Turkey meat quality (*Meleagris gallopavo*) submitted to different ventilation systems during fattening

*Qualidade da carne de perus (*Meleagris gallopavo*) submetidos a diferentes sistemas de ventilação durante a engorda*

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Abstract

The present investigation evaluated the quality of turkey meat produced in two production systems, according to the following parameters: water loss in cooking, drip water loss, texture (shear strength), pH, color, humidity, protein, ashes and lipids. A total of 200 turkey breast samples of 500 g, separated by a batch of 20 samples, from ten aviaries from Santa Catarina, Brazil, were used: five from breeding with a traditional ventilation system and five with a mechanical ventilation system. Samples were obtained after slaughter and frozen at -15°C for 30 days. The results were submitted to variance analysis and the Tukey test. Significant differences were found only in the analysis of drip water loss. The birds of the traditional ventilation system presented 14.26% loss of water drip, while those of the ventilation exhaust system presented a loss of 19.21%. There were no differences in the chemical composition of poultry meat in relation to the production systems.

Keywords: Quality of turkey meat. Ventilation in the production of turkeys. Ventilation systems. *Meleagris gallopavo*.

Resumo

O presente trabalho avaliou a qualidade da carne de perus criados em dois sistemas de produção, a partir dos seguintes parâmetros: perda de água na cocção, perda de água por gotejamento, textura (resistência ao cisalhamento), pH, cor, umidade, proteína, cinzas e lipídios. Foram utilizadas 200 amostras de peito de peru de 500 g, separadas por lote de 20 amostras, de dez aviários de Santa Catarina, Brasil, dos quais: cinco provenientes de criação com sistema de ventilação tradicional e cinco com sistema de ventilação mecânica. As amostras foram obtidas após o abate e congeladas a -15°C durante 30 dias. Os resultados foram submetidos à análise de variância e ao teste de Tukey. Diferenças significativas foram encontradas apenas na análise da perda de água por gotejamento. As aves do sistema de ventilação tradicional apresentaram 14,26% de perda de gotejamento de água, enquanto as do sistema de exaustão de ventilação, 19,21%. Não houve diferenças na composição química das carnes de aves em relação aos sistemas de produção.

Palavras-chave: Qualidade da carne de peru. Ventilação na produção de perus. Sistemas de ventilação. *Meleagris gallopavo*.

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Introduction

The poultry industry in Brazil has grown significantly in recent years, generating employment for two million people in different activities of the [illegible] und 10 billion dollars a year and representing approximately 2% of the gross domestic product (MENDES, SALDANHA, 2004; UBA, 2014). Turkey breeding produces more than 30 million birds a year, representing 3.5% of Brazilian poultry production (UBA, 2006).

New technologies and sanitary control stimulated the increase in the sector, particularly for farmers to diversify production and increase profit in small areas (MENDES et al., 2010).

Turkey meat is lean compared with red meat. Both are essential components of diets in developed countries, especially for their sensory characteristics, such as taste and texture. In addition, because of its high nutritional value, turkey is a source of animal protein, minerals and vitamins (LOPES, 2009).

One of the greatest challenges for the meat industry is to offer soft, juicy products, presenting pleasant color and flavor (DIRINCK et al., 1996). According to Gaya and Ferraz (2006), the main attributes evaluated to determine meat quality are color, water-holding capacity and texture.

The barn ventilation system is important to reduce thermal stress and, consequently, avoid losses in meat quality. Poultry at high temperatures spend less time feeding to decrease the energy consumed in digestion. There is also an increase in poultry consumption of water, responsible for cooling the body. Because of this and also due to age, the older the birds experiencing thermal stress, the lower their weight gain will be (SEVEGNANI et al., 2005).

Baêta (1998) says that Brazilian aviaries can be classified as opened (traditional system of ventilation) and closed (mechanical exhausted ventilation). Opened aviaries are simpler and have considerable porosity, even when the blinds are closed. Indoors aviaries are more complex, very expensive, and require forced ventilation and evaporative cooling.

Considering the lack of information for the evaluation of turkey meat quality according to breeding, this investigation evaluated the chemical composition and quality of turkey meat raised in two kinds of production systems: barns with traditional mechanical ventilation and barns with mechanical exhausted ventilation systems.

Materials and Methods

One hundred samples of turkey meat obtained from birds reared in a traditional ventilation aviary and one hundred samples of turkey meat obtained from birds reared in a mechanical exhausted ventilation aviary were compared. Each sample consisted of 500 g turkey breast, from male birds, which were obtained after slaughter and frozen at -15°C for 30 days. The analyses were for water loss for cooking, water loss for dripping, texture (shear force), pH, color, moisture, ash, lipids and proteins.

Meat Quality and Nutronal Composition

Water loss for cooking was measured following the methodology proposed by Garcia et al. (2005) and Costa et al. (2002), with some adjustments in cooking temperatures and material used to package the contents. Samples of approximately 50 g were weighed in a semi-analytical Shimadzu balance, Model AUY220, placed in a beaker, covered with aluminum foil, and boiled in water bath at 80°C for one h. They were then placed on absorbent paper to reach room temperature and weighed again. The difference between the weights was calculated and converted into percentage.

For the water loss for dripping analysis, 10 g of the sample were used, which were weighed in a semi-analytical balance, kept in a cooling chamber at 4°C for 48 h and weighed again. The water loss percentage from the difference between the initial and final weight (ATHAYDE et al., 2012) was calculated.

The texture analysis (shear strength) used the same samples as those for analyzing water loss for cooking. After baking, the samples were cut into rectangles of 1 x 1 x 2 cm diameter, in duplicate, and subjected to shear in TAXT2 texturometer equipped with Warner-Bratzler meat cell, SMS standard (Stable Micro System) with 50 kg force capacity (500 N). The result was obtained from the average of the duplicates (KERTH et al., 1995; HEINEMANN et al., 2003; ATHAYDE et al., 2012).

Ten grams of sample were weighed and placed in a 250 ml beaker, homogenized with 100 ml of doubly distilled water for 1 min, allowed to stand for 30 min and then subjected to reading digital benchtop pH meter, Lucadema, model LUCA - 210P (TERRA; BRUM, 1988).

Color was measured by portable colorimeter for food, Konica Minolta Chroma Meter CR-400. After the 30 min standard period of exposure to atmospheric air, the colorimeter was applied directly into the muscle to measure the color. (GARCIA et al., 2005; MAGANHINI et al., 2007). The system employed was the CIELAB, based on three components: luminance, represented by L*, ranging from 0 (black) to 100 (white); tone was represented by a*; -a* is the ratio of the colors red and green; and b*, -b* is the ratio between the yellow and blue colors (BARROS et al., 2014).

Moisture was determined by the gravimetric method at 105°C. It was measured as the difference between initial and final weight and expressed as a percentage (MORETTO, 2008).

For mineral material calculation, the same samples were used, but they were incinerated in a muffle furnace at 550°C, destroying the organic matter, without decomposing the mineral residue constituents, until the ashes acquire white coloring. After subsequent weighing, we calculated the value of sample percentage (TERRA; BRUM, 1988).

Protein was determined in three stages: digestion, distillation and titration. Sample 0.5 g was transferred into a Kjeldahl tube, with 2 g of catalyser and 5 ml of sulfuric acid. It was heated for 4 to 6 h until the liquid looks transparent. After this process, 20 ml of distilled water were added and it was connected to the distillation system; sodium hydroxide 50% was further added until a blue coloration indicated alkalinity. Lastly, the distillate received 5 ml of boric acid to 4% and titrated with a 0.1 NHCl solution, employing the conversion factor (6.25) and methodology proposed by Moretto (2008).

The carbohydrates analysis followed the Nifext method (PEDROSA; COZZOLINO, 2001). The lipid analysis followed the Bligh-Dyer method (1959).

Statistical Analysis

The unit values in growth performance, evaluation of meat quality and nutritional composition were tabulated in spreadsheets for calculating the average per lot and then by the raising system.

The system averages were subjected to variance analysis, using Tukey's test, by Sisvar program for Windows 5.3 Build 77.

Results and Discussion

Meat Quality

The average results of the breast meat quality of turkeys raised in the air traditional system and in the air exhausted system are shown in Table 1.

The average of the flocks was subjected to statistical analysis using Tukey's test, which showed significant difference ($p < 0.05$) only in water loss for dripping (WLD). The results obtained in the present paper, was higher than the value found by Bridi et al. (2012), who found 3.81% in chicken meat, and Woelfel et al. (2002), who found 3.32%, also in chickens. The high rates of WLD can be justified by differences in methodology. This research was decided by the absence of packaging the pieces of meat subjected to drip under refrigeration (ATHAYDE et al., 2012), whereas in other studies the prior packaging of parts was performed.

The average pH values found in this study, measured after 1-month freezing, were equal in both systems and very similar to the value of 5.94 found by Mckee et al. (1998), who carried out measurements on the day following slaughter. They were lower than those reported by Lopes (2009), which determined pH of 6.24, but the meat measurement was carried out after 3-month freezing time. Both surveys were conducted on turkey breast meat. However, the difference from Lopes (2009) may be justified because of the time difference between slaughter and measurement. The freezing and thawing processes may also have influenced results. When compared to chicken breast, the value was similar to that found by Wattanachant et al. (2004), who obtained pH of 5.93.

The water loss for cooking values was higher than those in Mckee et al. (1998) and Costa (2006), which determined 26.58% and 28.38%, respectively, in turkey breast. Water retention regards the appearance of the meat before and during cooking, and concerns softness (PALEZI et al., 2014).

Meat texture is related to the amount of intramuscular water and meat water retention capacity, so that the higher the water content in the muscle, the greater the meat tenderness (ANADÓN, 2002). Costa (2006), found 61.23 kgf in turkeys, almost double that found in our research, which was closer to the result of 2.27 kgf in turkeys in Lopes (2009), similar to the 2.36 kgf found by Oba et al. (2007), but in chickens.

Table 1 – Breast meat quality parameters of turkeys raised in traditional ventilation system (TS) or in an exhausted air system (ES) – Realeza/Paraná, Brazil – 2016

Lots/ Systems	pH	WLD (%)	WLC (%)	T (kgf)	C (L*)	C (a*)	C (b*)
1	5.90	11.18	33.37	3.67	51.33	4.38	6.87
2	5.79	12.39	30.89	3.68	51.17	4.20	6.92
3	6.07	11.72	30.80	3.28	47.80	3.90	6.18
4	6.08	14.47	30.54	4.35	47.91	4.00	6.01
5	5.99	21.53	33.45	4.07	47.81	4.54	6.84
Average TS	5.97	14.26**	31.81	3.81	49.20	4.21	6.56
Standard deviation	0.12	4.25	1.47	4.04	1.87	0.26	0.43
1	5.78	24.86	32.00	3.75	51.74	5.17	7.47
2	5.85	10.88	29.70	3.76	52.10	4.14	7.14
3	5.94	20.98	29.93	3.67	47.77	4.69	7.20
4	6.01	19.71	31.21	3.98	46.84	3.53	6.07
5	6.27	19.60	29.89	3.99	45.75	4.20	6.56
Average ES	5.97	19.21**	30.55	3.83	48.84	4.34	6.89
Standard deviation	0.19	5.12	1.01	1.43	2.9	0.62	0.56

** - statistical difference; WLD - Water loss for dripping; WLC - Water loss for cooking; T - Texture; C (L*) - Color, brightness; C (a*) - Color, tone (red-green) and C (b*) - Color, tone (yellow-blue)

Table 2 – Nutritional composition of breast meat from turkeys raised in a traditional ventilation system (TS) or in an exhausted air system (ES) – Realeza/Paraná, Brazil – 2016

Lots/ Systems	Moisture (%)	Protein (%)	Carbohydrates (%)	Mineral Matter (%)	Lipids (%)
1	75.82	23.63	0.00	1.24	0.33
2	66.67	23.18	0.58	1.15	0.84
3	62.62	24.10	11.60	1.21	0.83
4	68.73	24.55	5.00	1.28	0.81
5	68.29	24.47	3.82	1.23	1.67
Average TS	68.43	23.98	4.20	1.22	0.89
Standard deviation	5.23	0.58	0.03	4.65	0.47
1	73.77	23.15	2.05	1.27	0.39
2	74.70	22.72	0.06	1.26	1.31
3	60.25	24.47	13.91	1.23	0.72
4	62.68	24.02	11.33	1.16	1.00
5	70.65	25.49	2.29	1.32	0.42
Average ES	68.41	23.97	5.93	1.24	0.77
Standard deviation	6.57	1.09	0.04	6.24	0.39

The color observed on the meat surface is the result of the absorption of light by myoglobin and other components, such as muscle fibers and its protein, also being influenced by amount of free liquid present in meat (OLIVO; SHIMOKOMAKI, 2006). The determination is made by the measurement of three variables: L *, a * and b. The L* values found, which represent the luminosity, were higher in Lopes (2009), which was 40.74. Such values, 49.20 and 48.84, are characterized as a trend towards dark. When a* is observed, the 4.21 and 4.34 values are characterized by a reddish trend, and were lower than Lopes (2009), who found 6.47. For variable b*, the values found of 6.56 and 6.89 are characterized like trends to yellow, and the values were higher than Lopes (2009), who found -0.71. However, the brightness and trend in yellow values were closer to those found by Garcia et al. (2005), which evaluated chicken breast and obtained the following results: L* 49.99; a* 1.28; b* 7.98.

Nutritional Composition

The results of nutritional composition between animals raised in traditional system and in mechanical ventilation system presented no significant statistical difference. The arithmetic average of turkey breast meat for traditional and mechanical ventilation system is shown in Table 2.

The turkey breast moisture was lower than that of chicken breast; Garcia et al. (2005) observed 71.88% in chickens. The same authors found similar to protein values (23.83%) and mineral matter (1.23%); Oba et al. (2007) found 1.20% in chickens.

The lipid values found in the present research were larger than the 0.48% in turkey breast found by Lopes (2009). When compared to chicken breast, the values are greater than in Wattanachant et al. (2004), who found 0.68%, but are lower than in Oba et al. (2007), who found 1.53% fat in chickens.

Conclusion

Barn ventilation is an important factor that contributes to maintaining turkeys in a thermal comfort zone, which is directly related to the yield of these birds that could affect their productivity levels.

The ventilation with the air exhausted system has satisfactory results in chickens. However, the results of the present investigation showed that in the examined samples, there was no significant difference ($p > 0.05$) found in the following parameters evaluated in the turkey meat quality: loss of water by cooking, texture (shear strength), pH and color, only loss of dripping water, although the results may have been influenced by the method used.

The results for the nutritional production of moisture, protein, ash and lipids also did not present any significant difference ($p > 0.05$).

Thus, from the results found in this research, we concluded that there are no differences in the quality and nutritional composition of turkey meat according to the kind of ventilation system used in the raising barns.

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