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Physicochemical and functional properties of chicken meat

Dragan Milicevic[a,]*, Dejana Trbovic[a], Zoran Petrovic[a], Breda Jakovac-Strajn[b], Ivan Nastasijevic[a], Vladimir Koricanac[a]

[a]*Institute of Meat Hygiene and Technology, Kacanskog 13, 11040 Belgrade, Serbia*
[b]*Faculty of Veterinary Medicine University of Ljubljana, Gerbicev 60, 1000 Ljubljana, Slovenia*

Abstract

The physicochemical and functional properties of chicken meat under commercial processing in Serbia were studied. Samples (n = 48) of broiler breast and thigh muscles from two farms during 2012 were collected for subsequent meat quality analyses. The farm treatments modify significant growth performance, feed intake and the physicochemical properties of chicken meat. Fatty acid (FA) composition in tissues reflected the FA pattern of the diets, although the predominant FAs were monounsaturated FA (MUFA), in comparison to saturated FA (SFA) and polyunsaturated FA (PUFA). Therefore, our results suggest that quality of poultry meat is a complex and multivariate property.

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1. Introduction

Meat is a concentrated nutrient source, considered essential to optimal human growth and development[1]. Although some epidemiological data has revealed a possible association between its consumption and increased risk

* Corresponding author. Tel.: +381-11-2650-655; fax:+381-11-2651-825.
*E-mail address:*dragan@inmesbgd.com

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of several forms of cancer, cardiovascular and metabolic diseases, meat consumption has been major contribution to the risk factors for chronic disease[2]. Poultry meat has many desirable nutritional characteristics, such as low lipid content and relatively high concentrations of polyunsaturated fatty acids, which are considered as a positive and healthy aspect by consumers[3]. The purpose of this study was to determine the quality of meat and to investigate whether chicken meat available, generally gives a good quality product of interest to the poultry industry and food technology.

2. Materials and methods

2.1. Animals and diets

Two homogeneous groups of male and female (50%:50%) Ross 508 and Hubbard broilers were reared under commercial conditions on two farms in Vojvodina in the northern part of Serbia, and fed ad libitum commercial diets for growing broilers with different ingredients. All diets were formulated to meet the minimum requirements for broilers and were proved as mash feed

2.2. Sample preparation

At 39 days old, 12 birds per farm were selected on the basis of live weight within as wide a range as possible, and were slaughtered at a commercial abattoir.After slaughtering and dressing, the hot carcasses were chilled for 2 h at 4°C. The carcasses were weighed and refrigerated for 24 h. The breast with skin (Mm. *pectoralis major*) and thigh meat with skin (Mm. of regio *tibio-femoralis*) were cut, separated and weighed (Table 1). A total of 48 samples of breast and thigh meat were collected and analyzed during 2012.

2.3. Analyses

Meat color was evaluated immediately after deboning using a colorimeter (Minolta Chroma Meter RC-400, Japan). The CIE system color profile of lightness (L*), redness (a*) and yellowness (b*) was measured by reflectance colorimeter using illuminant source D, while pH value was measured 24 h postmortem, by inserting a portable pH meter (Testo 205, AG, Germany). Cooking loss was determined as percentage of weight lost during roasting (220°C for 30 min). Total lipid was determined in raw and roasted breast and thigh meat with skin[4]. Water-holding capacity of muscle samples was measured using the methodology of Wierbicki and Deatherage[5]. FA′s were determined by capillary gas chromatography on GC Shimadzu 2010. Thiobarbituric acid (TBA) was determined according to the method proposed by Tarladgis et al.[6] and Holland[7]. TBA content was expressed as mg of malondialdehyde per kg of meat (mg MAL/kg). Determinations of Fe in meat samples were performed by the method of Jorhem[8].

2.4. Statistical analysis

Data was analysed by descriptive statistics (mean, standard deviation, and range). ANOVA with Tukey's test was performed, in order to determine statistical differences among examined parameters between farms ($p < 0.05$). Pearson′s correlation coefficient (r) was generated using the correlation procedures.

3. Results and discussion

The slaughter traits,oxidative status, Fe content and physical and functional properties, of broiler meat are shown in Tables 1, 2 and 3 and Fig. 1.

Table 1. Slaughter traits (*n*=48).

Parameter (range)	X ± StD	CV (%)	Min. – Max.
Carcass weight (CW) (g)	1417.1±268	18.90	1021.7-2226.7
Breast Weight (g) (%)	499.7±110.5	22.12	337.1-775.1
Drumstick Weight (g) (%)	449.0±84.8	18.89	316.8-703.0

Table 2. Oxidative status(mg MDA/kg) and Fe content(mg/kg) of the breast and drumstick.

Parameter	Breast			Drumstick		
	X ± StD	CV (%)	Min.–Max.	X ± StD	CV (%)	Min.–Max.
Raw	0.06±0.04	65.6	0.00-0.17	0.07±0.04	55.0	0.00-0.24
Cooked	4.54±1.58	34.9	1.50-7.16	5.52±2.25	40.8	1.50-10.68
Fe total	4.16±0.77	18.6	2.26-7.74	7.97±1.20	15.0	6.03-11.18

Table 3. Physicochemical and functional properties of the breast and drumstick.

Parameter	Breast			Drumstick		
	X ± StD	CV (%)	Min.–Max.	X ± StD	CV (%)	Min.–Max.
aw	0.96±0.01	0.95	0.95-0.98	0.96±0.01	0.79	0.95-0.98
Moisture (%)	71.94±3.00	4.18	63.49-75.79	71.17±2.06	2.90	67.41-76.18
Protein (%)	21.82±0.83	3.80	19.59-23.62	18.24±0.91	5.00	16.72-19.93
Lipids (%)	3.85±1.16	37.95	1.32-6.78	8.21±2.40	29.30	4.33-15.29
Ash (%)	1.12±0.16	14.14	0.69-1.42	0.97±0.10	8.03	0.81-1.16
Ultimate pH_{24}	5.76±0.26	4.58	5.11-6.15	6.28±0.39	6.31	5.21-6.77
WHC (%)	34.84±10.50	30.30	14.77-62.76	28.27±11.20	39.78	8.87-63.60
Cooking loss (%)	33.14±3.91	11.80	24.04-40.12	31.31±3.60	11.50	23.7-41.34
*L**	56.75±3.71	6.55	48.68-66.08	56.73±3.34	5.89	49.01-62.33
*a**	0.54±0.89	165.45	-1.41-2.54	2.30±1.29	56.23	0.25-7.48
*b**	3.66±1.76	48.31	0.59-8.91	5,29±2.54	48.06	1.07-11.55
SFA	33.17±4.91	14.81	28.58-49.24	30.04±1.89	6.30	27.09-34.83
MFA	42.61±1.97	4.63	38.06-47.95	43.58±1.62	3.71	39.21-48.05
PFA	23.57±4.98	21.12	10.94-29.75	25.93±2.69	10.39	21.49-31.97

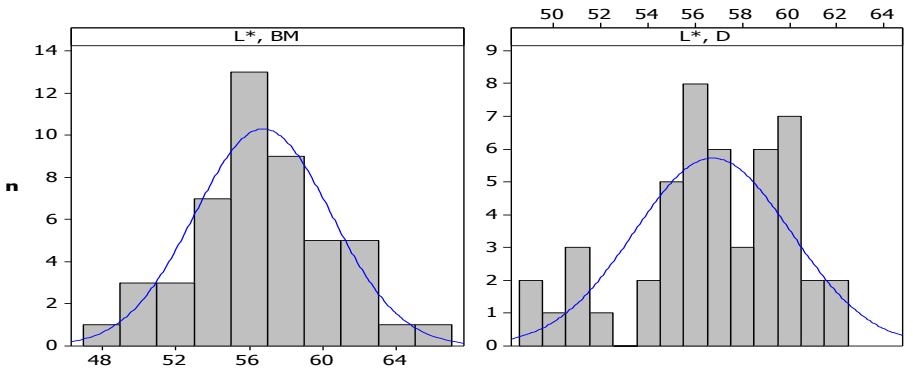

Fig. 1. Distribution of L* value of broiler breast and drumstick muscle.

At the same age, slaughter traits as well as the physicochemical properties, including cooking loss, color, pH, lipids and thiobarbituric acid (TBA) in raw and heat-processed breast and drumstick meat samples, varied significantly during the period of investigation. Colour of raw poultry meat is critical for consumer selection while colour of the cooked meat is critical for final evaluation[4].The overall range in measured lightness (L*) was considerable and varied from 48.68 (dark) to 66 (pale) in breast, and from 49 (dark) to 62 (pale) in drumstick. When applying a truncation value of L*=56, which was suggested to classify the paler-than-normal (PSE-like) broiler breast meat[9], our findings showed that the mean L* values classified the meat as pale. The results from this study indicate that variations in broiler meat pH and water-holding capacity could be related to differences in the shelf-life of the product. High muscle pH produced conditions that make dark-colored fillets more susceptible to bacterial spoilage than light-colored fillets when held at the same refrigerated storage conditions The major contributing factors to poultry meat colour are myoglobin content, chemical state of the haem structure, and meat pH[10]. The predominant FAs in drumstick and breast muscle were MUFA, in comparison to SFA and PUFA (100:78:55%, respectively). The results obtained in our study showed that the higher n-6/n-3 PUFAs ratio in meat adversely affected the oxidative stability as manifested by the significantly higher TBA concentrations in heat-processed breast and drumstick meat, compared with those of the group which had a low n-6/n-3 PUFAs ratio in meat samples. Lipid and myoglobin oxidation is one of the major problems encountered in meat processing and storage. However, many of the mentioned processes are interrelated[11].

4. Conclusion

This study contributes an update to the literature data about physicochemical and functional properties of chicken meat under commercial processing in Serbia. Poultry meat quality is a complex and multivariate property, which is affected by multiple interacting factors including genetics, feeding, husbandry, preslaughter handling, stunning and slaughter procedures, chilling, processing and storage conditions. Many problems may occur at these stages that potentially increase the rate of mortality, carcass downgrading and meat quality. Therefore, the results of this study could be used by future studies as well as by manufacturers to determine the ideal feeding, husbandry and slaughter conditions foroxidative stability and physico-chemical properties of chicken meat.

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