Lucrări ştiinţifice **Zootehnie şi Biotehnologii**, vol. **41 (2)** (**2008**), Timişoara

QUANTITATIVE AND QUALITATIVE FEATURES OF MEAT PRODUCTION IN COBB-500 CHICKEN HYBRID

ÎNSUŞIRI CANTITATIVE ŞI CALITATIVE ALE PRODUCȚIEI DE CARNE LA HIBRIDUL DE GĂINĂ COBB-500

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The paper reveals some partial results issued from a wide range of assessments regarding poultry meat production. Thus, certain data referring to the muscle mass yield and to muscular tissue quality at "Cobb-500" hybrids are presented within. Quantitative side of meat production was analyzed through several parameters (live and carcass weight, slaughtering efficiency and trenched parts participation in whole carcass formation) while the qualitative properties were linked to muscular fiber's thickness and to their cross surface area. Broilers of 42 days old, belonging to both genders, have been studied, the values being revealed for males and females and meanly calculated for all flock. Thus, average value of fresh carcass weight reached 1761.79±29.02g at both genders, leading to a slaughter efficiency value of 78.94%. Breast fillet participation in whole carcass reached 22.32%, value situated closer to that specified by the hybrid producer (22.63%). It has been also noticed that rear limbs parts (thighs and shanks) participation in whole carcass was higher in females than in males. Five representative pairs of skeletal muscles have been sampled: Pectoralis profundis et superficialis, Biceps brachii, Semimembranosus et Gastrocnemius medialis and served as biological material to be analyzed using photonic microscopy. White muscles (pectorals) were found to have the highest values for the myocytes' thickness (41.11μ), while the contractile cells of the red muscles were thinner (the thinnest within the brachial biceps – 27.9μ).

Key words: meat, broiler, slaughtering efficiency, breast fillet, texture

Introduction

The relevance of quantitative side of poultry meat production issues from the necessity to provide to consumers those healthy aliments in sufficient amounts, assuring meantime the economic efficiency of the field's companies. Nevertheless, the actual scientific literature, mainly those publications dealing with human nutrition and customers' alimentary safety, mainly focus on those aspects which pass over the meat yield. It is requested, more and more, to deepen the study of the food's features, and especially of those of animal origin, which straightly interfere with an appropriate and rational nutrition, mainly nowadays, when the so-called civilization maladies – circulatory and metabolic diseases – present high

occurrence. In a series of own researches, passed during the 16 months of the doctoral stage, the scientific team tried to study the morpho-structural, physical, chemical and nutritional features of the meat produced by the ultimate commercial chicken hybrids in Romania. This paper reveals, besides some meat yield parameters, certain elements related to the textural quality of broilers musculature. The wide panel of poultry meat quality parameters will be completed toward the research finalization, when high-resolution chemical assessments (amino acids and fatty acids contents) will allow to better estimate the nutritional and sanogenic value of this aliment.

Materials and Methods

Biological material was represented by 14 "Cobb 500" hybrid specimens (7♂ + 7♀), aged 42 days, selected as representative for the entire flock. Fowl feeding has been done using a corn-soy meal diet (3012Kcal ME and 24% CP - starter; 3175Kcal ME and 22.5% CP - grower; 3226Kcal ME and 20% CP - finisher). From each chicken, live weight, carcass (fresh and refrigerated, completely eviscerated) and main trenched parts have been weighted. Gravimetric assessments have been run using a Shimadzu UX4200H technical digital scales (0.01 g – 4200 g range) and a Denver Instruments Pinnacle 214 analytical digital scales (0.1 mg – 210 g range). The slaughtering efficiency has been calculated, dividing carcass weight values to the live weight ones and multiplying by 100. Same computation algorithm has been used to obtain the participation quota of the trenched parts. It followed the sampling of five pairs of muscles from each significant anatomic part: *Pectoralis superficialis et profundis* (breast), *Biceps brachii* (wings), *Semimembranosus* (thigh) and *Gastrocnemius medialis* (shank). A necropsy kit and other instruments have been used for sampling muscles: knives, scalpels, retractors, twisters, cotton wool, gauze pads, distilled water, Berzelius glasses of various capacities, Petri plates.

Muscular samples have been processed through formalin 10% fixation, paraffin impregnation at +56°C, acid fuchsine and Evans blue coloration, resulting histological smears. These have been studied at a photonic microscope, calibrated for three OBXOC associations: 10X10; 20X10 and 40X10. An ocular micrometer served to run the assessments. Quality studies comprised micro-measurements of myocytes diameter and the computation of their cross-section area, according to the mathematical relations listed below:

* *myocytes mean thickness*: $\boxed{D\bar{x}(\mu) = (D+d)/2}$, meaning: D=large diameter, d=small diameter;

* *cross section area*: $\boxed{S(\mu^2) = D \times d \times \pi / 4}$, meaning: π = 3.1416;

The achieved average values of the studied parameters have been statistically processed running the ANOVA single factor algorithm.

Results and Discussions

At 42 days old, COBB-500 broilers reached mean live weights of 2295.71±50.1g (males), of 2168.57±43.8g (females), respectively of 2232.14±36.5g (both genders). According to the gravimetric measurements, it was observed that fresh carcass weight values varied between the limits of 1705.0±33.4g (pullets) and 1818.57±38.17g (cockerels) (Table 1 and Figure 1). Variation coefficient revealed a good uniformity for the studied flock (V=6.2%). ANOVA algorithm appliance indicated significant statistic differences between males and females. The situation was similar when refrigerated carcasses have been studied. Consequently, average values of 78.94±0.35%, respectively of 77.76±0.35% have been calculated for slaughtering efficiency, right after slaughtering or after refrigeration (Table 1 and Figure 2). The achieved values revealed better performance than that specified within the broiler management guide (72% for the carcasses completely eviscerated).

Concerning the participation of main trenched parts in carcass formation, the data showed proportions of 29.79±0.16% (males) and of 29.52±0.21% (females), for breast, including bone and skin, while the homogeneity was found very good (V=1.7%) (Figure 3). When breast fillet (sum of superficial and profound pectoral muscles) participation was calculated, it was found a mean value of 22.32±0.07% (both genders), very close to that published in 2005 by Cobb Vantress UK ltd. Into the technical specification files of the hybrid (22.36%). Despite this, an improvement may occur, considering that "COBB-500" producer states that this production parameter could increase each 2 years with 0.9 p.p., using genetic improvement ways (Vacaru-Opriş et al., 2005). The others carcasses components reached mean participation quotas of 8.98±0.09% (wings); of 15.71±0.21% (thighs); 13.33±0.13% (shanks); 32.33±0.27% (other parts, meaning head, neck, back and legs). Comparing both genders, it could be stated that, for breast involvement in carcass formation, cockerels gave higher results, while the values for both rear limbs parts (thighs and shanks) were found better in pullets (Table 1 and Figure 3).

Cytometric assessments (Table 2) revealed that the diameter of muscular fibers from males' superficial pectorals varied within the 25.78…43.46µ interval, a mean value of 35.22±0.46µ and a variation coefficient of 12.93% being calculated. Values in the same interval were reported by Wattanachant et al., 2005 (28.9±5.95µ). The measurements on histological samples from females showed similar values, respectively a mean thickness of 35.29±0.29µ (Figure 4). These primary data led to the values of 953.70±24.20μ^2 (cockerels), respectively of 961.49±20.47μ^2 (females), when myocytes cross-surface area has been calculated. No statistical significance occurred for the superficial pectorals fibers. In profound pectoral muscles, variation amplitude was wider, leading to high significant difference between genders for average diameter and cross- section area (41.11µ vs. 36.51µ, respectively 1312.69μ^2 vs. 1035.03 μ^2) of the studied myocytes.

Table 1 - **Broilers live weight, carcasses weight, slaughter efficiency and trenching parts participation in whole carcass**

Variable	Males			Females			Both genders		
	$\bar{x} \pm$	$s_{\bar{x}}$	V (%)	$\bar{x} \pm$	$s_{\bar{x}}$	V (%)	$\bar{x} \pm$	$s_{\bar{x}}$	V (%)
Live weight (g)	2295.71	50.1	5.8	2168.57	43.8	5.3	2232.14	36.50	6.1
Fresh carcass weight (g)	1818.57 [b]	38.17	5.6	1705.00 [a]	33.42	5.2	1761.79	29.02	6.2
Slaughter efficiency on fresh carcasses (%)	79.23	0.38	1.3	78.64	0.60	2.0	78.94	0.35	1.7
Refrigerated carcasses weight (%)	1794.62 [b]	37.82	5.6	1676.68 [a]	33.40	5.3	1735.65	29.24	6.3
Slaughter efficiency on refrigerated carcasses (%)	78.19	0.43	1.5	77.33	0.52	1.8	77.76	0.35	1.7
Breast fillet+bone+skin weight (g)	534.59 [b]	11.11	5.5	495.01 [a]	11.03	5.9	514.80	9.31	6.8
% of carcass	29.79	0.16	1.4	29.52	0.21	1.9	29.66	0.13	1.7
Breast fillet weight (g)	402.64 [b]	9.08	6.0	372.32 [a]	8.26	5.9	387.48	7.24	6.9
% of carcass	22.43	0.04	0.4	22.20	0.12	1.5	22.32	0.07	1.2
Wings weight (g)	164.89 [b]	4.60	7.4	147.02 [a]	3.53	6.4	155.96	3.73	8.9
% of carcass	9.18 [b]	0.08	2.3	8.77 [a]	0.13	4.1	8.98	0.09	3.9
Thighs weight (g)	275.05	8.91	8.6	270.16	7.15	7.0	272.60	5.53	7.6
% of carcass	15.32	0.35	6.1	16.10	0.11	1.8	15.71	0.21	4.9
Shanks weight (g)	237.17	6.81	7.6	225.95	7.71	9.0	231.56	5.18	8.4
% of carcass	13.20	0.12	2.5	13.45	0.22	4.3	13.33	0.13	3.5
Other parts weight (g)	582.91 [c]	11.25	5.1	538.53 [a]	7.33	3.6	560.72	8.91	5.6
% of carcass	32.50	0.37	3.0	32.16	0.41	3.4	32.33	0.27	3.1
Other parts components:									
Head (g)	46.85	3.43	19.3	51.01	1.56	8.1	48.93	1.90	14.5
Neck (g)	61.59	3.56	15.3	65.28	1.82	7.4	63.44	1.99	11.7
Back (g)	396.50 [c]	7.04	4.7	357.18 [a]	7.52	5.6	376.84	7.36	7.31
Legs (g)	77.97 [c]	2.21	7.5	65.06 [a]	1.20	4.9	71.51	2.16	11.3

ANOVA test – for each analyzed variable, comparative between genders: [ab] significant differences; [ac] distinguished significant differences.

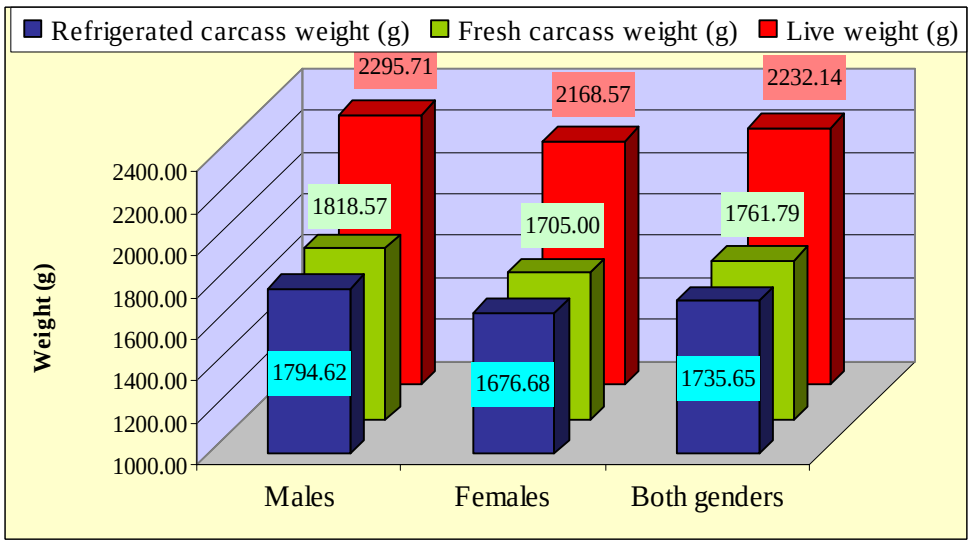

Fig. 1 – Values related to live weight, to fresh and refrigerated carcasses weight

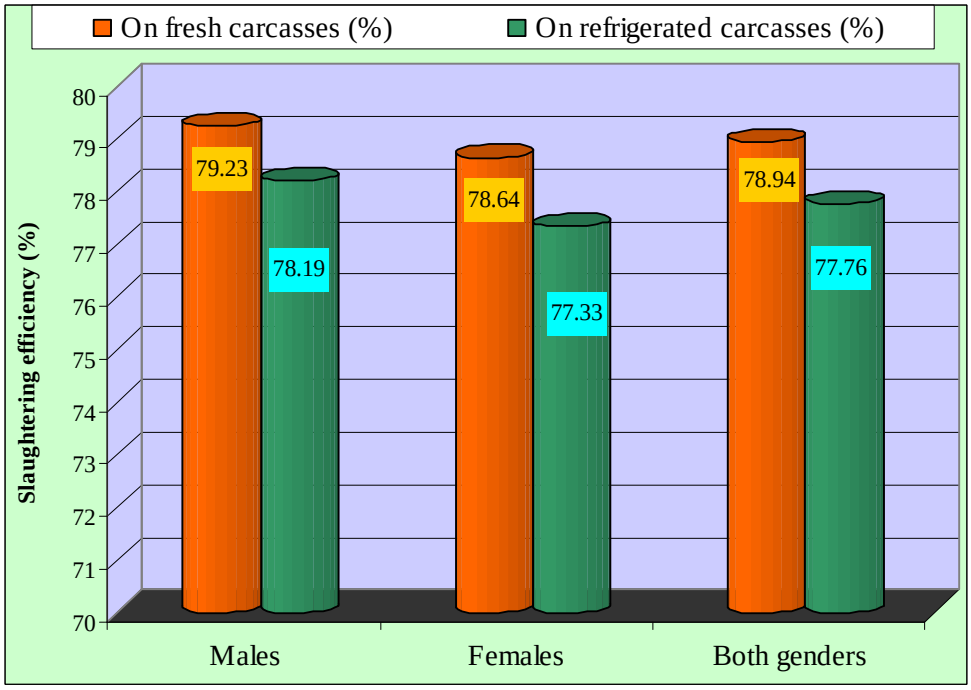

Fig. 2 – Slaughter efficiency, calculated on fresh and refrigerated carcasses

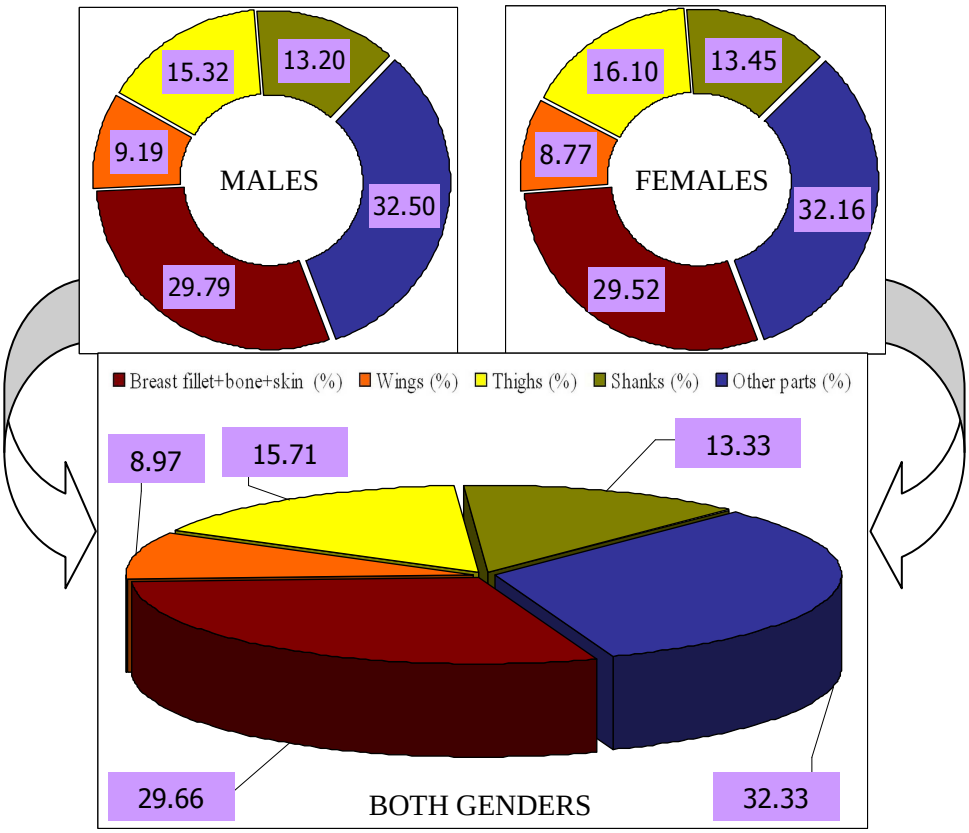

Fig. 3 – Participation of trenched parts in whole carcass formation

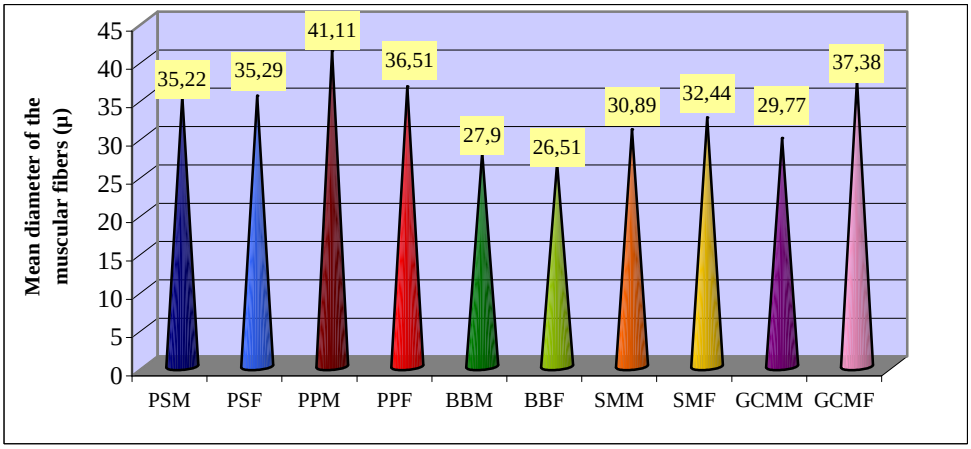

Fig. 4 – Mean myocytes thickness in the studied muscles
(*PS = Pectoralis superficialis; PP = Pectoralis profundis; BB = Biceps brachialis; SM = Semimembranosus; GCM = Gastrocnemius medialis; M = muscles from males; F = muscles from females)*

A slight increase with few percent points was observed for the heterogeneity degree, but higher values of the variation coefficient are considered almost normal when studies of this kind are carried on (high variability within the microscopic field). Mean diameter of the muscular fibers in *Biceps brachialis* muscles was found higher in cockerels samples (27.90±0.38µ), as compared to those issued from pullets (26.51±0.34µ), observing distinguished significant difference. This interval led to significant statistical differences when cross-section area values have been compared (Table 2 and Figure 4).

Table 2

- Thickness and cross-section area of the myocytes within studied muscles

Studied muscles	Broilers gender	Statistical estimators	Mean diameter (µ)	D/d ratio	Cross-section area (μ^2)
Pectoralis superficialis	♂	$\bar{x}$	35.22	1.41	953.70
		$\pm s_{\bar{x}}$	0.46	0.03	24.23
		V%	12.93	19.26	25.41
	♀	$\bar{x}$	35.29	1.36	961.49
		$\pm s_{\bar{x}}$	0.39	0.03	20.47
		V%	10.91	19.43	21.29
Pectoralis profundis	♂	$\bar{x}$	41.11 [d]	1.39	1312.69 [d]
		$\pm s_{\bar{x}}$	0.56	0.02	36.88
		V%	13.63	17.09	28.10
	♀	$\bar{x}$	36.51 [a]	1.36	1035.03 [a]
		$\pm s_{\bar{x}}$	0.45	0.02	26.39
		V%	12.28	13.85	25.50
Biceps brachialis	♂	$\bar{x}$	27.90 [c]	1.44	601.59 [b]
		$\pm s_{\bar{x}}$	0.38	0.02	17.33
		V%	13.72	13.87	28.80
	♀	$\bar{x}$	26.51 [a]	1.34	547.95 [a]
		$\pm s_{\bar{x}}$	0.34	0.02	13.34
		V%	12.72	13.26	24.35
Semi-membranosus	♂	$\bar{x}$	30.89 [a]	1.37	738.01 [a]
		$\pm s_{\bar{x}}$	0.32	0.02	15.29
		V%	10.41	12.04	20.72
	♀	$\bar{x}$	32.44 [b]	1.33	814.56 [b]
		$\pm s_{\bar{x}}$	0.28	0.01	13.88
		V%	8.64	9.77	17.05
Gastrocnemius medialis	♂	$\bar{x}$	29.77 [a]	1.33	693.70 [a]
		$\pm s_{\bar{x}}$	0.41	0.02	19.58
		V%	13.88	13.14	28.23
	♀	$\bar{x}$	37.38 [d]	1.25	1089.86 [d]
		$\pm s_{\bar{x}}$	0.38	0.02	22.29
		V%	10.15	13.81	20.45

ANOVA test – for each studied character and muscle, comparative between genders:
[ab] significant differences; [ac] distinguished significant differences; [ad] high significant differences.
D-large diameter, d-small diameter

Reversed status has been noticed during the examination of the histological smears issued from thighs and shanks: mean thickness and cross section area values were higher in females' samples. Significant differences occurred between genders for *Semimembranosus* muscles, while very significant ones have been calculated for the *Gastrocnemius* medialis muscles.

Ellipsoid shape of the myocytes was remarked on cross-sections, during microscopic examination, the D/d calculated ratio suggesting the same fact (1.25/1 … 1.44/1).

Conclusions

Mean live weight of 2.45 Kg was recorded for 42 days old broilers.

Slaughter efficiency, calculated on fresh carcasses for both genders, was of 78.94±0.35% and became 77.76±0.35% after refrigeration.

Participation of trenched parts in whole carcass formation reached 29.66±0.13% for breast with bone and skin; 8.98±0.09% for wings; 15.71±0.21% for thighs; 13.33±0.13% for shanks and 32.33±0.27% for the other parts.

Breast fillet mean participation reached an average value of 22.32±0.07%.

Thicker fibers were measured within cockerels' profound pectorals (41.11±0.56µ), while the thinnest texture was found in the arm biceps muscles, mostly on those sampled from pullets (26.51±0.34µ).

Bibliography

1. **Cotea, C.V.,** (2003) - *Histologie specială*, Tehnopress Publishing House, Iaşi
2. **Nickel, R., A. Schummer, E. Seiferle** (1977) - *Anatomy of the domestic birds*, Verlag Paul Parey, Berlin, Hamburg.
3. **Radu-Rusu, R.M., V., Teuşan, Anca Teuşan** (2007) - *Comparative researches concerning some histometric features of the myocytes in somatic musculature of the domestic chicken and waterfowl (I). Pectoral muscles*. U.S.A.M.V. Iaşi, Sc. Papers, Animal Science, 50: 115-120
4. **Radu-Rusu R.M., V., Teuşan, I. Vacaru-Opriş** (2007) - *Comparative researches concerning some histometric features of the myocytes in somatic musculature of the domestic chicken and waterfowl (II). Wing and thigh muscles*. U.S.A.M.V. Iaşi, Sc. Papers, Animal Science, 50: 107-114
5. **Vacaru-Opriş I., L., Apostol, T.F., Apostol, G. Movileanu, M.G., Usturoi** (2005) - *Sisteme şi tehnologii de creştere a puilor de carne*, Ceres Publishing House, Bucureşti
6. **Wattanachant S., S., Benjakul, D.A. Ledward** (2005) - *Microstructure and Thermal Characteristics of Thai indigenous and broiler chicken muscles*, Poult. Sci., 84:328-336
7. ******* (2006) *COBB 500 Broiler Management Guide* - http://www.cobb-vantress.com