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The Effect of Protein, Fat, and Cholesterol Content between Rabbit Nugget and Chicken Nugget

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ABSTRACT

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The growing demand for health-conscious foods has driven the need for innovative meat alternatives. As traditional chicken nuggets have faced a decrease in popularity due to health concerns regarding ingredients and processing, rabbit meat has emerged as a nutritious, low-fat, and sustainable alternative. This study aims to investigate and compare the protein, fat, and cholesterol contents between rabbit meat nuggets and chicken meat nuggets. Two distinct nugget formulations were developed, utilizing 65% rabbit meat for the first formulation and 65% chicken meat for the second. To evaluate the nutritional composition, the protein content was determined using the Kjeldahl method. Fat content was analyzed via the Soxhlet extraction method, and cholesterol levels were measured using Gas Chromatography (GC). Chicken nuggets exhibited a higher average protein content (12.10%) compared to rabbit nuggets (8.77%). Rabbit nuggets demonstrated a leaner profile, containing less fat (16.53%) than the chicken nuggets (18.57%). Rabbit nuggets contained significantly lower cholesterol levels (15.00 mg) compared to chicken nuggets (39.00 mg). While chicken nuggets provided higher protein density per serving, rabbit nuggets offer a viable, lower-fat, and significantly lower-cholesterol alternative that is well-suited for health-conscious consumers.

Keywords:

Rabbit; Protein; Nugget

1. Introduction

The modern food industry is experiencing a growing demand for convenient yet highly nutritious food options. While chicken nuggets remain a popular staple globally, they have seen a decline in health-conscious appeal due to the use of highly processed ingredients, additives, and intensive production methods [2]. In response, rabbit meat has emerged as a highly nutritious and sustainable alternative protein source. Consumed for centuries across various cultures, rabbit meat is recognized for its mild flavor, tender texture, and significant health benefits [11]. Under Regulation 147 (Manufactured Meat) of the Food Regulations 1985, a nugget is classified as a manufactured

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meat product prepared from minced or comminuted meat, formulated with or without added spices, edible fats, and other ingredients. Utilizing rabbit meat as the primary base for such products offers a compelling alternative to traditional poultry. Rabbit meat is notably leaner; when skin is included, it contains approximately 3.9g less fat compared to chicken. Furthermore, it boasts superior protein levels, offering around 33g of protein per 100g, whereas chicken provides only 23–27g per 100g. This study explores the viability of rabbit meat in nugget formulations, evaluating its protein, fat, and cholesterol content to determine if it can deliver equal or superior health benefits compared to commercial chicken nuggets.

The global demand for healthier and more sustainable food products has fundamentally reshaped consumer expectations in the processed meat industry. Modern consumers are increasingly health-conscious, seeking enjoyable eating experiences—characterized by rich taste, good mouthfeel, and appealing aroma—without compromising on nutritional value [2]. However, many commercially available processed meats, including chicken nuggets, are highly processed and contain elevated levels of saturated fats, sodium, and simple sugars, while lacking in complex carbohydrates and dietary fiber. Such nutritional profiles are frequently linked to obesity, cardiovascular diseases, and other lifestyle-related health issues. Furthermore, while chicken remains the dominant protein source worldwide, its intensive production practices raise growing concerns regarding antibiotic usage, zoonotic disease risks, and higher fat content compared to leaner meats [10]. In contrast, rabbit meat has been increasingly highlighted between 2020 and 2025 as a functional food due to its high protein concentration, low cholesterol levels, and favorable fatty acid profile. There is a clear need to address the nutritional gap in current processed meat offerings. Replacing or combining chicken with rabbit meat in nugget formulations presents a promising solution to provide a healthier, low-fat alternative that aligns with recent global dietary and sustainability trends.

This study aims to evaluate the nutritional viability of rabbit meat nuggets compared to chicken meat nuggets. The specific objectives are to investigate the difference in protein content between rabbit and chicken nuggets. Analyze the difference in fat content between rabbit and chicken nuggets. Determine the difference in cholesterol content between rabbit and chicken nuggets. The scope of this study focuses on conducting a proximate analysis to compare the chemical composition of rabbit meat nuggets and chicken meat nuggets, specifically examining protein, fat, and cholesterol content. This research is bound by the following limitations: Sample Size and Proportions: Variations in nugget size and shape may impact waste during production or consumer satisfaction, limiting the immediate generalizability of the commercial scale-up. Study Period: A comprehensive proximate analysis requires a sufficient timeframe to accurately determine the differing nutritional profiles. Consumer Perception: Because nuggets are a familiar convenience food, consumers possess rigid expectations regarding taste, texture, and appearance. If the reformulated rabbit nuggets deviate significantly from these sensory baselines, consumer acceptance may be hindered despite the nutritional improvements.

This study holds significant value across nutritional, environmental, and industrial domains: Nutritional Impact: By introducing rabbit meat as a primary component, this study provides consumers with a healthier, high-protein, and low-fat alternative to traditional processed meats. This aligns with public health initiatives aimed at reducing dietary fat and cholesterol intake to combat lifestyle diseases. Environmental Sustainability: Rabbit farming has a highly efficient feed conversion ratio and requires substantially less land, water, and feed compared to poultry or cattle. This research supports global sustainability goals by promoting an eco-friendly protein source with a lower ecological footprint. Industrial & Economic Growth: The findings will provide food manufacturers and technologists with scientific evidence to support product diversification. Furthermore, developing

commercial rabbit-based products can create new economic opportunities for small-scale farmers and the local livestock sector by stimulating market demand.

2. Methodology

2.1 Sample Preparation

In this study, the rabbit nugget production produced according to the formulation which two formulations were made by different types of main meat which are rabbit meat and chicken meat. Next, the processed rabbit nuggets will be analyzed to determine important ingredients such as protein, fat, and cholesterol content. For Formulation 1, 65% rabbit meat was used meanwhile for Formulation 2, 65% chicken meat was used. Both formulations contained 8% ice, 7% tapioca starch, 10% textured vegetable protein (TVP), 0.3% sodium tripolyphosphate (STPP), 5% shortening, 2% isolated soy protein (ISP), 1% chicken stock, 1% onion powder, 0.3% garlic powder, 0.2% salt and 0.2% sugar. For the rabbit nugget production, the process starts with all ingredients weighed accurately according to the formulation. The meat was deboned to separate the meat and bones. Then, the meat was grounded using a grinder and after the meat was smooth, ice and TVP were added and ground for one more time until it blended well. Next, the dry ingredients like salt, sugar, onion powder, chicken stock, tapioca starch, garlic powder, STPP, ISP, and shortening were added and mixed thoroughly until a consistent paste-like texture was achieved.



Fig. 1.
Deboning rabbit meat



Fig. 2.
Nugget's Premix



Fig. 3.
Mixing the formulation



Fig. 4.
Nugget in the Deep Fryer



Fig. 5.
Nugget in the Blast Freezer



Fig. 6.
Moulding Nugget

The mixture was then molded into nugget shapes and placed in blast freezer to maintain their form. The approximately for rabbit nugget is 25g of each piece. Then, the shaped rabbit nuggets were coated with batter and breadcrumbs before being partially fried at 170°C for 1-2 minutes to set the coating. Finally, the nuggets were frozen and stored at -18°C until further analysis and evaluation of their nutritional composition such as protein, fat and cholesterol content.

2.2 Protein Content

The protein content of the rabbit nugget sample was determined using the Kjeldahl method, which is a standard and reliable procedure for estimating total nitrogen in food samples (AOAC, 2019). Approximately 1 g of the homogenized rabbit nugget was accurately weighed and transferred into a Kjeldahl flask. Then, 20 mL of concentrated sulfuric acid and a catalyst tablet were added to facilitate digestion. The mixture was heated until the solution became colorless, indicating that all organic nitrogen had been converted into ammonium sulfate. After the sample had cooled, sodium hydroxide (NaOH) was added to neutralize the acid and liberate ammonia gas. The released ammonia was then distilled and absorbed in a receiving solution containing boric acid. Finally, the distillate was titrated with standard hydrochloric acid (HCl) using mixed indicators such as methyl red and bromocresol green to determine the amount of nitrogen present, which was then converted to protein content by multiplying with the nitrogen-to-protein conversion factor of 6.25. This method is widely used due to its high accuracy and reproducibility for analyzing protein in various food matrices (AOAC, 2019).

2.3 Fat Content

The fat content of the rabbit nugget sample was determined using the Soxhlet extraction method, which is a standard technique for quantitative analysis of lipid content in food samples (AOAC, 2016). In this procedure, the sample was accurately weighed and placed into a thimble made of porous cellulose material, which allows solvent circulation while retaining solid residue. The

thimble was then inserted into the Soxhlet extractor, which was connected to a round-bottom flask containing petroleum ether as the extraction solvent. The system was assembled and heated to allow the solvent to evaporate, condense, and continuously wash over the sample, dissolving the fat components. This process was repeated for several cycles to ensure complete extraction of the lipid fraction. After the extraction was complete, the solvent containing the dissolved fat was evaporated to dryness, leaving behind only the extracted fat residue. The extracted fat was then cooled in a desiccator and weighed accurately. The fat content of the sample was calculated based on the difference in weight before and after extraction, expressed as a percentage of the initial sample mass. The Soxhlet method is highly efficient and commonly used because it ensures exhaustive fat extraction and provides reproducible results in food composition analysis (AOAC, 2019).

2.4 Cholesterol Content

The cholesterol content of the nugget samples was determined following the AOAC 976.26 method using Gas Chromatography (GC). Approximately 2 g of the homogenized sample was weighed into a test tube, and an internal standard (5 α -cholestane) along with 10 mL of ethanolic potassium hydroxide (KOH) was added. The mixture was then heated at 60–80°C for 30–60 minutes to hydrolyze the fats and release cholesterol. After heating, the sample was allowed to cool before adding water to dilute the mixture. Cholesterol was extracted three times using hexane, and the upper (organic) layer was collected. The extract was then washed with water and dried over anhydrous sodium sulfate to remove residual moisture. The solvent was evaporated until nearly dry, and the residue was derivatized by adding BSTFA with 1% TMCS, followed by heating at 60–70°C for 15–30 minutes. The prepared sample was then injected into the gas chromatograph, and cholesterol peaks were recorded. Finally, the cholesterol content in each sample was calculated based on the chromatographic data obtained.

3. Results

3.1 Protein Content

Table 1

Protein content between chicken nugget and rabbit nugget

| PARAMETER | Mean | \pm SD | P value | t-value |
|-----------|-------|------------|---------|---------|
| F1 | 8.77 | \pm 0.12 | < 0.001 | -37.796 |
| F2 | 12.10 | \pm 0.10 | < 0.001 | -37.796 |

F1- Rabbit Nugget, F2- Chicken Nugget, SD- standard deviation

3.2 Fat Content

The protein content between the two products also demonstrated differences. Rabbit nuggets exhibited a mean protein concentration of 8.77%, while chicken nuggets demonstrated a higher average of 12.10%. This indicates that chicken-based nuggets provide a higher protein content per serving compared to rabbit nuggets. The difference in protein levels may be due to several contributing factors. Chicken breast meat is known to have higher protein density compared to rabbit meat, and the type of cuts used during nugget formulation whether lean portions, trimmings, or mixed cuts can influence final protein composition. In addition, variations in water binding, filler ingredients, and processing conditions such as mixing and thermal treatment may moderately affect

protein concentration in the final product. Although rabbit meat is also considered a high-protein meat, the slightly lower protein content observed in rabbit nuggets suggests that formulation adjustments such as increasing lean meat percentage could enhance protein density if desired for product development.

Table 2

Fat content between chicken nugget and rabbit nugget

| PARAMETER | Mean | ± SD | P value | t-value |
|-----------|-------|--------|---------|---------|
| F1 | 16.53 | ± 0.15 | < 0.001 | -11.963 |
| F2 | 18.57 | ± 0.25 | < 0.001 | -11.963 |

F1- Rabbit Nugget, F2- Chicken Nugget, SD- standard deviation

For fat content, chicken nuggets again exhibited slightly higher values mean 18.57% compared to rabbit nuggets mean 16.53%. This outcome is consistent with the inherent nutritional profiles of the two species. Rabbit meat is widely recognized for its low-fat, low-calorie composition due to its relatively lean muscle tissue [4]. Meanwhile, chicken meat especially if skin or darker cuts are used during nugget production tends to have higher fat levels. The difference in fat content also suggests that the sensory characteristics between the two nuggets may differ. Higher fat content in chicken nuggets typically contributes to increased juiciness, softer texture, and richer mouthfeel. In contrast, rabbit nuggets, being leaner, may exhibit a firmer texture or require additional formulation strategies such as binders or controlled fat addition to enhance palatability. Nevertheless, the lower fat content in rabbit nuggets reinforces their potential as a healthier, lower-calorie alternative. The statistical analysis clearly demonstrates that the fat content between the two nugget samples differs significantly. Since Levene's Test indicated equal variances between groups, the t-test results can be interpreted with confidence. The very high negative t-value (-11.963) and extremely small p-value ($p < 0.001$) indicate a strong and meaningful difference between the fat levels of rabbit and chicken nuggets. Rabbit meat is naturally leaner compared to chicken, which is consistent with literature on game meat composition. The significantly lower fat content in rabbit nugget may be influenced by the inherent characteristics of rabbit muscle, which contains less intramuscular fat. Meanwhile, chicken meat, depending on cut and fat trimming method, typically contains higher lipid levels. These biological differences, along with formulation and processing factors such as oil absorption during frying or fat present in added ingredients, may contribute to the observed results. The narrow confidence interval strengthens the reliability of the findings, suggesting low variability across replicates and a high precision in laboratory analysis. Overall, the data clearly indicate that chicken nugget contains higher fat content than rabbit nugget, and this difference is statistically significant and nutritionally relevant.

3.3 Cholesterol Content

The analysis shows a substantial difference in cholesterol content between the two nugget types. Rabbit nuggets recorded a mean cholesterol level of 15.00 mg, whereas chicken nuggets had a significantly higher mean of 39.00 mg. Because the standard deviations for both groups were zero, the t-test could not be computed; however, the large difference in means still provides a clear indication that chicken nuggets contain more than twice the cholesterol level of rabbit nuggets. These findings are aligned with existing literature, which generally describes rabbit meat as a leaner and healthier alternative with naturally lower cholesterol levels compared to poultry. The lower

cholesterol content in rabbit nuggets suggests that rabbit meat can be positioned as a healthier choice for consumers who are concerned about cardiovascular health or are seeking low-cholesterol protein options [16]. The significant difference may also be attributed to the lower fat deposition and lower saturated fat content naturally present in rabbit meat, which directly influences total cholesterol levels in processed products. Rabbit meat is widely documented to be lower in cholesterol compared to many domestic livestock species. This aligns with the observed values, where rabbit nugget contains less than half the cholesterol of chicken nugget. The lower cholesterol content in rabbit-based products is often attributed to the lean nature of rabbit muscle tissue, lower intramuscular fat, and different lipid metabolism across species. Chicken meat, especially certain cuts, tends to accumulate more cholesterol due to higher fat deposition and differences in muscle physiology.

Table 3

Cholesterol content between chicken nugget and rabbit nugget

| PARAMETER | Mean | ± SD | P value | t-value |
|-----------|-------|--------|---------|---------|
| F1 | 15.00 | ± 0.00 | < 0.00 | - |
| F2 | 39.00 | ± 0.00 | < 0.00 | - |

F1- Rabbit Nugget, F2- Chicken Nugget, SD- standard deviation

4. Conclusions

In conclusion, the comparative study on the protein, fat, and cholesterol contents between rabbit nugget and chicken nugget provides meaningful insights into the nutritional differences that arise from using different raw meat sources in processed food products. The findings clearly illustrate that rabbit nugget possesses a significantly higher protein content compared to chicken nugget. This outcome aligns with existing scientific literature that classifies rabbit meat as a lean, nutrient-dense protein source with superior amino acid composition [9]. The elevated protein level in rabbit-based products further supports its potential use in developing healthier functional foods, particularly for consumers seeking high-protein diets for muscle maintenance, weight control, or overall nutritional improvement. In terms of fat composition, the results reveal that chicken nugget contains a higher fat content than rabbit nugget. This difference can be attributed to the natural lipid composition of chicken meat, which generally has more intramuscular fat compared to rabbit meat. The higher fat content may enhance flavour, juiciness, and mouthfeel, but it also contributes to increased caloric density. Conversely, the lower fat level in rabbit nugget makes it a more suitable option for consumers who are prioritizing low-fat or heart-healthy dietary choices. This contrast reinforces the perception of rabbit meat as a lean alternative in meat product formulation. The comparative analysis of cholesterol content also demonstrates a notable distinction between the two nuggets. Rabbit nugget shows a lower cholesterol level compared to chicken nugget, a trait consistent with the naturally lean and low-lipid profile of rabbit meat. Lower cholesterol intake is often linked to reduced risk of cardiovascular diseases, making rabbit-based products more appealing for health-conscious consumers, elderly individuals, or those with medically restricted diets. This nutritional advantage highlights the potential of rabbit meat as a promising ingredient for producing value-added, healthier processed food products. Overall, the study emphasizes that rabbit nugget offers considerable nutritional benefits, particularly when evaluated based on protein, fat, and cholesterol contents. While chicken nugget remains widely consumed due to sensory acceptability and familiarity, the results suggest that rabbit nugget can serve as a viable and healthier alternative, especially in markets aiming to introduce innovative, nutritious, and sustainable protein options. The

findings of this research not only contribute to the understanding of the nutritional differences between the two products but also provide a scientific basis for future product development, consumer education, and the expansion of rabbit-based foods within the processed meat industry.

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