

Comparative Analysis of Sodium, Fat and Protein Content in Nuggets and Sausages Across Diverse Brands and Flavours in the Malaysian Market

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ABSTRACT

Nuggets and sausages are among the most popular processed meat products in Malaysia, widely consumed for their convenience, affordability, and variety of flavours; however, they also contribute substantially to Malaysians' dietary sodium and fat intake. This study evaluated and compared the sodium, fat and protein content of chicken nuggets and sausages in original, spicy, cheese, and BBQ flavours from diverse brands in the Malaysian market. The purposive sampling method with an inclusive approach was adopted. A total of 56 nugget products and 58 sausage products from various brands available in Malaysia were analysed. The study included original, spicy, cheese, and BBQ flavours, while products lacking sodium, fat, or protein information on the food label were excluded. The samples were collected either from the physical stores across Kota Bharu town or through Malaysian-based online grocery shopping platforms. Nutritional information was obtained from product labels. Kruskal-Wallis test and Mann-Whitney U test were used to compare the nutrient contents. The assessment showed there are no significant differences ($p>0.05$) in nutrients across different flavours of nuggets. However, there are significant differences ($p<0.05$) in the sodium, fat, and protein content of sausages, depending on the brand and flavour. Notably, cheese flavour has the highest protein level while original flavour has the lowest sodium and fat content. The study emphasizes the usage of cost-effectiveness to ensure nutrient intake efficiency. 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. Future research should also examine micronutrients, trans fat, and fibre, as these are vital for overall health and provide a more complete picture of the nutritional quality of nuggets and sausages in Malaysia.

Keywords: Comparative study, Malaysia, Nutrients, Ultra-processed foods

1 INTRODUCTION

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 savoury snacks, processed meat products, frozen meals, soft drinks, and other food products, making classification challenging [1].

The NOVA system [2] stands out as the most prevalent among food classification systems whereby foods are allocated into 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 [3].

The prevalence of ultra-processed food consumption has surged globally, including in Malaysia; for example, recent studies report that ultra-processed foods contribute about 31-40% of daily energy intake among Malaysian young adults and adults [4, 5]. Concerns have emerged regarding the nutritional value particularly elevated levels of sodium, fat, and protein. 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 as well as increasing the risk of heart disease [6]. 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.

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Although previous studies suggest that processed meat is not necessarily high in nutritional value, consumers tend to prioritize protein content in their purchasing decisions. The emphasis on protein content can sometimes distract from the potential health risks associated with their high sodium and fat content [7]. Although sausage and nuggets do provide protein, standard nugget and sausage products are typically low in dietary fibre and contain limited amounts of vitamins and minerals, as shown in both nutrient composition analyses and formulation studies [8, 9].

While international studies suggest that flavoured varieties, such as BBQ or spicy options, often contain higher sodium and fat, to our knowledge, no local study has compared the nutritional differences of these flavour variants. Most available analyses only focus on the basic or unflavoured products, leaving consumers with little guidance on how seasonings may alter the protein, fat, or sodium content [10]. Since product formulations are tailored to local taste preferences, relying on data from other countries may not reflect what Malaysians are actually consuming. This lack of local evidence is important, as it limits the ability of both consumers and health authorities to make informed choices in promoting healthier eating habits. Hence, this study aimed to evaluate cost-effectiveness by comparing sodium, fat, and protein levels across different flavours of nuggets and sausages from popular brands in the Malaysian market.

2 METHODOLOGY

2.1 Study Design and Scope

This study employed a cross-sectional comparative analysis of nuggets and sausages sold in Malaysia. Products assessed included supermarket-owned brands, local Malaysian brands, and international brands available in the market. Nutritional information was obtained directly from product labels, either through physical collection in supermarkets or from official supermarket and manufacturer websites. Reliance on standardized nutritional labelling, as mandated by regulatory authorities, ensured consistency and reliability in comparing nutrient composition across brands and flavour variants.

2.2 Sampling and Timeframe

Samples were collected from physical stores across Kota Bharu town as well as Malaysian-based online grocery shopping platforms. The purposive sampling method with an inclusive approach was adopted to capture a comprehensive coverage of products commonly purchased by consumers. Data collection was conducted from April 2024 to January 2025.

2.3 Inclusion and Exclusion Criteria

Eligible products included nuggets and sausages in original, spicy, cheese, and BBQ flavours. Products were excluded if sodium, fat, or protein information was not provided on the food label. Duplicates of the same product purchased from different outlets were excluded from the analysis.

2.4 Variables and Statistical Analysis

The primary variables of interest were sodium, fat, and protein content per 100 g, as stated on the product labels. Additional information, including per-serving nutrient values and price, was also extracted to allow for cost-effectiveness analysis (nutrient content per 100 g/price per 100 g). For products with varying prices across outlets and platforms, the average price was calculated and used in the analysis to provide a representative estimate of consumer cost. Descriptive analysis was performed to examine nutrient trends, while group differences were assessed using the Kruskal–Wallis test, followed by the Mann–Whitney U test with Bonferroni–Holm correction. Statistical significance was set at $p < 0.05$. All analyses were performed using SPSS version 29.

3 RESULTS

3.1 Descriptive Statistics

A total of 56 nugget products and 58 sausage products from various brands in Malaysia were analysed. Descriptive data for nuggets are presented in Table 1. Among nuggets, Double Snack Spicy Flavoured and Double Snack Original Flavoured had the highest sodium content (822 mg/100 g), while Raffie Crispy Nugget Original Flavour contained the highest fat (23.50 g/100 g). The highest protein content was observed in Spicy Tempura Chicken Nugget, Lotus Flavoured Spicy (21.80 g/100 g).

For sausages (Table 2), *Ayamas* Chicken Frankfurters Cheese contained the highest sodium (943 mg/100 g), Saudi Gold Cheesy Chicken Bratwurst had the highest fat (19.40 g/100 g), and Megahdeutsch German Cracked Black Pepper Sausage, Spicy Flavoured, recorded the highest protein (16.90 g/100 g).

3.2 Nutrient Differences by Flavour

Despite variations in sodium, fat, and protein among nugget products, the Kruskal–Wallis test showed no significant differences across the three flavours (spicy, cheese, and original) (Table 3). This suggests that flavour did not significantly influence the nutrient content of chicken nuggets. In contrast, significant nutrient differences were observed among sausage flavours. The Kruskal–Wallis test (Table 4), followed by Bonferroni–Holm correction,

Table 1: Sodium, fat, and protein content per 100 g in nugget products (n = 56) based on product label information

Nutrient	Minimum	Maximum	Mean	Median	Standard Deviation
Sodium	70	822	420.73	412.00	181.00
Fat	4.00	23.50	12.23	11.85	4.34
Protein	5.00	21.80	11.85	11.40	2.72

Table 2: Sodium, fat, and protein content per 100 g in sausage products (n = 58) based on product label

Nutrient	Minimum	Maximum	Mean	Median	Standard deviation
Sodium	240	943	553.23	533.00	220.57
Fat	0.20	19.40	7.25	7.10	5.36
Protein	8.70	16.90	12.47	11.80	1.75

Table 3: Comparison of sodium, fat, and protein content in nuggets of different flavours (n=56)

Nutrient	Flavours Compared	Kruskal-Wallis Statistic	Degree of Freedom(df)	p-value
Sodium (mg)	Spicy, Cheese, Original	1.989	2	0.370
Fat (g)	Spicy, Cheese, Original	4.879	2	0.087
Protein(g)	Spicy, Cheese, Original	0.253	2	0.881

Table 4: Comparison of sodium, fat, and protein content in sausages of different flavours (n=58)

Nutrient	Flavours Compared	Kruskal-Wallis Statistic	Degree of Freedom (df)	p-value
Sodium (mg)	Spicy, Cheese, Original	7.511	2	0.023 *
Fat (g)	Spicy, Cheese, Original	6.528	2	0.038 *
Protein(g)	Spicy, Cheese, Original	11.879	2	0.003 *

*significant at $p < 0.05$

Table 5: Multiple Comparison of sodium, fat, and protein content in sausages of different flavours (n=58)

Dependent	Comparison	p-value	rank	adjusted rank
Sodium	spicy vs cheese	0.226	7	0.020*
Fat	spicy vs cheese	0.397	8	0.025*
Protein	spicy vs cheese	0.849	9	0.050*
Sodium	cheese vs original	0.008	2	0.006*
Fat	cheese vs original	0.043	6	0.013*
Protein	cheese vs original	0.020	4	0.008*
Sodium	spicy vs original	0.002	1	0.006*
Fat	spicy vs original	0.012	3	0.007*
Protein	spicy vs original	0.041	5	0.010*

Note: Bonferroni Holm Adjustment for multiple comparisons in sausages. *significant at $p < 0.05$

Table 6: Analysis of cost-effectiveness for sodium, protein, and calorie content in nuggets and sausages

Products	Range	Sodium (mg/ RM)	Protein (g/RM)	Calories (kcal/RM)
Nuggets	Minimum	28.72	2.82	58.87
	Maximum	548.84	12.21	252.57
Sausages	Minimum	96.94	2.22	24.68
	Maximum	540.63	12.66	492.41

indicated that sodium, fat, and protein contents differed significantly across spicy, cheese, and original sausage products (Table 5).

3.3 Cost-effectiveness Analysis

The cost-per-nutrient analysis revealed substantial variation in nutrient value across nugget and sausage products (Table 6). For sodium, Nutriplus Spicy Nuggets had the lowest value (28.72 mg/RM), while *Ayamadu* Original Nuggets had the highest (548.84 mg/RM). Among sausages, CP Sausages Chill Cocktail offered the lowest sodium (96.94 mg/RM), whereas Topvalu Cheese Sausage contained the highest (540.63 mg/RM).

Protein cost-effectiveness also varied considerably. *Ayam Seri* Original Nuggets provided the greatest protein per ringgit (12.21 g/RM), while EB Cheese Nuggets offered the least (2.82 g/RM). Among sausages, Topvalu Chicken Frankfurters delivered the highest protein value (12.66 g/RM), and MegahDeutsch Spicy Sausage the lowest (2.22 g/RM).

Energy per ringgit followed a similar trend. *Ayam Pertiwi* Nuggets provided the highest energy return (252.57 kcal/RM), while First Pride Tempura Nuggets offered the lowest (58.87 kcal/RM). For sausages, Topvalu Original Chicken Frankfurters had the highest energy content (492.41 kcal/RM), while MegahDeutsch Spicy Sausage had the lowest (24.68 kcal/RM).

4 DISCUSSION

The analysis reveals significant variations in sodium levels among different brands of nuggets and sausages. This finding is aligned with a study [11] which also reported high sodium content in processed meat products such as burgers, sausages, and hotdogs. Their research attributed these elevated sodium levels to the use of food additives, including monosodium glutamate (MSG) and phosphates, commonly used for flavour enhancement and preservation. Similarly, the observed differences in sodium content may be influenced by variations in seasoning formulations and preservation techniques adopted by different manufacturers.

While sodium is vital for maintaining product quality and safety, there is a growing consumer and regulatory demand for lower sodium alternatives. Research indicates that effective methods like employing ultrasound technology and substituting sodium with potassium chloride (KCl) can help reduce sodium content while maintaining product quality [12, 13]. Another studies [14, 15] investigated the partial replacement of sodium chloride (NaCl) with potassium chloride (KCl) in pork sausages and pork bologna, respectively. In fact, the substitution revealed no shifts in the overall physicochemical characteristics or sensory attributes of the final products. Reformulating these

products to decrease sodium levels could assist manufacturers in conforming to dietary guidelines and tackling public health issues related to high sodium consumption.

The findings of this study demonstrate that certain brands exhibit higher fat content compared to others which aligns with previous study [16]. They reported that locally produced meat products often contain elevated fat levels and reduced protein content. High-fat content can present both benefits and drawbacks. On the beneficial side, fats improve flavour, texture, and overall sensory experience, making the product more appealing to consumers. Additionally, fats provide a richer mouthfeel and serve as a concentrated energy source. However, excessive consumption of fat, especially saturated fats, is associated with adverse health effects, including an increased risk of cardiovascular disease and obesity. These results emphasize the necessity of finding a balance in fat content when formulating products to satisfy consumer preferences for taste while also offering healthier alternatives.

The nugget and sausage products in this study displayed a wide range of protein levels. The highest protein content in nugget contributes 21.8% of protein daily value. Meanwhile, sausage with the highest protein content contributes 16.9% daily value. Many locally processed meat products contained protein levels below the minimum standards set by food regulations [16]. A similar pattern is evident in this study, certain brands demonstrated lower protein content which is likely due to the replacement of high-quality meat with extenders such as soy protein and cereal starch. This study highlights the importance of implementing stricter quality control measures to ensure commercially available meat products maintain the adequate protein levels.

In addition to support various bodily functions such as muscle repair and immune system, protein is vital for the functionality and quality of nuggets and sausages. Protein in nuggets provides structural integrity, texture, and overall sensory properties by facilitating water retention, emulsification, and gel formation [17]. These are important to ensure juiciness, cohesiveness, and pleasant chew. The increased protein content in the Lotus Flavoured Spicy Tempura Chicken Nugget boosts these characteristics, resulting in a balanced texture and flavour profile that aligns with consumer quality expectations. In sausages, protein affects texture and mouthfeel by enhancing firmness and bite. The elevated protein content in the MegahDeutsch German Cracked Black Pepper Sausage likely enhances its hearty and enjoyable texture.

These insights underscore the importance of sufficient protein content in nuggets and sausages, not only to enhance sensory qualities like taste, texture, and juiciness [18], but also to deliver health

benefits. Processed meat products are still recognized as valuable sources of high-quality protein that support growth and maintenance [19]. Enhancing protein content, alongside sensory attributes, aligns with consumer expectations for both nutritional worth and enjoyable eating experience.

There are no significant differences in the levels of sodium, fat, and protein found in a range of nuggets from different flavours sold in Malaysia. In other words, the addition of flavouring does not significantly change the nutrient content of nuggets. Notably, sodium content varied between 70 mg and 822 mg, which is rather dangerous for those who adhere to low-sodium diets.

Conversely, there are significant differences in the levels of sodium, fat, and protein found in a range of sausages from different flavours sold in Malaysia. The original flavour sausage has always been associated with low sodium and fat content as compared to the spicy and cheese flavour. Appealing to health conscious consumers, especially those who are on a low sodium or low fat diets due to high blood pressure or any cardiovascular complications, the original flavoured type sausages maybe more appropriate. Producers could seize this opportunity by marketing the original flavour sausages as a healthier alternative to the cheese and spicy variants. As expected, the spicy and cheese sausages have more protein content as compared to the original flavoured. Cheese in general contains high levels of protein, especially if it is hard cheese such as cheddar or mozzarella.

From a broader perspective of cost-effectiveness, products offering higher protein content per ringgit represent better nutritional value for money. Beyond nutrient density alone, factors such as brand pricing strategies, degree of processing, ingredient quality, and perceived brand reputation also influence consumer choices. These findings suggest that consumers who prioritize affordability and nutrition may benefit from selecting simpler or less-processed products that provide greater value without compromising on quality.

In terms of calorie cost-effectiveness, *Ayam Pertiwi* Nuggets (original flavour) exhibited the highest caloric value per ringgit (252.57 kcal/RM), indicating lower suitability for consumers managing calorie intake. In contrast, First Pride Tempura Nuggets (58.87 kcal/RM) and MegahDeutsch Spicy Sausage (24.68 kcal/RM) offered lower energy-to-cost ratios, making them preferable options for calorie-conscious individuals. Meanwhile, Topvalu Chicken Frankfurters (492.41 kcal/RM) provided the greatest energy density, appealing to those seeking higher caloric value per expenditure. These findings highlight substantial variability in calorie cost-efficiency among brands, emphasizing the

importance of transparent labelling to enable informed and health-aligned consumer choices.

The variations in calorie cost-effectiveness likely arise from differences in formulation, ingredients, and brand strategy. Products like *Ayam Pertiwi* Nuggets and Topvalu Chicken Frankfurters may have higher fat or filler content, increasing calorie density and lowering production costs. In contrast, First Pride and MegahDeutsch products may use leaner meat or higher-quality ingredients, resulting in fewer calories but higher prices. These differences reflect varied market approaches in balancing affordability, satiety, and health-focused formulations.

When selecting high-quality nuggets and sausages, it is essential to evaluate the ingredients to achieve a balance between nutritional benefits and cost-effectiveness. Certifications also help in defining better products. The public should put into practice 'low sodium' or 'reduced sodium' label. When reviewing the ingredients, it is essential to check for the inclusion of additives like monosodium glutamate (MSG) or sodium nitrates. It is also important as labels like Halal, Organic, or No Added MSG claim certain dietary, ethical, and health standards, especially in Malaysia. Equally important is verifying the product's expiry date to ensure it provides adequate shelf life, thereby reducing the risk of wastage for consumers.

This study stands out as one of the first survey to provide a detailed look at the nutritional value of chicken nuggets and sausages across popular brands in Malaysia. By focusing on key nutrients such as sodium, fat, and protein, it offers valuable, evidence-based insights to help consumers make healthier and more informed choices about processed foods. These findings of high sodium levels in nuggets and sausages support Malaysia's National Salt Reduction Strategy (NSRS) and NPANM III (2016–2025), which aim to lower population salt intake to below 5 g per day. The variation in sodium content across brands underscores the need for stronger product reformulation, clearer labelling, and greater consumer awareness to reduce sodium intake from processed meats.

While this study is comprehensive in covering leading brands, it may not fully capture products from smaller or regional producers, and price comparisons could vary depending on location. Even so, the findings give a clearer picture of the quality and cost-effectiveness of these widely consumed ultra-processed foods.

While this study provides useful insights, several limitations should be considered when interpreting the findings. This study relied mainly on product label information, which may be incomplete or inaccurate. Differences in manufacturing, raw materials, and storage conditions could affect nutrient content, while inconsistent labelling limited

data uniformity and comparability. Some imported or smaller brands also failed to fully comply with labelling regulations.

5 CONCLUSION

This study 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. Notable variations were found for sodium, fat, and protein contents across brands and flavours. While nutrient levels did not differ significantly among nugget flavours, significant differences were observed among sausage flavours sold in Malaysia. This study addresses gaps in Malaysian consumer awareness regarding nutritional variations in nuggets and sausages across brands and flavours. These findings can improve food labelling, support public health campaigns on sodium and fat reduction, and guide policymakers in strengthening Malaysia's nutrition and sodium reduction strategies, ultimately promoting informed choices and healthier eating habits. Future studies should expand their scope to include micronutrients such as vitamins and minerals, along with trans-fat and dietary fibre. These components play a critical role in overall health and may significantly influence the nutritional quality of nuggets and sausages beyond just macronutrients.

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CONFLICT OF INTEREST

All authors declared no conflict of interest.

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