ASSESSMENT OF SODIUM LEVELS OF PROCESSED AND PACKAGED FOOD PRODUCTS FROM SELECTED SUPERMARKETS IN NAIROBI AND KIAMBU COUNTIES, KENYA

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A RESEARCH THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF SCIENCE, FOODS NUTRITION AND DIETETICS, SCHOOL OF PUBLIC HEALTH AND APPLIED HUMAN SCIENCES, KENYATTA UNIVERSITY

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DECLARATION

This Research thesis is my original work and has not been presented for the award of a degree in any other University.

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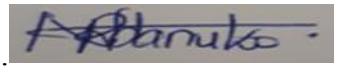
Signature:…  ……. Date…….

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DEDICATION

I dedicate this thesis to the Almighty God, my Creator, my only tower of strength, source of inspiration, knowledge, wisdom and understanding.

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Foremost, I would like to thank my Creator who has been my principal source of inspiration in the whole journey of my research process. I am extremely grateful to my esteemed supervisors, Professor Judith Kimiywe and Dr. Rhoda Ndanuko for their precious time they sacrificed in this study and the wonderful coordination they accorded in the course of data collection. I would also like to thank them for their immense knowledge, insightful inputs and suggestions in the production of this paper. My special gratitude goes to the George Institute for Global Health, Australia, for their funding support they contributed towards the smooth running and successfully completion of this project in Kenya. I wish to acknowledge the management of the following supermarkets for allowing us to access their premises and collecting data from their products: Tuskys, Food plus Chandarana, Kassmatt, Stanmatt and Kamindi Selfridges supermarket. I would also like to acknowledge various research assistants including Mercy, Brian, Sharon, Bilha, Cate, Beatrice, Faith, Damackline and Fridah for their commitment and discipline in completing the data collection within the stipulated timeframe. Finally, and most importantly, I would like to thank my brother Ben and my sister Pasko. Their love, support and continuous encouragement has been my greatest motivation in this project.

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LIST OF ABBREVIATIONS AND ACRONYMS

NCDs : Non-Communicable Diseases

CVDs : Cardiovascular Diseases

WHO : World Health Organization

SSA : Sub-Saharan Africa

UKFSA : United Kingdom Food Standards Agency

NIP : Nutrition Information Panel

ISO : International Organization for Standardization

KEBs : Kenya Bureau of Standards

WINA : World Instant Noodles Association

DV : Daily Value

UPC : Universal Product Code

NACOSTI: National Council of Science, Technology and Innovation

KUERC : Kenyatta University Ethical Review Committee

UK : United Kingdom

SBP : Systolic blood Pressure

DBP : Diastolic Blood Pressure

OPERATIONAL DEFINATION OF TERMS

Standard: Refers to mandatory set of requirements related to the nature, composition, and essential characteristics (e.g., manufacturing, appearance) of a food that must be met in order to be marketed under a specific name.

Percent Daily Value: It is calculated by dividing the amount of a nutrient in a serving size by its daily value, then multiplying that number by 100

Cardiovascular events: Refers to any incidents that may cause damage to the heart muscle.

Salt: Refers to a strong-tasting substance in the form of white powder or crystals, which is used to improve the flavor of food or to preserve it.

Sodium: Refers to the positive ion (cation) surrounding cells in the body. It is one of the chemical elements found in salt.

Regulation: Refers to rules made by a government or other authority in order to control food production, processing and distribution to the consumers

Legislation: Refers to the process of preparing and enacting of food laws by local, state, or national legislatures

Hypertension: Refers to a systolic blood pressure (SBP) of 140 mm Hg or more, or a diastolic blood pressure (DBP) of 90 mm Hg or more.

Food group-Refers to a collection of processed and packaged food products, which share similar nutritional properties.

Nutrition Information Panel-Refers to a small piece of paper attached to the package of a food product that contains a range of information that describes the nutritional value of the food item.

Reformulation- Is the process of re-designing an existing processed food product with the objective of making it healthier.

Packaged food-Refers to food that has its entire surface covered in order to prevent direct contact of the food with the environment, either by permeable or impermeable wrapping.

Benchmark: Refers to a standard or point of reference, against which aspects of food environments or policies can be assessed and compared.

ABSTRACT

Excessive intake of sodium can lead to serious health problems and complications overtime. Of special interest is high blood pressure, which is a major risk factor for heart diseases and

stroke. This is attributed to the massive intake of ultra-processed foods that possess high energy, fats and above all added salts. This study presents an assessment of sodium content in a selection of food groups as reported on the nutrient information panels and compared with the international standards, notably, the United Kingdom food standard agency (UKFSA) 2017 salt benchmark targets. A cross sectional research design was employed in carrying out this study. Purposive sampling technique was used in selection of five suitable supermarkets stores in Nairobi and Kiambu counties. Supermarkets with more branches that translated to a bigger market share, wider aisles and distributed across the low, middle and high-income residential areas of both counties were suitable. Similarly, four food groups (sauces and spreads, meat products, snack foods and cereal products) basing from other related studies were also selected purposively. The data was collected using *FoodSwitch* data collector mobile app developed by The George Institute for Global Health, Australia. The app was used to scan the product bar code and captured images of the front and back of the package, product name, ingredients details, manufacturer, brand name and the nutritional information. These images were uploaded into a cloud-based content management system, from where label information could be coded into a database. The study sample was later obtained by applying stratified random sampling technique where the database population was sub-divided into various food groups/strata and a random sub-sample from each selected food group obtained. This was then pooled to make up the required sample of 422 food products. The data was then extracted and exported into SPSS Version 23. Descriptive statistics including the average sodium content together with their standard deviations were computed at each food group as well as their respective food categories. To test for significance differences in average sodium content, the One-way ANOVA was applied followed by Games-Howell Post Hoc Tests. Statistical significance was set at $p<0.05$. The study found that sauces and spreads had the highest level of sodium content with 1919.81mg/100g, followed by meat products, snack foods and finally cereal products (567.03mg/100g, 551.29mg/100g and 276.10mg/100g respectively). There was a statistically significant differences in the mean sodium content between the four food groups as determined by One-Way ANOVA, [$F(3,418) = 32.87$, $P<0.001$]. Games-Howell post hoc test revealed that the level of sodium was significantly higher in sauces and spreads (1919.81±2426.91mg/100g, $P<0.001$) compared to snack foods (551.29±342.75mg/100, $P<0.001$), cereal products (276.01± 357.04mg/100g, $P<0.001$) as well as meat products (567.03±403.95mg/100g, $P<0.001$). In the same way, snack foods had significantly higher levels of sodium than cereal products, ($P<0.001$). However, there was no statistically significant difference in sodium levels between snack foods and meat products ($P=0.995$). Overall, 36% of the products that were assessed across the four food groups had sodium levels that exceeded the UKFSA 2017 maximum salt benchmark targets, with all the food groups exhibiting wide ranges between the products with the most and the least sodium content. Frequent monitoring of these food groups and their respective categories by regulatory bodies is of extreme importance in enhancement of consumer safety. Moreover, there is a high potential of reducing sodium levels in most processed foods in Kenya as evidenced by variation of sodium content within the four food groups.

CHAPTER ONE: INTRODUCTION

1.1 Background of the Study

Sodium is an element that is crucial for the proper functioning of the human body. It is involved in the auto-regulation of water and fluid balances (WHO, 2012; Gama & Ching'anda, 2015). It also works together with potassium and chloride ions, in triggering muscle contraction and nerve impulses, which is achieved through shifting positions across the cell membrane (Bellows & Moore, 2013; Cloe, 2018). However, excessive intake of sodium has been implicated in the development of cardiovascular diseases, which are also ranked as the leading causes of mortality globally (Rodrigues *et al.,* 2016).

According to WHO (2019), of the total global mortality that occurred in 2016, 32% were attributed to CVDs, of which 85% were jointly contributed by stroke and heart attack. Shockingly, the biggest percentage of these deaths (80 percent), were reported in the low- and middle-income countries (Kyobutungi & Mohamed, 2021; Nekesa, 2018). Moreover, in Kenya, basing from Ministry of Health (2015), it is estimated that 25% and 13% of hospital admissions and deaths respectively, were attributed to CVDs. Therefore, identification of the actual causal factors is extremely crucial for enactment of mitigation measures.

Processed foods have been largely reported by various studies as the biggest contributors of sodium (Prynn *et al.,* 2018; Webster *et al.,* 2010). Even though, sodium has a key role to play in food processing, including enhancement of food safety, texture and flavor as argued by Akan (2017), its association with high blood pressure and CVDs is a health concern of our time which cannot be overlooked (Burnier *et al.,* 2015; Cappuccio, 2013; Webster *et al.,* 2010). Moreover, it is claimed that the biggest portion of NCDs are contributed by CVDs

(WHO, 2018). Therefore, urgent research of processed food products remains the only way of detecting those foods and food groups that have high levels of sodium.

This research was nested within a larger international study initiated from George Institute of Global Health, Australia, whose goal was to collate the nutritional composition of processed food products across the various nations of the world into a central database using the information from the nutrition information panels. In the context of assessing the amount of sodium by this present study, the source of data was the database, which was established in close collaboration with the researchers of the aforementioned institute. This was achieved by pooling the entire information reported on the labels of the food products across the selected supermarkets in Kenya.

1.2 Statement of the Problem

According to WHO (2018), the recommended limits of sodium intake for adults is 2g/person/day, translating into 5g of salt. However, Sub-Saharan African population has not held on to the standard (Oyebode *et al.,* 2016; Prynn *et al.,* 2018). This is largely due to increased consumption of processed foods coupled with urbanization and adoption of western patterns of life that are perceived as fashionable. As a result, it is reported that Sub-Saharan Africa CVD burden is three quarters of the total world burden. The question comes, out of the bigger lot of processed foods, where could be the exact source of this excess sodium.

Basing from other studies that analyzed sodium data from the nutrition information panels, it was revealed that sauces and spreads, meat products, snack foods, breads and bakery products had significantly higher sodium (Kloss *et al.,* 2015; Peters *et al.,* 2016; Webster *et al.,* 2010). However, these findings disagree with a similar study conducted in the United Kingdom that

reported a low sodium levels in these food groups. This apparently confirms that sodium content of processed foods varies significantly between different countries and a call for each nation to assess the sodium content of their processed foods (Kloss *et al.,* 2015).

In Kenya, there is scarcity of studies determining levels of sodium in processed foods using the information displayed on the nutrition information panel despite this being the final information presented to the consumer at the point of sale. Nevertheless, the linkage between sodium intake, hypertension and CVDs-the chief contributor of NCD burden, is very clear. Moreover, in spite of food labels incorporating essential information for making dietary changes, this may not translate to healthier diets (Gezmen-Karadağ & Türközü, 2018). Analysis of the nutritional information panel of processed and packaged food products in regard to their sodium content is crucial in identifying foods that have surpassed the minimum standards. In addition, the data may play a great role in formulation of effective policies in future to reduce sodium levels and guard public health. For that reason, this study aimed at assessing sodium levels of processed and packaged food products from selected supermarkets in Nairobi and Kiambu Counties, Kenya. Food groups that were covered by this study included sauces and spreads, meat and meat products, snack foods as well as cereal products.

1.3 General Objective

To assess the levels of sodium of processed and packaged food products from selected supermarkets in Nairobi and Kiambu Counties, Kenya.

1.4 Specific Objective

a) To establish the average sodium content of processed and packaged food products across selected food groups as well their respective food categories.

b) To determine the proportion of processed and packaged food products compliant with or exceeding the UK Food standards agency (UKFSA) 2017 sodium benchmark targets.

c) To identify any significant differences in the average sodium levels of processed and packaged food products between the selected food groups.

1.5 Hypothesis

Null hypothesis: There is no significant difference in the average sodium content of between different food groups.

1.6 Significance of the Study

- The study was very important in establishing the average sodium content of selected food groups and their respective food categories. This will provide baseline data against which future public health interventions to reduce sodium in processed foods will be compared.
- The study findings will be useful in future policy development by regulatory bodies for instance, Kenya Bureau of Standards (KEBs).
- The findings will also be important in development, implementation and monitoring of the adherence level to labeling legislations, in regard to sodium content.
- The study will be useful to clinical nutritionists and dietitians in recommending processed and packaged food products with reduced sodium levels to hypertensive patients and for general nutrition education.
- The findings will inform the consumers on the processed and packaged foods with excessive levels of sodium and consequently assist in reducing population salt intake.

1.7 Delimitation of the Study

This study selected only four food groups, basing from similar studies, and only those foods accompanied with nutrition information panels (NIP) were studied. In addition, the authenticity of the label information was not determined but focus was on the nutrition information panel analysis in regard to sodium content. Furthermore, the sales and price information of the food products was not part of this study.

1.8 Limitation of the Study.

Some processed and packaged foods were currently not labeled with nutrition declaration. However, only those food products accompanied with the nutrition information panels were studied. Moreover, it is acknowledged that processed foods are the major diets in urban centers in Kenya. Therefore, the study findings can only be generalized in similar settings.

1.9 Justification of the Study

According to WHO global goals of reducing NCDs premature deaths by 25% in 2025, a 30% reduction of mean population salt intake has been targeted (Muthuri *et al.*, 2016). To materialize this proposed goal, there is a greater need for effective interventions strategies. Moreover, in spite of the average sodium excretion in 24-hour urine being well recognized as the gold standard marker for sodium intake, it does not identify the food source (Korosec & Pravst, 2014). Further, according to another study that focused on food label information use by consumers, a mere display of the nutrition label information does not assist consumers in making informed decisions since some of these labels are not utilized (Vemula *et al.*, 2014). For that reason, assessing the current sodium levels of these packaged food groups was to aid in identifying the sentinel foods that may be used by the standardizing bodies as a starting

point to establish the sodium standards and therefore protect the overall health of the public. This would act as a primordial prevention strategy against NCDs and CVDs among the populations.

1.10 Conceptual Framework

The conceptual framework for this study is shown in figure 1.1.

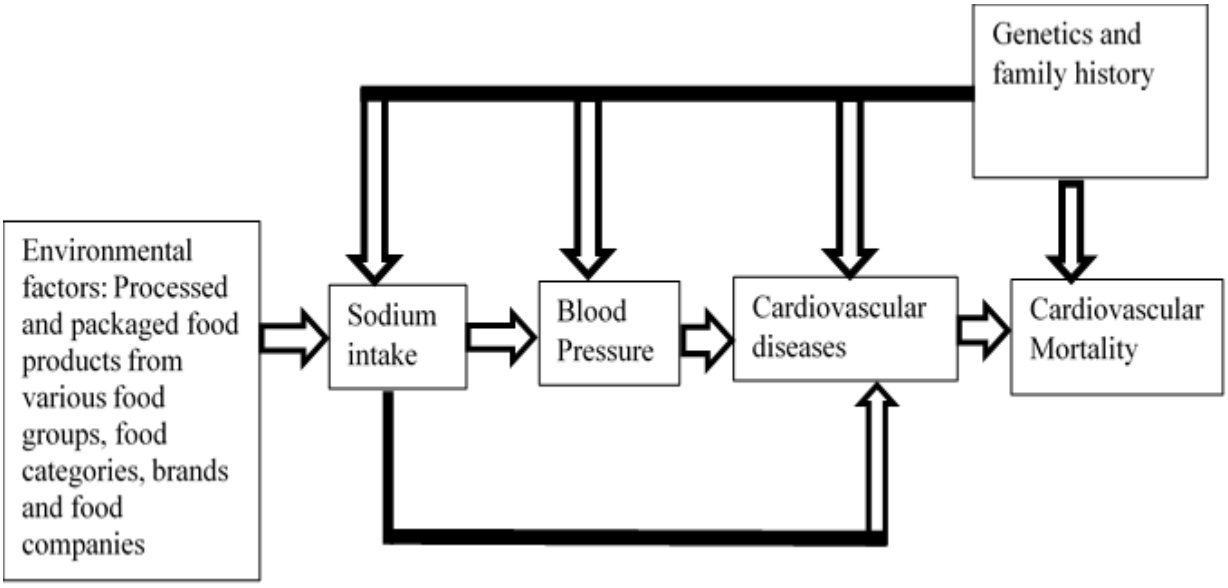

Figure 1.1: *Conceptual Framework describing the link between daily sodium intake from packaged and processed foods and Morbidity/Mortality*

(Source: Adapted and modified from (World Health Organization, 2007)

Excessive intake of sodium from processed and packaged food products sourced from different food groups, categories, brands as well as food companies could raise the blood pressure, which is a major risk factor for heart diseases, stroke and eventually death.

CHAPTER TWO: LITERATURE REVIEW

2.0. Introduction

Sub-Saharan Africa is currently bearing the biggest burden of CVDs globally, with most cases of hypertension (the precursor for most but not all CVDs), going undiagnosed. Currently, the prevalence of hypertension is 46% among adults aged 25 years and over (Onyango *et al.*, 2017; Sookram *et al.*, 2015). Surprisingly, by 2025, it is projected that 75% of the elderly people will be hypertensive. This is so unfortunate for this region, where strategies to prevent hypertension are so rare on the agenda of most countries (Ogah & Rayner, 2013). Moreover, according to the Ministry of Health (2015) hypertension is the greatest risk factor for the development of CVDs. Therefore, its mitigation, through healthy lifestyle choices, is of utmost importance in the control of CVDs and other health complications.

2.1 Relationship between Salt Intake, Hypertension, Cvds and Stroke

A number of epidemiological studies (Ha, 2014; Kloss *et al.*, 2015; O'Donnell *et al.*, 2013) have verified association between higher intake of salt and cardiovascular events. However, in spite of this evidence, it is surprising that the benefits of salt reduction remain controversial (Huang *et al.*, 2016; Kolata, 2013; Nghiem, 2016; Trevena *et al.*, 2014). According to Yehuda (2018), CVD development commence after ingestion of large amounts of salt, which consequently leads to high sodium concentration in the blood stream. This eventually causes water to enter the blood vessels through osmosis that amounts into a greater volume of liquid. Accordingly, the overall blood pressure increases. Owing to this, the heart has to work harder to pump blood against the higher pressure in the vessels. To achieve this, the pumping chamber should thicken (left ventricular hypertrophy). Consequently, due to the thickened

muscle, the heart experiences hard times in pumping blood to meet the body's needs and this is commonly known as heart failure. Besides, the high blood pressure can also lead to hardening and thickening of the arteries (atherosclerosis) and this in turn lead to heart attack and stroke. With this series of events, that eventually lead to CVDs, the global population has no option but to hearken to the WHO recommended limits of salt intake.

2.2 Levels of Sodium Intake across the Nations of the World

Quantifying the sodium intake in the current generation is vital, having been given a target by the World Health Organization (Oyebode *et al.*, 2016). Presently, consumption of sodium around the world is exceedingly high. In 2010, a global mean of 3.95g/day was reported (Powles *et al.*, 2013). This corresponds to 10g/day of salt (Sookram *et al.*, 2015). In actual fact, this is above the recommended levels needed for optimal physiological functions (Dong, 2018).

Across the regions of the world, the Asians have been reported to consume the highest levels of sodium worldwide, with East and Central Asia average sodium intake found to be 4.8g/day and 5.51g/day respectively (Firestone *et al.*, 2017) (Figure 2.1). Similar trends are also depicted in Eastern Europe (4.18g/day), Central Europe (3.92g/day), the Middle East and North Africa (3.92g/day). Regarding this huge amounts of sodium, awareness on the need to reduce excessive salt consumption should be done among the population. In addition assessing consumer knowledge, attitude and behavior regarding salt is very crucial in informing policy decisions (Noubiap, 2020).

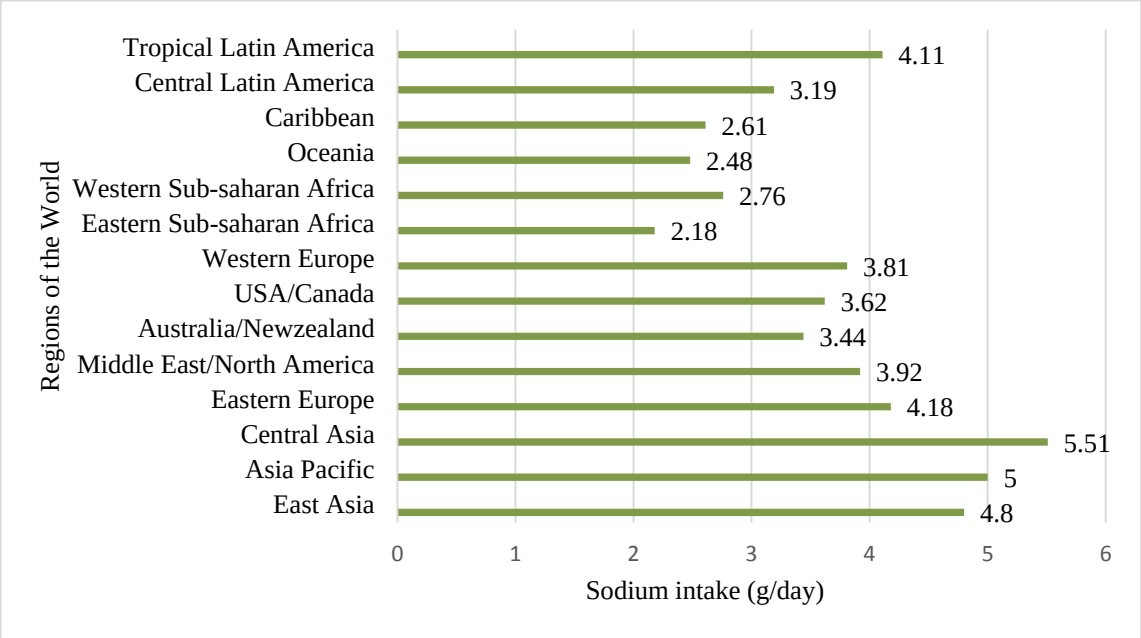

Figure 2. 1: Sodium Intake (g/day) across the regions of the world (Powles et al., 2013)

On the other hand, Western Sub-Saharan Africa (SSA), Eastern SSA, Central Latin America, Caribbean and Oceania had an average mean of 2.76g, 2.18g, 3.19g, 2.61g and 2.48 g respectively. This is quite encouraging though these figures cannot be reported with utmost confidence owing to the few data sources that were used from these regions (Powles *et al.*, 2013). Moreover, Sub-Saharan Africa has been reported to carry a heavy burden of CVDs. This affirms that its average sodium consumption might not be at that stated level. Therefore, this calls for research to accurately quantify the magnitude of salt intake in this region for easier public policy and planning.

2.3 Sodium Reduction Strategies

A number of countries across the six WHO regions including Eastern Mediterranean, Africa, America, Europe, South East Asia and Western Pacific, have taken into consideration the

WHO global sodium reduction target (Trieu *et al.*, 2015). Moreover, in an effort to attain this, all the regions have implemented more than one sodium reduction strategy (Table 2.1).

Table 2. 1: Countries with Legislative Action on Salt (Adapted from (Trieu et al., 2015)

SODIUM REDUCTION STRATEGIES	**COUNTRIES**
Mandatory salt targets	Argentina (most foods), Belgium (bread), Bulgaria (bread, milk products, meat products & lutenica), Greece (bread, tomato products), Hungary (bread), Netherlands (bread), Paraguay (bread), Portugal (bread), South Africa (most foods)
Taxation on high salt foods	Fiji (tax on Monosodium Glutamate), Hungary, Portugal
Regulation on Front of Pack Labeling	Chile, Ecuador, Finland, Indonesia, Korea (on children's foods), Mexico, Portugal, Thailand (on 5 snack food categories)

On the contrary, in other countries, partnership with food industries to reformulate lower sodium food products and sensitization of consumers on processed and packaged foods with excessive levels of sodium has been very effective. Whilst, this is a great milestone in global sodium reduction strategy, some regions, Africa in particular, are lagging behind. According to Hofman & Lee (2013), globally, South Africa is the first country to regulate sodium consumption at the processing level. This is a very big challenge and awakening call to other nations of Sub-Saharan Africa. They ought to follow a similar course that South Africa has taken.

2.3.1 Sodium Reduction through Reformulation of Food Products

This is one of the strategies that has been adopted by most countries. Moreover, among the food products, sodium levels in breads have been legislated by a number of countries. For instance, in South Africa, the high sodium levels contributed by breads (650mg/100g) as revealed by a local study compelled for a mandatory sodium regulation (Hofman, 2013). Other foods under this regulation included margarine and soups.

Elsewhere, in Australia, the Australian Food and Health Dialogue, set voluntary sodium reduction targets for ready to eat breakfast cereals, breads and processed meat products (Trevena *et al.,* 2014). These were to be achieved at the end of 2013. Similarly, in Argentina the ministry of Health in collaboration with the food companies signed a voluntary agreement to gradually lower sodium in processed foods (Allemandi *et al.,* 2015). In 2013, a sodium reduction law was passed which was to be strictly observed as from 2014.

2.3.2 Sodium Reduction through Nutrition Labeling Schemes

Nutrition labeling is a population-based approach recognized by WHO to help curb the growing Non-Communicable disease epidemic (WHO, 2015). This intervention strategy was purposely meant to help the consumer in making informed dietary decisions that is consistent with health. Moreover, the label displays a range of information that convey to the reader on the nutritional content of the food product including the nutrition information panel, ingredient list and some optional nutritional claims (Gezmen-Karadağ & Türközü, 2018). The nutrition information panels contain information on the calories, serving size and percent daily values (% DV) of several macronutrients, vitamins and minerals e.g. sodium.

These details which accompanies the food product, requires the consumer to read, interpret and consequently apply them in making a decision based on his/her health status. In the context of sodium, the consumer can read the nutrition information panel of one product and compare with different but closely related products to rule out which one has less sodium. Therefore, this is a cost-effective method of communicating the nutrition information as it is found at the point of sale according to (Miller & Cassady, 2015), and if consumers will utilize it suitably, it may reduce the current health burden experienced by the developing nations.

2.4 Salt Reduction Initiative in the United Kingdom (UK).

The United Kingdom made salt reduction a public health priority in 2003 and is presently claimed to have the most successful salt reduction program (He *et al.*, 2014). As such, significant progress has been made which is evidenced by reductions in salt content in their processed foods and 15% reduction in 24-hour urinary sodium, notably, from 9.5-8.6g/day, over 7 years period (He *et al.*, 2014).

Among the components that enhanced its success involved strong government leadership and agreement with the food industry including setting up of salt benchmark targets by the UK Food Standard Agency (Wyness *et al.*, 2012). The set targets had a well-defined time frame for the industry to achieve. In addition, determination of salt intake by measuring 24-hour urinary sodium and recording the various sources of salt, engaging and recruiting ministerial support (Department of Health), nutritional labeling, consumer awareness campaigns and monitoring progress also played a significant role in implementation and success of this program. Moreover, until now, four sets of benchmark targets have been published: the 2006,

2009, 2011 and the 2014 (Public Health England, 2017). The 2014 targets, against which this study is comparing with, were set up to be met in December 2017 (table 2.2).

Table 2.2: *UK Food Standard Agency (UKFSA) 2017 Maximum sodium Benchmark Targets (Adopted from (Public Health England, 2017)*

Food groups and Categories	**Sodium content (mg/100g)**
Meat Products	-
Bacon	1150
Ham and other cured meats	650
Sausages	550
Cooked uncured meat	270
Comminuted or chopped reformed meat	540
Burgers and grill steaks	350
Fresh chilled frankfurters	750
Cereal products	-
Breakfast cereals	400
Pasta and Noodles	350
Rice	
➢ Flavoured	230
➢ Unflavoured	70
Snack foods	-
Standard potato crisps	580
Extruded and sheeted snacks	800
Pelleted snacks	1150
Salt and Vinegar products	1000
Sauces and spreads	-
Table sauces	-
Tomato ketchup	680
Brown sauce	480
Salad cream	630
Mayonnaise (not reduced fat/calorie)	500
Mayonnaise (reduced fat /calorie only)	680
Salad dressing	600
Cook-in and Pasta Sauces, thick sauces and pastes	-
a) All cook in and pasta sauces (except Pesto and other thick sauces and pastes)	370
b) Pesto and other thick sauces	650
c) Thick pastes Includes all thick pastes used in very small quantities (e.g.15-20g) such as curry and Thai.	1500
Spreads	-
a) Butter	

i) *Salted butters and buttery spreads:* Include all regional and salted butter and buttermilk-enriched spreads	670
ii) *Lightly salted butter* Includes all lightly salted butters	450
b) Fat spreads	-
Margarines/other spreads	550

2.5 Nutrition Labeling In Kenya

Nutrition labeling regulations of processed foods is extremely important for a nation in guarding public health. Kenyan standards are adopted from the international ones; International Organization for standardization (ISO) and Codex Alimentarius Commission (Oloo, 2011). They are formulated by Kenya Bureau of standards (KEBs) that is under the jurisdiction of Ministry of Trade and Commerce. KEBs is involved in formulation of standards, certification of industrial products and quality assessment at the port of entry. Moreover, in the laws of Kenya, standards regarding labeling of food products have been spelled out in the act of parliament, the food drug and chemical substance act CAP 254 which is implemented by the department of public health. Manufacturers ought to ensure that their products conform to these laws so as not to jeopardize the health of the public.

As stated by this act, the listing of the ingredients should be in a descending order of proportion by mass. The label should declare both the common and brand name, physical address of the manufacturer, distributor, packer, exporter and importer of the food product. This information should appear clearly in the inner and outer label incase both of them have been used. Moreover, foods described as low calorie should not contain more than 15 calories in an average serving and not more than 30 calories in a reasonable daily intake. Further, for sodium reduced special dietary foods, “the milligrams of sodium contributed by these foods

should not exceed one sixth of the milligrams contained in a reasonable intake of the same food."

According to these regulations, foods meant for special dietary needs, ought to conform to the sodium guidelines spelled out in this act. A special dietary need in this case refers to people with a particular disease/disorder. However, the other lots of food products lack a defined standard to follow in relation to sodium content. This means that there might be an increased sodium exposure to the rest of the population. According to Oloo (2011), 75% of diet intake in urban areas in Kenya is processed foods. This is very high. With these alarming levels, the incidence and consequently the burden CVDs will increase. This justifies sodium regulations in some of our processed foods.

2.6 Sodium Reduction Initiatives across East Africa

Specific recommendations and strategies have been made to reduce the sodium content in processed and packaged food products in East Africa. In accordance with Kenya National strategy for prevention and control of NCDs, objective 3 recommends implementation of health related legislations and regulations on salt, saturated and trans-fatty acids and refined sugar content of processed and packaged foods (Ministry of Health, 2015). Besides, draft east African standards (2015), Nutrition labelling-requirements (KS EAS 803: 2014) is a very significant legislation in sodium reduction among processed and packaged foods (Kenya Bureau of Standards, 2015). Therein, two types of Nutrient reference values (NRVs) have been highlighted: the Nutrient reference values requirements (NRVs-R) and Nutrient Reference Values-Non Communicable diseases (NRVs-NCD).

Moreover, the NRVs-NCDs includes sodium, which is stipulated at 2000mg and fat (20g). Noteworthy, sodium levels at 2g is considered sufficient in a reducing the risk of CVD in the general adult population (Turck *et al.,* 2019). Further, information on vitamins and minerals including sodium, are supposed to be expressed in metric units and/or as a percentage of NRV per 100 g or per milliliters or per package. These requirements have been adopted and implemented by Kenya Bureau of standards (KEBs) and consumers should make an effort of selecting food products with low percent daily value of sodium. This will consequently reduce excessive sodium intake.

2.7 Summary of Literature Review

In Conclusion, Sub-Saharan African region is increasingly pressed by a heavy burden of CVDs accounting for 75% of the world's burden. Despite existence of a clear link between sodium intake and CVDs, salt intake is still under-researched and its magnitude has not been understood, whatsoever. This delays formulation and implementation of policies. Further, it is not surprising that strategies to control hypertension hardly appear on the agenda of most countries.

In East African region, labelling regulations seems to be the only salt reduction strategy. Nutrition education to limit sodium intake is also feasible option for population-wide sodium reduction. Besides, the region needs to formulate specific sodium legislations among processed and packaged foods.

In the nation of Kenya, sodium standards have majorly focused on food products related to special dietary needs. Narrowing of these regulations to a small lot of products may not produce a huge positive public health impact as this means that focus is on the disease outcome

rather than preventive measures against the disease. This calls for studies on salt to underscore on the issue of salt intake, which will further help in policy development in matters relating to salt intake. Moreover, as noted from United Kingdom, the war against salt intake can be successfully be won by adopting a multi-sectorial approach.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

This chapter entails a discussion of the research methodology that was employed in an effort to assess the level of sodium in processed and packaged food products from selected supermarkets from Nairobi and Kiambu Counties, Kenya.

3.2 Study Design

The study employed a cross-sectional descriptive design. The design was appropriate in this context as it aided in getting a snapshot of the current levels of sodium in the food groups selected by this study within a short span of time.

3.3 Study Variables

The dependent variable in this study was the average sodium levels in the packaged and processed food products whereas the independent variables comprised of the food groups, parent companies and different brands.

3.4 Study Setting

The study was conducted in Nairobi and Kiambu counties in Kenya, owing to the presence of large-sized supermarkets that offered a wide variety of processed and packaged food products.

3.5 Study Population

Refers to a population, which is a subset of the target population. In other words, it refers to a group, which can actually be measured by a researcher. In this context, the study population was limited to four food groups namely; sauces and spreads, meat and meat products, snack

foods as well as cereal products. This population was selected purposively based on similar studies.

3.6 Inclusion and Exclusion Criteria

To be included in this study, the food products were to meet certain criteria; they were to have a Universal Product Code (UPC), details of the manufacturer and the nutrition information panel. Additionally, this information were to be in English language. Food products without the aforementioned details were not eligible for this study.

3.7 Sampling Technique

Owing to the nature of this study, selection of supermarkets sites was done purposively (Figure 3.1).

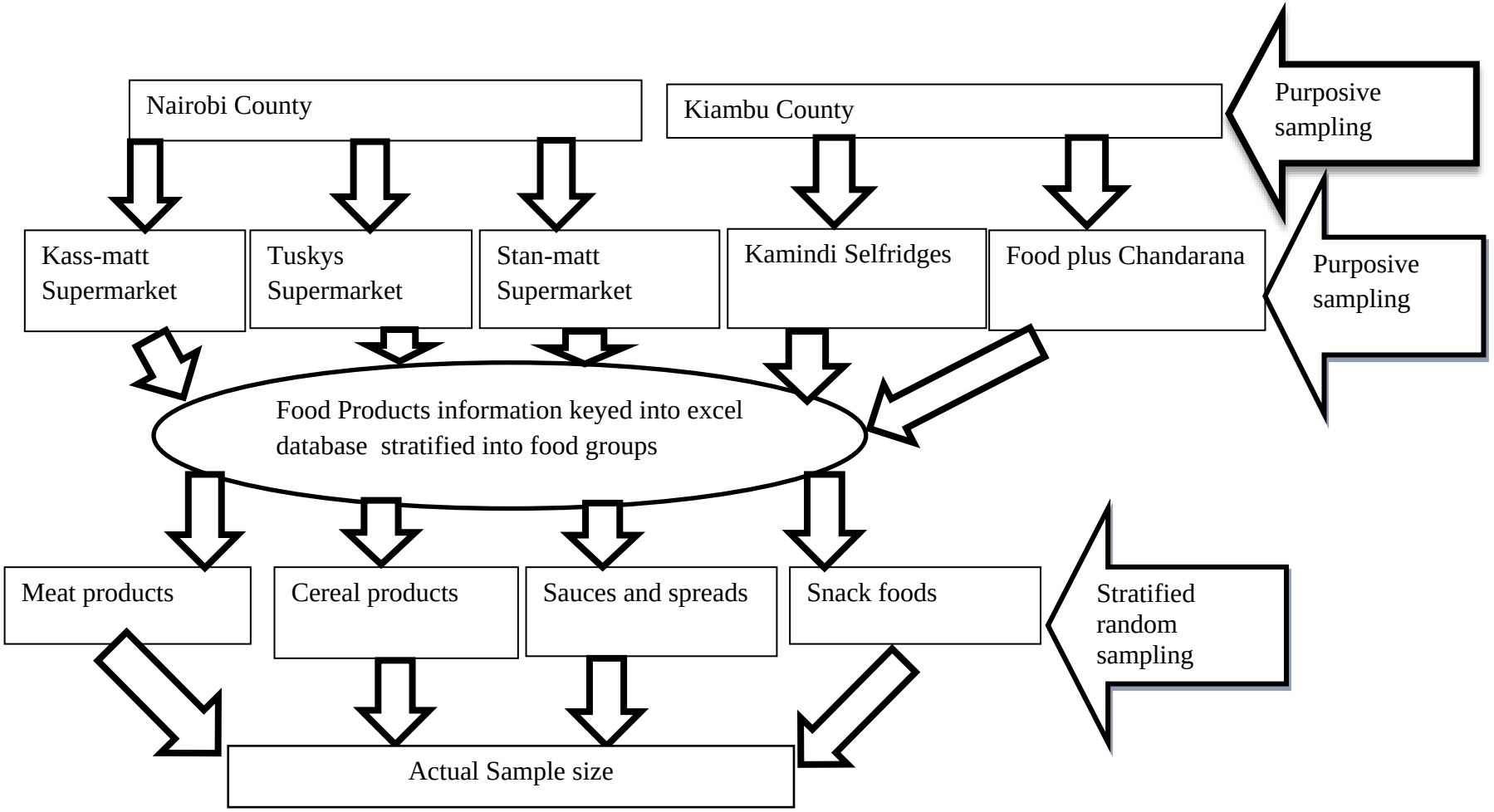

Figure 3. 1: Sampling techniques

Large-sized supermarkets with several branches, were given more preference, as this translated into having a larger market share in the Kenyan economy. Under this attribute, Tuskys and Chandarana Food plus fitted this description as they had 47 and 17 branches respectively, distributed across the nation of Kenya. Moreover, the major branches of these two supermarkets are located in middle to high-income residential suburbs of Nairobi and Kiambu Counties.

In addition, to balance with the supermarket stores from middle to low income residential areas, Kassmatt, stanmatt and Kamindi Self ridges (with the major branches of the latter two located in Kiambu County), were selected for this study. Further, selected supermarkets stores were to be well structured including broader aisles, which provided an appropriate space for both the research assistants and the consumers without any distraction of each of either. However, to check on these conditions, a preliminary visit was conducted which provided a true picture of these supermarkets.

On the other hand, the food groups that were employed in this study were selected purposively basing from reports of previous related studies (Figure 3.1). In this case, sauces and spreads, meat products, snack foods as well as cereal products were studied. After keying all the information from the photos taken from various supermarkets into the excel database, stratified random sampling technique was used to obtain the required sample for this study. This was done by stratifying the population into various food groups (figure 3.1). This task was done with the assistance of the George Institute of Global Health researchers.

To get a sub-sample from each stratum (food group) meant for this study, the following formula was applied;

$$\frac{\textit{Sample size} \quad x\ \textit{stratum size}}{\textit{Population size (total population of the four selected food groups)}}$$

A random sample was then taken from each selected food group with the aid of a random number generator app. This was then pooled to form the actual sample for this particular study.

3.8 Sample Size Calculation

The sample size for this study was calculated by using (Cochran *et al.*, 1977) formula,

$n_0 = \frac{Z^2\ P\ q}{e^2}$ with 95% confidence interval.

Where n_0 denotes the sample size, 'Z' is the value found in the Z table usually 1.96 corresponding to 95% confidence level, 'P' is the estimated proportion of the population which has the attribute in question, q=1-P (proportion in the target population not having the particular attribute), and 'e' is the desired level of precision.

In this case, taking into consideration that there is no available data on the proportion of food products with high level of sodium, P was set at 50%, that is, 0.5. Thus, (1-P) would be 0.5 and a margin of error, 0.05 was appropriate.

$n_0 = (1.96^2 \times 0.5 \times 0.5)/0.05^2 = 384$

To cater for any product with no sodium information during random selection, a 10% of the sample was added increasing our sample size to 422.

3.8.1 Calculation of Sub-Sample Size

The four food groups extracted from the original database comprised of a total population of 788 food products with 283 coming from sauces and spreads, 210 from cereal products, 194

from snack foods and 101 from meat products. To obtain a sub-sample of each food group before random selection, the formula outlined in sampling technique section was applied (table 3.1).

Table 3. 1: Calculation of sub-sample size at each food group (N=788)

Food groups	**Stratum size**		**Sub-sample size**
Snack foods	194	(194×422)/788	104
Sauces and spreads	283	(283×422)/788	152
Cereal products	210	(210×422)/788	112
Meat products	101	(101×422)/788	54
N	**788**	Actual sample size	**422**

3.9 Selection Process of the Supermarkets

Table 3.2 below is a list of supermarkets stores located in Nairobi and Kiambu Counties with their respective number of branches countrywide.

Table 3. 2: Supermarkets stores in Nairobi and Kiambu Counties and their respective number of branches (Adapted from (Shawiza, 2018)

Supermarket	Number of Branches in Kenya
1. Naivas	47
2. Tuskys	47
3. Choppies (Formerly Ukwala)	11
4. East matt Supermarket	9
5. Quick matt	10
6. The game store	1
7. Carrefour Hypermarket	6
8. Tumaini supermarket	3
9. Clean shelf supermarket	7
10. Food plus chandarana supermarket	17
11. Kassmatt supermarket	2
12. Stanmatt supermarket	1
13. Kamindi self-ridges	2

NB: Even though Kassmatt, Stanmatt and Kamindi Selfridges supermarkets are not widely distributed countrywide, they had at least all the other features that this study needed.

Suitable supermarket stores were selected as illustrated in the figure 3.2 below.

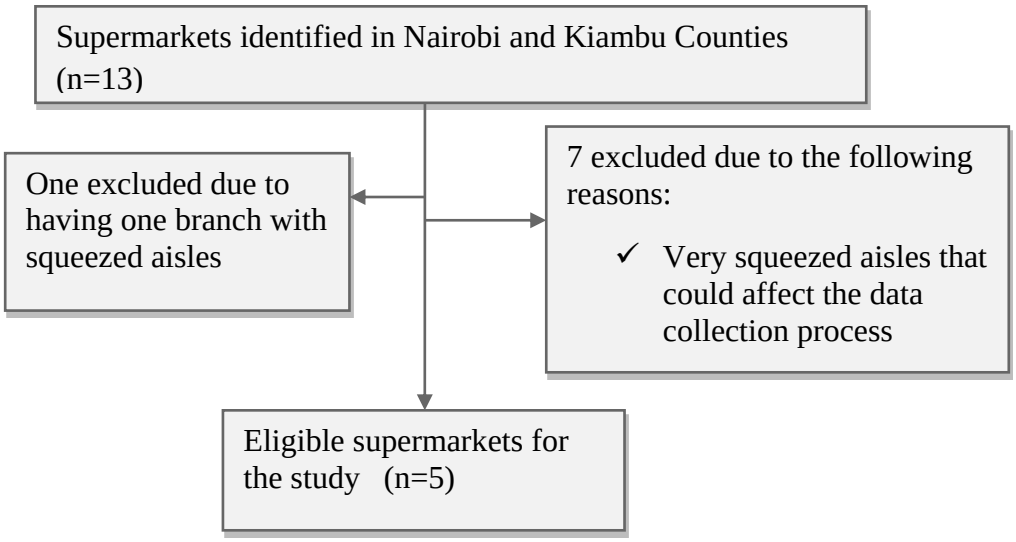

Figure 3. 2: Selection process of the supermarkets

3.10 Research Instruments

The study employed smart phone technology to collect the required data from the food products. The *FoodSwitch* data collector mobile app developed by the George Institute for Global Health, Australia was adopted for this research.

3.11 Validity

The study utilized the established *FoodSwitch* data / technology platform developed by George Institute for Global Health, Australia, to capture and process the label information from packaged food products. To ensure validity of the data collected, the *FoodSwitch* system was pre-tested three months prior to the study in a different but similar setting, to check its precision in capturing information from the packaged products, and then storing and processing the data.

3.12 Reliability

To ensure reliability of the data collected, comparisons across sites was made including review of the original nutrition information panel and manufacturer's websites. This aided in solving any discrepancy arising and therefore enhanced the consistency of the data. Further, after the collation of the packaged food products information into the database, a random sample of 5% was extracted and checked to confirm whether the information in the database were in agreement with the original source.

3.13 Data Collection Technique

Upon gaining permission from the supermarket stores, data collection was carried out by scanning the products' bar codes including taking photographs of the front and the back of the

package, the name of the product, manufacturers' information, ingredient list and the nutrition information panel. These were then uploaded into a database. Data from four food groups of interest in this study was extracted, and cross-checked in preparation for analysis. Moreover, the food products were classified in a specific order based on Dunford *et al.*, (2012), and in line with United Kingdom Food Standard Agency (UKFSA) for easier comparison with their latest sodium benchmarks. The whole data collection process is illustrated in figure 3.3. During this process, the food products were categorized in their respective food groups as illustrated in appendix E.

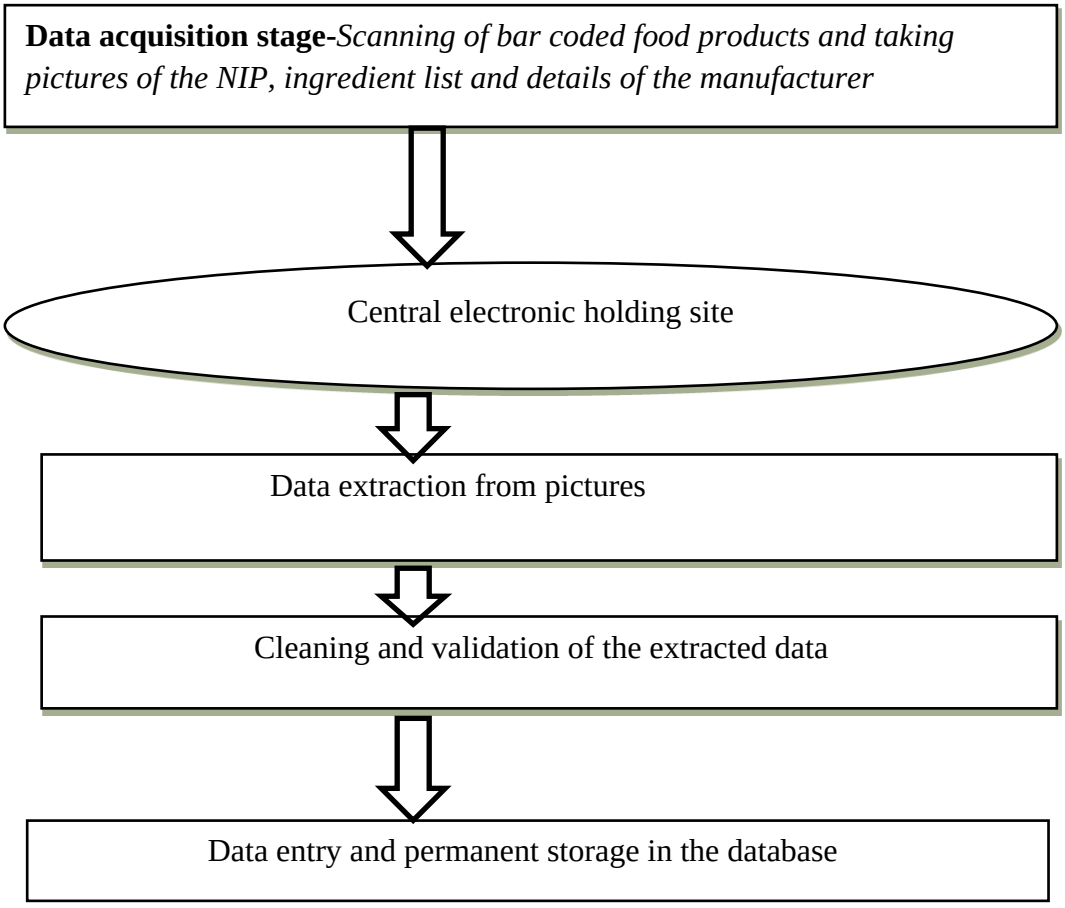

***Figure 3.3**: Schematic diagram of data collection from the supermarkets and entry into the database*

3.14 Categorization of Foods in the Database

Food products were classified in a specific order based on (Dunford *et al.,* 2012), and in line with UKFSA for easier comparison with their latest sodium benchmarks. This comprised of the food groups and food categories as illustrated in Appendix E. This classification of food groups was based on the foods that use the same raw materials and have quite the same nutritional content. Food categories included foods with the same manufacturing process, for instance, biscuits and bread, within the bread and bakery products category. The products variables included both primary and secondary variables as defined in Table 3.3. Products bearing only company and product name, with other details missing, were recorded as such in to the databases though they were not used in the assessment of sodium levels.

Table 3. 3: Variables entered into the database and their format (Adopted from (Dunford et al., 2012)

PRIMARY VARIABLES		SECONDARY VARIABLES	
Variable	**Format**	**Variable**	**Format**
Country	Country where data is collected	Total fat	Grams/100grams or 100 milliliters
Food group	Refer to appendix A	Trans fat	Grams/100grams or 100 milliliters
Food category	Refer to Appendix A	Monounsaturated fat	Grams/100grams or 100 milliliters
Brand name	As per product label	Polyunsaturated fat	Grams/100grams or 100 milliliters
Manufacturer	As per product label	Protein	Grams/100grams or 100 milliliters
Product Title	As per product label	Carbohydrates	Grams/100grams or 100 milliliters
Pack size	Grams or milliliters	Dietary Fibre	Grams/100grams or 100 milliliters
Serving size	Grams or milliliters	Sub-category (Major)	Refer to appendix A
Energy	Kilojoules or kilocalories/100g or 100mls	Sub category (Minor)	Refer to appendix A
Saturated fat	Grams/100g or 100 milliliters	Ingredient list	List of ingredients on the label
Total sugar	Grams/100g or 100 milliliters	Symbols and claims	Health and nutrient claims and symbols
Sodium	Milligrams/100 grams or 100millilitres		
Data source	NIP, MANUF, WEB, OTHER		
Date of data collection	Date (dd/mm/yyy)		
Date of data entry	Date (dd/mm/yyy)		
Universal Product Code (UPC)	Number as per product bar code		

3.15 Data Analysis

The data was extracted from the database and imported into SPSS package version 23 (for windows) for assessment of sodium levels. All food products with sodium content in mg/serving were converted into standardized units (mg/100g). The serving sizes were not considered in this case because of variation (of the serving size) across different foods. Calculation of the average sodium content and standard deviations was done at each food group and their respective food categories, including the standard error, minimum and maximum values of sodium content. Further to compare with international standards of sodium, the United Kingdom food standard agency (UKFSA) 2017 sodium benchmark targets were adopted (Chapter 2, Table 2.2), which have been highly recognized and adopted in most scientific literature to benchmark the sodium content of various food products from different nations. This includes studies performed in Mexico (Nieto *et al.,* 2018), Malaysia (Shahar *et al.,* 2019) and in India by the George institute for global health. Proportion of foods that met or exceeded these standards were plotted in bar graphs, pie charts and presented using tables. In addition, One-Way analysis of variance (ANOVA) was used to determine whether the observed differences among the means of sodium across different food groups was significant and it was also used to test significance between and within food groups with $p<0.05$ level of significance used. Further, Games Howell Post hoc Tests was used to show which groups differed significantly in their sodium content. Table 3.4 illustrates a summary of the study objectives with an appropriate data analysis technique employed.

Table 3. 4: Summary of data collection and analysis method

Objectives	Data collection Instrument	Data Analysis
1) To establish the average sodium content of selected food groups and their respective sub-groups	George Institute Data Collector App	Descriptive Statistics: *Mean, standard deviations, minimum, maximum and standard error of the mean.*
2) To determine the proportion of products compliant with or exceeding the United Kingdom Food standards agency (UKFSA) 2017 sodium benchmark targets.	George Institute Data Collector App	Presented by bar graphs, pie charts and tables
3) To test whether there will be any significant differences in the average sodium levels among the selected food groups.	-	One-Way ANOVA Games Howell Post Hoc Tests

3.16 Logistical and Ethical Consideration

After obtaining research proposal approval letter from the graduate school, a written permit was sought from National Council of Science, Technology and Innovations (NACOSTI) and an ethical exemption letter from Kenyatta University Ethical Review Committee (KUERC). In addition, at the selected supermarkets, permits were sought from the Branch managers of the respective supermarkets before the actual day of study.

CHAPTER FOUR: FINDINGS

This chapter presents the findings of this study in three major sections. The first section highlights the distribution of sodium content in mg/100g across the four sampled food groups and their respective categories. The second section presents the proportion of food products that complied and those that exceeded the UKFSA 2017 salt targets. This has been analyzed across the overall sample population and in each food group, food categories including locally manufactured as well imported food products. The third section contains One-way ANOVA results and the Games Howell post comparisons of the average sodium across the four food groups.

4.1 Distribution of Sodium Content in Various Food Groups and Their Respective Categories

The analysis comprised of 422 food products sampled from four food groups with 25% of the products coming from snack foods, 27% from cereal products, 13% from meat products and 36% from sauces and spreads. Between food groups, sauces and spreads had the highest level of sodium content (1919.81±2426.91mg/100g) (table 4.1).

Table 4. 1: Sodium content in mg/100g across the four sampled food groups (N=422)

Food Group	**n**	**Average sodium levels (mg/100g)**	**Minimum**	**Maximum**	**Range**	**Std. Dev.**
Sauces and Spreads	152	1919.81	5.00	9680.00	9675.00	2426.91
Meat Products	54	567.03	29.60	2320.00	2290.40	403.95
Snack Foods	104	551.29	1.00	1800.00	1799.00	342.75
Cereal Products	112	276.10	1.53	2313.00	2311.47	357.04
TOTAL	**N=422**	**973.19**	**1.00**	**9680.00**	**9679.00**	**1647.23**

Meat products, snack foods and cereal products had 567.03±403.95/100g, 551.29±342.75mg/100g and 276.10±357.04mg/100g respectively.

Figure 4.1 below is a visual presentation of the average sodium levels in the four food groups.

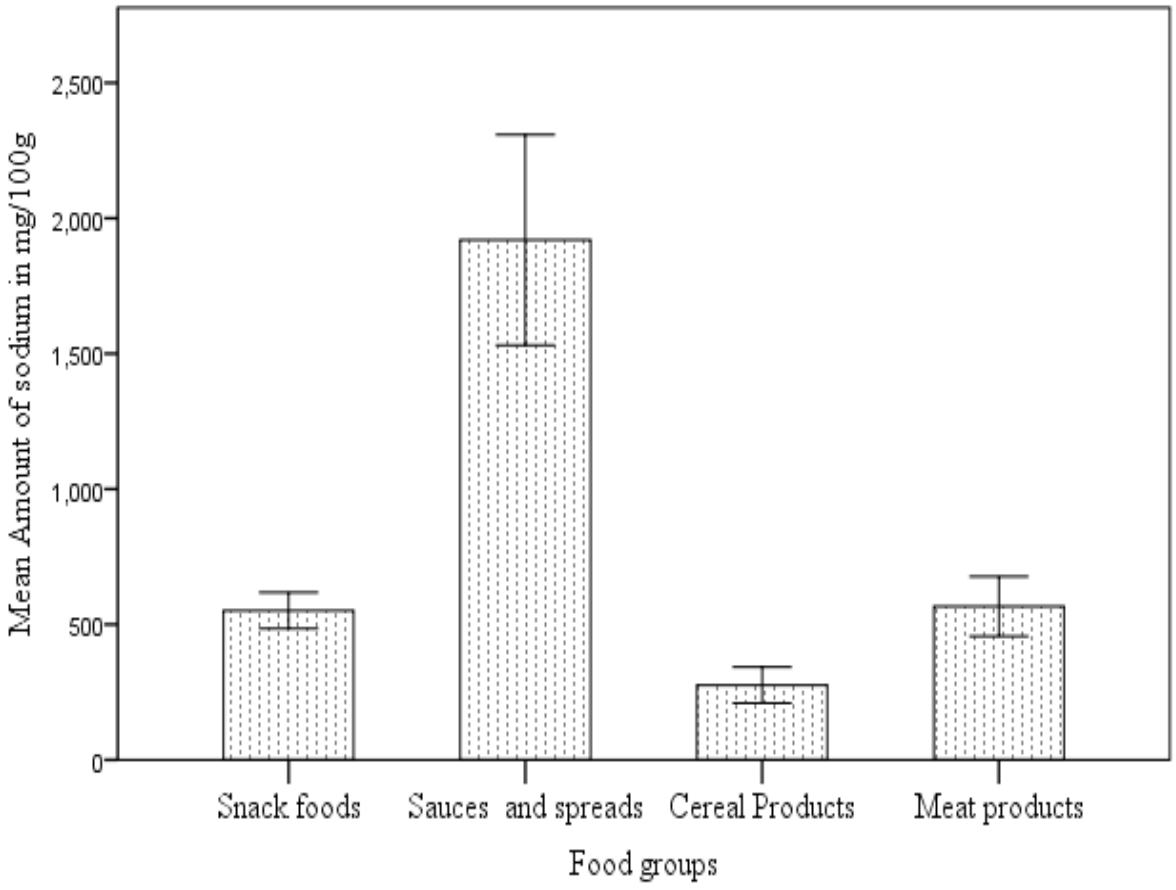

Figure 4. 1*: Mean level of sodium in mg/100g across the four food groups*

Within the food groups, food categories that had the highest level of sodium were sauces (2089.91±2497.56mg/100g), flavored rice (1233mg/100g), bacon (937.50 ± 760.89mg/100g), salt and vinegar products (886.00±518.96mg/100g), noodles (804.00±560.67mg/100g) and fresh chilled frankfurters (800.00mg/100g) (table 4.2).

Table 4. 2: Sodium levels in mg/100g across the food categories

Food Categories	n	Mean	Median	Minimum	Maximum	Std. Deviation	% of Total N
Sauces	137	2089.91	900.00	8.00	9680.00	2497.56	32.5%
Flavored Rice	1	1233.00	1233.00	1233.00	1233.00	.	0.2%
Bacon	6	937.50	850.00	65.00	2320.00	760.89	1.4%
Salt and Vinegar products	4	886.00	680.00	540.00	1644.00	518.96	0.9%
Fresh chilled frankfurters	2	800.00	800.00	800.00	800.00	.00	0.5%
Meat-based pastry products	5	730.00	800.00	520.00	830.00	127.28	1.2%
Noodles	20	691.07	760.00	24.80	2313.00	584.09	4.7%
Sausages	25	690.00	600.00	500.00	1300.00	181.11	5.9%
Pelleted snacks	12	591.87	555.50	1.00	1400.00	442.17	2.8%
Extruded and sheeted snacks	18	575.49	700.00	18.80	800.00	273.47	4.3%
Standard potato crisps	70	518.99	480.00	8.00	1800.00	325.68	16.6%
Spreads	15	366.27	312.00	5.00	750.00	248.65	3.6%
Ham and other cured meats	5	241.84	70.00	34.40	660.00	278.95	1.2%
Comminuted meat	4	219.80	66.00	47.20	700.00	320.26	0.9%
Breakfast cereals	83	189.49	180.00	1.53	972.00	161.86	19.7%
Burgers and Grill Steaks	1	170.00	170.00	170.00	170.00	.	0.2%
Cooked uncured meat	6	39.33	39.80	29.60	47.20	7.40	1.4%
Pasta	8	17.68	13.07	2.00	62.50	20.37	1.9%
Total	**N=422**	**973.19**	**480.00**	**1.00**	**9680.00**	**1647.23**	**100%**

4.2 Proportion of Food Products That Complied and Exceeded the UKFSA 2017 Salt Targets

Overall, 36% of the total sample population had sodium levels that were above the UKFSA 2017 salt targets (figure 4.2).

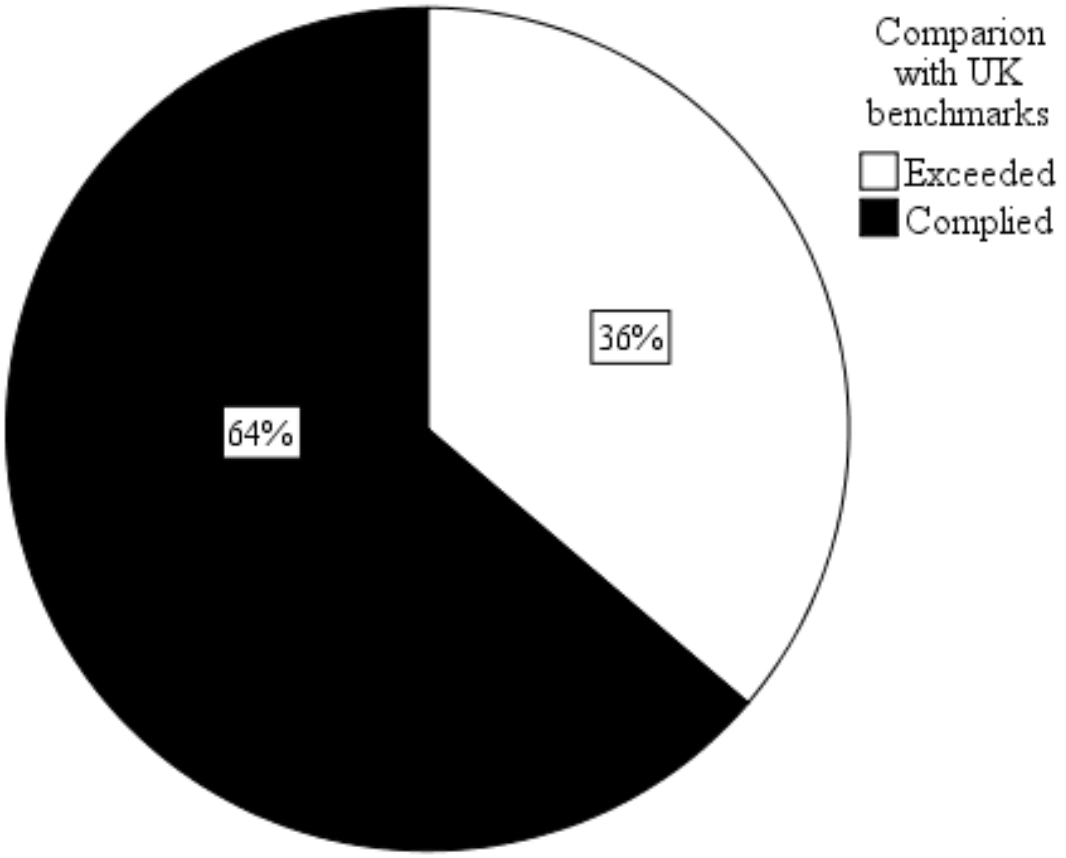

Figure 4. 2*: Proportion of food products that exceeded and complied with UKFSA 2017 salt targets across the overall sample.*

Out of this proportion (36%), 16% were locally manufactured food products with 20% contributed by the imports (table 4.3).

Table 4. 3: Comparison of sodium content among the imported and locally manufactured products with UKFSA targets

Origin	Exceeded/Complied the UK targets	Mean	Median	Minimum	Maximum	Range	Std. Dev.	% of Total N	n
Imported	Exceeded	3200.84	2319.00	400	9680	9280	2588.584	20.4%	86
	Complied	248.26	256.00	2	781	779	189.956	29.4%	124
	Total	1457.41	400.00	2	9680	9678	2205.578	49.8%	210
Local	Exceeded	836.79	760.00	400	1800	1400	335.964	15.9%	67
	Complied	334.94	320.00	1	1000	999	244.698	34.4%	145
	Total	493.54	480.00	1	1800	1799	361.758	50.2%	212
TOTAL	Exceeded	2165.60	1040.00	400	9680	9280	2276.144	36.3%	153
	Complied	294.98	280.00	1	1000	999	224.960	63.7%	269
	Total	**973.19**	**480.00**	**1**	**9680**	**9679**	**1647.226**	**100.0%**	**N=422**

On the other hand, between the food groups, the proportion of food products that had exceeded the UKFSA 2017 sodium salt targets were: meat products (63%), cereal products (19%), sauces and spreads (53%) and snack foods (16%) (figure 4.3). Most of the processed and packaged food products (81% and 84%) from cereals and snack food groups respectively, complied with the UK food standard agency 2017 salt targets as compared to meat products, which had the lowest percentage (37%) that conformed.

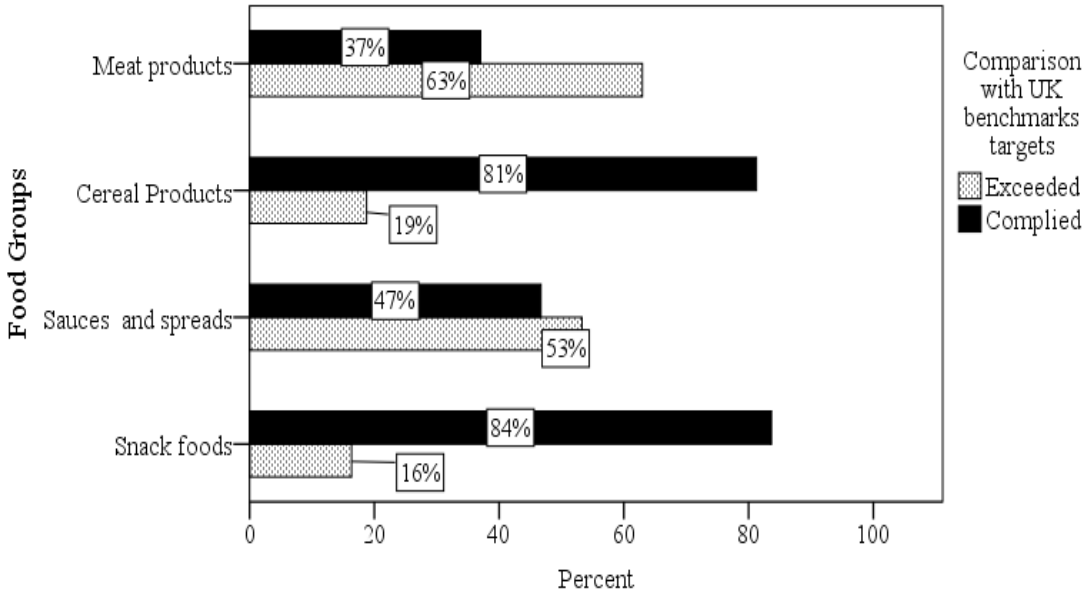

Figure 4. 3: Proportion of food products between the four food groups that exceeded United Kingdom Food Standards Agency (UKFSA) 2017 targets

Within the food groups, food categories that exceeded the UK targets included: sauces (56%), noodles (60%) and spreads (27%) (table 4.4).

Table 4. 4: Proportion of food products within various food categories that had sodium levels above the UKFSA 2017 salt benchmarks

Food category	**N**	**(%) Above the UK targets**
Fresh chilled frankfurters	2	100
Other meat-based pastry products	5	100
Flavored rice	1	100
Sausages	25	100
Noodles	20	60
Sauces	137	56.2
Spreads	15	26.7
Comminuted/chopped reformed meat	4	25
Salt and Vinegar products	4	25
Extruded and sheeted snacks	18	22.2
Bacon	6	16.7
Pelleted snacks	12	16.7
Standard potato Crisps	70	14.3
Breakfast cereals	83	9.6
Burgers and Grill Steaks	1	0
Cooked uncured meat	6	0
Ham and other cured meats	5	0
Pasta	8	0

Among the snack's categories, 14% and 22% of the standard potato crisps and extruded and sheeted snacks respectively exceeded the benchmarks. All the products from some of the meat categories surpassed the targets. This included sausages, fresh chilled frankfurters, and meat-based pastry products.

4.4 One-Way Anova Results and the Games Howell Post-Hoc Comparisons

A One-way Analysis of Variance (ANOVA) was used to test the hypothesis of whether food products in the four sampled food groups had equal average level of sodium. The dependent variable was the average sodium content and independent variables were the food groups, different brands and manufacturers. The results are presented in table 4.5.

Table 4. 5: ANOVA results and Levene's test for equality of variances

TEST FOR EQUALITY OF MEANS		*Sum of squares*	*df*	*Mean square*	*F*	*Sig.*
	Between Groups	218050190.311	3	72683396.770	32.871	<.001
	Within Groups	924270991.220	418	2211174.620		
	Total	1142321181.531	421			
LEVENE'S TEST FOR EQUALITY OF VARIANCES		Levene's statistic	df1	df2		
		101.092	3	418		<.001

The One-Way ANOVA revealed statistically significant differences in average sodium content between the food groups [F (3,418) =32.71, P<.001], indicating that the four food groups did not have similar level of their average sodium content.

Levene's F test revealed that the homogeneity of variance assumption was not met [F (3,418) =101.092, P<.001)] as shown in table 4.5. As a result, Games Howell post-hoc test was applied to identify which pairs among the four food groups differed significantly in their average sodium levels (table 4.6). An alpha level of .05 was applied for every subsequent analyses.

Table 4. 6: Games-Howell post hoc comparisons of the average sodium levels across the sampled food groups

(I) Food group	(J) Food group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Snack foods	Sauces and spreads	-1368.518*	199.697	<.001	-1886.99	-850.05
	Cereal Products	275.191*	47.621	<.001	151.88	398.50
	Meat products	-15.735	64.431	.995	-184.28	152.81
Sauces and spreads	Snack foods	1368.518*	199.697	<.001	850.05	1886.99
	Cereal Products	1643.709*	199.718	<.001	1125.19	2162.23
	Meat products	1352.783*	204.380	<.001	822.57	1883.00
Cereal Products	Snack foods	-275.191*	47.621	<.001	-398.50	-151.88
	Sauces and spreads	-1643.709*	199.718	<.001	-2162.23	-1125.19
	Meat products	-290.926*	64.498	<.001	-459.62	-122.23
meat products	Snack foods	15.735	64.431	.995	-152.81	184.28
	Sauces and spreads	-1352.783*	204.380	<.001	-1883.00	-822.57
	Cereal Products	290.926*	64.498	<.001	122.23	459.62

**. The mean difference is significant at the 0.05 level.*

The sodium content in sauces and spreads (1919.81±2426.91mg/100g, P<0.001) was significantly higher compared to snack foods (551.29±342.75mg/100, P<0.001), cereal products (276.01± 357.04mg/100g, P<0.001) as well as meat products (567.03±403.95mg/100g, P<0.001). Similarly, snack foods had significantly higher level of sodium than cereal products (P<0.001). However, there was no statistically significant differences in sodium content between snack foods and meat products (P=0.995). The post hoc results have also been plotted in figure 4.4. The points on the chart represents the average sodium content of each food group.

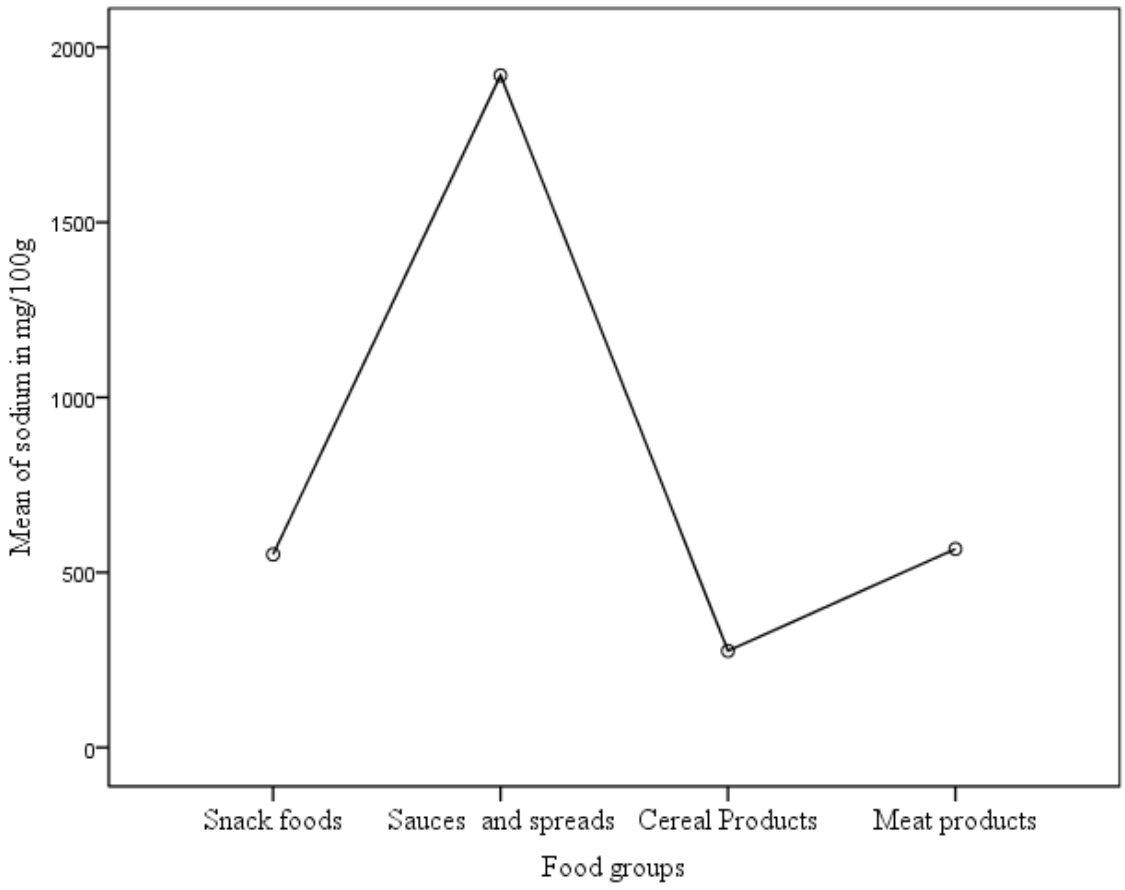

Figure 4.4*: Post-hoc comparisons plot of average sodium content across the four food groups*

As shown in Figure 4.4, sauces and spreads food group contained the most sodium than either snack foods, cereals or meat products. Similarly, meat products and snack foods had the highest levels of sodium than cereal products. However, there was no significant differences in sodium content between snack foods and meat products.

CHAPTER FIVE: DISCUSSION

5.1 Introduction

This chapter discusses the findings of this study in line with the stated objectives and compares with other related studies.

5.2 Sodium Content in Different Food Groups

In this present study, the sodium content of sauces and spreads was found to be considerably high. Even though, these results were found to be inconsistent with similar studies. For instance, a survey conducted in India by George Institute for Global Health (2017) reported slightly higher levels of sodium-2313.00mg/100g, in this particular food group. A similar case was also reported in Malaysia according to a study by Shahar *et al.,* (2019), where extremely high levels of sodium (3164±204mg/100g) from sauces category was revealed. Contrastingly, studies based in Argentina (Allemandi *et al.,* 2015) and Australia (Webster *et al.,* 2010), reported that the average sodium content of sauces and spreads were 1089.40mg/100g and 1283mg/100g respectively. This is more than 50% lower than the findings of this study.

However, regardless of these variations, the mean differences in sodium levels among these countries cannot be explained by taste differences alone, owing to wide variations in sodium content among sauces and spreads within each individual country (Farrand *et al.,* 2017). Nevertheless, in Argentina, this particular study was conducted after introduction of sodium reduction law (National Act 26905) by Argentinian government that outlined the amount of sodium in particular food groups, covering up to the sauces and spread group. This justifies the low sodium levels of their sauces and spreads in comparison with the findings of this study. It also emphasizes on the legislation measures as an effective salt reduction strategy.

It is also worthy of note that within sauces and spreads group, the sauces category was found to contain substantially high levels of sodium. Moreover, out of all the food categories assessed by this particular study, sauces emerged as the leading in sodium content. In South Africa, according to a follow-up study conducted during the introduction of mandatory sodium legislations, it was revealed that sauces not covered in that particular legislation had higher levels of sodium (Peters *et al.*, 2016). This included curry pastes (2597mg/100g), Asian sauces (3229mg/100g), mustard (1959mg/100g) and table sauces (1355mg/100g). Still, in Malaysia, a study that was confined to sauces only depicted a similar trend with fish/prawn sauce containing 5192±3228mg/100g, light/thin sauce (5116±2084mg/100g), sweet soy sauce (3696±2000mg/100g) and dark/thick soy sauce (3680±2180mg/100g. This is very high and calls for a stronger regulation with very close monitoring that will eventually propel reformulation strategies within this category.

Meat products and snack foods did not differ significantly in their sodium content with each containing (567.03 ± 403.95mg/100g) and (551.29± 342.75mg/100g) respectively. However, within the meat group, several categories were detected to have high levels of sodium. These included bacon (937.50±760.89mg/100g), fresh chilled frankfurters (800mg/100g), meat-based pastry products (730±127.28mg/100g) and sausages (690±181.11mg/100g). Contrarily, in a study based in Mexico, higher levels of sodium in Mexican meat products were reported as follows: bacon (1027± 585mg/100g), ham (1255± 738mg/100g and sausages (884± 204mg/100g). This is slightly higher than our findings. Moreover, according to Nieto *et al.*, (2018), the high levels are attributed to lack of monitoring system that is meant to evaluate the sodium content of processed foods. Further, in South Africa, meat products not targeted by the legislation were found to have high levels of sodium as follows: bacon (1008mg/100g),

salami (1681mg/100g) and biltong (2000mg/100g). In that regard, legislation measures seem to be an effective salt reduction strategy in meat products as depicted in the republic of South Africa on high levels of sodium on meat categories that were not covered by the sodium legislation.

A systematic survey conducted in Australia from 2010 to 2017, which was part of The George Institute for Global Health's Food Switch database protocol, revealed slightly different findings with regard to sodium content among meat products (Sparks *et al.,* 2018). In 2017, processed meats comprising of bacon, canned and dried meat, had an average sodium content of 857±470mg/100g. Noteworthy, from this category, bacon had an average sodium content of 1047±167mg/100g, which was higher than the findings of this present study (937.50±760.89mg/100g). Moreover, meat burgers, salami and cured meats, as well as sliced meats had an average sodium content of 523±161mg/100g, 1493±409mg/100g and 979±271mg/100g respectively. Sausages (706±242mg/100g) had slightly higher average sodium content as compared with the current study results (690±181.11mg/100g). In spite of these Australian findings being higher than this present study, it was reported that the sodium content of processed meat had decreased by 12% from 2010 to 2017. However, this applied exclusively to the food categories where the government had set targets under the Food and Health Dialogue (FHD). In that regard, setting voluntary targets acts as the best strategy that the nation of Kenya needs to adopt in an effort of reducing sodium content in their processed meat products.

There were significant differences in snack food group results in comparison with other related studies including both from South Africa and India that reported 785mg/100g and

665mg/100g of sodium respectively (George Institute for Global Health, 2017; Peters *et al.*, 2016). In South Africa, it was revealed that snack foods were not among the sentinel foods targeted by the mandatory sodium legislation law. Moreover, within the snack group, salt and vinegar products had the highest amount of sodium (886±518.96mg/100g), with extruded and sheeted snacks, pelleted snacks as well as standard potato crisps containing 575.49±273.47mg/100g, 591.87±325.68mg/100g and 518.99±325.68mg/100g respectively. In a Mexican study, the following results were found among snack categories: potato crisps (464±88mg/100g), extruded and sheeted snacks (839±415mg/100g) and salt and vinegar products (572±263mg/100g). Noteworthy, salt and vinegar products and standard potato crisps assessed by this study had the most sodium as compared to Mexican study whereas extruded and sheeted snacks reported lower results. In a different study, that assessed on snacking behaviors among high school adolescents in Nairobi, Kenya, higher socio-economic status was associated with more snacking (Nguu-Gutu et al., 2017) which is very detrimental to health. It is further argued that adolescents consume significantly more meat, sweets and snacks than the recommended signifying that they obtain more salt from this food group than any other consumers (Kloss et al., 2015). Therefore, reformulation strategies of this food group by the food industry will be of utmost importance in helping and supporting adolescents in not only consumption of healthy snacks but also their overall future health outcomes.

Of the four food groups, cereal products had the least amount of salt. These findings though not exact, were very close with two similar studies conducted in Argentina and South Africa that reported average level of sodium in this food group as 277.50g/100g and 262.00mg/100g respectively (Allemandi *et al.,* 2015; Peters *et al.,* 2016). However, the above results were inconsistent with a study conducted in India that found average sodium levels as 474mg/100g.

This was nearly twice the amount reported in this present study. In spite of this food group containing the least amount of sodium, the noodles category contained 804.22±560.67mg/100g and would therefore require close monitoring.

5.3 Variability of Sodium Content between the Four Food Groups

There was a huge variability of sodium levels across the groups including sauces and spreads (5.00-9680mg/100g), meat products (29.60-2320.00mg/100g), snack foods (1.00-1800.00mg/100g) and cereal products (1.53-2313.00mg/100g). Among products in sauces and spreads group for instance, the high variability of 5.00-9680mg/100g clearly denote that manufacturers can be able to produce with as little as 5.00mg of sodium per 100g, which is approximately 2000 times lower than the product in this group with highest amounts of sodium.

Nonetheless, existence of these products with such lower levels of sodium within sauces and spreads food group and other food groups, further illustrates a high potential for reducing the amount of sodium across the food groups (Kloss *et al.*, 2015). This can be achieved with additional research among stakeholders including the food industry that focuses on preserving the sensory and functional characteristics that sodium imparts on food and at the same time reducing the level of sodium to acceptable amounts. Furthermore, the wide variation of sodium levels in each individual group that was assessed including different categories, brands and across manufacturers is important to the consumers as they have an option of selecting low sodium products. However, consumers can achieve this by reading and understanding the nutrition information panels as well as making comparisons across similar products**.**

5.3 Comparison of the Sodium Content in the Four Food Groups with UK Food Standard Agency (UKFSA) Salt Benchmarks.

Findings from this study revealed that 64% of the products between and within the food groups had sodium levels at or below the UK sodium benchmarks with 36% having sodium levels above the reasonable benchmarks. Nevertheless, there was a large within-group variation in the proportions of products that met or were above the benchmark targets. Among the meat products group, 63% of the products exceeded the benchmarks with 100% of the products from three categories: sausages, fresh chilled frankfurters and meat-based pastry products containing sodium above these targets. A quarter of the reformed meat products and 16% of bacon exceeded the benchmarks. Similarly, among sauces and spreads, over half of the sauces and spreads also had sodium levels above the stipulated benchmarks. In fact, more than half of the products from sauces category as compared to spreads were found with very high levels of sodium above the UK standards. This has been the trend across the literature. Meat products including sauces and spreads have always been featured as the leading food groups with highest proportion of products with the most sodium above the acceptable levels. Given this analysis, the nation of Kenya and the globe at large, needs to prioritize these two food groups with their specific food categories in any salt reduction projects that may be launched in future. Consequently, this will impart long-term health benefits to the general population together with different sub-groups with high sensitivity to excessive sodium such as those with pre-hypertension, hypertension and cardiovascular diseases (Arcand *et al.*, 2014).

Further, among the cereals and snack foods, more than three quarters in each case, 81% and 84% respectively, complied with the standards. Whilst this is encouraging, this study detected

some categories within these two food groups that would require very close monitoring. In particular, among the cereal group, 60% of the instant noodles surpassed the maximum benchmarks. According to a recent study that assessed the sodium levels of instant noodles across ten countries, it was revealed that countries with established sodium targets for noodles had a higher proportion of their noodles meeting the targets. This included the United Kingdom, which had 90% of their instant noodles meeting the 2017 salt targets with 86% of the South African noodles meeting the South African targets. Moreover, according to the World Instant Noodles association (WINA), it is claimed that 270 million servings of instant noodles are consumed globally on a daily basis (Farrand *et al.*, 2017). This exposes the global population to the huge amounts of sodium contained in this product with further negative health outcomes. Within this backdrop, setting sodium targets for each food category, including instant noodles, seems to be a very good strategy in any salt reduction program.

On the other hand, among snacks, salt and vinegar products category contained 25% of the products classified as high in comparison with the legislated UK limits. This was followed closely by extruded and sheeted snacks (22%); pelleted snacks (17%) and the fewest came from standard potato crisps (14%). According to a similar study that was conducted in Mexico, 60 % of standard potato crisps, 40% of extruded and sheeted snacks as well as 71 % of salt and vinegar products complied with UK targets (Nieto *et al.*, 2018). In other words, 40%, 60% and 29% respectively were found not to comply. In addition, this food group as a whole had a product with sodium levels of up to 1800 mg/100g. Intake of such products by consumers will account for about 90 % of the daily-recommended sodium limits. However, in spite of these extreme values, the nation of Kenya has an opportune time to reduce the amount of sodium in this food group.

CHAPTER SIX: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents a brief summary of the findings with conclusions and key recommendations for further research and reducing excessive amounts of sodium among the food groups covered by this study.

6.1 Summary

The study found out that sauces and spreads are loaded with excessive amounts of sodium with sauces category being the chief contributor. In fact, the sauces and spreads group contained nearly four times the amount of sodium in either of meat products group or snack foods. The meat group came second in sodium content with bacon, fresh chilled frankfurters, and meat-based pastry products having much higher amounts of sodium. Similarly, among the snack foods, standard potato crisps, extruded and sheeted snacks together with pelleted snacks were among the top, whereas the instant noodles category was detected with much higher sodium levels in the cereal group.

In line with the UKFSA benchmarks targets, the meat group had the most products (63%) exceeding the targets. Moreover, within this group, sausages, fresh chilled frankfurters and meat-based pastry products had the greatest proportion of products with sodium content above the targets. Among sauces and spreads, more than half of the sauces and 27% of the spreads had sodium levels above the set targets. The snacks and cereals group had the largest proportion of products meeting the targets benchmarks of the UK food standard agency, even though, more than half of the noodles, 25% and 22% of salt and vinegar products as well as extruded and sheeted snacks respectively, exceeded the benchmarks.

6.2 Conclusions

The prevalence and incidence rate of hypertension and cardiovascular diseases cases continuous to rise at an alarming rate all over the globe including the nation of Kenya. Many studies attribute these problems to the excessive consumption of sodium among the processed foods. The present study was an important assessment of sodium content in a selection of food

groups in Nairobi and Kiambu counties in Kenya at a time when there are neither published sodium legislations nor reduction strategies.

Moreover, according to the findings presented by this study basing from chapter 4, Table 4.6 post hoc results, the average sodium content in sauces and spreads was significantly higher than either of the three food groups. The cereal products group had significantly lower sodium content than either of the meat products group or snack foods. However, there were no statistically significant differences in sodium content between the meat group and snack foods. As a result, there is sufficient evidence to reject the null hypothesis that stated that, "there is no significant differences in sodium content between various food groups" in favor of the alternative hypothesis.

In addition, this study noted that more than one third of the products (36%) had sodium levels above the benchmarks with huge variations being noted among different products within the same food group and category. In that regard, the regulatory bodies should establish standards that guide the specific amounts of sodium that should be added in processed and packaged foods. To ensure adherence by the food industries a strong monitoring system is required. Consumers are also encouraged to choose low salt alternatives. Most importantly, there should be collaboration between the food industry, government agencies, academic and research institutions as well as public health partners in an effort to reduce the amount of sodium added in the processed and packaged foods.

6.3 Recommendations

Based on the findings from this study, a number of key recommendations have been highlighted below.

6.3.1 Recommendations for Policy

- This study recommends for establishment of mandatory sodium legislations, sodium reduction benchmark targets and a nationally coordinated monitoring framework that tracks sodium reduction progress in the food supply.
- To make the food industry accountable, an obligatory food reformulation program is recommended.

6.3.2 Recommendations to the Food Industry

- To reduce the incidence of hypertension and CVDs, the food industry is recommended to reformulate lower sodium products.
- The high levels of sodium among more than half of the meat products together with sauces and spreads in comparison to the UKFSA benchmarks should be given priority by the food industry. Moreover, they should be the first food groups to be dealt with in any sodium reduction project.

6.3.3 Recommendations for Further Research

Specific future research suggestions have been highlighted below:

- ✓ Accuracy of sodium information as displayed on the nutrition facts panel of packaged food products from selected supermarkets in Kenya, which should be conducted in the laboratory.
- ✓ Documented use and perceived understanding of sodium information by consumers as presented on packaged food products from selected supermarkets in Kenya.
- ✓ Assessment of levels of dietary sodium intake across the Kenyan population.

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APPENDICES

Appendix A: Distribution of Sodium across Selected Brands of Food Products

Brand Name	N	Mean	Std. Deviation	Median	Range	Minimum	Maximum	% of Total N
Pearl River Bridge	3	8066.67	2136.20	9300.00	3700.00	5600.00	9300.00	0.7%
Virginia Green G	1	7430.00	.	7430.00	.00	7430.00	7430.00	0.2%
Exotic Food	2	6244.50	4434.27	6244.50	6271.00	3109.00	9380.00	0.5%
Kitchen Mate	2	6030.00	2644.58	6030.00	3740.00	4160.00	7900.00	0.5%
Desly	1	5220.00	.	5220.00	.00	5220.00	5220.00	0.2%
Golden River Bri	9	4783.33	2887.26	4160.00	7520.00	690.00	8210.00	2.1%
Kikkoman	6	4677.67	1132.14	4067.00	2300.00	3833.00	6133.00	1.4%
Vegeta	1	4600.00	.	4600.00	.00	4600.00	4600.00	0.2%
Chainkwo	5	4528.00	2325.06	5920.00	5320.00	800.00	6120.00	1.2%
DeSiam	4	4380.00	3468.95	4200.00	7680.00	720.00	8400.00	0.9%
SUREE	10	3948.00	2455.15	3960.00	8320.00	1360.00	9680.00	2.4%
Enso	1	2920.00	.	2920.00	.00	2920.00	2920.00	0.2%
JADE BRIDGE	4	2702.50	1051.04	2500.00	2510.00	1650.00	4160.00	0.9%
Corte Buona	1	2320.00	.	2320.00	.00	2320.00	2320.00	0.2%
Tabasco	1	2318.00	.	2318.00	.00	2318.00	2318.00	0.2%
Miyata	1	2080.00	.	2080.00	.00	2080.00	2080.00	0.2%
Kenzy	2	2000.00	.00	2000.00	.00	2000.00	2000.00	0.5%
Jaguar Chips	2	1800.00	.00	1800.00	.00	1800.00	1800.00	0.5%
Tawil	1	1800.00	.	1800.00	.00	1800.00	1800.00	0.2%
Real Thai	2	1678.50	945.40	1678.50	1337.00	1010.00	2347.00	0.5%
Nongshim	4	1573.25	510.26	1410.00	1153.00	1160.00	2313.00	0.9%

Dececco	1	1480.00	.	1480.00	.00	1480.00	1480.00	0.2%
De Siam	3	1440.00	415.69	1200.00	720.00	1200.00	1920.00	0.7%
Peptang	4	1405.00	237.42	1420.00	580.00	1100.00	1680.00	0.9%
Pietro Coricelli	1	1400.00	.	1400.00	.00	1400.00	1400.00	0.2%
Soletti	1	1400.00	.	1400.00	.00	1400.00	1400.00	0.2%
Royale Garden	1	1283.00	.	1283.00	.00	1283.00	1283.00	0.2%
KRACKLES	3	1262.67	427.84	1344.00	844.00	800.00	1644.00	0.7%
Old El Paso	1	1233.00	.	1233.00	.00	1233.00	1233.00	0.2%
KOL	2	1114.00	5.66	1114.00	8.00	1110.00	1118.00	0.5%
Filippo Berio	2	1080.00	169.71	1080.00	240.00	960.00	1200.00	0.5%
NuVita	1	972.00	.	972.00	.00	972.00	972.00	0.2%
Shan	1	960.00	.	960.00	.00	960.00	960.00	0.2%
American Garden	1	944.00	.	944.00	.00	944.00	944.00	0.2%
Samyang	1	914.00	.	914.00	.00	914.00	914.00	0.2%
Heinz (Africa an	1	900.00	.	900.00	.00	900.00	900.00	0.2%
El Sabor	2	860.00	254.56	860.00	360.00	680.00	1040.00	0.5%
Noodies	2	840.00	56.57	840.00	80.00	800.00	880.00	0.5%
Mr. Corn Puff's	2	800.00	.00	800.00	.00	800.00	800.00	0.5%
Indomie	1	760.00	.	760.00	.00	760.00	760.00	0.2%
Numi	3	760.00	.00	760.00	.00	760.00	760.00	0.7%
Antha	1	750.00	.	750.00	.00	750.00	750.00	0.2%
Haldiram's	2	729.00	26.87	729.00	38.00	710.00	748.00	0.5%
FRY'S Family	3	726.67	192.18	760.00	380.00	520.00	900.00	0.7%
Heinz	2	720.00	.00	720.00	.00	720.00	720.00	0.5%
Kenoodles	1	720.00	.	720.00	.00	720.00	720.00	0.2%
Farmers Choice	28	715.00	162.92	700.00	800.00	500.00	1300.00	6.6%
Kripsii	2	700.00	141.42	700.00	200.00	600.00	800.00	0.5%
Tropical Heat	2	690.00	127.28	690.00	180.00	600.00	780.00	0.5%

RAGU	1	688.00	.	688.00	.00	688.00	688.00	0.2%
Kracks	1	670.00	.	670.00	.00	670.00	670.00	0.2%
Nut Gold	3	668.00	.00	668.00	.00	668.00	668.00	0.7%
Bakemate	1	600.00	.	600.00	.00	600.00	600.00	0.2%
Krispii	1	600.00	.	600.00	.00	600.00	600.00	0.2%
Choice Meats	2	500.00	.00	500.00	.00	500.00	500.00	0.5%
Parliament	1	480.00	.	480.00	.00	480.00	480.00	0.2%
Kellogg's	4	413.00	26.00	400.00	52.00	400.00	452.00	0.9%
Weetabix	1	400.00	.	400.00	.00	400.00	400.00	0.2%
Total	**153**	**2165.60**	**2276.14**	**1040.00**	**9280.00**	**400.00**	**9680.00**	**36.3%**

Appendix B: Distribution of Sodium across Selected Manufacturers

Manufacturer	N	Mean	Std. Dev.	Median	Range	Minimum	Maximum	% of Total N
AREEJ Vegetable Oils & Derivatives	43	5214.47	2222.23	4400.00	8780.00	900.00	9680.00	10.2%
Italia AlimentariÂ Spa	1	2320.00	.	2320.00	.00	2320.00	2320.00	0.2%
McLLenny Company	1	2318.00	.	2318.00	.00	2318.00	2318.00	0.2%
Seven Sky for Food Industries	2	2000.00	.	2000.00	.00	2000.00	2000.00	0.4%
Suree Interfoods Co. Ltd	3	1653.33	473.85	1400.00	840.00	1360.00	2200.00	0.7%
Zhongshan Desley Foodstuffs	1	1650.00	.	1650.00	.00	1650.00	1650.00	0.2%
Nongshim Co Ltd	4	1573.25	510.26	1410.00	1153.00	1160.00	2313.00	0.9%
Paese Di Coltivazione Del Gr	1	1480.00	.	1480.00	.00	1480.00	1480.00	0.2%
Lian Yi Development Co.	2	1440.00	905.10	1440.00	1280.00	800.00	2080.00	0.5%
Premier Food Industries Ltd	4	1405.00	237.42	1420.00	580.00	1100.00	1680.00	0.9%
Kelly Ges.m.b.H	1	1400.00	.	1400.00	.00	1400.00	1400.00	0.2%
Pietro Coricelli Spa	1	1400.00	.	1400.00	.00	1400.00	1400.00	0.2%
Tawil Food Industries	5	1400.00	547.72	1800.00	1000.00	800.00	1800.00	1.2%
Promark Exim Limited	1	1283.00	.	1283.00	.00	1283.00	1283.00	0.2%
deSIAMCUISINE Co Ltd	4	1260.00	494.77	1200.00	1200.00	720.00	1920.00	0.9%
General Mills Sales Inc	1	1233.00	.	1233.00	.00	1233.00	1233.00	0.2%
Njoro Canning Factory (K) Lt	2	1114.00	5.66	1114.00	8.00	1110.00	1118.00	0.5%
Salov S.P.A	2	1080.00	169.71	1080.00	240.00	960.00	1200.00	0.5%
Thaitan Foods International	1	1010.00	.	1010.00	.00	1010.00	1010.00	0.2%
Mjengo Limited	1	972.00	.	972.00	.00	972.00	972.00	0.2%
Propack Kenya Limited	6	964.67	430.25	800.00	1044.00	600.00	1644.00	1.4%
Shan Foods (Private) Ltd	1	960.00	.	960.00	.00	960.00	960.00	0.2%
American Garden Co.	1	944.00	.	944.00	.00	944.00	944.00	0.2%
Samyang Foods Co Ltd	1	914.00	.	914.00	.00	914.00	914.00	0.2%
El Sabor Mexican Foods SA	2	860.00	254.56	860.00	360.00	680.00	1040.00	0.5%

Bidco Africa Ltd	2	840.00	56.57	840.00	80.00	800.00	880.00	0.5%
Kapa Oil Refineries Ltd	3	760.00	.00	760.00	.00	760.00	760.00	0.7%
Salim Wazaran Kenya Co. Ltd	1	760.00	.	760.00	.00	760.00	760.00	0.2%
Antha Foods	1	750.00	.	750.00	.00	750.00	750.00	0.2%
Haldiram Foods International	2	729.00	26.87	729.00	38.00	710.00	748.00	0.5%
Baraka Kenya Limited	1	720.00	.	720.00	.00	720.00	720.00	0.2%
Ultracongelados Virto S.A.	2	720.00	.00	720.00	.00	720.00	720.00	0.5%
Farmers Choice Limited	29	716.55	160.21	700.00	800.00	500.00	1300.00	6.9%
Fry Group Foods	2	710.00	268.70	710.00	380.00	520.00	900.00	0.5%
Debenham & Fear Ltd	1	690.00	.	690.00	.00	690.00	690.00	0.2%
Tropical Heat Limited	2	690.00	127.28	690.00	180.00	600.00	780.00	0.5%
Westlands Trading Ltd	1	690.00	.	690.00	.00	690.00	690.00	0.2%
Mizkan America INC	1	688.00	.	688.00	.00	688.00	688.00	0.2%
Alex Africa Limited	1	670.00	.	670.00	.00	670.00	670.00	0.2%
Zenko Kenya Limited	3	668.00	.00	668.00	.00	668.00	668.00	0.7%
Pahal Foods Private Ltd	1	600.00	.	600.00	.00	600.00	600.00	0.2%
Choice Meats	2	500.00	.00	500.00	.00	500.00	500.00	0.5%
Barilla G. eR Fratelli	1	480.00	.	480.00	.00	480.00	480.00	0.2%
Nordisk Kellogg's	4	413.00	26.00	400.00	52.00	400.00	452.00	0.9%
Weetabix East Africa Limited	1	400.00	.	400.00	.00	400.00	400.00	0.2%
Total	**153**	**2165.60**	**2276.14**	**1040.00**	**9280.00**	**400.00**	**9680.00**	**36.3%**

Appendix C: Comparison of Sodium Content of Locally Manufactured and Imported Products across the Four Food Groups with UKFSA Benchmarks

Origin	Exceeded/Complied	Food group	Mean	Median	Minimum	Maximum	Range	Std. Dev.	% of Total N	N
Imported	Exceeded	Snack foods	952.67	748.00	710	1400	690	387.868	0.7%	3
		Sauces and spreads	3703.64	3319.50	680	9680	9000	2605.653	16.6%	70
		Cereal Products	903.55	600.00	400	2313	1913	617.360	2.6%	11
		meat products	1610.00	1610.00	900	2320	1420	1004.092	0.5%	2
		Total	3200.84	2319.00	400	9680	9280	2588.584	20.4%	86
	Complied	Snack foods	354.45	360.00	16	781	765	216.511	4.5%	19
		Sauces and spreads	339.55	384.00	5	600	595	178.279	11.1%	47
		Cereal Products	152.69	132.00	2	345	343	119.861	11.4%	48
		meat products	76.24	45.00	30	400	370	113.944	2.4%	10
		Total	248.26	256.00	2	781	779	189.956	29.4%	124
	Total	Snack foods	436.02	360.00	16	1400	1384	314.103	5.2%	22
		Sauces and spreads	2352.26	1040.00	5	9680	9675	2606.632	27.7%	117
		Cereal Products	292.68	207.00	2	2313	2311	405.395	14.0%	59
		meat products	331.87	45.20	30	2320	2290	677.277	2.8%	12
		Total	**1457.41**	**400.00**	**2**	**9680**	**9678**	**2205.578**	**49.8%**	**210**
Local	Exceeded	Snack foods	1059.86	800.00	600	1800	1200	496.155	3.3%	14
		Sauces and spreads	989.27	750.00	668	1680	1012	377.535	2.6%	11
		Cereal Products	804.50	760.00	400	1233	833	209.780	2.4%	10
		meat products	696.88	700.00	500	1300	800	164.482	7.6%	32
		Total	836.79	760.00	400	1800	1400	335.964	15.9%	67
	Complied	Snack foods	483.88	480.00	1	800	799	197.214	16.1%	68
		Sauces and spreads	238.13	273.00	38	630	592	147.908	5.7%	24

		Cereal Products	130.47	100.00	2	320	318	109.293	10.2%	43
		meat products	433.70	355.00	65	1000	935	392.001	2.4%	10
		Total	334.94	320.00	1	1000	999	244.698	34.4%	145
	Total	Snack foods	582.22	526.00	1	1800	1799	345.296	19.4%	82
		Sauces and spreads	474.20	320.00	38	1680	1642	426.489	8.3%	35
		Cereal Products	257.65	143.00	2	1233	1231	296.898	12.6%	53
		meat products	634.21	680.00	65	1300	1235	258.955	10.0%	42
		Total	**493.54**	**480.00**	**1**	**1800**	**1799**	**361.758**	**50.2%**	**212**
TOTAL	HIGH	Snack foods	1040.94	800.00	600	1800	1200	469.673	4.0%	17
		Sauces and spreads	3335.02	2400.00	668	9680	9012	2597.921	19.2%	81
		Cereal Products	856.38	760.00	400	2313	1913	461.454	5.0%	21
		meat products	750.59	700.00	500	2320	1820	321.756	8.1%	34
		Total	**2165.60**	**1040.00**	**400**	**9680**	**9280**	**2276.144**	**36.3%**	**153**
	LOW	Snack foods	455.61	480.00	1	800	799	207.376	20.6%	87
		Sauces and spreads	305.27	320.00	5	630	625	174.383	16.8%	71
		Cereal Products	142.19	120.00	2	345	343	114.897	21.6%	91
		meat products	254.97	65.50	30	1000	970	335.506	4.7%	20
		Total	**294.98**	**280.00**	**1**	**1000**	**999**	**224.960**	**63.7%**	**269**
	Total	Snack foods	551.29	480.00	1	1800	1799	342.750	24.6%	104
		Sauces and spreads	1919.81	689.00	5	9680	9675	2426.908	36.0%	152
		Cereal Products	276.10	197.00	2	2313	2311	357.040	26.5%	112
		meat products	567.03	600.00	30	2320	2290	403.950	12.8%	54
		Total	**973.19**	**480.00**	**1**	**9680**	**9679**	**1647.226**	**100.0%**	**422**

Appendix D: Letter of Introduction

XXth Month, 2019

INSERT NAME

Store Manager

INSERT STORE NAME

Dear NAME,

For the past 10 years, the George Institute for Global Health has compiled a database that contains the nutritional information for all of the packaged foods available in Australian supermarkets. This information has been used to help the government and food industry to understand and improve the nutrition quality of the foods on sale and hence improve public health. Over this time, we have expanded our collection to 8 additional countries, in which stores such as yours have helped us by allowing this information to be collected. We are now wishing to collect nutrition information for food products in Kenya and seek your permission to come into your store to do this. We propose to send researchers for a few days between in the month of June and July, 2019. Please note that we will not be collecting information about price. Confidentiality will be maintained to ensure your supermarket is not identified in research findings. The findings of this research will be shared with you on request. Thank you in advance for your support and assistance with this project and we would of course be happy to discuss with you any aspect of the study you need more information about.

With Kind regards.

Appendix E: Categorization of Foods (Adopted From Danford Et Al, 2011)

Food group	Food category	Description
Beverages	Fruit and vegetable juices	Fresh and ambient fruit and vegetable juices
	Soft drinks	Sugar-sweetened and artificially-sweetened soft drinks
	Cordials	Cordials
	Coffee and tea	Coffee and tea products
	Electrolyte drinks	Sports electrolyte drinks
	Alcoholic beverages	All alcoholic beverages
	Waters	Plain and flavored waters
Bread & bakery products	Bread	White, whole meal and mixed grain/seed sliced bread and rolls
		Fruit bread and fruit-based muffins/rolls
		Wraps and other flatbread products
		Turkish pide, bagels, English-style muffins, crumpets, pizza bases and other plain bread-based products
	Biscuits	Filled and unfilled sweet biscuits
		Flavored and plain crisp bread and crackers
	Cakes, muffins & pastry	Scones, pikelets, doughnuts, cakes, sweet buns, pancakes, crepes, muffins (cake-style), slices etc
		Cake, pikelet and pancake dry mixes
		Sweet pastries (fresh, ambient, chilled and frozen)
Cereal and cereal products	Cereal bars	Plain, chocolate-topped and yoghurt-topped cereal-based bars
	Noodles	Flavored and plain dry packet and fresh noodles
	Breakfast cereals	Ready to eat breakfast cereals
		Oats and other breakfast cereals that require heating
		Other processed cereals (e.g. bran)

	Pasta	Canned and ambient pasta and sauce (with and without meat) products (excludes frozen ready meals)
		Packaged fresh pasta with sauce
		Savory/flavored dry pasta-based side dishes
		Plain dry pasta
	Maize (corn)	Tortillas, tamales, tacos and other corn-based cereal products
	Rice	Plain rice
		Savory rice-based side dishes
	Couscous	Couscous side dishes and plain couscous
	Unprocessed cereals	Flour and other unprocessed cereals (e.g. polenta, psyllium, bread crumbs, yeast)
Confectionery	Chocolate and sweets	Chocolate-based confectionery, sugar-based confectionery
	Jelly	Jelly products and mixes
	Chewing gum	All chewing gums and bubble gum products
Convenience foods	Pizza	Frozen and refrigerated pre-packed pizzas
	Soup	Canned, chilled and ambient soup products
	Ready meals	Frozen, chilled and ambient pre-prepared meals
	Pre-prepared salads and sandwiches	Chilled pre-prepared salads and sandwiches (excluding fast food)
	Others	Other pre-prepared foods such as quiches and pasta
Dairy	Cheese	Feta, haloumi, parmesan and other high-salt cheeses
		All types of full and reduced fat cheddar/Colby etc cheese including shredded, block or sliced
		Soft cheeses such as cream cheese, ricotta and cottage cheese
		Processed cheese slices and products
	Yoghurt products	Fruit, flavored and natural yoghurts (full fat, reduced fat and skim varieties)

		including yoghurt drinks
	Milk	Flavored and unflavored dairy milk products
		Flavored and unflavored soymilks
		Flavored and unflavored oat, almond and other milks
		Condensed, evaporated and powdered milk products (including coconut milk)
	Cream	Thickened, sour and regular cream products
	Desserts	Dairy-based desserts (e.g. custards, rice puddings)
		Dairy-based dessert mixes (e.g. powders)
	Ice cream and edible ices	Dairy and soy-based ice cream varieties and edible ices
Edible oils and oil emulsions	Butter and margarine	Salted and unsalted butter and margarine products
	Cooking oils	Cooking oils such as olive oil, canola oil and other vegetable oils
Eggs		All egg products
Fish and fish products	Canned fish and seafood	Plain and flavored canned tuna, salmon, sardines, anchovies, mackerel, herring, kipper, oysters and shellfish
	Chilled fish	Chilled processed fish products (e.g. smoked salmon)
	Frozen fish	Coated frozen fish products (e.g. fish fingers) and uncoated fish products
Foods for specific dietary use	Baby foods	All infant formula products and baby food
	Meal replacements	Formulated meal replacements (e.g. diet shakes)
Fruit and vegetables	Vegetables	Canned tomato products
		Canned beans and peas
		Baked beans in tomato sauce (with and without additions)
		Canned creamed, plain and sweet corn
		All other canned vegetables

		Pickled vegetable and olive products
		Frozen potato-based products
		Frozen unprocessed vegetables
	Fruit	Dried fruit products including coconut
		Fruit-based bars
		Fruit products canned in juice or syrup
		Fruit gels, fruits in jelly and fruit puree
	Jam and spreads	Jams, marmalades and other preserves
	Nuts and seeds	Salted and unsalted nuts and seeds
Meat and meat products	Processed meat and derivatives	Pre-packed bacon products
		Beef, pork, chicken and lamb sausages and chilled hot dogs
		Pre-packaged sliced deli meats
		Pre-packaged salami and cured meats
		Beef, pork, chicken and lamb meat burgers
		Canned meat products (excluding soup and pasta)
		Frozen meat pies, sausage rolls and other meat-based pastry products such as dim sims
	Meat alternatives	Plain tofu and other meat-free alternatives
		Meat-free products (e.g. meat-free sausages)
Snack foods	Crisps and snacks	Plain and flavored potato crisps
		Plain and flavored snack foods
		Extruded snacks (e.g. cheesy snacks)
		Plain and flavored corn chips
		Pretzels, popcorn and other snack foods
		Other fried snack foods (e.g. plantain chips)
		All varieties of cracker-based snack packs
Sauces and spreads	Sauces	Table sauces such as tomato sauces and ketchups, sweet chilli, BBQ sauces
		Steak, HP and Worcestershire sauces
		Soy, fish, oyster and other Asian high-salt sauces

		Mustard products
		Marinade products
		Meat accompaniments (e.g. apple, cranberry and mint sauces)
		Plain and flavored tomato paste products
		Asian and Indian flavored powdered, ambient and liquid meal-based sauces
		Ambient and fresh pasta sauces
		Recipe bases
		Liquid and powdered gravies and stock
	Mayonnaise/dressings	Full and low-fat mayonnaise
		Oil-based, vinegar-based and other types of salad dressing
	Spreads	Crunchy and smooth salted and unsalted peanut butter
		Relishes, chutneys and pickles
		Other savory spreads (e.g. vegetable spreads)
		Pâté spreads
		Sweet spreads
		Yeast-extract spreads (e.g. vegemite)
		Chilled and ambient dips and salsa
Sugars, honey and related products	Honey and syrups	Honey, golden, maple and other syrups
		Dessert toppings

Appendix F: The Study Work plan

MONTH ACTIVITY (YEAR 2019 & 2020	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Proposal presentation											
Data Collection											
Data extraction and entry											
Data analysis, Final Report Writing and Defense											

Appendix G: Study Budget

Activity	Sub-activity	Details	Unit cost	Total
Proposal writing	Printing and binding	Three copies	400	1200
Data collection	Transport costs	Fare and lunch for 2 weeks for 8 people	700 per person	11,200
Data extraction and entry costs	Data cleaning, validation and payments for data entry technicians			100,000
Data analysis and final project report writing	Printing, binding and internet costs			5000
Sub-total				117,400
Contingencies			10% of the total costs	11740
Grand Total				**129,140**

Appendix H: Exemption From Ethical Approval Letter

KENYATTA UNIVERSITY
OFFICE OF THE CHAIRMAN ETHICS REVIEW COMMITTEE

Email: chairman.kuerc@ku.ac.ke

Moi Library Building, 1st Floor, Room 25

FROM: The Chairman
Ethics Review Committee

DATE: 28th May, 2019

TO: National Commission for Science, Technology and Innovation

REF: KU/ERC/NACOSTI/VOL. I/ (01)

Dear Sir/Madam,

REF: PROPOSAL CLEARANCE FOR EXEMPTION FROM ETHICAL APPROVAL

The Kenyatta university ethics review committee, has looked at the proposal for Mr. Alex Kibet titled **"Assessment of sodium levels of packaged food products from selected supermarkets in Nairobi, Kenya".** The committee has concluded that this study will not involve direct contact with people. It is only looking at packaged food products.

The committee has therefore granted this study an exemption from Ethical Clearance. Please see attached the application for the same.

Sincerely,

KENYATTA UNIVERSITY OFFICE OF THE CHAIRMAN 28 MAY 2019 ETHICS REVIEW COMMITTEE P.O. BOX 43844 - 00100 NAIROBI

PROF. JUDITH KIMIYWE
CHAIRPERSON: KENYATTA UNIVERSITY ETHICS REVIEW COMMITTEE

JK/ewk.

Appendix I: Proposal Approval Letter from the Graduate School

KENYATTA UNIVERSITY
GRADUATE SCHOOL

E-mail: dean-graduate@ku.ac.ke
Website: www.ku.ac.ke

P.O. Box 43844, 00100
NAIROBI, KENYA
Tel. 020-8704150

Internal Memo

FROM: Dean, Graduate School

DATE: 30th August, 2019

TO: **Mr. Kibet Alex**
C/o Department of Food, Nutrition & Dietetics

REF: H60/38746/2017

SUBJECT: APPROVAL OF RESEARCH PROPOSAL

==========

We acknowledge receipt of your Research Proposal after fulfilling recommendations raised by the Graduate School Board of 7th August, 2019.

You may now proceed with your Data collection, subject to clearance with the Director General, National Commission for Science, Technology & Innovation and Ethics Review Committee, Kenyatta University.

As you embark on your data collection, please note that you will be required to submit to Graduate School completed Supervision Tracking Forms per semester. The form has been developed to replace the Progress Report Forms. The Supervision Tracking Forms are available at the University's Website under Graduate School webpage downloads.

Thank you

EDWIN OBUNGU
FOR: DEAN, GRADUATE SCHOOL

CC. Chairman, Department of Food, Nutrition & Dietetics
Supervisors:

1. Prof. Judith Kimiywe
   C/o Department of Food, Nutrition & Dietetics
   Kenyatta University

2. Dr. Rhoda Ndanuko
   Research Fellow, Food Policy Division,
   The George Institute for Global Health and Conjoint Lecturer, University of New South Wales, Australia.
   C/o Department of Food, Nutrition & Dietetics
   Kenyatta University

Appendix J: Research Authorization Letter from NACOSTI

NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY AND INNOVATION

Telephone:+254-20-2213471,
2241349,3310571,2219420
Fax:+254-20-318245,318249
Email: dg@nacosti.go.ke
Website : www.nacosti.go.ke
When replying please quote

NACOSTI, Upper Kabete
Off Waiyaki Way
P.O. Box 30623-00100
NAIROBI-KENYA

Ref: No. **NACOSTI/P/19/95904/30921** Date: **25th June, 2019**

Alex Kibet
Kenyatta University
P.O. Box 43844-00100
NAIROBI.

RE: RESEARCH AUTHORIZATION

Following your application for authority to carry out research on ***"Assessment of sodium levels of packaged food products from selected supermarkets in Nairobi, Kenya,"*** I am pleased to inform you that you have been authorized to undertake research in **Nairobi County** for the period ending **24th June, 2020.**

You are advised to report to **the County Commissioner and the County Director of Education, Nairobi County** before embarking on the research project.

Kindly note that, as an applicant who has been licensed under the Science, Technology and Innovation Act, 2013 to conduct research in Kenya, you shall deposit **a copy** of the final research report to the Commission within **one year** of completion. The soft copy of the same should be submitted through the Online Research Information System.

BONIFACE WANYAMA
FOR: DIRECTOR-GENERAL/CEO

Copy to:

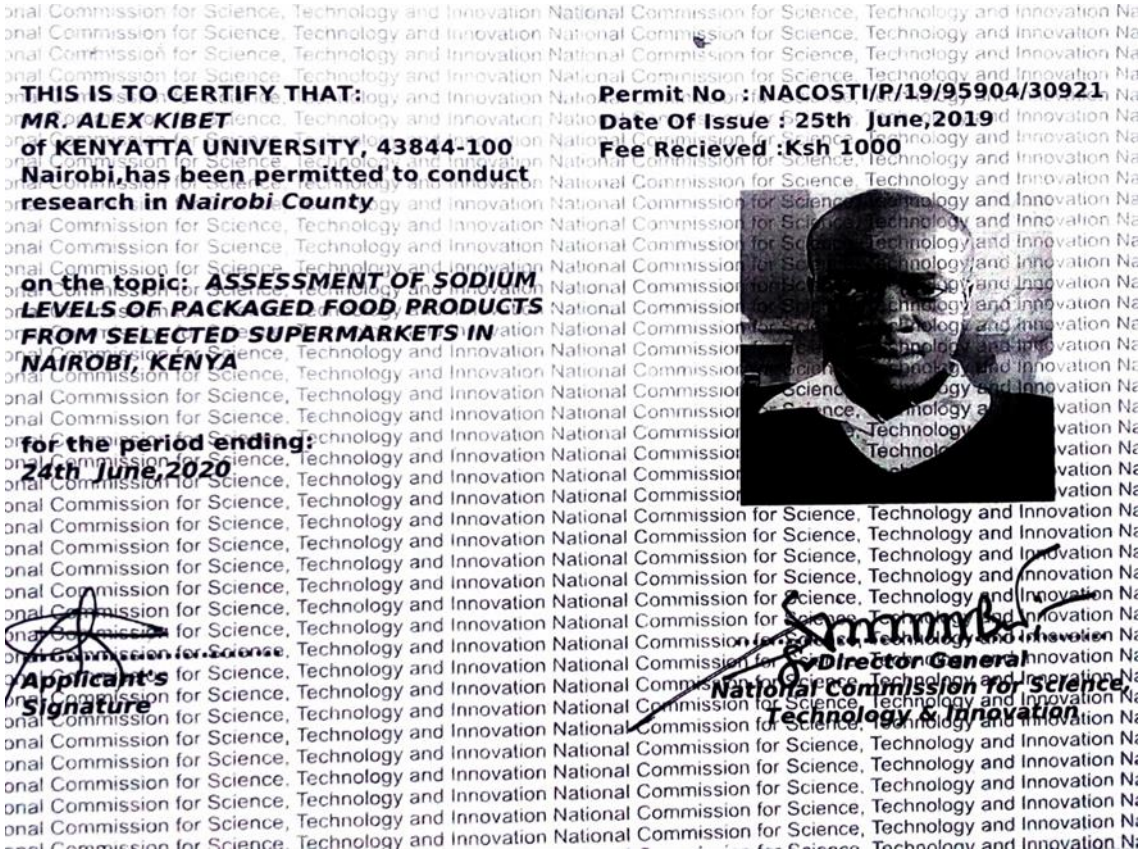
The County Commissioner
Nairobi County.

25/06/2019

COUNTY COMMISSIONER
NAIROBI COUNTY
P. O. Box 30124-00100, NBI
TEL: 341666

The County Director of Education
Nairobi County.

Appendix L: Research Permit from Nacosti



Appendix M: Research Authorization Letter from Ministry of Education

Republic of Kenya
MINISTRY OF EDUCATION
STATE DEPARTMENT OF EARLY LEARNING & BASIC EDUCATION

Telegrams: "SCHOOLING", Nairobi
Telephone: Nairobi 020 2453699
Email: rcenairobi@gmail.com
cdenairobi@gmail.com

When replying please quote

REGIONAL DIRECTOR OF EDUCATION
NAIROBI REGION
NYAYO HOUSE
P.O. Box 74629 – 00200
NAIROBI

Ref: **RCE/NRB/GEN/1/VOL. 1**

DATE: **25th June, 2019**

Alex Kibet
Kenyatta University
P O Box 43844-00100
NAIROBI

RE: RESEARCH AUTHORIZATION

We are in receipt of a letter from the National Commission for Science, Technology and Innovation regarding research authorization in Nairobi County on **"Assessment of sodium levels of packaged food products from selected supermarkets in Nairobi, Kenya".**

This office has no objection and authority is hereby granted for a period ending **24th June, 2020** as indicated in the request letter.

Kindly inform the Sub County Director of Education of the Sub County you intend to visit.

REGIONAL DIRECTOR OF EDUCATION
25 JUN 2019
MINISTRY OF EDUCATION
P.O. Box 74629, NAIROBI

JAMES KIMOTHO
FOR: REGIONAL DIRECTOR OF EDUCATION
NAIROBI

C.C
Director General/CEO
National Commission for Science, Technology and Innovation
NAIROBI