International Journal of Food Science and Nutrition
www.foodsciencejournal.com
ISSN: 2455-4898
Received: 10-01-2026, Accepted: 09-02-2026, Published: 24-02-2026
Volume 11, Issue 1, 2026, Page No. 100-102

Development of protein-fortified biscuits incorporating chicken meat

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Abstract
Chicken meat is a highly nutritious protein source, offering essential vitamins, minerals and unsaturated fats. With increasing consumer demand for healthier snack options, incorporating chicken meat powder (CMP) into baked products like biscuits presents a novel approach to enhancing their nutritional value. This study aimed to formulate and evaluate protein-enriched chicken meat biscuits by replacing refined wheat flour (RWF) with CMP at varying levels (25%, 30%, 35% and 40%). The biscuits were prepared, baked and analysed for sensory attributes, including appearance, meat flavour intensity, crispiness, aftertaste and overall acceptability. Results indicated that the 35% CMP-incorporated biscuit (C_3) achieved the highest overall acceptability score (7.23±0.05), excelling in crispiness and aftertaste. The findings suggest that replacing 35% of RWF with CMP produces biscuits with superior sensory properties while enhancing protein content. This formulation offers a nutritious and convenient alternative to traditional snacks, meeting modern dietary preferences.

Keywords: Chicken meat biscuits, chicken meat powder, value addition and meat-based snacks

Introduction

Chicken meat is a highly nutritious food, offering easily digestible proteins of high biological value, moderate energy levels and essential nutrients such as unsaturated fats, B- vitamins like thiamine, vitamin B_6 and pantothenic acid and key minerals like iron, zinc and copper (Marangoni *et al*., 2015) [9]. With increasing consumer demand for healthier snack options, there is a growing interest in developing products that integrate diverse ingredients to achieve better nutritional balance. Goswami *et al*. (2017) [6] highlighted that incorporating both meat and non-meat ingredients in optimal proportions can create snack foods that provide higher protein content and fewer calories while effectively competing with traditional cereal-based snacks. Cakmak *et al*. (2016) [4] demonstrated that fortifying white and whole wheat pan breads with chicken meat powder significantly increased their protein content by up to 18.70%, showcasing the potential of meat-based ingredients in bakery products.

Moreover, value-added meat products offer several advantages, including extended shelf life, enhanced functional properties, improved sensory attributes and greater convenience for consumers (Toldra *et al*., 2012) [12]. Biscuits, as a widely consumed ready-to-eat snack, serve as an excellent medium for incorporating chicken meat to boost dietary protein intake. The development of chicken meat biscuits provides an opportunity to combine the nutritional benefits of poultry with the convenience and appeal of baked snacks. This study focuses on formulating and evaluating protein-enriched chicken meat biscuits, aiming to create a nutrient-dense, functional food product that meets consumer demands while ensuring sensory acceptability and shelf stability.

Materials and Methods

Broiler chickens weighing 2 to 2.5 kg were procured from the local market and processed under hygienic conditions following standardized scientific methods at the Meat Technology Unit in Mannuthy. After slaughter, the birds were dressed, packed in high-density polyethylene bags and stored aerobically in a freezer at -21±1°C until further analysis.

Preparation of Chicken Meat Powder

The frozen, dressed chickens were left to thaw overnight at 4±1°C. After thawing, the meat was manually deboned, ensuring the removal of visible fat, fascia and loose connective tissue. It was then cut into small pieces, boiled and minced. The minced meat was dried in a cabinet tray dryer with a blower at 60°C for 3 to 4 hours. Once dried, it was finely ground into powder using a grinder, packaged in low-density polyethylene bags and stored at 4±1°C.

Preparation of chicken meat biscuit

Table 1: Formulation of control chicken biscuits

Ingredients	In percentage
Refined wheat flour*	100
Over and above this, following ingredients were added	
Butter	33
Sugar	26
Salt	1
Spice mix	1
Baking powder	0.6
Symega chicken flavour	0.4
Whole egg**	-

*Refined wheat flour was replaced by chicken meat powder in the treatment samples, **One whole egg

The ingredients listed in Table 1 were accurately measured based on the specified quantities, following the method described by Kumar *et al*. (2016) [7]. Refined wheat flour (RWF), chicken meat powder (CMP), sugar and salt were initially blended using a planetary mixer. Butter, egg and baking powder were then incorporated and thoroughly mixed. Subsequently, the spice mix and chicken flavour were added, ensuring even distribution throughout the mixture.

First, the chicken meat biscuit formulation was standardized. Then, chicken meat powder was introduced by replacing 25% (C_1), 30% (C_2), 35% (C_3) and 40% (C_4) of RWF. The prepared dough was molded into biscuit shapes and baked at 180°C for 20-25 minutes. After baking, the biscuits were cooled to room temperature, packed in laminated pouches and stored under ambient conditions. The chicken meat powder-enriched biscuits were then assessed for their sensory characteristics.

Sensory evaluation

A semi-trained panel consisting of seven members from the Department of Livestock Products Technology at the College of Veterinary and Animal Sciences, Mannuthy, Thrissur, carried out the sensory evaluation. The assessment was based on an eight-point Hedonic scale, focusing on attributes such as colour and appearance, meat flavour intensity, crispiness, aftertaste and overall acceptability. Each panellist received uniformly prepared chicken meat biscuit samples, labelled with three-digit codes and rated them using the Hedonic scale. To ensure an unbiased evaluation, plain water was provided for palate cleansing between sample evaluation and the individual scores were averaged for each attribute. The sensory data collected for CMP-incorporated biscuits were analysed statistically using the Kruskal-Wallis test, with computations performed in SPSS software (version 24.0) following the methodology outlined by Snedecor and Cochran (1994) [11].

Results and Discussion

The sensory parameters evaluated to determine the impact of chicken meat powder incorporation on appearance, meat flavour intensity, crispiness, aftertaste and overall acceptability. The sensory evaluation scores were compiled and presented in Table 2.

Table 2: Effect of different levels of chicken meat powder on the sensory attributes of biscuits

Sensory attributes	C	C_1	C_2	C_3	C_4	(p-value)
Appearance and colour	7.02±0.09	7.07±0.05	7.11±0.07	7.16±0.07	7.17±0.05	(0.342) ^{ns}
Meat flavour intensity	6.07±0.03^{a}	6.64±0.09^{b}	6.72±0.09^{b}	6.95±0.05^{b}	6.98±0.03^{b}	(0.001) **
Crispiness	6.19±0.202^{a}	6.45±0.16^{ab}	6.73±0.14^{b}	6.85±0.14^{b}	6.78±0.202^{b}	(0.034) *
After taste	6.71±0.14^{a}	6.85±0.08^{ab}	7.02±0.07^{c}	7.17±0.05^{c}	6.84±0.11^{a}	(0.006) **
Overall acceptability	6.71±0.11^{a}	6.89±0.13^{a}	7.07±0.06^{b}	7.23±0.05^{b}	6.88±0.12^{a}	(0.02) *

* Significant at 0.05 level; ** Significant at 0.01 level; ns – non- significant at 0.05 level

Means with different superscripts in rows differ significantly.

The values are expressed as their Mean ± Standard error.

C: Control biscuits (without chicken meat powder-CMP)

C_1: C+ RWF replaced with 25% CMP

C_2: C+ RWF replaced with 30% CMP

C_3: C+ RWF replaced with 35% CMP

C_4: C+ RWF replaced with 40% CMP

There were no notable differences in the appearance and colour ratings among the samples ($p>0.05$). However, C_4 had a slightly higher score (7.17±0.05) than C (7.02±0.09). In terms of meat flavour intensity, the control sample (C) showed a significant difference ($p<0.01$) compared to the treatment groups (C_1, C_2, C_3 and C_4), with C_4 receiving the highest score (6.98±0.03) and C the lowest (6.07±0.03). Anil *et al*. (2023) [1] similarly reported enhanced flavour scores in ready-to-cook porridge mix containing CMP, attributing it to the increased meat flavour intensity.

A significant variation ($p<0.05$) was observed in crispiness scores between the control and treatment samples C_2, C_3 and C4. Crispiness improved as CMP incorporation increased from 20% to 40%, likely due to the enhanced binding properties of CMP, as noted by Mackie (1994) [8].

Regarding aftertaste, samples C_2 and C_3 had significantly higher scores ($p<0.05$) than the others. Goswami *et al*. (2017) [6] reported a similar trend, where flavour and aftertaste scores improved with increasing carabeef powder content up to 50%, likely due to its higher fat and protein content.

Overall acceptability scores also showed significant differences ($p<0.05$) between the control and treatment samples, with C_3 receiving the highest rating (7.23±0.05) and C the lowest (6.71±0.11). These results align with findings from Berwal (2013) [3], who observed that control and chicken-incorporated biscuits remained within acceptable sensory limits even after 90 days of storage.

While C_4 excelled in flavour, appearance and colour, C_3 stood out in crispiness, aftertaste and overall acceptability, making it the preferred choice. These findings are consistent with research by Kumar *et al*. (2016) [7], who developed chicken meat biscuits with wheat and oat bran incorporation and achieved similar optimal results.

Conclusion

Based on sensory evaluations, it is concluded that well accepted biscuits can be prepared by incorporation of 35% chicken meat powder by replacing RWF without adversely affecting the sensory attributes. This combination could be an excellent option for enhancing protein content while maintaining strong consumer acceptability.

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