

**COMPARATIVE ANALYSIS OF SODIUM, FAT, AND PROTEIN  
CONTENT IN NUGGETS AND SAUSAGES ACROSS DIVERSE  
BRANDS IN THE MALAYSIAN MARKET**

**SHALINIE A/P MOGAN**

**SCHOOL OF HEALTH SCIENCE  
UNIVERSITI SAINS MALAYSIA**

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BRANDS IN THE MALAYSIAN MARKET**

by

**SHALINIE A/P MOGAN**

**Dissertation submitted in partial fulfillment of the requirements for  
the degree of Bachelor in Nutrition with Honours**

**JANUARY 2025**

## **CERTIFICATION OF APPROVAL**

This is to certify that the dissertation entitled “*Comparative Analysis of Sodium, Fat, and Protein Content in Nuggets and Sausages Across Diverse Brands in The Malaysian Market*” is the bona fide record of research work done by Ms *Shalinie A/P Mogan (159186)* during the period from April 2024 to Jan 2025 under my supervision. I have read this dissertation and in my opinion, it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation to be submitted in partial fulfillment for the degree of Bachelor in Nutrition With Honours.

Main supervisor,



.....

Dr.Soo Kah Leng

Lecturer

School of Health Sciences

Universiti Sains Malaysia

Health Campus

16150 Kubang Kerian

Kelantan, Malaysia

Date: 12 January 2025

## DECLARATION

I affirm that this dissertation is the result of my own research unless I have explicitly acknowledged any contributions made by others. I also confirm that it has not been submitted in full for any degree at Universiti Sains Malaysia or any other institution, either previously or at the same time. I give Universiti Sains Malaysia permission to use this dissertation for educational, research, and promotional purposes.

*Shalinie*

.....

SHALINIE A/P MOGAN

Date: 8 January 2025

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## **List of Symbols, Abbreviations and Acronyms**

DV	Daily Value
UPF	Ultra Processed Food
RNI	Recommended Nutrient Intake
CVD	Cardiovascular Disease
CDC	Centers for Disease Control and Prevention
NaCl	Sodium Chloride
$A_w$	Water Activity
WHO	World Health Organization
HFD	High Fat Diet
CKD	Chronic Kidney Disease
SPSS	Statistical Package for the Social Sciences
SD	Standard Deviation
<	Less than
>	More than
p	Significance level

# **ANALISIS PERBANDINGAN KANDUNGAN NATRIUM, LEMAK, DAN PROTEIN DALAM NUGGET DAN SOSEJ MERENTASI PELBAGAI JENAMA DI PASARAN MALAYSIA**

## **ABSTRAK**

Kajian ini menyelidik kandungan nutrisi nugget ayam dan sosej daripada pelbagai jenama di pasaran Malaysia, dengan memberi tumpuan kepada tiga nutrien penting: natrium, lemak, dan protein. Kajian ini menangani kekurangan data perbandingan yang penting untuk pilihan pengguna yang lebih bijak dan strategi kesihatan awam di tengah-tengah peningkatan penggunaan makanan ultra-proses di Malaysia. Maklumat nutrisi diperoleh daripada label produk, dan analisis statistik, termasuk ujian Kruskal-Wallis, digunakan untuk mengenal pasti perbezaan. Penilaian menunjukkan konsistensi komposisi nutrien dalam semua nugget ayam, di mana tiada perbezaan ketara antara nutrien dalam nugget. Namun begitu, kajian ini mendapati terdapat perbezaan ketara dalam kandungan natrium, lemak, dan protein pada sosej, bergantung kepada jenama dan perisa. Secara khususnya, sosej perisa asli mengandungi kandungan natrium and lemak yang terendah. Bagi kandungan protein pula, sosej berperisa keju menunjukkan paras tertinggi. Kajian ini juga menekankan penggunaan keberkesanan kos untuk memastikan kecekapan pengambilan nutrien serta menonjolkan kepentingan saiz hidangan yang standard dan pelabelan yang jelas dan tepat. Penemuan ini memberikan panduan berguna kepada pengguna, pembuat dasar, dan pengeluar makanan, menyokong usaha untuk mempromosikan pilihan pemakanan yang lebih sihat dan melaksanakan langkah pengawalseliaan bagi meningkatkan kualiti nutrisi produk daging proses di Malaysia.

**COMPARATIVE ANALYSIS OF SODIUM, FAT, AND PROTEIN  
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**ABSTRACT**

This study investigates the nutritional content of chicken nuggets and sausages from diverse brands in the Malaysian market, focusing on three important nutrients: sodium, fat, and protein. It addresses the lack of comparative data essential for informed consumer choices and public health strategies in light of Malaysia's growing consumption of ultra-processed foods. Nutritional information was obtained from product labels, and statistical analysis, including the Kruskal-Wallis test, was used to identify differences. The assessment showed consistency of nutrient compositions in all chicken nuggets where there is no significant difference between nutrients in nuggets. However, the study found significant differences in the sodium, fat, and protein content of sausages, depending on the brand and flavor. Notably, the original flavor has the lowest sodium and fat content. Regarding protein content, cheese flavors have the highest protein level. The study emphasizes the usage of price-effectiveness to ensure nutrient intake efficiency and highlights the importance of standardized portion sizes and clear, accurate labeling. These findings offer valuable guidance for consumers, policymakers, and food manufacturers, supporting efforts to promote healthier dietary choices and implement regulatory measures to improve the nutritional quality of processed meat products in Malaysia.

# CHAPTER 1

## 1.0 INTRODUCTION

### 1.1 Background of the study

Unhealthy dietary patterns, including the growing intake of heavily processed items, pose significant health risks and present a considerable obstacle to public health efforts. These products are not considered "whole foods" but rather consist of food components that have often been altered through chemical processes and combined into easily consumable, highly palatable items, usually referred to as cosmetic food. This category encompasses a wide range of industrially processed food items, including savory snacks, processed meat products, frozen meals, soft drinks, and other food products, making classification challenging (Gibney et al., 2017). The NOVA system stands out as the most prevalent among food classification systems. Its primary aim is to categorize foods based on the nature, extent, and purposes of the industrial processes they undergo (Monteiro et al., 2019). Under the NOVA system, foods are allocated into one of four groups: (i) NOVA 1 encompasses "unprocessed or minimally processed foods," which include natural or minimally modified edible parts of plants or animals; (ii) NOVA2 comprises "culinary ingredients," such as salt, oil, sugar, or starch, derived from NOVA1 foods; (iii) NOVA3 involves "processed foods," including items like freshly baked bread and canned vegetables, obtained through the combination of NOVA1 and NOVA2 foods; and (iv) NOVA4 comprises "ultra-processed foods," which are ready-to-eat industrially formulated products made predominantly or entirely from food-derived substances and additives, with minimal intact Group 1 food components (Braesco et al., 2022).

The prevalence of ultra-processed food consumption, exemplified by the popularity of nuggets and sausages, has surged globally, including in Malaysia. These convenient and

versatile food options are favored by many due to their ease of preparation and enjoyable taste. Nevertheless, concerns have emerged regarding the nutritional value of these products, particularly concerning their levels of sodium, fat, and protein.

Despite their convenience, nuggets and sausages often contain elevated levels of sodium, fat, and protein, posing potential risks to public health. Excessive sodium intake has been associated with various health issues like hypertension and cardiovascular diseases. Similarly, high levels of saturated and trans fats can elevate cholesterol levels, increasing the risk of heart disease.

Recognizing the significant health implications associated with these nutritional components, there is a pressing need for thorough research to evaluate the sodium, fat, and protein content of nuggets and sausages available in the Malaysian market. Through a comparative analysis spanning different brands, this study aims to furnish valuable insights into the nutritional compositions of these ultra-processed meat products, empowering consumers to make informed dietary decisions. Furthermore, the outcomes of this research hold the potential to guide policymakers and food regulatory bodies in implementing strategies to enhance the nutritional quality of processed meat offerings, thereby advancing public health and well-being.

## **1.2 Problem Statement:**

The increasing consumption of ultra-processed meats such as nuggets and sausages in Malaysia is a growing concern due to the potential negative health effects associated with the typically high sodium and fat content of these foods. Although previous studies suggest that processed meat is not necessarily high in nutritional value, consumers tend to prioritize protein content in their purchasing decisions. This emphasis on protein content can sometimes distract from the potential health risks associated with these products, including their high sodium and fat content (De Araújo et al., 2022).

Sausage and nuggets are two common processed meat items in Malaysia, especially among youngsters. Sausages are commonly included as a convenient breakfast option for schoolchildren, along with other ready-to-eat choices (Huda et al., 2010). Their convenience and palatability are usually achieved by adding various cosmetic additives, making them attractive but lacking nutritional value. However, there are issues with their nutritional content, particularly with their levels of fat, protein, and sodium. Consuming processed meat may also be linked to an increased risk of heart disease and various metabolic disorders such as diabetes and weight gain (Godfray et al., 2018). While sausage and nuggets do provide protein, they typically lack essential vitamins, minerals, and fiber, which are crucial for overall health. This deficiency in nutrients could potentially result in an imbalanced diet that doesn't meet the body's requirements for optimal well-being.

However, different flavours of nuggets and sausages may contain varying amounts of sodium, fat, and protein. Original flavours may present a balanced mix of these nutrients, suitable for various dietary preferences. However, flavors such as BBQ or spicy varieties tend to contain higher levels of sodium and fat due to the addition of seasonings, which enhance flavor but also contribute to increased sodium and fat content. Understanding the

nutritional differences between flavour variants empowers individuals to make informed choices that promote a balanced diet

### **1.3 Significance of study**

This study compares the sodium, fat, and protein content of chicken nuggets and sausages available in the Malaysian market. By analyzing these crucial nutritional aspects across different brands and types, the study aims to provide useful information for consumers. Sodium poses a significant worry for numerous consumers due to its association with elevated blood pressure and related health issues. Through this study, Malaysians will gain insights to make informed decisions regarding their purchases of chicken nuggets and sausages, pinpointing brands offering lower sodium levels. Moreover, the fat content can greatly differ among various brands and variations of chicken nuggets and sausages. Certain producers options for leaner meat cuts and healthier breeding choices to minimize fat content. This research will aid consumers in identifying healthier selections within their preferred product categories. The results of this research hold significant relevance, especially for parents seeking healthier alternatives for their children. Chicken nuggets and sausages are commonly favored options in kids' meals; however, being mindful of their sodium and fat levels is crucial.

### **1.4 Research Question**

1. Which brand of chicken nuggets and sausages contains the highest level of sodium, fat, or protein level?
2. Is sodium, fat, and protein level significantly different across the 3 flavours of chicken nuggets and sausages?

## **1.5 Research Objective**

### **1.5.1 General objective:**

- To compare levels of sodium, fat, and protein found in a range of nuggets and sausages from different brands in the Malaysian market.

### **1.5.2 Specific objective:**

1. To compare sodium levels in different brands and flavours of nuggets and sausages sold in Malaysia.
2. To compare the fat composition among various brands and flavours of nuggets and sausages in the Malaysian market.
3. To compare the protein content in different brands and flavours of nuggets and sausages sold in Malaysia
4. To determine sodium, fat and protein Daily Value for different brands and flavours of nuggets and sausages sold in Malaysia

## **1.6 Research Hypothesis**

### **Null :**

- There is no significant difference in the levels of sodium, fat, and protein found in a range of nuggets from different flavours sold in Malaysia.
- There is no significant difference in the levels of sodium, fat, and protein found in a range of sausages from different flavours sold in Malaysia.

### **Alternative:**

- There is a significant difference in the levels of sodium, fat, and protein found in a range of nuggets and sausages from different flavours sold in Malaysia.

## 1.7 Conceptual Framework

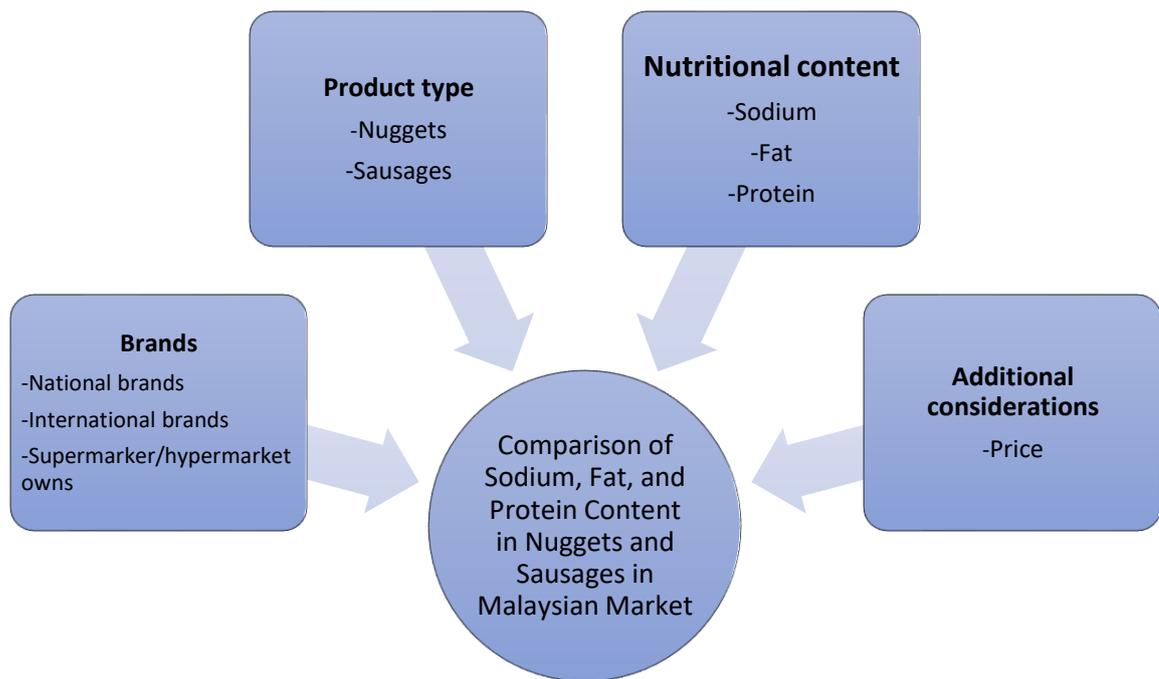


Figure 1.1 Conceptual framework of the study

## 1.8 Conceptual Definition:

### Daily Value

The Daily Value is a standard reference used to measure the nutrient content of foods, aiding in comparing different products and understanding dietary intake. It's usually shown on nutrition labels as a percentage (%DV) next to the nutrient content per serving size. For instance, if a food item has 15% DV of sodium per serving, it indicates that consuming one serving provides 15% of the recommended daily sodium intake for a 2,000-calorie diet.

### Price Effectiveness

Price effectiveness is about getting the most nutritional value for the money you spend on a product. This shows you how much of that nutrient you're getting for every 1 sen

spent. By applying this method to sodium, protein, and calories, you can compare how well different products deliver essential nutrients for their cost. A higher value indicates a greater nutritional return for the cost, making the product a more cost-effective choice overall.

## **1.9 Operational Definition**

### **1.9.1 Daily Value**

These calculations correspond to the proper balances of fats and proteins according to the recommended daily intake of 2,000 kcal per person which guarantees the proper nutrition of an adult person. Notably, the percentages of fat (30%) and protein (20%) are declared as the recommended average portions for a daily rate and food labeling. 30 % of fat and 20% of protein is used to calculate DV for adults with a 2,000 Kcal intake. For sodium, the recommended amount for an adult based on Recommended Nutrient Intake (RNI) is 2000 mg a day.

30% of fat from 2,000 Kcal is 600 Kcal .Then convert Kcal into grams by dividing it by 9 g as 1 Kcal of fat will yield 9 g. We will get 66.67g. Hence, to calculate the DV of fat from the nutrition label we need to divide fat per 100g by 66.67g and then multiply it by 100% to get the DV of fat.

$$\text{Fat DV(\%)} = \frac{\text{Fat per 100g}}{66.67\text{g}} \times 100\%$$

20% of protein from 2,000 Kcal is 400 Kcal. Then convert Kcal into grams by dividing it by 4 g, as 1 Kcal of protein will yield 4 g. We will get 100g. Hence, to calculate the DV of protein from the nutrition label, we need to divide protein per 100g by 100g and then multiply it by 100% to get the DV of protein.

$$\text{Protein DV(\%)} = \frac{\text{Protein per 100g}}{100\text{g}} \times 100\%$$

DV for sodium is calculated by dividing the amount of sodium per 100 g by 2,000 mg and then multiplying by 100%.

$$\text{Sodium DV(\%)} = \frac{\text{Sodium per 100g}}{2000 \text{ mg}} \times 100\%$$

### **1.9.2 Price Effectiveness**

This represents the general measure of price effectiveness as the relation of the product's price to the amount of one of the nutrients either protein, fat, or sodium that 100 grams of the product will contain. It's calculated by dividing the amount of a nutrient, like sodium, protein, or calories, per 100mg of the product by its price per 100mg (in RM). Quantities are expressed in terms of 100 grams of nutrient for ease of comparison of products across brands. It is calculated in the manner in this formula.

$$\text{Price Effectiveness( g/RM )} = \frac{\text{Nutrient Content per 100 g (g)}}{\text{Price of Product per 100 g (RM)}}$$

## CHAPTER 2

### 2.0 LITERATURE REVIEW:

#### 2.1 Nuggets and Sausages

According to the NOVA food classification, nuggets and sausages are typical representatives of ultra-processed foods. These foods are processed industrially, by large utilizing components from other foods for example oils, fats, sugars and starches, and protein. The NOVA classification clearly defines ultra-processed foods as extremely complicated industrial mixtures of food-derived substances; these mixtures entirely lack whole foods, furthermore, they are usually fortified with many additives, such as colorants, flavorings, emulsifiers, thickeners, along with other cosmetic ingredients to importantly improve flavor, often making them excessively appealing (Monteiro et al., 2019). Industry processes many of these products and this process happens on a massive scale.

Reconstituted meat or meat substitutes, along with additives, preservatives, flavorings, as well as other synthetic ingredients, typically form the base of these products, which usually include only a minimal amount of whole food. Multiple cosmetic additives, added for convenience as well as palatability, make them attractive, but nutritionally deficient. Many industrial formulations, using many food-derived substances and undergoing several physical, chemical and biological processes, create ultra-processed foods (UPF) (Monteiro et al., 2019). High levels of refined starch, sugar, and salt are generally found in these foods, while unfortunately necessary nutrients, typically present in whole foods, are importantly absent. Manufacturers frequently add many artificial colors, a lot of added flavors and many other additives to these products.

Nuggets and sausages are popular nowadays because of their sodium content, sugar, and unhealthy fats for human body consumption but they have dangerous health consequences. Increased consumption of such foods is associated with obesity, type 2 diabetes, and cardiovascular diseases (CVD) mainly because these ultra-processed foods dominate people's diets (Liu et al., 2023). Although they are convenient, appealing, and easily accessible, these foods are highly unhealthy, and lacking in essential nutrients. The long-term effects of their consumption pose significant risks to public health.

## **2.2 Sodium content in nuggets and sausages**

Sodium has important functions in controlling fluid and electrolyte balance in the body due to its presence and its effect on osmotic pressure (Minister of Health Malaysia, 2017). On the other hand, excessive sodium intake results in very bad health issues. According to the Centers for Disease Control and Prevention (CDC), more than 40% of our daily sodium intake comes from common foods like bread, processed meats, sandwiches, pizza, pre-made soups, cheese, and snacks. This also suggests an association between the intake of ultra-processed foods and high sodium intake (De M Cunha et al., 2019). Of primary concern of too much sodium is its association with hypertension and high blood pressure, making control of sodium levels an important factor for optimal health. Since sodium plays a role in fluid homeostasis, excessive intake can elevate blood pressure by increasing blood volume. Sodium, although necessary for the body, excessive sodium intake is associated with cardiovascular disease. It has been demonstrated that excess sodium intake is related to a variety of health conditions all over the world and is causal to 3.1 million deaths, over 5% of the lifetime premature deaths and millions of years of life lived with disability (Allemandi et al., 2015).

Sodium chloride (NaCl) serves more purposes than just enhancing flavor in processed meats; it plays a vital role in texture and preservation as well. NaCl facilitates the dissolution of myofibrillar proteins which do not dissolve in water on their own and processes such as blending and tumbling facilitate extractions and transport of salt-soluble proteins to the surface of the meat. This solubilization is critical to bind the meat to different processed types. For example, in processed meats whose texture is molded and heat-treated to specific shapes, salt-soluble proteins constitute a gel network that retains the processed meat during processing. Also, in emulsified meats such as bologna and frankfurter, these proteins coat fat molecules, thus preventing fat and protein separation (Henney et al., 2010). In addition, NaCl decreases water activity ( $A_w$ ), making it a condition that inhibits microbial growth and prevents the degradation of processed meats (Matthews Strong, 2005).

Excess sodium can also put stress on the kidneys, which must work harder to remove the surplus from the bloodstream, potentially causing kidney damage over time. For renal health, a low sodium intake should be maintained and hydration achieved as much as possible by drinking fluids. Also, high sodium intake can lead to calcium loss from bone, which increases the risk of osteoporosis and fractures. To protect bone health, it's advisable to limit sodium consumption and ensure adequate intake of calcium and vitamin D through foods like dairy, leafy greens, and fortified options. Hypernatremia is also linked to a wide range of health problems, including gastric cancer, cognitive deterioration, and pulmonary edema (thoracic fluid accumulation). However, to decrease these risks, it's very important to remember the amount of sodium contained in processed food, restaurant meals, and condiments, and to choose low-sodium alternatives whenever possible.

Although the maximum amount of sodium the human body requires for normal functioning is estimated to be between 200-500 mg/day, the actual sodium intake around the world as determined by the World Health Organization (WHO) is much higher than this. Sadly, in a number of countries, the daily per capita intake exceeds the World Health Organization's (WHO) recommended limit of 2 g of sodium per day.

### **2.3 Fat content in nuggets and sausages**

Fat is abundant in products such as nuggets and sausages from the processed meats. It contributes significantly to both taste and texture. Fat has an important effect on moisture retention in frying, which thus has an important effect on frying. Fat serves as a binder, keeping the other constituents together and controlling moisture loss during cooking in turn ensuring the final product has a juicy textural characteristic and product stability. Moreover, fat is the quality parameter of the combined taste and mouthfeel of these goods. Some of the fats, for example, saturated fats, may enhance the flavor and the mouthfeel even with possible relationship to negative health outcomes. Observed a correlation of consumption of ultra-processed foods (UPF) with multiple body fat parameters, including total percentage of body fat, android percentage of body fat, gynoid percentage of body fat, and multiple secondary body fat measures (Liu et al., 2023).

Dietary patterns composed of saturated and trans fats of daily consumption may have important public health implications for childhood, but in a powerful way, concerning obesity and cardiovascular disease. An imbalance of the calories of food with a high-fat content can cause obesity-causing physical and sociopsychological problems. Additionally, intake of these fats is also associated with a higher risk of cardiovascular diseases such as coronary heart disease, and stroke, via elevation of dyslipidemia and in turn, promoting the formation of plaques in the arteries.

Furthermore, high dietary saturated fat intake can decrease insulin sensitivity eventually leading to insulin insensitivity and increasing type 2 diabetes patients at children. This insulin resistance poses enduring implications for metabolic health. Specifically, recent data indicates that the consumption of foods high in unhealthy fats is related to deleterious effects on cognitive ability and fine motor abilities necessary for proper brain development in children and thus to academic achievement. Over the long term, children consuming a high-fat diet (HFD) may become susceptible to the development of chronic diseases in later life, including diabetes mellitus, cardiovascular disease, and specific types of cancer. Therefore, the mechanisms by which dietary fat intake and its multifactorial effect on childhood health should be clarified to devise specific preventive interventions and integrative pediatric management.

#### **2.4 Protein content in nuggets and sausages**

Protein is a key component of the formulation of formed meat products such as nuggets, and sausage. Protein is employed in numerous ways in ultra-processed foods (UPF) and is commonly added to improve the tactile, sensory, and overall desirability of the product.

In nuggets, protein is the primary structural element, giving the product its structure and texture. Poultry meat, the major component of chicken nuggets, is high protein and therefore it is the most suitable raw product for nuggets. Protein is one of the nutritional components in the nutritional content of nuggets which give it the necessary principal amino acids for muscle building and recovery as well as for other physiological functions in the whole body.

Analogously protein plays an important role in the sausage texture to obtain a balanced texture of the sausage and keep the sausage system intact during processing and cooking. Ground meats, such as pork, beef, or poultry, constitute the basis of sausage recipes and

are a significant source of protein. Due to the inclusion of mechanically deboned chicken meat in the sausage formulation, the chicken sausage is softer, more bouncy, and less texturally cohesive. This is because of the extreme water-holding ability of boiled chicken meat, and soft sausages (Huda et al., 2010). In addition, other protein-derived components like binders or extenders can also be incorporated to enhance textural features and moisture retention.

Protein content in nuggets and sausages is one of the most crucial factors that affect nutrient quality and consumer preference for the product. However, this review should not ignore the source of the protein as well as the possible inclusion of other ingredients like additives and preservatives, which might affect the quality of the product. Analysis of nuggets and sausage protein content comparison between brands available in the Malaysian market could provide valuable information about product diversity and potential nutritional matters for consumers.

## **2.5 Other nutrient content in nuggets and sausages**

Nitrates are vital in cured meats, which give it characteristics such as its pink color and yummy taste. One of their functions is also to protect fats and proteins in meat from oxidation and also to arrest the growth of pathogenic bacteria such as *Clostridium botulinum* (Shakil et al., 2022). Nitrite, therefore, has limited uses as a preservative for meat and has mainly the following three functions. First, it is used to hinder the growth of *Clostridium botulinum*, which results in foodborne toxins and, hence foodborne illness (Patarata et al., 2022). Nitrite plays a major role in making the processed meats safe for human consumption. Nitrite inhibits the growth of *Clostridium botulism* by interfering with the metabolism. Nitrites are pH-dependent and non-oxygen dependent whereas they will convert to a reactive form and are highly effective at lower pH even the absence of oxygen can inhibit the growth of bacteria (Majou & Christieans, 2018). Next, improve

the brightness of the red color of some meat products such as sausage, ham, and salami since the nitrite will react with the myoglobin in the meat (Candan & Bağdatlı, 2018). Red-coloured nitrosomyoglobin is generated from the reaction of nitrite with myoglobin (Chatkitanan & Harnkarnsujarit, 2020). Nitrite also plays a role in flavour and texture of cured meats (Callewaert et al., 2018). Also, nitrite decelerates lipid oxidation in meats and so helps in delaying the formation of rancid tastes (Aminzare et al., 2019).

The mineral phosphate is a vital participant in so many processes that it is present in most of the foods we take. However, the source and the quantity of phosphate consumed it has some proportionable effect on health. Organic phosphorus from natural food usually does not lead to pathological consequences, while excessive consumption of inorganic phosphate, which is abundant in processed and ultra-processed foods, can be dangerous. Unlike organic phosphorus in plant foods, which is often limited due to phytates, inorganic phosphate is added to many ultra-processed foods (UPF) as an additive and is highly bioavailable. Inorganic phosphate additives lead to excessive phosphate consumption, with recent evidence accumulating that this leads to adverse health effects in the normally healthy general population (Calvo et al., 2019). Foods that contain significant amounts of inorganic phosphates include processed meat, ham, sausage, canned fish, baked goods, cola drinks, and other soft drinks. The risks associated with high dietary phosphate exposure, particularly from inorganic phosphate supplements, are well documented in CKD patients, including the association with increased risk of bone loss, cardiovascular disease, and all-cause mortality. Nonetheless, knowledge about the effects arising from the continuation of excessive phosphate consumption is still scarce, as the overall population's diet is abundant with ultra-processed foods containing added phosphates (Su et al., 2022). Quantitative measurement of phosphate in the diet is

difficult, and the task is often underestimated because the content of phosphate in food and food additives is rarely declared on the label.

## **2.6 Energy content in nuggets and sausages**

Energy and calorie content is a parameters of considerable significance for evaluations of the nutritional quality and possible health effects of foods. Fat nuggets and sausages which fall under the ultra-processed products are characterized by high energy density by their composition and processing. These products are usually rich in fats and carbs and are generally foods that have many calories for each serving size. UPF can be described as foods that are minimally fresh and easy to consume, but are characterized by high calories, sugar, and sodium content, together with low protein, fiber, and micronutrient densities. This leads to gaining less than an optimal nutrient intake (Livingston et al., 2021). However, the addition of these substances and methods of processing can also improve the caloric value of the feed. Hence anyone who wants to limit the amount of calories they take, or those with other dietary guidelines they should follow should do so carefully when taking nuggets and sausage and realize the consequences that come with it.

## **2.7 Health Impact**

Twenty-first-century diet increasingly incorporates UPFs, which affect the population's well-being regardless of age and gender. These food items represent new types of highly processed foods that are rich in additives and are consumed daily by citizens worldwide. As a result, they have supplanted traditional foods, despite the significant decline in the quality of ultra-processed foods (UPFs). Their intake is progressively linked to all forms of health complications, ranging from metabolic diseases to chronic illnesses. In addition,

ubiquitous marketing of UPFs together with socio-economic factors has contributed greatly to increased accessibility and utilization of UPFs. This discussion explores the complicated impact of UPFs on health to understand the interaction between diet, health behaviors, and health outcomes across cultures.

An increased consumption of UPFs during pregnancy increases the odds of gestational diabetes mellitus and preeclampsia (Paula et al., 2022). Ultra-processed foods have ingredients that are not frequently used in conventional preparations and it often contain additives. They are meant to have a long shelf life and can remain in close contact with the packaging materials for long and during the process, the packaging compounds can be absorbed (Hwang et al., 2018).

Obesity within childhood and adolescent populations increases the risk for the development of chronic disease and has both short-term and long-term consequences. In the short run, some of the effects include psychological incidents, eating disorders, asthma, and musculoskeletal disorders (Quek et al., 2017). Further, metabolically abnormal overweight or obese youth is characterized by dyslipidemia, type 2 diabetes mellitus, or cardiovascular complications (Di Cesare et al., 2019). Persistent issues in adults have roots in socio-environmental contexts that contribute to obesity during adulthood. These illnesses by themselves could disable and increase the risk of early mortality; the two most chronic conditions worsen with persistent obesity. This has been fueled by higher advertisements placed for attractive and tasteful, cheap, easily accessed, but nutrient-deficient and energy-dense foods such as nuggets and sausages.

Sustenance with UPFs was reported to predispose consumers to a variety of metabolic diseases such as obesity, insulin resistance, and dyslipidemia. These conditions not only

increase the probability of having type 2 diabetes and cardiovascular diseases but also come with a lot of risk factors on their own.

In addition, UPFs often contain little or no nutritive value but have a high content of fats, sugars, coloring agents, and preservatives among others. The reliance on these foods leads to poor health due to malnutrition and weak body immunity system which is very dangerous to human health. This unhealthy distribution of nutrients leads to many diseases as well as worsens the existing diseases and health complications.

The chemicals contained in UPFs may act as additives, or preservatives and can upset the typical functioning of the digestive system hence leading to symptoms such as stomach upset, bloating, and gassiness. Additionally, UPFs high in refined sugars and processed ingredients can worsen gastrointestinal illnesses affecting the gastrointestinal tract such as IBS altering the risk of these complications further.

It is well understood that the ingredients of UPF food components like refined sugars, artificial trans fats, and processed oils are inflammatory. Chronic inflammation is connected with several health problems such as arthritis, autoimmune diseases, and cardiovascular diseases.

Although the connection between UPF consumption and cancer risk has not been proven, few studies point toward the possibility of this link. Some of the foods contain additives, preservatives, and chemical compounds, which are well known to be carcinogenic or indirectly promote the formation of cancer through obesity and inflammation. Research by Azizah & Cheah (2019) highlights the growing concern about cancer incidence in the country, drawing attention to this emerging issue.

Of all the major cancers diagnosed during this time, two that dominated the list included breast and colorectal cancers taking the first and second positions respectively. In relative

proximity were Lung cancer, Lymphoma, Nasopharynx cancer, Leukemia, Prostate cancer, Liver cancer, Cervical cancer, and Ovarian cancer.

However, using UPFs as a regular tradition has many negative impacts on health concerning metabolic disturbances and nutritional deficiencies, gastrointestinal problems, inflammation, and possibly cancer. Redirection of the diet towards whole, minimally processed foods, and avoiding UPFs is well averted to achieve optimal and disease-free health.

## **2.8 Demand size**

The current consumption rate of ultra-processed foods has expanded notably in numerous nations and parts of the world, including Malaysia (Baker et al., 2020). From the current data, there is an increased trend indicating consumers in Malaysia prefer Nuggets and Sausages flavors such as spicy, cheese, BBQ, and original. Numerous reasons led to the increase in demand for the product including convenience, variety in flavor, and change in consumer behavior. In 2024, the consumption of sausages stands at \$ 257.40 million, and its annual growth rate from 2024 to 2028 is 3.78% ( Statista, n.d.). Secondary data analysis reveal that there has been rising trends in the sales of nuggets and sausages in Malaysia over the last few years due to increased urbanization and increased convenience eating. According to Eng et al. (2022), people living in low-income households in Malaysia are more likely to develop obesity and metabolic diseases because they consume unhealthy food. These comprise high consumption of ultra-processed foods, sweetened beverages, and calorie-dense local foods, and low consumption of fruits and vegetables. Original-flavored products are considered standard due to their broad consumer preference. Likewise, there is an ever-increasing trend towards hot and spicy flavors of food which could be attributed to the expanding phenomena of preference of dishes with

robust and pungent flavors. Cheese-flavoured products are popular since cheese is one of the most preferred types of products by the child and adult population of Malaysia. Further, products with BBQ flavor sensation are slowly entering the market to match the trend that tastes sweeter and tangier like the food grilled on the barbeque. Though these kinds of figures are beyond this analysis, the trend illustrated by the proportion of varied flavors signals the importance of flavor diversification practically. This has been made possible through the willingness of the manufacturers and retailers to modify themselves and their stocks to meet these preferences by stocking a diverse flavor portfolio. To summarize, one could argue that the increase in the consumption of nuggets and sausages is a sign of Malaysians' preference for fast-food products that offer taste and convenience. The fact that consumers are very selective and prefers to select high-quality products, the market is set for further improvement and new flavors can be introduced into the market.

## **CHAPTER 3**

### **3.0 METHODOLOGY**

#### **3.1 Study design**

This comparative study was carried out among various brands of nuggets and sausages sold in Malaysia.

#### **3.2 Study location**

The studied location for this research consisted of a careful choice of nugget and sausage brands available in physical stores across Kota Bharu as well as through Malaysian-based online grocery shopping platforms. This inclusive approach endeavored to capture a wide continuity of the products that are bought by the consumers in any outlet. To achieve the objective of the analyzed study, which was to obtain a broad range of products and variations of nutrition content from both offline and online stores. In more detail, variables of interest included sodium content per 100g, fat content per 100g, and protein content per 100g as described in the product labels, refer Appendix 1.

Thus, this analysis provided a richer view of the context for the consumption of nuggets and sausages in Malaysia, as well as the influences of both traditional point of sale and new eCommerce influences. Prospective differences or similarities in the nutritional values of these products between different brands and selection sources such as supermarkets and online platforms were highlighted and revealed through a detailed quantitative evaluation of the products that Malaysians consume.

#### **3.3 Study duration**

The duration of the study is between April 2024 to January 2025.

### **3.4 Source population**

To perform a comparative study on the sodium, fat, and protein levels in chicken nuggets and sausages from various brands in Malaysia, examine all the different brands of these products available in the Malaysian market. This encompasses all supermarket-owned brands, local Malaysian brands, and international ones sold in Malaysia. The analysis aims to encompass a diverse yet representative sample of these brands, shedding light on the nutritional differences among the available products for consumers in Malaysia.

### **3.5 Subject criteria**

Inclusion criteria:

- Those nuggets and sausages flavored spicy, cheese, and BBQ and original.

Exclusion criteria:

- Brands of nuggets and sausages that do not provide information about sodium, fat, and protein in the food label.

### **3.6 Data collection**

To obtain relevant and factual information on the actual nutrient composition of the chicken nuggets and sausage consumed in Malaysia, the nutrition labels of the ultra-processed food products are used. This was done either by physically going to physical supermarkets or by logging on to the internet to access sites where these products were being sold. Per serving information such as sodium, fat, and protein and also the price was obtained directly from the product label during these visits refer to Appendix 2.

Otherwise, the information was available on the official websites of supermarkets retailers, or manufacturing companies that were searched by the researchers. This online approach offered full nutritional information while not necessitating any face-to-face consultation. This method helped to employ standardized nutritional labeling that is provided by the regulatory authorities to have a clear picture of nutritional information for various brands of chicken nuggets and sausages in Malaysia.

### **3.7 Data analysis**

The study then carried out an analysis to provide a basis for comparing nugget and sausage brands in different categories. These categories included the type of products, whether nuggets and sausages, flavors, whether spicy, cheese, BBQ and the original. The nutritional values were obtained from the labels on the food products and standard database information.

In this study, descriptive analysis was used in analyzing the trends and fluctuations of the concentration of sodium, fat, and protein in the categories under consideration. To identify the tops ranked products, the daily value of sodium, fat, and protein for those goods, as well as price effectiveness, was defined, and, in turn, the minimum and maximum of the calculated price effectiveness were defined.

To assess significant differences between the brands and the flavors – and because the data were not normally distributed – the Kruskal Wallis test followed by Mann Whitney U test with Bonferroni Holm correction were used. By following this approach, a higher level of accuracy was achieved in terms of distinguishing between groups and the chosen level of significance was  $p < 0.05$ .

The analysis with these statistical methods showed significant differences in nutrient composition between sausage flavours and no significant differences for nugget flavours which provided an enhanced understanding of the nutrient composition in the Malaysian context.

The data collected for the research was analyzed using the Statistical Package for the Social Sciences (SPSS) tool version 29, which is reliable and easy to use. Thus, SPSS offered the necessary complex statistical procedures and options for a more profound