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Valorization of chicken processing by products into protein rich dog biscuits

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Abstract

A study was carried out to assess the quality of dog biscuits incorporated with chicken processing by products. Two types of biscuits were prepared. One was control and the treated was chicken skin incorporated biscuits. Prepared biscuit physicochemical, nutritional and dog acceptability studies were conducted. A significant difference ($p < 0.05$) was observed in the spread factor of control and treated biscuits. The control and treated biscuits moisture, protein, fat and ash content percentage was 5.11 ± 0.17 and 4.90 ± 0.00 ; 20.45 ± 0.32 and 16.62 ± 0.14 ; 16.65 ± 0.13 and 18.23 ± 0.12 and 2.98 ± 0.02 and 3.08 ± 0.04 , respectively. Dog biscuits incorporated with chicken skin were well accepted by dogs. Based on the study results, protein-rich dog biscuits were developed and biscuits were well accepted by dogs.

Keywords: Valorization, dog biscuits, chicken skin

Introduction

Pet animals are defined as animals that are kept for a person's company or for entertainment at home. Pets play an important role in human life and human health (Day 2016)^[5]. The overall population of pet dogs in India was over 33 million in 2023. The population is likely to reach more than 51 million by 2028. The growth in the number of pet dogs has led to an increase in pet food sales across the country. Pet owners as consumers remain largely price conscious. They are however, becoming increasingly focused on the health and wellness of their pets and are spending more on pet dietary supplements and better-quality pet food (Schleicher, 2019)^[19]. There has been a noticeable shift in pet owners' nutritional preferences, which is reflected in the demand for dry dog food among dogs (White *et al.*, 2016)^[22]. The pet food market has continued to grow, with an impressive average annual expansion rate of 2.6% during the previous three years (Kepinska-Pacelik and Biel, 2021)^[8].

Biscuits are a type of dog treat that are typically produced from wheat flour and baked and slowly dried in an oven. Research has shown that dogs are naturally drawn to sweet and umami flavors, making them highly desirable in dog food and treats (Yarmolinsky *et al.*, 2009)^[24]. The nutritional value of dog treats can vary depending on their ingredients and processing methods (Morelli *et al.*, 2018)^[15]. Vinothraj *et al.* (2020)^[21] studied that Consumer's preference for quality attributes of chicken meat- An application of conjoint analysis. The results revealed that the ideal characteristic of chicken meat should be type (broiler bird), appearance (without skin) and form of meat (curry cuts). One of the chicken slaughterhouse by-products with the highest impact is chicken skin, which represents between 8 and 20% of chicken carcass weight (Heydarpour *et al.*, 2006)^[7]. Chicken skin is a major byproduct of the poultry industry. It is usually underutilized despite its composition, containing 30–40% fat with high concentrations of n-3 and n-6 fatty acids and 8–12% protein, which makes it a good source of collagen. The present study aimed to develop chicken meat and skins incorporating dog biscuits and evaluate their physicochemical, nutritional and dog acceptability studies.

Materials and Methods

Raw materials

Raw materials like broiler Chicken meat and skin, Fresh refined wheat flour (maida), Maize Flour, Rice flour, Rice bran, Meat cum bone meal, Sodium bi carbonate, sugar powder were procured from the local market.

Table 1: Formulation of dog biscuits

Ingredients	Control	Treated
Chicken meat (minced) (g)	50	25
Skin (minced) (g)	-	25
Vegetable oil (ml)	8	-
Maida (g)	12.5	12.5
Maize Flour (g)	10	10
Rice flour (g)	10	10
Rice bran (g)	2.5	2.5
Meat and bone meal (g)	2.5	2.5
Sugar (g)	12.5	12.5

Preparation of skin mince incorporated biscuits

The deboned chicken meat and skin kept at refrigeration temperature (4±1 °C) before mincing through a meat mincer and then thoroughly kneaded for preparation of chicken meat and skin mince incorporated biscuits. Two types of biscuits were prepared by using different levels of chicken meat mince (CMM), chicken skin mince (CSM), refined wheat flour (maida), sugar, shortening and other ingredients as given in the Tables 1. All the ingredients were mixed in the bowl mixer for 2-3 minutes to make homogenous emulsion. Then the prepared emulsion was made in to desired shape at the end. The shaped emulsion was then dropped into steel trays and baked in preheated hot air oven at 160 °C for 25-35 min or till golden brown. Then ready biscuits were cooled and packed in low density polyethylene (LDPE). The prepared biscuits physical properties, proximate composition and dog acceptability of biscuits were studied.

Physical properties of biscuits

The diameter and thickness of six biscuits was measured using ruler & Vernier caliper and average values were recorded (AACC 2000)^[2]. The spread ratio was calculated by dividing diameter with thickness.

Diameter

Six biscuits were placed edge to edge and total diameter (D) was measured in cm by using a ruler. The biscuits were rotated at an angle of 90° for duplicate reading. This act repeated twice, and average value of D was noted in cm.

Thickness

Six biscuits were placed on top of one another and total height was measured in cm with Vernier caliper. This practice was repeated thrice to get an average value and results were recorded in cm as thickness (T).

Spread factor

Spread factor (SF) was determined from D and T by employing subsequent formula.

$$\text{Spread Factor} = \left\{ \frac{\text{Diameter} \times 1}{\text{Thickness}} \right\} \times 10$$

Water activity

The Water activity measurement was conducted by measuring

the baked product after 45 minutes and the result were recorded.

Nutritional analysis

The moisture, fat, protein, crude fibre and mineral content of prepared biscuits are determined by standard AOAC (2000)^[2] methods.

Dog acceptability

The palatability assessment test was conducted as per Poppi *et al.* (2022)^[16] with necessary modification. The biscuit palatability test was carried out with a panel of 12 adult dogs, male and female, of different breeds and sizes, belonging to different pet owners. The feeding trials were replicated three times. The dog biscuits were fed to the dogs at after one to two hours of normal feeding time. The reaction of the dog towards the biscuits was observed. The observation was made, giving stress towards the approach to biscuits, interest to eat, and nature of eating. The observation was recorded on a scorecard. Control and treated biscuits were analyzed and scored on a 1-5 scale. The biscuits evaluation was carried out by using the scorecard adopted by Kuleswan *et al.* (2017)^[10] with necessary modification.

Result and Discussion

Physical properties of biscuits

Physical properties of chicken skin incorporated biscuit are presented in Table 2. It was observed, the diameter of cookies decreased gradually from 4.9 to 4.8 cm with broiler skin incorporated biscuits. There were no significant changes in the thickness of control and treated biscuits. The spread ratio of cookies decreased significantly from 7.0 to 6.86 with broiler skin incorporated biscuits. The spread factor of cookies decreased from 70 to 68.6% with broiler skin incorporated biscuits. Significantly reduced spread ratio and spread factor observed in broiler skin incorporated biscuits. Reduced spread ratio and spread factor of cookies were attributed to the fact that composite flours of wheat and soy apparently form aggregates with increased number of hydrophilic sites available for competing, for the limited free water in cookies dough (Mc Watters 1978; Yamazaki *et al.* 1977)^[11, 23]. Mohammadnezhad, S., and Farmani, J. (2022)^[14] reported that Chicken skin gelatin showed higher viscosity, foaming capacity, bloom value, and storage modulus than the commercial bovine gelatin. Moreover gelatin and fat from chicken skin can be considered as a valuable byproduct from the poultry industry.

Table 2: Physical properties of chicken skin incorporated biscuit

Parameters	Control biscuit	Treated biscuit
Weight (g)	8±0.01	8±0.01
Diameter (cm)	4.9±0.01	4.8±0.01
Thickness (cm)	0.7±0.01	0.7±0.01
Spread ratio (g/cm)	7.0±0.01	6.86±0.04
Spread factor	70±0.0 ^a	68.57±0.04 ^b
Water activity	0.39±0.01	0.39±0.01

Mean ± SE with at least one common superscript within classes do not differ significantly ($p>0.05$). n=6 for each treatment

Proximate composition of biscuits

There was a significant difference for the levels of moisture, lipids, ash and caloric value (Table 3). Moisture was significantly lower (4.90%) and had higher ash content (3.08%) in biscuits incorporated with chicken skin. The variation in biscuits' moisture may be related to the chicken

skin used, as seen in Table 4, that is, this is visible from the results shown. The moisture value recorded in this study was with the safe moisture content that has no adverse impact on the shelf life of the developed products. This may be because a high baking temperature reduces sample moisture content. Also, it can be inferred that the higher moisture content may be due to the higher lipid content present in chicken skin incorporated biscuit, making it difficult for these biscuits to lose moisture.

Table 2: Proximate composition of chicken skin incorporated biscuit

Proximate composition	Control biscuit	Treated biscuit
Moisture (%)	4.80±0.07 ^a	4.90±0.06 ^b
Protein (%)	20.45±0.32 ^a	16.62 ±0.14 ^b
Fat (%)	16.65±0.13 ^b	18.23±0.12 ^a
Fibre (%)	2.01±0.01 ^b	2.07 ±0.02 ^a
Ash (%)	2.98 ±0.02 ^b	3.08 ±0.04 ^a
Gross energy Kcal/Kg	4763±0.35 ^b	4949 ±0.16 ^a

Mean ± SE with at least one common superscript within classes do not differ significantly ($p>0.05$). n =6 for each treatment

The result also indicated significant improvements in fat contents in the treated biscuit compared to the control samples. The increases in fat content were due to the high-fat content of chicken skin. Poppi *et al.* (2022) [16] reported that pet biscuits made with the inclusion of three flours. The treatments were chicken viscera flour (CVF), commercial Nile tilapia flour (FF) and mixed fish flours of several species (FVF). The average crude protein value was 18.43%. These values are lower than those found in the pet biscuits of this current study, whose average crude protein value was 16.62%. Melini *et al.* (2017) [13] reported that pet biscuits made with carob and cotyledon flour had 10.7 to 13.3 g 100 g⁻¹ crude protein. Furthermore, the authors mentioned pet biscuits enriched with 5% fish flour had a crude protein content of 10.10 g 100 g⁻¹.

It can be observed that the lipid content (18.23%) of these biscuits made with chicken skin was significantly higher than the control biscuits. This may be due to the higher fat content of the chicken skin (30%–40%). Chug 2015 [3] revealed that the texture of biscuit was greatly dependent on the level of the fat and sugar in the biscuits.

Among the biscuits made in the current study, treated biscuits had a significantly higher caloric value (494.90 kcal 100 g⁻¹) compared to control biscuits (476.30 kcal 100 g⁻¹). According to Santos, Lima, Madruga, and Silva (2020) [18], chicken skin has an unsaturated fatty acid content greater than 65%, highlighting the presence of oleic and linoleic acid. In addition to these, other fatty acids of nutritional importance such as eicosapentaenoic acids and docosahexaenoic acids have also been identified (Dalziel, Kliem, & Givens, 2015) [4]. Therefore, there is a need to study the fatty acid profile in pet biscuits with the inclusion of chicken skin, mainly associated with the omega 3 series fatty acids.

Dog acceptability

The new food product is only considered a success if the end consumer – the pet – enjoys and readily consumes the food. Food is accepted by a pet dog and measured in terms of its attractiveness and consumption. Taste, aroma, texture, nutrition, and environment are the key attributes that profoundly influence the feeding experience. All these attributes are emotionally connected, from the pet's reaction to what is offered in their bowl to the pet parent's perception of how their pet enjoyed their meal.

Table 3: Dog's acceptability scores of chicken skin incorporated biscuit

Parameter		Control	Treated
1	Approach to biscuit	5.00±0.00	5.00±0.00
2	Interest to eat	4.66±0.00	4.83±0.00
3	Nature of eating	4.5.00±0.00	4.5.00±0.00
4	Quantity consumed	5.00±0.00	5.00±0.00

Mean ± SE with at least one common superscript within classes do not differ significantly ($p>0.05$). n =6 for each treatment

Hall *et al.* (2018) [6] developed a palatability study with small, medium and large dogs and observed that diets containing higher levels of crude protein had better palatability results, both in terms of consumption and preference. Knight and Satchell (2021) [9] also stated that high levels of crude protein in dog diets interfere with palatability, digestibility and faeces quality. In addition to the high crude protein content, some authors mention that high fat content also contributes to palatability results, as a preference for moist or semi-moist foods (Meineri *et al.*, 2021; Samant *et al.*, 2021) [12, 17].

Souza *et al.* (2022b) [20] in their study tested different levels of carcass flour inclusion with Nile tilapia head residues. These ingredients were included in a toothpick treat for dogs. The authors reported that there was a decreasing preference for dogs as the level of inclusion of fish flour in these treats increased. With the inclusion of fish flour, according to these authors, there was a reduction in the snacks' protein content. Probably the inclusion of fish flour has contributed to the reduced pet snack palatability. Therefore, it was a very different result from the one observed in the study, with the pet biscuits with the inclusion of fish flour and poultry viscera, the authors did not find any difference in the crude protein content, nor in the palatability between the biscuits, being able to be included any of the flours analyzed in the study.

Conclusion

To minimize environmental impact, as well as to bring a healthy alternative, it would be relevant to utilize chicken skin differentiated applicability as protein and fat sources in animal nutrition, especially for pets. When included in the pet industry, it enriches them nutritionally without altering their organoleptic aspects. Based on the study results, dogs accepted incorporating chicken skin in the dog biscuits formulation.

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Conflict of Interest

Not available

Financial Support

Not available

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