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Differences in processing methods on hedonic, physical quality, and fat content of chicken floss

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ABSTRACT

Chicken floss is a processed product of chicken meat that has a long shelf life. Frying is the most used method in the production of chicken floss; however, it often leads to a product with high fat content, which may raise health concerns among consumers. Consequently, alternative techniques such as oven and air frying are being explored to develop a healthier version of chicken floss without compromising its sensory appeal. This study investigates the impact of three different cooking methods (oil, air, and oven frying) on the consumer acceptance, physical properties, and fat content of chicken floss. By comparing these techniques, the research aims to identify a healthier yet appealing alternative to traditional frying methods. The observed parameters included fat content, water activity (a_w), color (lightness (L*), red-green axis (a*), yellow-blue axis (b*) values), and hedonic attributes such as aroma, color, taste, texture, and overall acceptability. The results showed that the cooking method significantly ($p<0.05$) affected fat content, water activity, and color parameters of the chicken floss. The oil frying method produced chicken floss with a yellowish-brown color, the highest a_w value, and the highest fat content (23.06%). In contrast, air frying resulted in the lowest a_w (0.55) and fat content. The oven frying method produced a lighter-colored product with fat content between the other two treatments. Hedonic analysis indicated that the panelists equally well accepted products from all three processing methods. Air frying and oven frying represent viable alternatives for health-conscious consumers, providing a promising reduction in fat content.

Introduction

Chicken floss is a dry meat-based food product made through the process of frying and the addition of various spices. The processing of meat into floss aims to produce a shelf-stable product with desirable sensory attributes and a distinctive fibrous texture. Chicken floss can achieve a long shelf life when processed properly due to its low moisture content (Huthaimah *et al*., 2017). In chicken floss production, the selection of meat cuts also plays a critical role, as it influences the texture, flavor, and nutritional profile of the product. Broiler chicken breast is the preferred cut due to its higher lean meat content, finer muscle fibers, lower fat content, and higher protein content, reaching 35.24 g per 100 g, compared to 31.04 g per 100 g in the thigh part (Afiyah, 2022).

The selection of an appropriate cooking method significantly influences the final quality of the floss, including its nutritional content, physical attributes, and consumer acceptance. The most used method is deep frying or oil frying, which involves submerging the meat in a large volume of hot oil at temperatures between 140–180°C. This method effectively reduces moisture and enhances flavor (Indarto *et al*., 2024). However, it also results in increased fat content because oil absorption during frying (Susanty *et al*., 2019). Due to the increase in non-communicable diseases such as diabetes, cardiovascular disease, and obesity, there has been an escalated demand for healthier cooking methods. Air frying is the latest cooking method as a healthier alternative that significantly reduces fat absorption and acrylamide formation while preserving crunchiness and sensory qualities (Coria-Hernández *et al*., 2023). Air frying applies rapid hot air circulation to cook food with little or no oil, which significantly reduces fat content while maintaining desirable flavor and texture. Studies have shown that air frying can develop meat-based products with lower fat content, while maintaining the sensory characteristics of the food (de Oliveira *et al*., 2024). The other method is oven frying, which operates through a combination of radiant heat, hot air convection, and direct contact with heated surfaces (Ateş and Unal, 2023).

Cooking methods significantly impact parameters such as moisture content, fat absorption, texture firmness, and color intensity. For example, non-enzymatic browning reactions like the Maillard reaction during cooking contribute to the desirable golden-brown coloration in meat floss (Aini *et al*., 2023). Additionally, oil frying typically results in higher fat absorption compared to air frying or oven drying (Coria-Hernández *et al*., 2023). However, existing literature often focuses on general aspects such as moisture reduction or fat content without a holistic evaluation of sensory characteristics, physical appearance, texture, and nutritional composition. This study aims to determine the influence of different cooking methods, including oil, air, and oven frying, on the hedonic quality, physical characteristics, and fat content of chicken floss.

Materials and methods

The main raw material used in this study was broiler chicken breast meat, which was kept in good condition under cold storage. The spices used included shallots, garlic, coriander, pepper, lemongrass, galangal, turmeric, ginger, candlenuts, bay leaves, kaffir lime leaves, salt, sugar, and cooking oil, all of which were purchased from local stores. The equipment utilized in this study included a blender (Philips, Netherlands), gas stove (Miyako, Indonesia), air fryer (Mito, Indonesia), oven (Kris, Indonesia), oil press, wooden pestle, color reader (Konica Minolta, Japan), water activity meter (Novasina, Switzerland), and Soxhlet extractor.

Preparation for chicken floss

The production of chicken floss followed a modified method from Mandjurungi *et al*. (2022), the formulation consisted of broiler chicken breast meat (500 g), sugar (100 g), garlic (26 g), shallots (14 g), galangal (10 g), ginger (10 g), salt (4 g), coriander (3 g), pepper (2 g), turmeric (2 g), bay leaf (1 g), kaffir lime leaves (1 g), and lemongrass (1 g). The processes began by blending all the spices (garlic, shallots, candlenuts, galangal, ginger, turmeric, pepper, coriander, lemongrass, bay leaves, kaffir lime leaves, salt, and sugar) into a smooth paste. Broiler chicken breast meat was thoroughly cleaned and placed in a pot with the spice mixture and 600 to 800 mL of water. The mixture was simmered for approximately 45 minutes with occasional stirring to ensure flavor penetration and water reduction. After cooking, the meat was split, cooled, and shredded into fine fibers. The shredded chicken was then subjected to three different thermal treatments including oil frying at 180°C for 5 minutes followed by mechanical pressing to reduce excess oil (Masahid *et al*., 2022). Air frying at 120°C for 12 minutes with a minimal amount of oil sprayed onto the surface using an oil sprayer prior to heating, and oven method at 100°C for 10 minutes also preceded by oil application using an oil sprayer (Jasila and Zahro, 2015). After each thermal treatment, the floss was cooled at room temperature before being analyzed for physical quality, fat content, and sensory acceptance.

Hedonic quality

The hedonic test referred to the method described by Rahim *et al*. (2023), employing 25 semi-trained panelists. Each sample was labeled using a three-digit randomized numeric code consisting of digits ranging from 0 to 9. The degree of preference was assessed using a 4-point hedonic scale, where 1 = dislike, 2 = slightly like, 3 = like, and 4 = very much like. Attributes evaluated included color, aroma, taste, texture, and overall acceptability.

Water activity (a_w)

Water activity analysis was conducted following the method by Dewi *et al.* (2011), using a water activity meter that operates based on the principle of measuring the ratio of water vapor pressure from the sample to that of pure water at the same temperature. The instrument was first calibrated, and then 2 grams of chicken floss were placed in the sample holder. The water activity value was displayed automatically by the device.

Color measurement

Color analysis referred to the AOAC (2005) method and was carried out using a Hunter Lab Colorimeter to obtain objective color readings. The instrument provided L*, a*, and b* values, which represent the average hue of the sample. The L* value ranges from 0 to 100, indicating black to white, with higher L* values corresponding to lighter (whiter) appearance. Positive a* values indicate redness, while negative values indicate greenness. Positive b* values reflect yellowness, and negative values reflect blueness (Nainggola and Amwar, 2023). Calculation of chromatic color areas (°hue) is calculated by the following equation.

$°hue = \tan^{-1}(b^*/a^*)$

Fat content

Fat content was determined based on the Soxhlet extraction method described in AOAC (2005). Filter papers (11×11 cm) were prepared according to the number of replications required and dried in an oven at 105°C for 1 hour. Two grams of chicken floss sample (recorded as weight A) were wrapped in the dried filter paper and labeled using a 2B pencil. The wrapped sample was dried again in the oven at 105°C for 4 hours, placed in a desiccator for 15 minutes, and then weighed. The sample was reheated for an additional hour until a constant weight (<0.02 g) was achieved and recorded as weight B. The constant sample was then placed into the Soxhlet extractor tube, and 450 mL of n-hexane solvent was added. The apparatus was assembled, connected to a heat source, and placed in a water bath at 50°C. The water tap was turned on to initiate condensation, and the extraction process was carried out for a minimum of six cycles. Upon completion, the heating was turned off, and the sample was removed from the extractor and air-dried for 30 minutes. The sample was then oven-dried at 105°C for 1 hour, placed in a desiccator for 15 minutes, and weighed to obtain weight C.

Data analysis

Sensory evaluation data were analyzed using the Kruskal–Wallis test at 5% significance level. If significant differences were detected, the Mann–Whitney U test was used for pairwise comparisons between treatments. Data from fat content and physical quality measurements were subjected to parametric analysis using Analysis of Variance (ANOVA) with IBM SPSS Statistics 26.0 software at a 5% significance level. Significant differences between means were further examined using the Duncan's Multiple Range Test (DMRT).

Results

Hedonic quality

The hedonic quality of chicken floss produced using three different processing methods, including oil, air, and oven frying, was evaluated based on hedonic test using five sensory attributes: color, taste, texture, aroma, and overall acceptability (Fig. 1). Among the three methods, oil frying received the highest scores across most attributes. It received a rating close to 4 in color, indicating strong consumer preference. Taste and overall acceptability were also rated highly for chicken floss with oil frying, suggesting that this method delivers a more preferred flavor and general sensory quality. Oven frying achieved a moderate score across all parameters, with no extreme highs or lows. It showed a relatively balanced hedonic profile, especially in taste and aroma, where its scores were comparable to oil frying. Air frying, on the other hand, consistently received the lowest ratings across all attributes. The most noticeable reductions were observed in color and taste, indicating that air-fried chicken floss was less visually appealing and less flavorful compared to the other methods. These results suggest that oil frying is the most favorable method in terms of hedonic quality, followed by oven frying, while air frying may require further optimization to improve consumer acceptance.

Fig 1. Hedonic Quality of Chicken Floss with Different Processing Methods.

Water activity (a_w)

The oil frying method resulted in the highest water activity (a_w) value of 0.62±0.03, which was significantly higher ($p < 0.05$) than those of the air frying (0.56±0.07) and oven methods (0.55±0.04). There was no significant difference between the air frying and oven methods, as indicated by the shared superscript letter (b). These results indicate that the choice of cooking method significantly affects the water activity of the product, as reflected in a_w values.

L*a*b*

The color characteristics (L*, a*, b*) of chicken floss produced using oil frying, air frying, and oven frying methods are shown in Table 1. Significant differences ($p < 0.05$) were observed among all three methods for each color parameter. The L* value, which represents lightness, was significantly lower in the oil frying method (55.1±2.50) compared to both the air frying (69.2±1.01) and oven frying methods (70.1±1.05), with the latter two showing no significant difference from each other. For the a* value (redness), oil frying yielded the highest redness (10.31±1.84), followed by air frying (7.60±1.01), and oven method (5.06±0.69), all significantly different from each other. The b* value (yellowness) was significantly higher in oven-dried (32.58±2.84) and air-fried (30.34±3.09) samples compared to oil-fried (25.50±2.69).

Table 1. Color Characteristics of Chicken Floss with Different Processing Methods.

Method	L*	a*	b*	Hue (°)
Oil Frying Method	55.1±2.50^{b}	10.31±1.84^{a}	25.50±2.69^{b}	67.99
Air Frying Method	69.2±1.01^{a}	7.60±1.01^{b}	30.34±3.09^{a}	75.94
Oven Frying Method	70.1±1.05^{a}	5.06±0.69^{c}	32.58±2.84^{a}	81.17

The data shown is the mean of 7 replicates ± standard deviation. a-c values with different lowercase superscripts in the same column indicate significant differences ($p<0.05$). L* denotes lightness (0 = black; 100 = white); a* indicates the green (–) to red (+) axis; b* indicates the blue (–) to yellow (+) axis; and Hue angle (°) represents the dominant color attribute, calculated from a* and b*

Fat content

Figure 2 shows the fat content of chicken floss produced using oil, air, and oven frying methods. The fat content differed significantly among the three methods ($p < 0.05$). Chicken floss produced by the oil frying method had the highest fat content (23.62±2.37%), followed by the oven method (8.19±1.26%), and the air frying method resulted in the lowest fat content (4.97±0.83%). The superscript letters indicate that all three values were significantly different from each other.

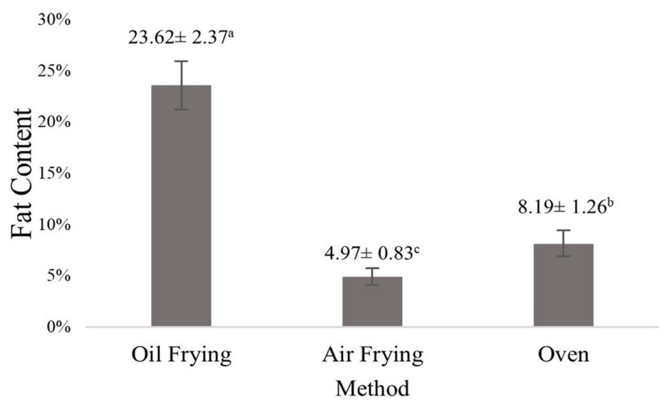

Fig 2. Fat Content (%) of Chicken Floss Produced Using Different Processing Methods.

Discussion

Sensory evaluation and product development are strongly related. The purpose of sensory analysis methods is to assess the product quality, consumer expectation, and consumer reaction to the product (Świąder and Marczewska, 2021). One type of sensory evaluation is hedonic test. Hedonic testing was conducted with 25 semi-trained panelists to evaluate the sensory attributes of chicken floss processed using different cooking methods. The assessment used a 4-point hedonic scale to rate color, taste, texture, aroma, and overall acceptability. The results of the Kruskal-Wallis test revealed that only the color parameter showed a significant difference ($p < 0.05$) among the processing methods, while the other sensory attributes did not show significant differences ($p > 0.05$). Detailed data from the hedonic evaluation are presented in Figure 1. Further analysis using the Mann-Whitney test indicated that the oil frying method produced chicken floss with the most preferred color among the panelists. The appealing brownish-yellow hue observed in oil-fried chicken floss is primarily attributed to the Maillard reaction between reducing sugars and amino acids occurring at high frying temperatures (180°C) within a short duration (4–5 minutes), promoting non-enzymatic browning (Safitri and Holinesti, 2023).

Although the taste parameter did not differ significantly across methods, oven-processed chicken floss received the highest taste score. The similarity in taste profiles is likely due to the consistent spice composition used across treatments. Taste development in chicken floss is influenced by the addition of sugar and traditional spices such as garlic, coriander, and galangal (Mirratunnisya *et al*., 2021). Texture evaluation also showed no significant differences among the methods, although air-fried chicken floss received the highest texture score, while the oil-fried sample had the lowest. These variations, however, were not substantial, as all three processing methods produced dry, fibrous, and tender chicken floss through common stages of boiling, pounding, and cooking (Safitri and Holinesti, 2023).

Similarly, aroma scores did not vary significantly. The oven method achieved the highest aroma score, whereas air frying yielded the lowest. The aroma of chicken floss is influenced by the interactions of amino acids and lipids during cooking, as well as the presence of aromatic herbs and spices such as shallots, lemongrass, and galangal (Salman *et al*., 2015). The aroma of chicken floss is affected by volatile substances in chicken meat. Amino acids and fatty acids are the primary precursors of volatile organic compounds (VOCs) in meat. VOC found in breast muscle and abdominal fat tissue of chicken meat including hexanal, octanal, 1-octen-3-ol, (E,E)-2, 4-nonadienal, benzaldehyde, heptane and diethyl disulphide (Luo *et al*., 2022). The overall acceptability of chicken floss also did not show significant differences among the processing methods. This result is also coherent with Singh *et al*. (2015) which indicated that the cooking method didn't alter the overall acceptability of the chicken cutlet. All processing methods yielded chicken floss that was generally well accepted by the panelists.

Water activity (a_w) plays a crucial role in determining the shelf life, microbial stability, and texture of food products. The findings from this study highlight that different cooking methods significantly influence the a_w of the final product. The water activity in oil-fried foods is higher compared to those by air or oven-fried foods. This variation can be explained by the formation of a crust when immersed in oil, which acts as a barrier and limits the movement of water from the inner parts of the food to the surface, thereby preventing sufficient water removal during frying (Coria-Hernández *et al*., 2023).

On the other hand, air frying and oven frying rely on hot air circulation, where the forced convection inside the fryer facilitates water removal at a slower rate. As a result, this slower process allows moisture to migrate more readily from the interior to the exterior of the product (Coria-Hernández *et al*., 2023). The significantly lower a_w values observed in these two methods suggest a more thorough dehydration effect, contributing to a drier final texture. Despite the differences observed, all processing methods produced chicken floss with a_w values below 0.70, indicating a low-risk level for microbial growth and ensuring product safety during storage (Br. Karo *et al*., 2017).

Color is a vital component in visual and sensory attributes influencing consumer perception and acceptability of meat products. In this study, the processing method significantly affected the L*, a*, and b* values of chicken floss. Higher L* values reflect a lighter appearance of the product. The significantly lower L* value in the frying method indicates a darker product color, which is attributed to a more intense Maillard reaction occurring at higher frying temperatures (180°C) within a short time span (4–5 minutes). This reaction encourages the formation of melanoidin pigments, which contribute to the reduction in lightness and darkening of the product (Vu *et al*., 2022).

The highest a* value (10.31±1.84) was also observed in the oil frying method, indicating greater redness compared to the other methods. This increased redness is associated with the Maillard reaction between carbonyl groups from reducing sugars and amino acids at high temperatures, which generates reddish to brown melanoidin compounds (Sari *et al*., 2024). In contrast, the oven method, which operates at a lower temperature (100°C), produced the lowest a* value (5.06 ± 0.69), resulting in a paler product due to the slower rate of browning reaction.

The high b* value in the oven method is attributed to low-temperature dry heating, which preserves natural pigments and minimizes color degradation due to the absence of direct contact with hot oil (Burrochman *et al*., 2022). Conversely, the elevated temperatures in the frying process may accelerate non-enzymatic browning, diminishing the intensity of yellow tones. Therefore, variations in processing temperature, duration, and heat transfer mechanisms among the methods influence the Maillard reaction intensity and pigment stability, resulting in significant differences in the color profile of chicken floss.

According to Sinaga (2019), L* indicates lightness (with higher values representing a lighter color), a* represents the red–green spectrum (positive values for redness), and b* reflects the yellow–blue spectrum (positive values for yellowness). According to a previous study, meat floss produced from retired laying hens with added granulated sugar exhibited color values of L*= 56.18±0.606, a*= 4.52±0.208, and b*= 34.96±0.963 (Susanti *et al*., 2025). The hue angles of the oil, air, and oven frying methods were 67.99°, 75.94°, and 81.17°, respectively, all falling within the 60° to 90° range, which indicates a shift toward golden-yellow hues. These findings are consistent with previous research, which reported a hue angle of 82.62° for meat floss derived from retired laying hens (Susanti *et al*., 2025).

The elevated fat content in the frying method is due to oil absorption during processing at high temperatures (180°C), where the oil replaces water that evaporates from the meat tissues during frying (Azzahra, 2024). In contrast, the air frying method utilizes high-velocity hot air circulation, minimizing oil absorption and resulting in a significantly lower fat content (Habibi and Utami, 2022). Additionally, air frying contributes to health by producing relatively lower levels of acrylamides (Téllez-Morales *et al*., 2024). The oven method, which applies convective heating at a lower temperature (100°C), yields a moderate fat content as a portion of the fat is retained in the product (Wibowo *et al*., 2024).

The difference in fat content also affects the product's oxidative stability. Chicken floss processed by oil frying is more susceptible to lipid oxidation due to its higher fat content, which may form volatile compounds responsible for rancid odors and quality degradation (Domínguez *et al*., 2019). Conversely, air-fried chicken floss tends to be more resistant to rancidity, potentially offering a longer shelf life. Oven-processed floss lies between the two, offering a balance between desirable flavor and oxidative stability (Amaral *et al*., 2018).

Conclusion

Oil-fried chicken floss has a yellowish-brown color, the highest water activity, and the highest fat content. The oil frying method stands out as the most favorable in terms of hedonic quality, particularly due to its appealing color, taste, and overall acceptability. However, air frying and oven frying present viable alternatives for health-conscious consumers, with the added benefits of lower fat content. The air frying method has the lowest a_w and fat content, while the oven frying produces a brighter color with moderate fat levels.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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