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COMPLEX EVALUATIONS OF CAPONS MEAT QUALITY GROWN IN A TRADITIONAL HUSBANDRY SYSTEM

EVALUĂRI COMPLEXE ASUPRA CALITĂȚII CĂRNII DE CLAPONI CRESCUȚI ÎN SISTEM TRADIȚIONAL

A.S. GREAPCĂ [1),*)], S.D. DAN[1)], Ligia Rebeca MUNTEAN[1)], Eliza GEANĂ[1)], Romolica MIHAIU[2)], M. MIHAIU[1)]

ABSTRACT | REZUMAT

We conceived an experimental model for observing the effects of caponization upon autosexed chicken hybrids between red Rhode Island and barred Plymouth Rock breeds. In order to obtain autosexed hybrid chickens we cross-bred barred Plymouth Rock females with red Rhode Island males, thus the one-day-old chicks obtained through artificial incubation presented distinctive morphological characteristics between their sex. The male autosexed chicken hybrids were grown in a traditional (extensive) husbandry system, thus is was observed a good development pattern through manifesting the heterosis phenomenon, and at the age of 3.5 months, before reaching sexual maturity, the chickens have undergone caponization through unilateral gonadectomy method using a human tonsillectomy instrument. In some individuals gonadectomy was performed by squeezing the testes with the fingers, obtaining the same result. The individuals had a 100% survival rate. On histological examination of the meat samples from the capons and intact chickens, we observed significant differences in the subcutaneous adipose tissue thickness from the breast and thigh muscles as well as the thickness of the adipose tissue disposed around the sciatic nerve. Thereby in the capons, the thickness of the subcutaneous adipose tissue and respectively, the thickness of the adipose tissue disposed around the sciatic nerve are significantly higher compared to the intact chickens. Regarding the chemical composition of the meat of intact and neutered cockerels, slight differences were noticed in the thigh protein content, where in capons the mean value is higher than in the intact chicken. As for the collagen content, the mean value of the thigh muscles of the capons is significantly lower than the mean value of the thigh muscles of the intact male chickens. Slightly higher mean values were noticed in the fat content of the thigh muscles in capons compared with the fat mean value of the thigh muscles in the intact chickens.

Keywords: quality, capons, autosexed chicken, traditional husbandry

Am conceput un model experimental pentru a observa efectele claponajului asupra puilor hibrizi autosexabili din rasa Rhode Island roșu cu rasa Playmouth Rock barat. Pentru obținerea puilor hibrizi autosexabili am folosit femele din rasa Playmouth Rock barat ce le-am încrucișat cu masculi din rasa Rhode Island roșu, astfel puii obținuți prin incubație artificială la o zi aveau caractere morfologice distinctive între sexe. Puii hibrizi autosexabili de sex mascul au fost crescuți în sistem tradițional (extensiv), astfel s-a observat o dezvoltare bună a acestora manifestând fenomenul heterozis, iar la vârsta de 3 luni jumătate, înainte de a ajunge la maturitate sexuală au fost supuși claponajului prin metoda cu abordare laterală a testiculelor pe o singură parte folosind un amigdalotom de uz uman, iar la câțiva cocoși s-a făcut enuclearea testiculelor prin strângere cu ajutorul degetelor rezultatul fiind același. Aceștia au avut o rată de supraviețuire de 100%. După castrare lotul de cocoși castrați, împreună cu lotul de cocoși necastrați au fost crescuți în aceleași condiții de mediu și furajare și au fost la vârsta de 7 luni jumătate sacrificați, urmărindu-se diferențe cantitative și calitative la carcasele acestora. La examenul histologic al preparatelor din carnea de cocoși castrați și necastrați, am observat diferențe semnificative în ceea ce privește grosimea țesutului adipos subcutanat de la nivelul musculaturii pieptului și pulpei, precum și grosimea țesutului adipos dispus în jurul nervului sciatic, astfel la cocoșii castrați grosimea țesutului adipos subcutanat, respectiv grosimea țesutului adipos dispus în jurul nervului sciatic sunt mult mai mari față de cele ale cocoșilor necastrați. În ceea ce privește compoziția chimică a cărnii de cocoși castrați și necastrați, diferențe semnificative s-au înregistrat la proteina musculaturii pulpei, unde la cocoșii castrați valoarea medie este mai crescută decât la cocoșii necastrați. În ceea ce privește colagenul, valoarea medie a musculaturii pulpei de la cocoșii castrați este mult mai scăzută decât valoarea medie a musculaturii pulpei de la cocoșii necastrați. Valori medii ușor crescute s-au întâlnit și la grăsimea din musculatura pulpei de cocoș castrat, comparativ cu valoare medie a grăsimii din musculatura pulpei de cocoș necastrat.

Cuvinte cheie: calitate, clapon, pui autosexabili, sistem tradițional

1) University of Agricultural Sciences and Veterinary Medicine, Faculty of Veterinary Medicine, Cluj-Napoca, Romania
2) Babeș Bolyai University, Faculty of Economics and Bussines Administration, Cluj-Napoca, Romania
*) *Corresponding author: andrei.greapca91@yahoo.com*

The concept or notion of meat quality has different meanings for the training to embrace this subject. As an example, for the scientist Pearson (1960), cited by Gheorghe Georgescu (2000), meat quality means a combination of physical, structural, and chemical characteristics which determines the aspect and preference grade of the consumers (5). A serving of 100g of white chicken meat with skin, is an excellent source of proteins, assuring approximately 58% of the daily reference intake of proteins and 17% of the daily reference intake of fats. Furthermore, chicken meat is a rich source of phosphorus, selenium, niacin, and vitamin B6 by assuring 20%, 34%, 56%, and respectively 26% of the recommended dietary allowance of each nutrient (9). From a structural point of view, poultry meat differentiates from the meat of mammals by more compact muscle tissue, superior fineness of the meat grain, and thinner muscle fibres with a significantly reduced sarcolemma (2). The quantity of connective tissue is lower and the ratio of different types of collagen is different from the meat of mammals (12). In poultry, the fat is not uniformly distributed, deposits being present mainly subcutaneously and in the abdominal cavity. Opposed to the meat of mammals, poultry meat is accessible and mechanically separable, which are key elements for processing. Since fat is not present in the muscle fibres, poultry meat does not present the marbling phenomenon (2). The quantity of connective tissue and its solubility influences meat tenderness and texture (6). The connective tissue is fibrous and first of all made up of collagen fibres. It is known that in poultry, collagen is soft in young individuals and hard in old ones (10).

Age is playing an important role in defining the juiciness degree of poultry meat, meat always being juicier in young animals than in adults because of its higher fineness and water content (1). Meat with a higher protein content has a higher biological food value. In case the meat has a higher protein content from collagen, the overall nutritional value is lower. In this type of protein, amino acids like methionine, isoleucine, tyrosine, and tryptophan are missing.

Cockerel caponization reduces testosterone concentration and increases the capacity of lipogenesis and fat storage in the organism (4).

Aiming to obtain an autosexed chicken hybrid with light skin and meat colour in the male carcasses and with a good developing pattern (manifesting the heterosis phenomenon), we cross-bred two dual-purpose chicken breeds: barred Plymouth Rock females and red Rhode Island males. Thus, the obtained males were early grouped in order to prepare them for caponization. We performed the neutering procedure at 3.5 months, the individuals were grown in the same conditions, and at the age of 7.5 months, the control (intact) and experimental (caponized) groups were slaughtered in order to assess the quantitative and qualitative differences of the obtained carcasses.

MATERIALS AND METHODS

In order to evaluate the main quality parameters of the chicken meat, we used a total of 18 cockerel carcasses brought to the meat hygiene laboratory of the Faculty of Veterinary Medicine Cluj-Napoca. The biological material was grouped in the control (intact) and experimental (caponized) groups with 9 individuals each. Samples from each individual were collected and send to the Sanitary Veterinary and Food Safety Laboratory (L.S.V.S.A.) of Cluj, Romania.

For determinations, we used the FoodScan device from the laboratory of food chemistry from L.S.V.S.A Cluj for accurate fast determinations from meat and meat products. FoodScan is a device used for the analysis of meat and meat product samples from any stage of production.

Using infrared wave technology, highly accurate results are provided in less than 50 seconds. The device analyses a variety of parameters: humidity, fats, proteins, collagen, and the collagen/protein ratio. Inside the analyser is a monochromator to which the light from a halogen lamp is guided through an optical fibre. Cup rotation around the sample allows its overall analysis. Samples for analysis are placed on a concentric circle, offering the possibility of obtaining representative results. The FoodScan technology is based on the transmission of infrared waves, representing an advantage in analysing homogeneous samples. Since the infrared waves pass through the mass of the sample, this analysis has advantages over other methods based on the reflection of light from the surface. The device is equipped with an artificial neural network, a fact that makes its calibration easy. The network covers almost every meat product, from raw meat to processed products.

The histological samples from the 18 individuals were processed. The histological staining methods used were Haematoxylin-Eosin (HE) and Haematoxylin-Eosin-Light Green (HEM) for identification of cellular structures, fibrillar structures, and other structures of interest. Laboratory materials used: histological slides, gauze, filter paper, containers for liquid waste, containers for solid waste, hydrophilic cotton wool, sanitary alcohol, Berzelius glasses, Erlenmeyer flasks (500 ml), glass graduated pipettes, graduated cylinders of different volumes, weighing vials, glass stirring rod, and tall weighing vials.

Used reagents, solutions, and decontaminants: glacial acetic acid, absolute ethanol, concentrated hydrochloric acid, aluminium potassium sulphate, lithium carbonate, potassium iodate, sodium iodate, eosin, red mercury oxide, haematoxylin, toluene, xy-

lene, benzene, Canada balsam, Light Green, phosphotungstic acid. The tissue samples were placed in paraffin blocks and cross-sections made at a rotary microtome. The histological slides were removed from toluene containers, paraffin cleaning was performed, and the slides were moved in glasses with staining solutions. To examine the histological slides, we used an Olympus BX 51 microscope (Olympus, Japan) equipped with an Olympus SC180 digital camera to capture images. Measurements and morphometric investigations were realized with the Olympus cellSens Entry software (Olympus, Japan)

RESULTS AND DISCUSSIONS

For this study, we used 18 hybrid autosexed cockerels obtained through cross-breeding barred Plymouth Rock females with red Rhode Island males. At the age of 3.5 months the individuals underwent the unilateral gonadectomy procedure (Fig. 1), 7 of them with human tonsillectomy instrument, and 2 were neutered by squeezing out the testes with the fingers, obtaining the same results.The survival rate was 100%. After caponization, the experimental group and the control group were raised for 4 months in the same environment and feeding conditions manifesting different morphological characteristics (Fig. 2) and slaughtered for multiple analyses of the meat from their carcasses.

Fig. 1. Cockerel caponization 3,5 months

Determination of 4 chemical parameters was done with the FoodScan Lab analysis device: collagen, fat, water, and proteins from the breast and thigh meat of the intact and caponized cockerels. Compositional meat quality without skin of the intact and caponized chicken revealed different compositional values in order with the anatomic region taken into consideration (Table 1).

Fig. 2. Morphological differentiation capons and intact cockerel (i.e., smaller comb and wattles dimensions)

The results of the laboratory analysis revealed faintly higher mean values in favour of humidity if the capon thigh muscles 74.09%, compared to the humidity mean value in the thigh muscles in intact chickens 72.69% and respectively faintly higher mean values of fat in the capon thigh muscles 4.92%, compared with the mean values of fat in the thigh muscles of the intact chicken. Significant differences have been noted in the protein content of the thigh muscles, that is 20.64% in capons and 18.3% in intact chickens. Regarding collagen, the mean value of the thigh muscles in the capons was 1.35%, significantly lower than the mean values from the thigh of the intact chicken by 2.75%. Some authors reported that the fat and collagen content of the muscles is related to the tenderness of the meat (16,15). According to Miguel et al. (2008), capon meat is juicier and less fibrous (8).

We observed insignificant differences regarding the mean values of humidity, fat, protein, and collagen from the breast muscles of capons compared with the mean values of humidity, fat, protein, and collagen in the breast muscles of the intact chickens. After analysing the histological slides, focusing mainly on the thickness of the subcutaneous fat tissue from the thigh

Table 1

Mean compared values of humidity, fat, protein, and collagen

Sample	Caponized chicken-mean values (%)				Sample	Intact chicken-mean values (%)			
	U*	G*	P*	C*		U*	G*	P*	C*
Thig	74%	4.92%	20.64%	1.35%	Thigh	72.6%	4.54%	18.7%	2.7%
Breast	73.4%	1.91%	22.98%	0.91%	Breast	73%	1.15%	23.7%	0.9%

* U=humidity (water), G=fat, P=protein, C=collagen

Table 2

Thickness values of the subcutaneous adipose tissue in the thigh meat of capons and intact chicken

No.	Sample	Capons	Sample	Intact chickens
		Thickness of the subcutaneous adipose tissue (µm)		Thickness of the subcutaneous adipose tissue (µm)
1	Thigh	908	Thigh	341
2	Thigh	780	Thigh	295
3	Thigh	789	Thigh	334
4	Thigh	935	Thigh	120
5	Thigh	1009	Thigh	230
6	Thigh	1112	Thigh	242
7	Thigh	760	Thigh	151
8	Thigh	1247	Thigh	299
9	Thigh	928	Thigh	404

-measured in the same zone in both groups

and breast from the control experimental and control group and the disposal of adipocytes in the muscular tissue. Using the Olympus cellSens Entry software (Olympus, Japan) we performed the measurements, the results being noted in the tables below and highlighted through images captured with the help of the microscope's digital camera.

After examination of the histological slides from the meat of the capons and intact chickens, we observed significant differences regarding the thickness of the subcutaneous adipose tissue from the thigh and breast meat between the two groups. Thus, the mean thickness of the subcutaneous adipose tissue from the thigh in capons (Fig.3.), was 940.88 µm, significantly higher than the mean value of the subcutaneous adipose tissue from the thigh of intact chickens (Fig. 4.), respectively 268.44 µm. The mean thickness of the subcutaneous adipose tissue of the breast in capons (Fig.5.), was 1762.77 µm, significantly higher than the mean thickness of the subcutaneous adipose tissue in the breast of intact chickens (Fig.6.), respectively 506.1 µm.

We observed both in intact chickens and capons the mean thickness of the subcutaneous adipose tissue from the breast is significantly higher than the mean thickness of the subcutaneous adipose tissue from the thigh. Another aspect to be mentioned is that in the thighs of the capons (Fig.7.) were more adipocytes around the blood vessels and between the muscular fibres compared to the intact chickens (Fig.8.).

Some authors reported that an increased intramuscular fat is associated with improvements in

Table 3

Thickness values of the subcutaneous adipose tissue in the breast meat of capons and intact chicken

No.	Sample type	Capons	Sample type	Intact chickens
		Thickness of the subcutaneous adipose tissue (µm)		Thickness of the subcutaneous adipose tissue (µm)
1	Breast	1600	Breast	632
2	Breast	948	Breast	630
3	Breast	930	Breast	523
4	Breast	1689	Breast	225
5	Breast	2025	Breast	363
6	Breast	2203	Breast	471
7	Breast	1900	Breast	380
8	Breast	2309	Breast	627
9	Breast	2261	Breast	704

-measured in the same zone for both groups

Table 4

Overall thickness means values of the subcutaneous adipose tissue in thigh and breast meat from the experimental and control group

No.	Sample type	Capons	Sample type	Intact chickens
		Thickness of the subcutaneous adipose tissue (µm)		Thickness of the subcutaneous adipose tissue (µm)
1*	Thigh	940.88 ±162.24	Thigh	268.44 ±91.91
2*	Breast	1762.77 ±526.46	Breast	506.1 ±158.86

*mean value

meat tenderness (17). This aspect is also supported in the literature by the results of other authors like Lin and Hsu (2002), Sirri et al. 2009, and Rikimaru et al. (2009) (7, 14, 16).

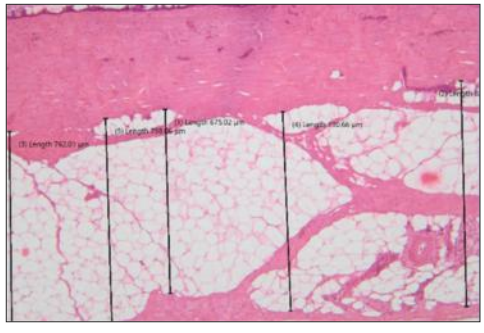

Fig. 3. Thigh subcutaneous adipose tissue in capon (x10 objective)

Authors have reported the increase of the body adipose tissue by caponization (8,10,18).

According to Cason et al. (1988), an important factor for studying the effect of caponization is the age when the capons are slaughtered (3).

Taking into consideration the presence of adipose tissue around the sciatic nerve of the thigh, we processed and examined the histological samples. Morphometric measurements from this area were performed and we noticed that the mean thickness of the adipose tissue is 2092.33 µm in capons (Fig. 9), significantly higher than the mean thickness of the adipose tissue from around the sciatic nerve in intact chickens 1047.55 µm (Fig. 10).

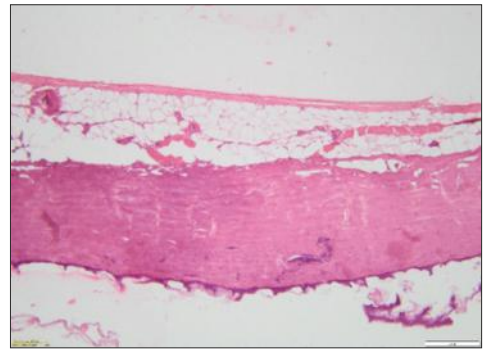

Fig. 4. Thigh subcutaneous adipose tissue intact chicken (x10 objective)

Table 5

Thickness of the adipose tissue disposed around the sciatic nerve in capons and intact chickens

Sample Nr.	Sample	Capons	Tip probă	Intact chickens
		Adipose tissue thickness around the sciatic nerve (µm)		Adipose tissue thickness around the sciatic nerve
1	Thigh	2100	Thigh	1186
2	Thigh	1851	Thigh	1055
3	Thigh	1900	Thigh	1180
4	Thigh	2125	Thigh	788
5	Thigh	2203	Thigh	943
6	Thigh	2322	Thigh	994
7	Thigh	1795	Thigh	889
8	Thigh	2405	Thigh	1006
9	Thigh	2130	Thigh	1387

-measured in the same zone in both groups

Table 6

Overall mean thickness of the adipose tissue disposed around the sciatic nerve in capons and intact chickens

Sample type	Capons	Sample type	Intact chickens
	Thickness of the adipose tissue around the sciatic nerve (µm)		Thickness of the adipose tissue around the sciatic nerve (µm)
Thigh	2092.33±208.84	Thigh	1047.55±180.28

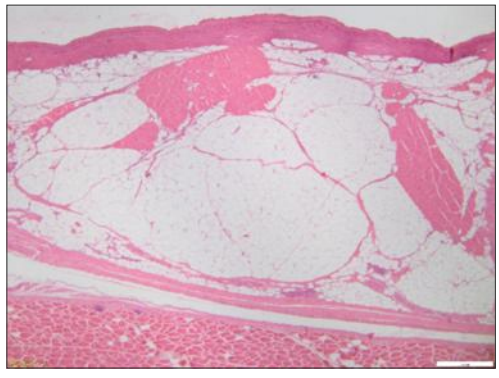

Fig. 5. Capon breast subcutaneous adipose tissue (x4 objective)

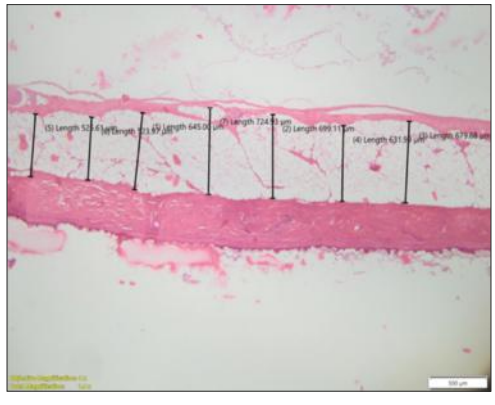

Fig. 6. Intact chicken breast subcutaneous adipose tissue (x4 objective)

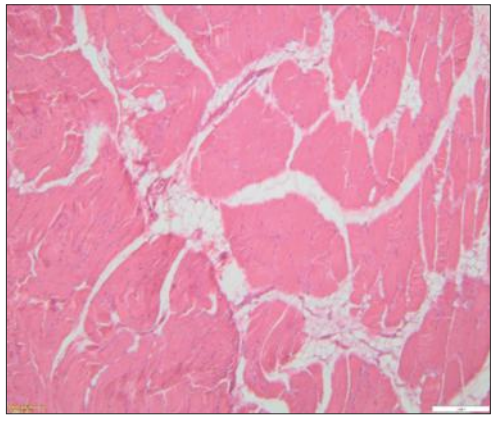

Fig. 7. Presence of adipocytes near the blood vessels and between the muscle fibres in capons (x10 objective)

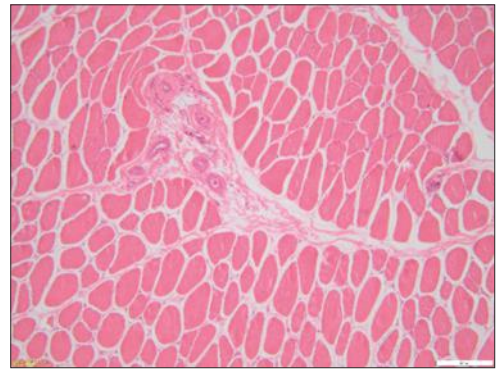

Fig. 8. Absence of adipocytes near blood vessels and between the muscle fibres in intact chickens (x10 objective)

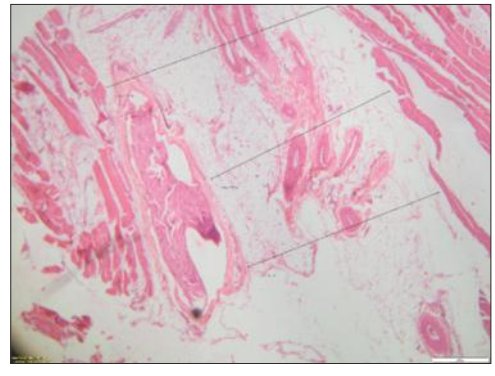

Fig. 9. Adipose tissue near the sciatic nerve in the thigh of capons (x4 objective)

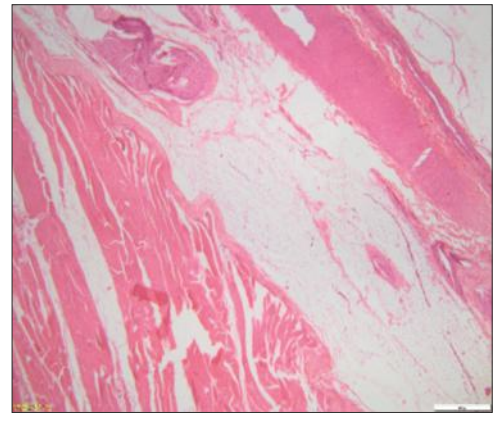

Fig. 10. Adipose tissue near the sciatic nerve in the thigh of intact chickens (x4 objective)

According to the results of Tor et al. (2005), caponization increases the adipose tissue in all anatomic parts of the capons' carcasses and mainly by accumulating in the subcutaneous adipose tissue.

CONCLUSIONS

Regarding the compositional changes through caponization, there has been noted a significant difference in the collagen content in the two meat types (without skin). The hybrid capon meat has a significantly lower collagen content than the intact chicken meat. In the literature is stated that a higher collagen content lowers the overall nutritional value of the meat, and the tenderness and texture are negatively influenced by the increased collagen. A slight difference was observed in the protein content in favour of the capon meat, thus we can state biological nutritional value isn't neglected regarding the hybrid capon meat. Considering that the disposition of the adipose tissue in poultry is mainly subcutaneous and less between the muscle fibres, we measured the thickness of the subcutaneous adipose tissue from the breast and thigh of both caponized and intact cockerels. Thus, we determined that the mean thickness of the subcutaneous adipose tissue from the breast and thigh of capons is significantly higher than the mean thickness of the subcutaneous adipose tissue from the breast and thigh of intact chickens. Therefore, we can state that through caponization the quantity of subcutaneous adipose tissue increases significantly.

Also, to be mentioned, the mean thickness of the adipose tissue disposed around the sciatic nerve from the thigh of hybrid capons is significantly higher compared to the mean thickness of adipose tissue disposed around the sciatic nerve in intact chickens and at the level of the capons thigh, we noticed adipocytes disposed between the muscle fibres and around the blood vessels, a fact that influences the tenderness and juiciness of the meat.

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