OKU Fen Bilimleri Enstitüsü Dergisi
6(Ek Sayı): 119-127, 2023

OKU Journal of The Institute of Science and Technology, 6(Suppl): 119-127, 2023

Osmaniye Korkut Ata Üniversitesi Fen Bilimleri Enstitüsü Dergisi

Osmaniye Korkut Ata University Journal of The Institute of Science and Technology

Investigation of Some Chemical and Textural Properties of Chicken Breast Meats Sold by Different Companies

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Research Article

Article History:
Received: 23.01.2023
Accepted: 16.05.2023
Published online: 20.12.2023

Keywords:
Broiler
Color
Meat
Texture

ABSTRACT

This study aimed to make chemical analyses and compare cooking loss, color and texture properties of breast meats from three companies (A, B, C) obtained from sales depots with similar weight, packaging, and expiry dates. For this purpose, 10 breast meat samples from each company were used as material. As a result, protein values in companies A, B, and C were 22.60, 22.59, and 22.82%, respectively (P > 0.05). Fat values were measured as 2.18, 2.77, and 2.42% (P>0.05). It was determined that the cooking loss value was the highest in enterprise A (28.90%). It was measured that the L* (lightness) value was between 59.47 and 59.70, and the a* (redness) value was between 2.84 and 3.60, and these values did not make a significant difference between enterprises (P>0.05). The b* (yellowness) value was found as 10.19, 12.89, and 14.95 in A, B, and C enterprises, respectively, and it was observed that the difference between these measurements was statistically significant (P<0.05). When the texture analysis results were examined, it was determined that there was no significant difference between the enterprises regarding hardness, springiness, adhesiveness, and gumminess. It was determined that the chewiness results significantly affected by the enterprises (P<0.05).

Farklı Firmalar Tarafından Satılan Tavuk Göğüs Etlerinin Bazı Kimyasal ve Tekstürel Özelliklerinin İncelenmesi

Araştırma Makalesi

Makale Tarihçesi:
Geliş tarihi: 23.01.2023
Kabul tarihi: 16.05.2023
Online Yayınlanma: 20.12.2023

Anahtar Kelimeler:
Broyler
Et
Renk
Tekstür

ÖZ

Bu çalışmada; satış deposundan temin edilen üç farklı firmaya (A, B, C) ait ağırlık, ambalaj ve son kullanma tarihleri benzer olan göğüs etlerinin kimyasal analizlerinin yapılması, pişirme kaybı, renk ve tekstür özelliklerinin karşılaştırılması amaçlanmıştır. Bu amaçla her firmadan 10'ar adet göğüs eti örneği materyal olarak kullanılmıştır. Sonuç olarak A, B ve C işletmelerinde protein değerleri sırasıyla %22,60; 22,59 ve 22,82 olarak bulunmuştur (P>0,05). Yağ değerleri %2,18; 2,77 ve %2,42 olarak ölçülmüştür (P>0,05). Pişirme kaybı değerinin en yüksek A işletmesinde (%28,90) olduğu belirlenmiştir. L* (açıklık) değeri 59,47 ile 59,70; a* (kırmızılık) değeri ise 2,84 ile 3,60 arasında olduğu ölçülmüş ve bu değerler bakımından işletmeler arasında görülen farklılıklar önemsiz bulunmuştur (P> 0,05). A, B ve C işletmelerinde b* (sarılık) değeri sırasıyla 10,19, 12,89, 14,95 olarak bulunmuş ve bu ölçümler arasındaki fark önemli bulunmuştur (P< 0,05). Tekstür analizi sonuçları; sertlik, yaylanma, yapışkanlık ve sakızımsılık açısından işletmeler arasındaki farklılıkların

önemsiz olduğunu göstermiştir. Çiğneme sonuçlarının ise işletmelerde anlamlı fark yarattığı belirlenmiştir (P<0.05).

To Cite: Varol Avcılar Ö. Investigation of Some Chemical and Textural Properties of Chicken Breast Meats Sold by Different Companies. Osmaniye Korkut Ata Üniversitesi Fen Bilimleri Enstitüsü Dergisi 2023; 6(Ek Sayı): 119-127.

Introduction

The chicken meat industry, which has been growing rapidly in recent years, offers an important animal food source for consumption in terms of providing a relatively cheap protein source, providing easily prepared products, and not being subject to any religious restrictions (Valceschini, 2006).

In addition, chicken meat is among the healthy foods in many diet lists, as it contains valuable essential amino acids as a source of animal protein, has a low cholesterol value, and contains valuable vitamins and minerals (Adamski et al., 2017; Isleyici et al., 2019).

Considering these advantages, the production and consumption of poultry meat globally, especially chicken, reached 132,476 and 130,832 million tons, respectively, according to the averages for 2019-2021 years (OECD-FAO, 2022).

Chicken meat, It is offered for sale as a fresh, processed and frozen animal product.In addition to the whole carcass consumption, an especially optional part of chicken meat (thigh, breast, wings etc.) consumption ensures that the meat portion suitable for the demands of the consumers is met.

Chicken breast meat, which is the most preferred, has an important place as the fundamental agent of mainly chicken meat processed products, which is easy to prepare and cook quickly (Sezen, 2009). The chemical composition of chicken breast meat was reported as moisture 76.10%, crude protein 21.95%, crude fat 1.29%, crude ash 1.67%, and 121 kcal/100g (skinless breast meat) energy amount (Kim et al., 2020, TURKOMP, 2022).

This chemical composition and the quality of the final product may vary due to reasons such as the breed of the animal, its age, gender, genetic characteristics, growing conditions, preferred carcass region, slaughtering, post-slaughtering cooling, shredding and packaging processes (Sezen 2009; Isleyici et al., 2019).

In the review studies, it has been reported that especially the loading, transportation, unloading, slaughtering and processing stages of poultry production have an effect on meat quality. It has been stated that these processes may cause stress and this will cause the formation of PSE-like meat (pale, soft, exudative) (Mir et al. 2017). In PSE meats, acceleration of postmortem glycolysis and rapid pH decrease occur while the carcass is still warm. These events can cause muscle protein denaturation, flesh discoloration, reduced water holding capacity and poor texture development (Zaboli et al.2019).

The color of chicken meat, which is one of the factors affecting the consumer's purchasing behavior, can be affected by environmental and genetic factors. At the same time, the amount of myoglobin and heme pigments in the structure of the meat is also essential. Chicken breast meat contains lower amounts of these pigments than other parts (Wideman et al., 2016).

As an indicator of consumer satisfaction, texture characteristics are important in selling meat. For example, characteristics that determine the consumption quality of meat, such as hardness, adhesiveness, springiness, and chewiness, are among the most important texture criteria. These criteria can be determined by means of TPA tests (Texture profile analyses), which try to define the events that occur in the mouth while consuming the consumer's food (Erdemir and Karaoğlu, 2021).

This study aimed to determine the current situation in chicken breast meat samples from different companies offered for sale by making some chemical analyses, cooking loss, color and textural analyses that are important in consumer preference.

Materials and Methods

Sampling

The study was carried out in May 2022 in Osmaniye/TURKEY. The samples were taken from the sales depots using a simple random method and transported to the laboratory maintaining the cold chain.

30 pieces of chicken fillets from three companies (A, B, C companies; 10 samples for each group) were taken as whole breast meat without opening their commercial packages. Care was taken to ensure that the samples' weights, packaging, and expiry dates were similar. They were kept in their original packaging and + 4°C until analysis was applied.

In all samples, chemical analysis was conducted in the lower left part of the breast meat, color measurements were made in the upper left part, and texture measurements and cooking loss were made in the right part.

Chemical composition

Approximately 5 g of the meat sample was dried in a drying oven (UNB400 Memmert, Germany) at 103°C for 3 hours to determine the moisture content. Moisture content was determined by calculating the weight differences before and after drying. Crude protein content was measured by the Kjeldahl method (VAPOdest45S, Gerhardt, Germany). Crude fat content was calculated by petroleum ether extraction using the Soxhlet method (SOX416, Gerhardt, Germany).

Meat color measurement

The color properties L*, a*, and b* of poultry meat were specified by a Chroma meter (Konica Minolta, CR-400, Japan). The average value was determined by taking three measurements from different places on the breast meat surface; L* (lightness), a * (redness), b* (yellowness) values were calculated.

Meat cooking loss

To measure the cooking loss value 5 g were taken from each samples. These samples were packed in polyethylene bags. It was kept in an 80 °C water bath (Selecta, Spain) for 1 hour. It was then cooled at room temperature for 30 min. Cooking loss was calculated from the difference between pre-and post-cooking weights (Honikel, 1998).

Meat texture analysis

Chicken breast samples' hardness, springiness, adhesiveness, gumminess, and chewiness were measured using the texture analyzer (CT3 Texture Analyzer; Brook field Engineering Labs Inc., Middleborough, MA, USA). The method used was modified according to Masoumi et al., (2022).

Statistical analysis

One-Way ANOVA and Kruskal–Wallis tests were used to determine the difference between groups; Tukey was performed as a post hoc test. While the One-Way ANOVA test was applied when the variances were homogeneous, the Kruskal–Wallis test was applied when the variances were not homogeneous. Significance was considered at $P < 0.05$. The SPSS Statistics 23.0 package program performed the statistical analysis. Mean ± std. error (SE) was used in the tables and in comparison between groups. The sample size used in the study was determined with the G Power 3.1 power analysis software (Faul et al. 2007).

Results

Chemical analysis values in samples that belong to different companies are given in Table 1. While the moisture value was 72.18% in the samples belonging to company C, results were close to each other in companies A and B. There was no statistically significant difference between the results ($P>0.05$). Protein values are highest in company C as 22.82%, and lowest in company A as 22.60%. It was observed that these numerical differences between the groups are not significant ($P>0.05$). The fat value was found to be the highest (2.77%) in company B. Cooking loss values were determined as 28.90, 24.24, and 26.13% in companies A, B, and C, respectively ($P>0.05$).

Color values of chicken breast meat samples are shown in Table 2. In the samples of companies A and C, L* values are close to each other (59.70 and 59.47).

In company B, it was measured as 56.61 ($P>0.05$). The highest a* value in breast meat samples was determined in company B (3.60). The values in other companies' samples are lower, and the difference between groups is not significant ($P>0.05$). The highest b* value in breast meat samples was determined in Company C (14.95).

For companies B and A, it is 12.89 and 10.19, respectively. This difference between the groups was statistically significant ($P<0.05$).

Table 1. Comparison of the proximate composition (%) and cooking loss (%) values of chicken breast meats from different companies.

Companies	Moisture (%)	Protein (%)	Fat (%)	Cooking loss (%)
A	71.28±0.32	22.60±0.21	2.18±0.13	28.90±1.47
B	71.43±0.25	22.59±0.30	2.77±0,33	24.24±1.23
C	72.18±0.28	22.82±0.16	2.42±0.35	26.13±1.45

Values are shown as mean ± std. error. Values without letters in the same column indicate no significant difference (P > 0.05), while lower case superscripts indicate a significant difference (P<0.05). (n = 10).

Table 2. Comparison of the surface color of raw chicken breast meat from different companies.

Companies	L^*	a^*	b^*
A	59.70±1.19	2.84±0.43	10.19 ± 0.48^{a}
B	56.61±1.27	3.60±0.90	$12.89\pm1.02^{a\,b}$
C	59.47±0.97	3.13±0.42	14.95 ± 1.01^{b}

Values are shown as mean ± std. error. Values without letters in the same column indicate no significant difference (P>0.05), while lower case superscripts indicate a significant difference (P<0.05). (n = 10). L: lightness, a: redness, b: yellowness.

The texture values of chicken breast meat samples are given in Table 3. The highest hardness value was found in company C (10.94). This was followed by companies A (10.92) and B (10.36), respectively. These differences between the values were not statistically significant (P>0.05). The springiness value was measured as 6.56 in company B. The highest adhesiveness value was measured as 1.46 in company A. The lowest gumminess value was measured as 1.71 in company C. The highest value was determined as 2.59 in company B. The chewiness value was measured as 11.18, 13.69, and 10.62 in companies A, B, and C, respectively. This difference between the groups was statistically significant (P<0.05).

Table 3. Comparison of texture characteristics of raw chicken breast of different companies.

Companies	Hardness (N)	Springiness (mm)	Adhesiveness (mJ)	Gumminess (N)	Chewiness (mJ)
A	10.92±0,20	5.71±0.29	1.46±0.41	2.12±0.27	11.18±0.87$^{a\,b}$
B	10.36±0.30	6.56±0.25	1.24±0.31	2.59±0.48	13.69±0.46^{b}
C	10.94±0.18	6.20±0.15	1.10±0.28	1.71±0.30	10.62±1.05^{a}

Values are shown as mean ± std. error. Values without letters in the same column indicate no significant difference ($P>0.05$), while lower case superscripts indicate a significant difference ($P<0.05$). (n = 10).

Discussion

Chemical analysis of meat is critical in determining the nutritional values before converting them into products to be processed. Xiong et al. (1993) reported that the chemical composition of chicken meat might change during sex, age, animal feeding, the part of the meat it belongs to and carcass processing.

In a review study, the amount of protein in chicken fillet was around 23-25%, while it was reported as 18% in thigh meat. It has been stated that the protein amount of chicken meat is affected by the consumed feed content and especially the slaughter age, and the increase in slaughter age can increase the protein content. It has been stated that the amount of fat in traditionally grown chicken meat is around 1.3% in fillet and 4.5% in thigh, and the amount of fat in chicken meat can be affected by the energy level of the consumed feed, slaughter age, genotype and production system. It has been stated that the mineral content of meat is little affected by nutrition and other breeding factors, and especially the vitamin content depends on the composition of the feed (Baeza et al. 2022).

In this study, there was no difference in chemical composition values chicken breast meat between the companies. The obtained values are similar to the results reported by various researchers previously performed (moisture, protein and fat values Petracci et al., (2013), 75.07; 23.48; 1.82%; Silva et al., (2017), 76.3; 19.9; 1.3%; Kokoszynski et al., (2022), 72.9; 24.3; 1.8%). In this study, it can be thought that the similarity of chemical compositions is because the companies from which the samples were supplied are integrated enterprises and the care-feeding conditions and carcass processing process are carried out properly.

While there was no statistically significant difference between the groups in terms of chemical composition values in the samples examined, it was observed that the cooking loss value was lower, especially in the B group. Some researchers have stated that the cooking loss value may vary depending on the amount of myofibrillar protein, connective tissue or collagen in the structure of the meat (Petracci et al., 2013). The fact that the cooking loss in group B is lower than the other groups and the chewiness value of the meat is higher suggests that the connective tissue amount of the meat of

this company may be greater. These results is appropriate to investigate in more detail with other chemical analysis methods.

The color of chicken meat can be particularly affected by feed. Color change is observed due to the accumulation of carotenoids found naturally or in feeds in intramuscular fats. It is the haem protein concentration that affects the brightness and redness of meat. Due to the increase in slaughter age, the meat becomes redder and darker because the heme pigment content increases. Muscle glycogen stores during slaughter and pH change after death are effective in the formation of color in white meat. Stress factors occurring before slaughter are effective in muscle glycogen stores and pH change. In addition, storage conditions and packaging processes can be effective on the color of fresh poultry meat (Baeza et al. 2022).

L* value is an important parameter in determining the color of chicken meat. It has been reported that when the L* value is high, the color is light and the pH is low (pH < 5.6), and when this value is low, the color becomes darker and the pH increases (pH > 5.9) (Garcia et al., 2010). In a study, L*, a* and b* values were reported as 52.5, 2.8, 2.1 in packaged chicken breast meat on the 3rd day (Chmiel et al., 2018). Another study reported that the pH was also low in meats with low water holding capacity after slaughter. In the same study, it was stated that the L* value is high, the a* value is low and the b* value is high, which determines the color criteria of the meat (Bowker and Zhuang, 2015). A study reported that high L* values may be due to the stressful situations of animals such as temperature, inappropriate catching, long-distance transportation before slaughter (Karunanayaka et al., 2016).

In this study, only a significant difference in b* value was found between the sample groups. Samples with similar expiration dates and weights were preferred in this study. However, the exact time of slaughter of the animals is not known, and how this will affect the pigments that give color to the meat may be influential in the formation of this difference.

The texture of poultry meat may change depending on the post-slaughter pH change and the development of rigor mortis. These factors may be affected by age, genotype, breeding systems, slaughter conditions and carcass handling processes (Baeza et al. 2022).

The texture of chicken meat is an essential factor affecting the quality of the meat and thus, consumer satisfaction. It was reported that the microstructure of the muscles, muscle fiber thickness, and the structure of the connective tissues surrounding the muscle cells are essential in determining the values such as adhesiveness, chewiness, and gumminess in breast meat (Kokoszynski et al., 2022).

This study determined that the numerical differences in hardness, springiness, adhesiveness and gumminess values were not statistically significant. In the chewiness value, it was determined that the difference between the enterprises was significant ($P<0.05$). Animal care and feeding conditions, transport processes, post-slaughter cooling, and storage conditions can be affected this value. In addition, the increase in the hardness of the meat may cause an increase in the chewiness value and in this case, a decrease in the consumer's demand (Erdemir and Karaoğlu, 2021).

Conclusions

As a result of, generally similar results were found in the samples of the three enterprises included in the study. This may be due to the fact that the enterprises are integrated enterprises, as well as providing the favorable conditions for feeding practices, transportation, slaughtering methods, storage conditions and putting up for sale, which affect both chemical composition and texture properties.

Statement of Conflict of Interest

Author has declared no conflict of interest.

Author's Contributions

The contribution of the author is 100%.

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