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Chemical composition and sensory analysis in hamburgers made from laying quails at the end of productive life

Abstract

Background: The aim of this study was to evaluate chemical composition and sensory analysis in hamburgers prepared with meat from laying quails at disposal age.

Main Body: The design was completely randomized, with four treatments of quail hamburger, represented by the inclusion of bacon in its preparation, as follows: quail meat without the inclusion of bacon; 5% inclusion of bacon, 10% inclusion of bacon and 15% inclusion, and three replicates. The quails were cleaned, ground and seasoned for each product. There was a significant difference in sensory acceptance for aroma and flavor characteristics. In all variables, acceptance increased following the level of bacon inclusion. In the purchase intent test, hamburgers with 10 and 15% inclusion of bacon were the most accepted. For the chemical analysis, there was a difference for the variables, lipids, protein, moisture, ash and caloric value. The products were accepted by the consumer, highlighting the highest levels of bacon inclusion.

Keywords: palatabilizers, fast food preparation, food alternatives, quail carcasses

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Introduction

The quail farming showes satisfactory growth in the country. In year 2021, the production of quail eggs was 273,750 thousand dozen, with approximately 15 million quails housed in Brazil.[1] According to Oliveira et al.[2] several factors explain the development of this activity, among them the fast growth of the animals, and their early production and sexual maturity which result in high productivity and longevity. Despite this contingent and increased exploitation, there is still little literature on quail meat processing as a food alternative.

One large obstacle for quail farming is when production begins to decline and there is a need to discard the quails to replace the flock, and with the birth of laying males that are discarded on the first day of life. The most widely used means of discarding laying quails are composting and incineration, feeding to other species, and throwing them into anaerobic streams and pits, alternatives that have a great impact on the environment.[3]

One way to mitigate the impacts caused by the improper disposal of these quails may serve as an alternative for human consumption. As the population increases, low-cost food alternatives are needed that meet the nutritional population requirements. Semi-finished products, such as those that are frozen or embedded, stand out at this point as they add value to the raw material. Furthermore, for the consumer, the purchase of ready-made products is timely given the growing need to minimize food preparation time, especially in large urban centers.[4]

Given the practicality of its preparation and the presence of nutrients that feed and satisfy hunger quickly, hamburgers have become a product consumed by all popular classes.[5] According to current Brazilian legislation, a hamburger is defined as an industrialized meat product obtained from ground beef with or without added adipose tissue and ingredients, molded, and subjected to an appropriate technological process, with a characteristic texture, color, taste and smell.[6] Thus, seeking to encourage the increased consumption of meat and quail byproducts in Brazil, this study evaluated the chemical composition and sensory acceptance of hamburgers made with carcasses of spent laying quail (*Coturnix coturnix japônica*) consisting of different proportions of bacon.

Material and methods

A total of 60 laying quails used with an average weight 186.6 g and approximately 18 months old at the production cycle end, were obtained from the quail farm sector of the experimental farm of Iguatemi (EFI), belonging to the Universidade Estadual de Maringá (UEM), Maringá city, Paraná state, Brazil. The study was conducted at the Laboratório de Tecnologia Pesqueira – UEM, with approval from the Animal Use Ethics Commission (CEUA/UEM - protocol No. 076/2013).

The quails were subjected to water and solids fasting for eight hours before slaughter. After being slaughtered and exsanguinated, the feathers, head, neck, feet, and viscera were removed. The experimental design used a completely randomized design with four treatments and three replications. These consisted of a control (excluding bacon) and three increments of bacon inclusion: 5, 10 and 15%.

The carcasses were ground whole in a conventional meat grinder (3 mm opening), this process was repeated three times. After grinding, the pasta was divided and weighed for the preparation of hamburgers and was seasoned with spices and their respective concentration of bacon. The dough mixing and the condiments was performed manually. The ingredients used for the preparation of hamburgers are shown in Table 1.

Table 1 Ingredients and their respective amounts (g) used in the formulation of hamburgers from laying quails at the end of productive life.

Ingredient (g)	Bacon inclusion levels (%)			
	0	5	10	15
Quail meat	600	600	600	600
Bacon	0	30	60	90
Textured soy protein	18	18	18	18
Salt	12	12	12	12
Chimichurri	3	3	3	3
Garlic	1.5	1.5	1.5	1.5
Beaten onion	1.5	1.5	1.5	1.5
Pepper	0.5	0.5	0.5	0.5

The hamburgers were molded into the shape of a 10 cm diameter common hamburger with an average weight 70 g per unit. Once they were ready, the burgers were frozen (-18°C) before being prepared for sensory analysis. The hamburgers were grilled on a conventional electric grill. When ready, they were cut into 2 cm square pieces, the ends were discarded, and the pieces were wrapped in properly identified aluminum foil and kept in a container so that they did not cool during the analysis application. To avoid any influence on the surveys, random numbers were assigned to identify all samples (Figure 1).

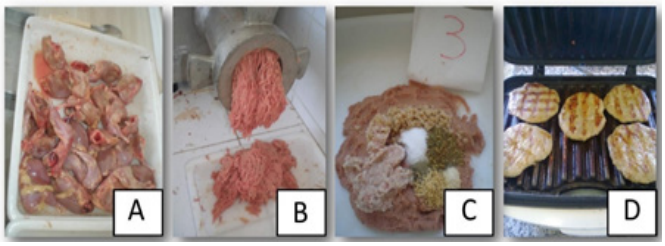

Figure 1 (A) Quail carcasses; (B) Carcasses being ground in a meat grinder; (C) Meat dough with condiments for hamburger preparation; (D) Hamburger being grilled for consumption on an electric grill.

A total of 37 untrained tasters took part in the hamburger tasting. The application of the sensory analysis was performed at the UEM facilities with academics and other members of the community. Participants received a sample of each treatment, accompanied by a cream cracker and water, and were instructed to ingest them between samples to eliminate residue and taste from the previous sample. They also received a form where they graded each sample on the following criteria: color, scent, texture, taste and overall impression. For these parameters, the scale ranged from 1 to 9, where 1 corresponded to 'very much disliked' and 9 corresponded to 'very much liked'.[7] On the same form, there was also a purchase intention test, with a scale 1 to 5, with grade 1 indicating that the taster would 'certainly would not buy' the product and 5 indicating that they 'certainly would buy' the product using the procedures described for sensory analysis.[8,9]

Chemical composition analyzes were performed at the Laboratório de Alimentos e Nutrição Animal – UEM, Maringá city, Paraná state, Brazil. Aliquots of the different treatments were used for the determination of chemical composition, moisture, ash,[10] and crude protein contents were estimated using the semi-micro Kjeldahl method.[11] For total lipids, we used the methodology described by Bligh & Dyer.[12] Carbohydrates were obtained through the difference of the other nutrients analyzed. The total caloric value was obtained by summing the average crude protein multiplication, lipid and carbohydrate values multiplied by the Atwater factors: 4, 9 and 4, respectively. The variables results were analyzed using ANOVA to compare the averages between the samples, significance level of 5%. Chemical composition data were subjected to ANOVA and regression analysis using the generalized linear model procedure (PROC GLM) at a 5% probability level.

Results and discussion

The cleaned carcasses average weight was 84.23g, therefore, with the processing, it was possible to calculate the yield 45.15% per carcass. Sensorially, it was observed that as the level of bacon inclusion in hamburgers increased, there was an increase in tasters scores (Table 2).

Table 2 Averages of sensory attributes in spent laying quail hamburger treatments.

Levels* (%)	Color	Scent	Texture	Flavor	Global impression	Buy intension
0	6.83 ± 1.44a	6.62 ± 1.58b	4.70 ± 1.85a	6.24 ± 1.90b	6.05 ± 1.58a	2.89 ± 1.32b
5	7.21 ± 1.29 a	7.18 ± 1.10ab	4.97 ± 2.11a	6.70 ± 1.59ab	6.62 ± 1.44a	3.13 ± 1.08ab
10	6.91 ± 1.36a	7.29 ± 1.24ab	5.67 ± 2.05a	7.21 ± 1.15a	6.54 ± 1.72a	3.48 ± 0.90ab
15	7.37 ± 1.23a	7.51 ± 1.12a	5.86 ± 2.08a	7.27 ± 1.53a	6.86 ± 1.49a	3.56 ± 1.06a
CV (%)**	18.84	17.88	38.05	22.83	23.9	33.64

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Table 2 Continued..

Levels* (%)	Color	Scent	Texture	Flavor	Global impression	Buy intension
Regression						
Levels (%)	**Equation (Y)**		**R² value**		**p value**	
Color	0.0264x + 6.882		0.8528		<0.05	
Scent	0.0556x + 6.733		0.8966		<0.05	
Texture	0.0836x + 4.673		0.9502		<0.05	
Flavor	0.072x + 6.315		0.9251		<0.05	
Global impression	0.047x + 6.165		0.796		<0.05	
Buy intension	0.047x + 6.165		0.9534		<0.05	

The inclusion of bacon did not statistically influence the tasters' preference for color, overall impression and texture. In a study by Ikhlas et al.,[13] meatballs produced with quail meat and different types of flour also did not result in differences in product color. This can be explained by the fact that meat is the main product of the formulation, giving the final product a characteristic color similar across all treatments. The texture, despite not having interfered between the treatments, was the attribute that received the lowest scores by the tasters. This can be explained by the carcasses grinding due to the presence of bones, even in small fragments they were perceptible by the tasters, citing the sensory analysis sheets.

Inclusion of 15% bacon was preferred by consumers in terms of both the aroma and flavor variables which showed statistical differences between treatments. Ainsworth et al.[14] also found differences in product aroma when they evaluated an elaborate hamburger from a mix of mincemeat, bacon, curing ingredients and seasoning. The authors reported that formulation changes were necessary as the product received comments such as "hard and spicy", so they added 25% pork fat. With the change, product acceptance in the sensory analysis increased by 17%, demonstrating that products such as bacon act as palatabilizers and delight consumers.

The inclusion of bacon influenced the evaluations of the hamburgers, and the highest averages were obtained in the treatment with 15% inclusion of bacon. For the treatment with 15% inclusion of bacon, despite the score for texture having been low, it showed a positive linear effect, explained by the dilution of bone particles with increased inclusion of bacon. In the intention-to-buy test, the sensory score showed that quail meat can successfully be used in the manufacture, least accepted treatment by the public was the hamburger without bacon, which scored an average grade 2.89 on a scale 1 to 5. The highest average for purchase intention was for the level of 15% bacon inclusion.

Regarding the chemical analyzes, lipids, protein and caloric value had positive linear effect (p <0.05). Ashes had a negative linear effect (p <0.05), which may be because the inclusion of bacon, which helped in the dilution of bones at the time of analysis. Moisture had a quadratic effect (p <0.05). The better estimate for moisture was found at a maximum inclusion point of 11.5% bacon. There was no significant difference for the carbohydrate variable (Table 3). The hamburger without bacon had a lipid content that denoted 'lean meat' status, which is currently sought by consumers. The current normative instruction on hamburger identity and quality requires a minimum 15% crude protein content and a maximum 23% lipids. All hamburgers were thus in compliance with the legislation. For total carbohydrates, the legislation provides a maximum 3%, and thus the hamburger without the inclusion of bacon had a higher-than-expected value.[6]

Table 3 Average values of chemical composition in laying quail hamburger at the end of productive life.

Chemical composition	Bacon inclusion levels (%)				p value	CV (%)*
	0	5	10	15		
Moisture	71.8 ± 2.4	69.2 ± 0.2	70.1 ± 0.6	66.6 ± 2.8	0	0.17
Crude protein	17.4 ± 0.8	18.6 ± 0.5	17.3 ± 0.8	19.2 ± 1.1	0.018	2.1
Lipíds	2.0 ± 3.0	4.0 ± 1.0	5.5 ± 0.5	8.7 ± 3.6	0.0215	23.74
Ashes	5.3 ± 0.1	5.7 ± 0.5	4.8 ± 0.4	5.1 ± 0.1	0.0022	1.67
Carbohydrates	3.5 ± 1.3	2.5 ± 0.3	2.3 ± 0.1	0.4 ± 1.8	0.1487	46.98
Calorific values	101.6 ± 25.1	120.7 ± 6.0	128.2 ± 1.5	156.3 ± 29.6	0.0041	4.89
Regression						
Chemical composition		**Equation (Y)**		**R² value**		**p value**
Moisture		-0.294x + 71.63		0.7648		<0.05
Crude protein		0.134x + 17.12		0.8674		<0.05
Lipíds		0.432x + 1.81		0.9748		<0.05
Carbohydrates		-0.19x + 3.60		0.8976		<0.05
Calorific values		3.432x + 100.96		0.9533		<0.05

The findings of study differ from those obtained by Petracci et al.,[15] who studied restructured chicken fillet breaded from mother and commercial laying hens and found protein levels greater than 21%, and fat and ash less than 2.1%. The authors did not use any type of fat in food preparation and the birds were boned, which would have influenced the obtained chemical values. Understanding the current study, with a commercial viewpoint, the introduction of practical products in the retail market is a great incentive to increase the consumption of quail meat and is an attractive way to add value to cuts and parts that would otherwise not commercialized.[16–19]

Ikhlas et al.[13] and Enke et al.[18] developed meatballs from the use of residue from the processing of old quail meat (*Coturnix coturnix japonica*). The quail meatballs made from different types of flour were analyzed for their chemical composition and physicochemical properties (cooking yield, moisture, lipid retention, juiciness, resistance test, colorimetry, texture profile analysis and sensory qualities). Meatballs expressed chemical composition, 64.94 to 66.33% moisture, 13.43 to 14.47% crude protein, 10.32 to 13.77% lipids, 2.30 to 2.95% ash and 4.80 to 7.67% carbohydrates. The cooking yield was higher for the formulation of quail meatballs with potato flour (98.97%), followed by the yields of the formulations with cassava (97.99%), sago (97.46%), corn (91. 06%) and wheat flour (91.00%). The sensory evaluation of quail meatballs performed by Ikhlas et al.,[13], Enke et al.[18] and Corrêa et al.,[19] the sensory score showed that quail meat can successfully used in the manufacture of meatballs as an alternative to other meats such as beef and chicken, using different types of flour.

McClements[20] conducted a systematic biobliometric survey. Studies from all over the world on the inclusion of bacon in hamburgers made with poultry meat were surveyed. This study showed that in 90% of the researches carried out, the inclusion of bacon in up to 15% did not influence the chemical composition of the hamburgers.

Conclusion

The spent quail hamburger had good acceptance and would have potential in the consumer market whilst meeting current requirements for chemical and sensory attributes. The preference was higher for products with 10 and 15% bacon inclusion, which had a low lipid content despite having considerable concentrations of bacon.

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Conflicts of Interest

The authors declare that there are no conflicts of interest.

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