilized in the household was fortified or not. The expected response was either yes, no or don't know. Data on knowledge and perceptions of the respondents on fortified maize flours was collected using a likert-type scales. In section C the level of knowledge was captured using two subsections C(A) firstly, responses on awareness of fortified maize flours were collected by asking the respondents whether they had heard of the fortified maize flour from any source of information. Respondents who heard responded with yes and those who had not responded with no. Those who responded on the affirmative were further asked to state the source of information, A list of possible sources was developed to make it easy to capture the information. In section C(B) the level of knowledge was captured using two statements on health benefits of fortified flours where the respondents were expected to respond with either yes-1, no-0 or Don't know-3. In Section D Four types of perceptions on

fortified maize flour were obtained and for each type, one statement was read and the respondents were asked their opinion which was rated at a 5 point scale from strongly disagree-1, disagree-2, neutral-3, agree-4 and strongly agree-5, neutral was taken as the mid-point. Other questions were assigned coded categories depending on the expected responses. The values representing the responses were entered in a computer prior to data entry. The research team pre-tested 10 (5% of the total) questionnaires which was useful in making amendments to the questionnaire. The interviewers were also able improve the familiarization of the questions and survey skills. The pre-test data collected was also used to test the data entry and analysis template.

3.6 Recruitment and training of research assistants

3.6.1 Recruitment

The study was carried with the assistance of two research assistants. The recruitment was done through interviews and the preference went to those who were fluent in English and Kiswahili and those who had prior experience in data collection using the Open data Kit (ODK collect)

3.6.2 Training

There was a two-day training on the purpose and objectives of the study, questionnaire administration, data collection technique and recording of data as shown on appendix 3. The research assistants were also trained on basic research ethics and participated in pre-testing of the questionnaire to sharpen their skills.

3.7 Data Quality Assurance

The data collection team ensured completeness of questionnaires daily before submission to the server. The data was then entered into the computer and then cleaned for any outliers using SPSS v.16 program.

3.8 Data management and analysis

Data was entered and analyzed using the Statistical Package for Social Sciences (SPSS). Descriptive statistical techniques (percentages, mean and frequencies) were used to report the results of the study. The respondents' perceptions were determined using four variables: cost, benefits, taste, and appeal. However, to facilitate analysis the responses on 'strongly agree' and 'agree' were collapsed into a single category referred to as 'agree'. In a similar manner, 'strongly disagree' and 'disagree' were collapsed to 'disagree'. The Pearson's Chi square test was used to analyze the associations between the variables.

3.9 Ethical Considerations

The University of Nairobi Research and ethics committee gave the approval to do the study and Permission to conduct the study in Nairobi County was obtained from the Nairobi County research committee and the Kibera sub-county commissioners' administrative offices. The respondents' confidentiality was maintained by ensuring that coding was used, and no names were written in the questionnaires. Informed consent was obtained from respondents before administering questionnaires.

CHAPTER FOUR: RESULTS

4.0: Socio-economic and demographic characteristics of the respondents

The survey was done in Kibera sub-location where about 185 respondents participated in the study. Slightly more than half (57%) of those interviewed were between the ages of 20 and 29 years. The respondents included pregnant women (10%), lactating (13%) and non-pregnant (77%). Majority of the respondents lived in informal livelihood zones characterized by low-income earners (the highest earning category had a mean of KES. 8870) who live in houses made of iron sheets and mud (73%). More than half (54%) of the respondents were married. 56% of the households were headed by adult males who were mostly aged between 31-40 years (38%). The main occupation of the household heads was Casual laborers (32%). The household's size was mostly 3-5 people (75%), with a mean household size of 4.2 people. Most of the respondents were unemployed (38%) while the least were students (6%), only 9% were salaried (employed). Those involved in petty trade and street vending were 16%, Casual laborers were 15% and those who had small scale businesses were 17%. Only 29% of the respondents were the main bread winners of the households. 27% of the respondents had reached and not completed secondary education (Table 4.1).

TABLE 4.1: DISTRIBUTION OF THE RESPONDENTS' SOCIOECONOMIC AND DEMOGRAPHIC CHARACTERISTICS

Variable	Category	Frequency(n=185)	Percentage
Respondent Age (yrs)	15-19	13	7
	20-24	56	30
	25-29	50	27
	30-34	34	18
	35-39	17	9
	40-44	6	3
	45-49	9	5
Level of Education	None/never went to school.	1	1
	Primary (in-complete)	28	15
	Primary (completed)	38	21
	Secondary (in-complete)	50	27
	Secondary (completed)	44	24
	College/University(incomplete)	11	6
	College/University (complete)	13	7
Occupation	Employed / Salaried	16	9
	Petty trade / Street vendor / Artisan	29	16
	Unemployed	70	38
	Self-employed/ Business	31	17
	Student	11	6
	Casual laborer / Waged laborer	27	15
	Others	1	1
Household composition	0-2 people	18	10
	3-5 people	138	75
	6-8 people	26	14
	Above 8 people	3	2
Type of House	Rented Permanent Structure (Brick/ Stoned Walled)	44	24
	Rented Temporary structure (Iron Sheet/Mud walled)	135	73
	Own House (Permanent Structure Bricked / Stoned Walled)	2	1
	Own House (Temporary Structure Iron sheet / Mud Walled)	4	2
Physiological status	Pregnant	19	10
	Non-pregnant	142	77
	Lactating	24	13
Variable	Category	Frequency(n=185)	Percentage

Marital Status	Married	100	54
	Divorced	20	11
	Single	44	24
	Widow	11	6
	Separated	10	5
Household head	Adult Male	103	56
	Adult Female	74	40
	Others	8	4
Age of household head	0-20	4	2
	21-30	60	32
	31-40	71	38
	41-50	31	17
	51-60	11	6
Main occupation of the household head	Employed / Salaried	41	22
	Petty trade / Street vendor / Artisan	36	19
	Unemployed	14	8
	Self-employed/ Business	33	18
	Casual laborer / Waged laborer	59	32
		2	1
	Others		
Household main bread winner	Myself	54	29
	Spouse	89	48
	Parent	36	19
	Others	6	3

4.1 Average Household Income by Source

Among households which reported to have been involved in any income generating activity, it was realized that employment was the highest paying source with a monthly average of KES.8870. This was followed by business/self-employment at KES.6400, other uncategorized activities (Donations from friends and neighbors, Cash transfer programs) at KES.1138 while those practicing farming earned about KES. 443. (Figure 1.2)

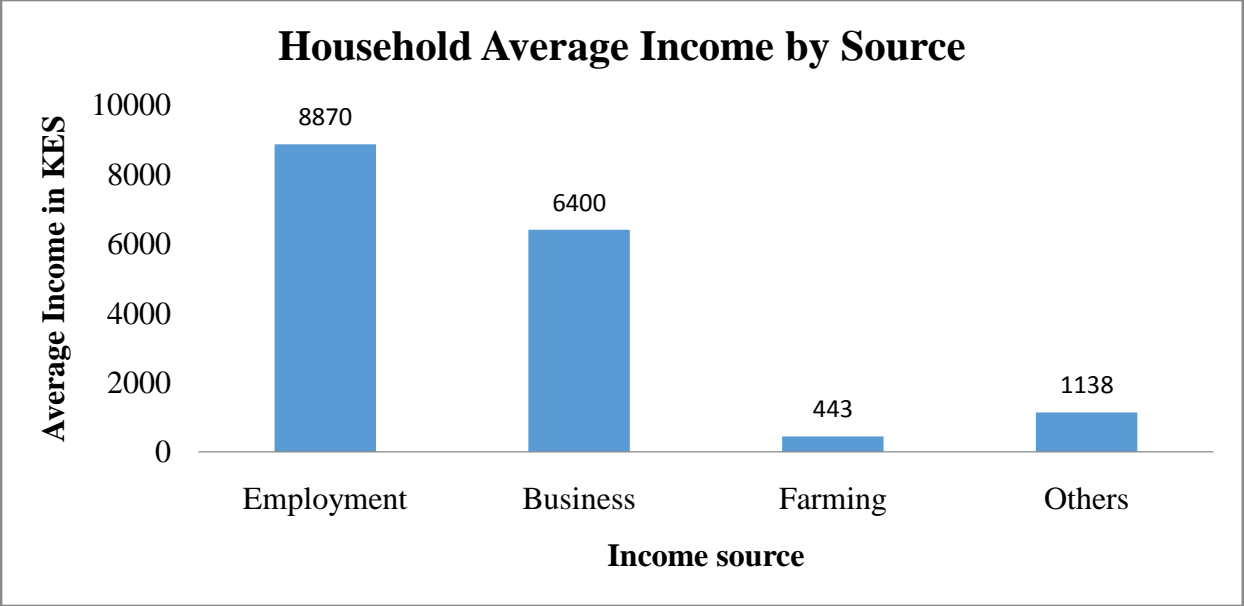


FIGURE 1.2: HOUSEHOLD AVERAGE INCOME BY SOURCE

4.2: Main sources of maize flour used in the Households of respondents

Majority of the households (63%) were getting their maize flour from the local shops followed by local millers (19%) and supermarkets at (15%) while only 2% relied on produce from their farms(Figure 1.3).

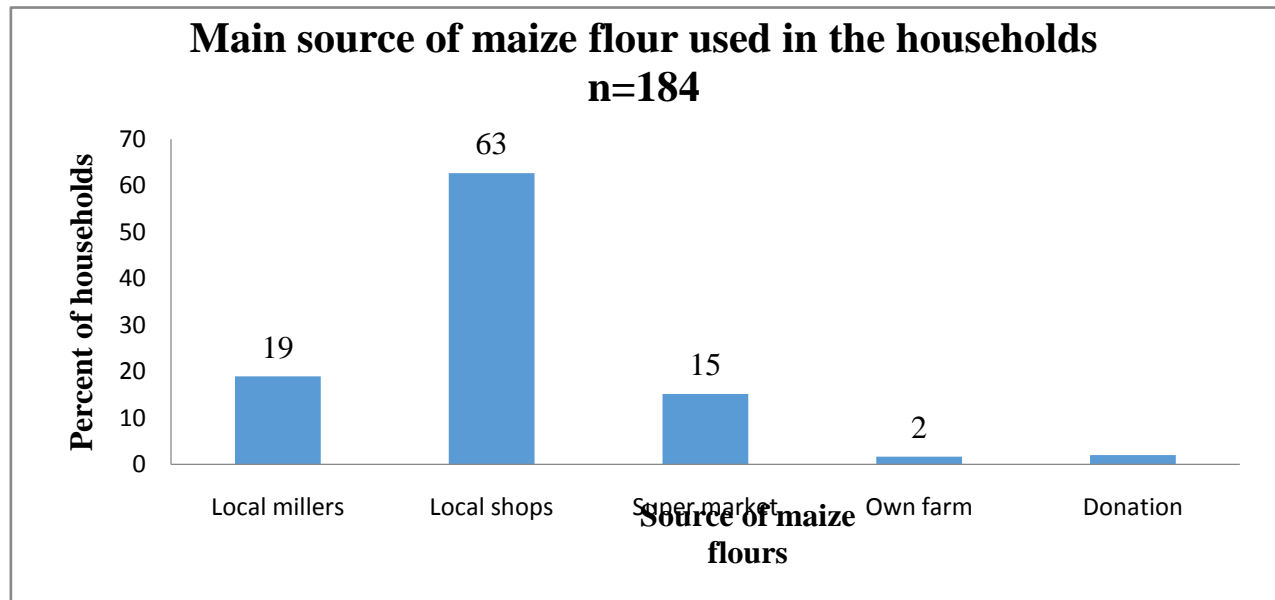


FIGURE 1.3: MAIN SOURCES OF MAIZE FLOUR USED IN THE HOUSEHOLDS OF STUDY POPULATION.

4.3: Households with study population utilizing fortified maize flour

Majority of the respondents (54%) indicated that they were consuming fortified maize flour while 28% disagreed. About 18% of the respondents were not aware whether the maize they were consuming was fortified or not. (Figure 1.4)

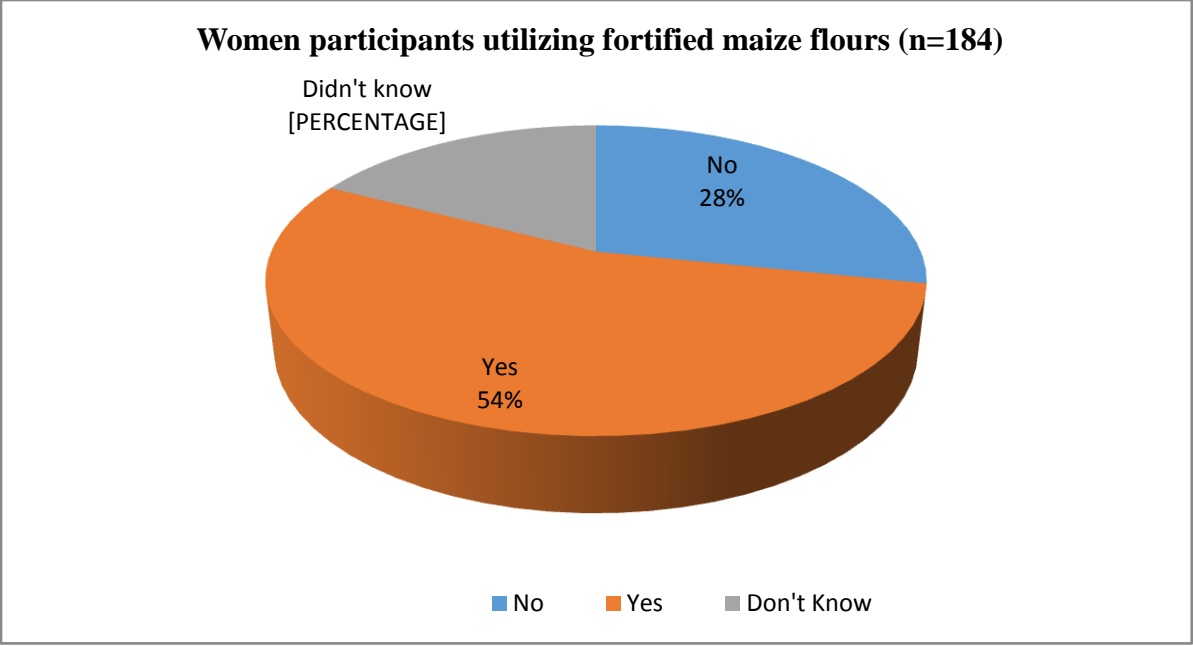


FIGURE 1.4: WOMEN PARTICIPANTS UTILIZING FORTIFIED MAIZE FLOUR

4.6: Study respondents’ physiological status and utilization of fortified maize flour

When the respondents’ physiological status was compared to utilization of fortified maize flour, The lactating women (65%) were more likely to consume fortified maize flour as compared to their counterparts who were pregnant (31%) and another who were non-pregnant and non-lactating women (55%) of the total in each of the categories mentioned. A chi-square test results p-value= 0.176 indicated that there was no statistical association between respondents’ physiological status and utilization of fortified maize flour in their households. (Table 4.2)

TABLE 4.2: DISTRIBUTION OF RESPONDENTS PHYSIOLOGICAL STATUS AND UTILIZATION

Utilization of fortified maize flours by respondents				
Respondents’ Physiological	No	Yes	Don’t know	Total

status

Pregnant	7(3.8%)	6 (3.3%)	6(3.3%)	19(10.3%)
Lactating	4 (2.2%)	15(8.2%)	4(2.2%)	23(12.5%)
Non pregnant and non-lactating	41(22.3%)	79(42.9)	22(12.0%)	142(177.2%)
Total	52(28.3%)	100(54.3%)	32(17.3%)	184(100%)

χ^2 - 6.324, n-184, df-4, P-0.176

4.4: Level of knowledge on fortified maize flours

Slightly less than half of the participants, (46%) had heard of fortified maize flour through various sources of information. The common sources of information on fortified maize flour were mentioned as follows; media (TVs and radios) as the common source was cited by 52% of the respondents, books, and magazines 17%, friends and relatives 14% other sources (school and Packaging) 13%, market 10% and finally internet at 9% (Figure1.6).

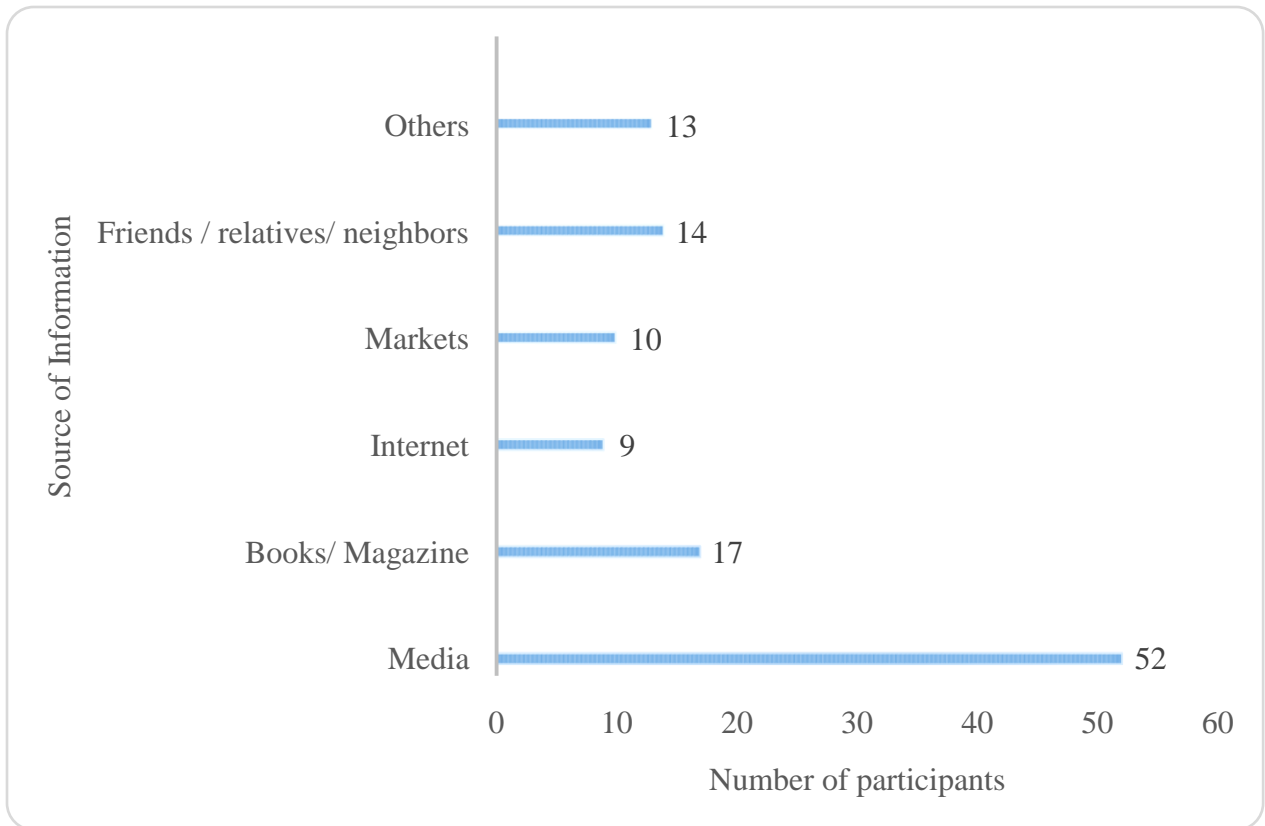


FIGURE 1.5: RESPONDENTS SOURCE OF INFORMATION ON FORTIFIED MAIZE FLOURS EXPRESSED AS A PERCENTAGE

Further investigation to examine if there was any relationship between knowledge of the respondents on the fortified maize flour from the sources of information studied and utilization revealed that the participants knowledge on the flours was more likely to influence utilization. A chi-square test conducted at a cumulative (CI) of 95% returned a p-value of 0.004 indicating significance of association. (Table 4.3)

TABLE 4.3: KNOWLEDGE OF FORTIFIED MAIZE FLOURS AND UTILIZATION BY RESPONDENTS

Knowledge of fortified maize flours	Utilization of fortified maize flours by respondents (n=184)			
	No	Yes	Don't know	Total
No	33(17.9%)	43(23.4%)	23(12.5%)	99(53.8%)
Yes	19(10.3%)	57(31.0%)	9(4.9%)	85(46.2%)
Total	52(28.3%)	100(54.3%)	32(17.4%)	184 (100%)

$\chi^2=10.852$, df-2, P-0.004, n-184.

4.5 Knowledge on fortified maize flour and utilization by study population

Table 4.4 shows that the respondents who had the knowledge that fortified flour can reduce the chance of bearing children with birth defects were 39% and 51.6% agreed that the fortified flours can improve work productivity. On further tabulations respondents who knew that fortified flours could reduce the chances of bearing children with birth defects were highly likely to consume fortified maize flour in their households. Chi-square test results p-value= 0.001 indicated that there was a significant relationship between this knowledge and utilization of fortified maize flour in the respective respondents in households.

TABLE 4.4: KNOWLEDGE- FORTIFIED MAIZE FLOUR CAN REDUCE CHANCES OF BEARING CHILDREN WITH BIRTH DEFECTS AND UTILIZATION BY RESPONDENTS

Fortified maize flour can reduce the chances of bearing children with birth defects	Utilization of fortified maize flours by respondents			
	No	Yes	Don't know	Total
No	14(7.6%)	10(5.4%)	8(4.3%)	32(17.4%)
Yes	17(9.2%)	51(27.7%)	5(2.7%)	73(39.7%)
Don't know	21(11.4%)	39(21.2%)	19(10.3%)	79(42.9%)
Total	52(28.3%)	100(54.3%)	32(17.4%)	184(100.0%)

χ^2 -17.914, df-4, P-0.001, n-184

The results of the study showed that utilization of fortified maize flour in the surveyed households has an association with the knowledge of the respondent that fortified maize flour improves work productivity. Cross tabulation analysis results of p-value=0.003 revealed that household utilization of fortified maize flour was associated with this knowledge. (Table 4.5)

TABLE 4.5: KNOWLEDGE- FORTIFIED FLOURS CAN IMPROVE WORK PRODUCTIVITY AND UTILIZATION BY RESPONDENTS

Knowledge-Fortified flour can improve work productivity	Utilization of fortified maize flours by the respondents (n=184)			
	No	Yes	Don't know	Total
No	10(5.4%)	3(1.6%)	4(2.2%)	17(9.2%)
Yes	20(10.9%)	62(33.7%)	13(7.1%)	95(51.6%)

Don't know	22(12.0%)	35(19%)	15(8.2%)	72(39.1%)
Total	52(28.2%)	100(54.3%)	32(17.4%)	184(100.0%)

χ^2 -15.841, df-4, P-0.003, n-184

4.6: Perceptions of respondents on fortified maize flour

About 64% of the respondents perceived that fortified maize flour is expensive, 69% indicated that fortified maize flour is beneficial to health, 72% indicating fortified maize flour have an appealing color while only 23% believed that fortified maize flour had a bad taste (Table 4.6).

TABLE 4.6: PERCEPTIONS OF THE RESPONDENTS EXPRESSED AS A PERCENTAGE(N=184)

Type of Perception	Statement	Disagree(%)	Neutral/Didn'tknow (%)	Agree (%)
Cost	The fortified maize flours are expensive	25	11	64
Benefit	The fortified maize flours are beneficial to health	21	10	69
Taste	The fortified maize flours have a bad taste	63	14	23
Appeal	The fortified maize flours have an appealing color	16	11	72

CHAPTER 5: DISCUSSION

5.0 Socio-economic and demographic characteristics of the respondents

This study was conducted in an informal livelihood zone where more than 70% of the respondents lived in informal settlements with houses made from iron sheets. The main source of income was employment of which almost one third of the household heads were working as casual Labourers and Less than 10% of the participants were employed. The average household income was low whereas the mean household size was 4.2 and this could possibly influence the choice of flour to utilize based on affordability. A study from a similar livelihood zone targeting food shoppers found a lower proportion of slightly more than one third of the respondents utilizing fortified maize flour consistently due to high cost (Hussein et al, 2019). Mostly the choice of the participants at the retail markets would be based on the available cheaper flour options against the fortified flours as seen in Mathare slums. (Hussein et al, 2019). The level of micronutrient deficiencies in this kind of livelihood zone is expected to be high therefore this is the first target group that the Kenyan government should focus on so that most of the residents utilize the fortified foods that will result in reduced micronutrient deficiencies. Household heads and main bread winners are the main decision makers in households, they determine the choice flours purchased and utilized. This study showed that more than half of the households were headed by males and slightly less than one third of the women participants were the main bread winners in the households (majority were parents and spouses). Therefore, they should be included in advocacy programs on fortified foods.

5.1: The level of utilization of fortified maize flours among participants

Findings from the study showed that about half of the respondents knew that they were utilizing fortified flours. Almost 20% of the participants did not know whether the flour they were consuming was fortified or not. This therefore indicates a gap in knowledge on fortified

flours. Almost two thirds of participants purchased maize flours from the shops and supermarkets and therefore there is a likelihood that most of them were utilizing the flours unknowingly in this case, this study could also not clearly define the utilization level. The reason for this could be probably because the fortification of the maize flour is mandatory and therefore any industry packaged flour purchased from these sources could be fortified. Another study in Pumwani Hospital among pregnant women showed over 80% of the participants accepted to use the flours when the brands were used in the survey tool (12). This therefore informs the government that majority of the consumers could be utilizing the flours without the knowledge that they are fortified. However, this study could not draw generalized conclusions because it was done in a formal livelihood zone, therefore a similar approach needs to be employed in an informal set-up to yield results that can inform the program. The study did not show any association between the physiological status and utilization. Even though Several studies have shown that folate fortification, supplementation and dietary intake of folic acid rich foods improved the folate status and lowered the prevalence of NTDs in many countries, the study revealed almost one third of the pregnant participants were less likely to utilize the flours and another one third did not know whether the flours they were utilizing were fortified or not. This could negatively affect the utilization level because almost half of the participants were not intentionally consuming the fortified flours.

5.2 The level of Knowledge on fortified maize flours among the participants

The study revealed that half of the respondents had heard of the fortified maize flour through the various sources of information prior to the interview. Another study in Kenya showed that only 28% of the respondents were aware of the term fortification (Amaya et al, 2020). Similar results were seen in the study done in Mathare, Nairobi by Hussein Samira, which showed that only 25.5% of the respondents understood the term fortification (Hussein et al, 2019). A study

conducted in Mongolia and city of Harbin, China showed that almost one third of urban Mongolians and almost half of Harbin residents were aware that industries were fortifying foods in their country during the inception of the fortification program. (Bromage et al, 2019). In Tanzania another study involving mothers and caregivers showed similar results whereby only 29% knew the term fortification whilst almost two thirds did not know which foods have been fortified in their country (Kasankala et al, 2018)). This consistency in results show some low levels of knowledge in the target groups on fortification. The Kenyan government in the components of the National Food Fortification Strategy recognizes that the awareness and knowledge on fortified foods influences their demand and utilization (KNFFSP, 2022). The statistics in this study confirmed that low levels of knowledge of fortified maize flour is likely to be a barrier in the utilization of the fortified maize flours among the participants. This therefore calls for education and advocacy to the population on fortification. To further recommend the appropriate channel to use for communication, this study confirmed media (television, radio, and newspaper) as the most preferred source of information on fortified flours, whereby more than half of the respondents got the information on fortified flours from the media. These results were consistent with (Amaya et al, 2020, Pambo. K, 2013 and Mgamb et al, 2017).

Regarding the Knowledge on benefits of fortified maize flours, only few respondents were aware that fortifying maize flour with vitamins and minerals can reduce the chances of bearing children with birth defects while half knew that fortified maize flours can improve work productivity. Data from a study in Tanzania showed that the awareness of women of the existence of folic acid on fortified flours was low. About half of the women participants had heard of folic acid fortified flours but slightly more than 10% knew that folic acid could prevent birth defects. (Mwendelile et al, 2019). Strategies to prevent micronutrient deficiencies in pregnancy should focus on women

of reproductive age. The government should review the policy to ensure that the information on fortified flours reaches the target group at the appropriate time. This can be done by inclusion fortification in the education component of mothers attending family planning, antenatal care, school, and institutions of higher learning curriculum. The information on benefits and risks of the deficiencies should be outlined in the government's mother child booklet for maternal child health services (MOH, 2016).

5.3 Study Respondents' perceptions on fortified maize flours in Kibera

The study found that the respondents' perception of taste good, color appeal acceptable and health benefits of the fortified maize to be high. However, they perceived the affordability of fortified maize to be high or costly. In the study done in Nairobi, availability of the flours and price were ranked the most important factors that influenced utilization. (Hussein, 2020). Another study in Kenya confirmed that the consumer believed that the flours were expensive when more than 60% of the respondents expressed their concern on the high cost of the flours. (Amaya et al, 2020). The study area showed that the average household's income is low, therefore the perception of cost of fortified maize flours should be clarified. The additional cost of the premix in large scale production of the flours is insignificant, the cost is KES. 400 per metric ton. This is an equivalent of approximately KSh 1 in a 2kg bag including the other additional costs of production (MOH and JKUAT, 2020). This therefore means that the manufacturers bear the larger amount of cost when purchasing the premix but due to the volumes of production the additional cost does not largely affect the consumers cost of purchase. The key players in fortification should provide this information to consumers since this perception can influence the choice of flour utilized.

5.4 Conclusions and recommendations

The study population was of a low socio-economic status who lived in temporary informal structures and low household income from informal sources. This shows that the area is an informal livelihood zone that depicts a resource poor setting with a high likelihood of micronutrient malnutrition. The study revealed that lack of knowledge was a barrier to utilization of fortified maize flours among the women participants in this informal settlement. The government should therefore revitalize the education, advocacy, and campaigns on these flours through radio which was the most popular channel of communication. Even though this study focused on women, the information should reach men since majority were households heads who are the main decision makers. The government should also review the policies to ensure that the information on fortified flours reaches the target group at the opportune time. This can be done by including fortification in the education component of mothers attending family planning services, antenatal care, school and institutions of higher learning curriculum. The information on benefits of fortified foods and risks of the micronutrient deficiencies can be outlined in the government's mother child booklet for maternal child health services (MOH, 2016). The study found taste and colour of the fortified flours acceptable. However, the perception that fortified maize flours are expensive as seen in the study should be clarified since there is no significant additional cost to the flour due to fortification as the benefits outweigh the cost of the product in the market. Mostly the high cost could be attributed to other factors. The Kenya National fortification alliance should advocate for tax exemption of the premix that will result to minimal increase on the production cost of fortified maize flours. This study did not bring out the utilization level of the fortified flours but rather revealed that the knowledge on these flours was low, therefore I would recommend a study in a similar livelihood zone that uses the specific brands of fortified flours in the assessment tools to assess the utilization level.

REFERENCES

Amaya L, Kyallo F, Okoth J, Kahenya P, Makokha A, Sila D. and Mwai J.(2020):Food Fortification: The Level of Awareness among Kenyan Consumers", *Journal of Nutrition and Metabolism*, vol. 2020, Article ID 8486129, 7 pages, 2020. Accessed on 19thJuly, 2023.

<https://doi.org/10.1155/2020/8486129>

Burgess A., Bijisma M., and Ismael C. (2009): Community Nutrition: A handbook for health and development workers. Macmillan Publishers Limited; Pp.91- 108

Bromage S, Gonchigsumlaa E, Traeger M, Magsar B, Wang Q, Bater J, Li H, Ganmaa D. (2019): Awareness and Attitudes Regarding Industrial Food Fortification in Mongolia and Harbin. *Nutrients*.;11(1)Available from<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6356891/>

Bonnie S., Sue R., Eleanor D., Peggy P., and Christine M. (1996): Nutrition throughout the life cycle. Mosby,third Edition.

Catherine G. and Hillary P. (2017): Human Nutrition. Oxford University Press, thirteenth edition.

Ellie W. and Sharon R. (2013): Understanding Nutrition. Wadsworth Cengage learning-Yolanda Cossio,thirteenth edition.

Food and Agriculture Organization, (1996): Food fortification Technology and quality control, a report of an FAO technical meeting Rome, Italy, 20-23 November 1995. pg.10

Galloway, R., Dusch, E., Elder, L., Achadi, E., Grajeda, R. and Hurtado, E. (2002): Women's perceptions of iron deficiency and anemia prevention and control in eight developing countries. *Social Science & Medicine*; Pp.529-544.

Githuku J. (2012) Presentation on Neural Tube Defects Investigation in Kijabe Hospital, 1998-2011: Fortification media briefing, crown plaza 24thSeptember 2012.

Hussein, S, Njogu E, &Makworo D (2020): Level of Knowledge and Utilization of Fortified Maize Flour by Primary Food Shoppers in Mathare, Nairobi County, Kenya. *Korean Journal of Food Science and Technology*. 1-8. 10.13106/kjfhc.2020.vol6.no2.1.

Joint statement by the World Health Organization, the World Food Programme and the United Nations Children's Fund (2006): Preventing and controlling micronutrient deficiencies in populations affected by an emergency. <http://www.who.int/nutrition/topics/ida/en/index.html> Micronutrient deficiencies

Kasankala L, Kitunda M,Mushumbusi D, Cyprian M Mgoba M, and Towo E. (2018) Knowledge and Awareness on Food Fortification among Mother/Child Caretakers of Kinondoni Municipality, Tanzania10.9734/AFSJ/2018/41103 *Asian Food Science Journal*. Accessed from.

<https://journalafsj.com/index.php/AFSJ/article/view/50>

Kusum W. (2019): Food fortification, criteria, Types and advantages

<https://www.publichealthnotes.com/food-fortification-criteria-types-and-advantages/>

Páv, Martin. (2023). Two Dimensions of Existence of the 'Slum' in the Global City: A Comparative Case Study of Informal Settlements in Nairobi and Mumbai. *Central European Journal of International and Security Studies*. 17. 10.51870/UDGJ8760.

https://www.researchgate.net/publication/368913696_Two_Dimensions_of_Existence_of_the_'Slum'_in_the_Global_City_A_Comparative_Case_Study_of_Informal_Settlements_in_Nairobi_and_Mumbai

Kenya National Bureau of Statistics (KNBS) and ICF macro (2010). Kenya Demographic Health Survey 2008-09 Calverton Maryland: KNBS and ICF Macro.Pp. 141-160

Kenya Gazette Supplement (2012): Legal Notice no.62, the food, drugs, and chemical substances (food labeling, additives and standards (amendment) regulations.

Kosuke K., Donna S., Anuraj H., and Wafaie W. (2011): Maternal multiple micronutrient supplementation and pregnancy outcomes in developing countries: meta-analysis and Meta- Regression. Bulletin of the World Health Organization 2011; 89:402-411B

Kothari C. (2004): Research Methodology methods and Techniques, New Age International Publishers 2nd Edition. Pp.65-95

Republic of Kenya, Ministry of Public Health, and Sanitation (2012): Food Fortification Newsletter - Vol. 1 Pp. 1-12. Available from. www.publichealth.go.ke/food-fortification

Republic of Kenya, Ministry of Health (2010): Kenya Food and Nutrition Security Policy

Republic of Kenya, Ministry of Health, (2011): The Kenya National Micronutrient survey

Matapandeu G, Dunn SH, Pagels P. (2017): An Outbreak of Pellagra in the Kasese Catchment Area, Dowa, Malawi. Available from.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5417224> accessed on 29/4/2023

Mgamb E, Gura Z, Wanzala P, Githuku J, Makokha A. (2015): Folate deficiency and utilization of folic acid fortified flour among pregnant women attending antenatal clinic at Pumwani Maternity Hospital, Kenya, Pan Afr Med J. Nov 4;28(Suppl 1):8. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6125111/>

Ministry of Health, 2012-2017: Accelerating reduction of iron deficiency anemia among pregnant women in Kenya-Division of Nutrition Plan of Action

Mwandelile, I.F., Mpembeni, R., Abade, A. et al. (2019) Awareness and factors associated with reported intake of folic acid-fortified flour among women of reproductive age in Ifakara, Morogoro region, Tanzania: a cross-sectional study. *BMC Nutr* 5, <https://doi.org/10.1186/s40795-019-0324-5>. Accessed on 23rd July 2023

Mwaniki, D., Omwega, A., Muniu, E., Mutunga, J., Akelola, R., Shako, B., Gotink, M. and Pertet, A. (1999). Anaemia and Micronutrient Status of Iron, Vitamin A and Zinc in Kenya; National Micronutrient Survey Report Pp: 5,156-158 Republic of Kenya (2012)

Pambo. K (2013): Analysis of consumer awareness and preferences of fortified sugar in Kenya, Msc. Thesis University of Nairobi.
[Http://ageconsaerch.umni.edu/handle/93991](http://ageconsaerch.umni.edu/handle/93991)

Sayed, A.-R., Bourne, D., Pattinson, R., Nixon, J. and Henderson, B. (2008): Decline in the prevalence of neural tube defects following folic acid fortification and its cost-benefit in South Africa. *Birth Defects Research Part A: Clinical and Molecular Teratology*, 82: 211–216

Shenkin, A. (2005): The key role of micronutrients, *Clinical Nutrition Journal* (2006) Vol 25. Pp: 1-13

World Health Organization and Food and Agriculture Organization (2006): Guidelines on food fortification with micronutrients. Edited by Lindsay Allen, Bruno de Benoist, Omar Dary, Richard Hurrell <http://www.who.int/nutrition/topics/ida/en/index.html>, Micronutrient deficiencies

APPENDICES

APPENDIX 1: QUESTIONNAIRE

Household number..... Date of
Interview.....(Day/Month/Year)

CONSENT

Study topic: Level of knowledge, perceptions and utilization fortified maize flours among women in Kibra, Nairobi

Hello, my name is _____. I am a Nutrition student at the University of Nairobi. We are conducting a Nutrition study in several households in this area and your household has been selected by chance. We would like to ask you questions about yourself and on the maize flours that you consume.

All the information that you give will be confidential and will be used to prepare a general report which will be submitted to your sub-county and county leaders. This report will be used in filling gaps in the implementation of the nutrition programs in this area.

I therefore request you to participate in this study. Your contribution and co-operation will be highly appreciated.

Respondent agreed to be interviewed 1= Yes 2= No

Name of interviewer_____ Signature_____ Date_____

SECTION A: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF THE RESPONDENTS

i) Respondents' information

A1 What is your age.....Years (Write the age in years)

A2 Confirm that the respondent is aged between 15 and 49 years.

Yes -1 No -0(End Interview)

A3 What highest level of education did you attend?

- None/never went to school- 0
- Kindergarten and below- 1
- Primary (in-complete)- 2
- Primary (completed)- 3
- Secondary (in-complete)- 4
- Secondary (completed)- 5
- College/University(incomplete)-6
- College/University(complete)-7
- Other specify..... 99

A4 What is your marital status currently?

- Married 1
- Divorced 2
- Single 3
- Widow 4
- Separated 5
- Engaged 6

Others..... 99

A5 What is your religion?

Muslim 1

Christian 2

Hindu 3

Others specify.....99

A6 What is your MAIN occupation?

Employed 1

Unemployed 2

Self-employed/ Business 3

Student 4

Casual laborer 5

Others specify..... 99

ii) Household Biodata

A7 Who is the head of the household?

Adult Male 1

Adult Female 2

Others specify.....99

A7 What is the age of the Household head (HHH)?

.....Years (99)

A8 What is the MAIN occupation of the HHH?

Employed/ Salaried 1

Unemployed 2

Self-employed/ Business	3
Student	4
Casual /waged laborer	5
Others specify.....	99

A9 What is the type of house do you live in?

Rented Permanent Structure (Brick/ Stoned Walled)-1	
Rented Temporary structure (Iron Sheet/Mud walled)-2	
Own House (Permanent Structure Bricked / Stoned Walled)-3	
Own House (Temporary Structure Iron sheet / Mud Walled)-4	
Others specify.....	99

A10 Who is the main bread winner in your household currently?

Myself	1
My spouse	2
Parent	3
Others specify.....	99

A11 What is your total household income?

SOURCE OF INCOME	Amount
Employment.....	
Business/Self Employment.....	
Farming.....	
Others specify.....	Total.....

A12 What is the total number of people in this household?

Name Age in Years Sex: Male-1 Female-2 (**List all persons mentioned**)

SECTION B: ASSESING THE UTILIZATION LEVEL OF FORTIFIED MAIZE FLOURS

B13, do you use maize flour to prepare your meals in this household.

Yes-1 No-0 **If yes go to B16 No go to C21**

B14 What is the main source of maize flour utilized in this household?

- Local millers 1
- Local shops 2
- Supermarket 3
- Own farm 4
- Donation 5
- Others specify..... 99

B15 Do you have maize flour in this household now?

Yes-1 No-0

B16 Is the maize flour consumed in this household fortified?

Yes-1 No-0 Don'tknow-2

SECTION C: ASSESSING AWARENESS OF FORTIFIED MAIZE FLOURS

C17 Have you heard of fortified maize flours Yes-1 No-0

C18 Where did you hear of the fortified maize flours? (**Do not read the response**)

- Media 1
- Books/ Magazine 2 (Tick all mentioned)
- Internet 3
- Markets 4

Friends / relatives/ neighbors	5
Local Leaders	6
Others Specify	99

SECTION D: ASSESSING LEVELS OF KNOWLEDGE ON HEALTH BENEFITS OF FORTIFIED MAIZE FLOURS

Read the statement to the respondent and record the response

D19 Statement: Fortified maize flours can improve work productivity.

Yes (1) No (0) Don't Know (3)

D20Statement: Fortified flours can reduce the chances of bearing children with birth defects

Yes (1) No (0) Don't Know (3)

SECTION E: ASSESING PERCEPTIONS

Read the matrix questions and record the response.

Start by asking; what is your opinion on fortified maize flours? Regarding

Read the matrix questions and record the response.

Start by asking; what is your opinion on fortified maize flours? Regarding

	Perceptions	Statement	Strongly agree (5)	Agree (4)	neutral (3)	Disagree (2)	Strongly disagree (1)
E21	Price	The fortified maize flours are expensive					
E22	Benefit	The fortified maize flours are beneficial to health					
E23	Taste	The fortified maize flours have a bad taste					
E24	Appeal	The fortified maize flours have an appealing color					

APPENDIX 2: TRAINING CURRICULUM

TIME	CONTENT	METHOD OF LEARNING
8.30-8.45a.m.	Welcome and Introduction	
8.45- 9.00a.m.	Overview of the Study	Lecture
9.00- 9.30a.m.	Purpose and Objectives of the Study	Lecture
9.30-10.30a.m.	Micronutrient Fortified maize flours	Lecture/ Demonstrations
10.30-11.00a.m.	TEA BREAK	
11.00- 11.30a.m.	Research questions and Significance of the study	Lecture
11.30- 12.30a.m.	Research Design	Lecture
11.30- 12.00a.m.	Location of the Study and Study Population	Lecture
12.00- 1.00p.m.	Target Population and Sample Selection	Lecture
	LUNCH BREAK	
2.00- 4.00p.m.	Research Instruments: Questionnaire	Lecture/ Demonstration
DAY 2		
8.30- 9.00a.m.	Data Collection Techniques/Methods	Practical's
9.00-10.30a.m.	Research Ethics and Data Quality assurance	Brainstorming
10.30- 11.00a.m.	TEA BREAK	
11.00- 1.00p.m.	Data Entry/ Cleaning	Demonstrations