THE INFLUENCE OF GENOTYPE AND SEX ON CARCASS CHARACTERISTICS AT BROILER CHICKENS

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Abstract

In this experiences was studied the influence of genotype and sex on carcass characteristics (slaughter yield, participation percentage of the cut parts from the whole carcasses structure, the meat:bone ratio from carcass and from major parts of the carcass) at broiler chickens reared in identical conditions and slaughtered at 42 days old. The genetic material was represented of broiler chickens that belonged hybrids: „Ross-308" (control batch-Lc) and „Lohmann Meat" (experimental batch-Lexp). After slaughter, from each group were sampled 30 carcasses (15 per sex), was determined slaughter yield and participation percentage of the cut parts from the whole carcasses structure using gravimetric measurements. The meat:bone ratio was determined on 10 carcases from each batch (five per sex) that were manually deboned. For analysis of variance was used Mann Whitney test. The results of this experiment showed that sex influenced the slaughter yield ($P \le 0.05$), participation percentage of the wings ($P \le 0.001$, at Lc and $P \le 0.01$, at Lexp) and thighs ($P \le 0.001$) and meat:bone ratio from thighs ($P \le 0.05$), at Lexp; while the genotype influenced slaughter yield ($P \le 0.001$), participation percentage from the breast ($P \le 0.001$) and thighs ($P \le 0.01$), meat:bone ratio from breast ($P \le 0.001$) and legs ($P \le 0.05$).

Key words: broiler chicken, carcass, meat:bones ratio, slaughter yield

INTRODUCTION

Through their nutritional value, foods of animal origin are required more increasingly worldwide in the human nutrition. Quantitatively, animal food consumption is however dependent on socio-economic factors and varies greatly from country to country [3].

In providing animal protein, science of animal breeding is very important and poultry is an important branch of animal husbandry. In this context, to provide animal protein in feeding the world population, poultry production has an important role [8].

Special qualities of poultry meat, high yields and relatively low production costs of its caused the accelerated development of this branch of modern animal husbandry [1].

Raising chickens for meat can be a profitable business in the conditions of modern technology and the use of a biological material of good quality.

Performances of broilers are influenced by several factors: characteristics of hybrid exploited, farm management, quality compound feed given and microclimate conditions provided in the operating period. These factors are particularly important for achieving the proposed productive performance and to achieve maximum economic efficiency [1, 5, 7].

Several authors [6, 8, 9, 15] have indicated that factors such as genetics, body mass or carcass weight, nutrition, sex, age, and environmental conditions influence the slaugther yield of broiler chickens, the weight of the cut parts from the carcass, quantity and quality of poultry meat.

Following Romania's EU accession, competition in the market quality of broilers is increasingly visible, and lately, the demand of Romanian consumers for quality carcasses and poultry products increased.

In this respect, research done in this work has studied the influence of genotype and sex on slaughter performance, at broiler chickens hybrids „Ross-308" and „Lohmann Meat', that were reared in the identical conditions.

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MATERIAL AND METHOD

Our research was conducted on broiler chicken belonging the hybrids „Ross-308”and „Lohmann Meat”, slaughtered at the age of 42 d. In this study were two batchs of chicks (males and females), the control batch (Lc) „Ross-308” hybrid and the experimental batch (Lexp) „Lohmann Meat” hybrid, reared in the identical condition. In the growth period (1 to 42 d) for microclimate factors of the house (air temperature and air relative humidity), the values have been according to the recomandations from Management manual „Ross-308” hybrid [16]. The growth system was on the permanent litter and a density of 12 chicks/m^2. The growth technological system was in accordance with new European Union regulation on animal welfare compulsory from 2012 in all EU members [17]. At the two batches of chickens were given feed mixed with protein and energy levels in conforming to recommendation of the Aviagen company for the „Ross-308” hybrid [16]. Depending on the age of chickens during the growth period (1 to 42 d) at each chickens batch were given three recipes compound feed, ad libitum: starter, grower and finisher (Table 1). [9, 16].

Table 1 Features of feed compound recipes for broiler chickens

Recipe features	Type of recipe		
	starter 1-14 days	grower 15-35 days	finisher 36-42 days
Crude protein (%)	24,02	22,63	21,06
M. E. (kcal/kg feed)	3041	3144	3190
Energy/protein ratio	126,6	133,00	151,50
Lysine (%)	1,27	1,19	1,03
Methionine+cystine (%)	0,93	0,84	0,73
Calcium (%)	1,12	0,95	0,82
Total phosphor (%)	0,73	0,65	0,57
Crude fiber (%)	3,37	3,45	3,91

At the end of the growing period (42 d), chickens were slaughtered and from each batch were sampled 30 carcasses (15 females and 15 males), which were weighed before and after refrigeration (24 hours at +4°C) and was determined the slaughter yield of fresh and refrigerated carcasses. The slaughter yield is ratio between fresh or refrigerated carcass weight and live weight, in percent expressed. [3]. To calculate the slaughter yield were used carcasses gutted, with: head, neck and legs.

After cutting the carcasses were determined weight of the cut parts, by gravimetric measurements. With this data were calculated the participation quota of the cut parts in the whole carcasses structure. The cut parts in the carcass were: breast with bone and skin, thighs, drumstick, wings and the remnants consists of head, neck, back and legs. The participation quota of the cut parts is ratio between weight for each part from carcass and carcass weight, percent expressed [3].

The meat:bone ratio from carcass and from major parts of the carcass was calculated after the manually deboning, using 10 carcasses per batch (five per each sex), percent expressed.

Raw data obtained from measurements were processing using methods of biostatistics with Microsoft Excel spreadsheet application. To test the statistical significance of differences between mean values of the characters studied has been applied analysis of variance using Mann Whitney test from the program MINITAB 14 [2].

RESULTS AND DISCUSSIONS

The values related for the slaughter yield, are presented in Table 2. After slaughter, the carcasses obtained were chilled 24 hours, at temperature +4°C. Following gravimetric measurements was observed that the values for fresh carcasses weight (after slaughter) have been from 1747.01 g, at females, in Lexp batch up to 2042.27 g, for males, in Lc batch and for refrigeration carcasses weight (4 hours at +4°C) have been from 1721.18 g, at females, in Lexp batch up to 2012.69 g, for males, in Lc batch with good uniformity of the studied flock (V%=5.48 to 9.17%). The test for analysis of variance has revealed statistical differences between chickens of different sex (P≤0.05 or P≤0.01) and between female chickens (P≤0.05), both before and after refrigeration.

From the data presented in Table 2, follows that, at Lc batch were achieved the highest values for slaughter yield (from 79.09%, in females up to 80.44%, in males, on fresh carcasses and from 77.55%, in females up to 79.00%, in males, on refrigerated carcasses), while at Lexp group were recorded the lowest values for both moments of measurement (from 77.58%, in females up to 78.81%, in males, after slaughter and after chilling, from 76.11%, at females up to 77.43%, at males) [10, 11, 12].

Table 2 The values for slaughter yield

Specification	Lc			Lexp.		
	Males (n=15)	Females (n=15)	Both sexes (n=30)	Males (n=15)	Females (n=15)	Both sexes (n=30)
Live weight $\overline{X} \pm s_{\overline{x}}$ (g)	^{a}2535.98 ±50.20	^{c}2325.07 ±26.68	2430.52 ±33.49	^{a}2463.13 ±37.62	^{c}2251.27 ±30.14	2357.15 ±29.92
V%	7.67	4.61	5.51	5.92	5.20	4.08
Fresh carcass weight $\overline{X} \pm s_{\overline{x}}$ (g)	^{a}2042.27 ±48.34	^{ac}1839.81 ±26.81	1941.04 ±33.03	^{a}1942.61 ±36.93	^{b}1747.01 ±25.90	1844.81 ±28.65
V%	9.17	5.64	9.32	7.36	5.74	8.51
Slaughter yield (fresh carcasses) $\overline{X} \pm s_{\overline{x}}$ (%)	^{a}80.44 ±0.57	^{ab}79.09 ±0.47	^{a}79.77 ±0.38	^{a}78.81 ±0.47	^{b}77.58 ±0.39	^{c}78.20 ±0.32
V%	2.76	2.28	2.64	2.29	1.94	2.24
Refrigerated carcass weight $\overline{X} \pm s_{\overline{x}}$ (g)	^{a}2012.69 ±47.61	^{ac}1811.14 ±25.66	1911.92 ±32.50	^{a}1915.76 ±36.25	^{bc}1721.18 ±25.08	1818.47 ±28.20
V%	9.16	5.48	9.31	7.33	5.64	8.50
Slaughter yield (refrigerated carcasses) $\overline{X} \pm s_{\overline{x}}$ (%)	^{a}79.00 ±0.59	^{ab}77.55 ±0.43	^{a}78.28 ±0.38	^{a}77.43 ±0.45	^{b}76.11 ±0.36	^{c}76.77 ±0.31
V%	2.88	2.13	2.67	2.25	1.85	2.21

Mann Whitney-test: ^{ab}significant differences *P*≤0.05; ^{ac}distinguished significant differences *P*≤0.01;
n-carcass number; $\overline{X}$ -mean; $\pm s_{\overline{x}}$ -standard error; V%-coefficient of variation

It is noted that the average values calculated for slaughter yield on fresh carcasses were higher compared to the yield calculated on refrigerated carcasses [10, 11, 12, 13, 14, 16]. This reducing trend for carcasses weight was due to dehydration process, which occurs normally, during refrigeration period.

For the slaughter yield, values the coefficient of variation had showed a very good uniformity of the character studied (V%=1.85 to 2.88%). The test for analysis of variance has revealed statistical differences, both before and after refrigeration, for each batch between males and females (P≤0.05), between Lc with Lexp at females and males (P≤0.05), while for both sexes were highlighted distinguished significant differences (P≤0.01). The values for slaughter yield were the different depending by the genetic and the chickens sex [4, 6, 15, 16]. Thus, this claim is supported by the statistical differences between the chicken batches (Lc and Lexp) or between chickens of different sex.

In this experiment were obtained values at the upper limit of the range specified by the company „Aviagen" for the two hybrids „Ross-308" and „Lohmann Meat", which ensures the achievement of values between 69.85% to 73.71%, respectively between 69.12 to 72.94% for the slaughter yield at completely drawn carcasses (without head, neck, legs and abdominal fat) [16].

Values related of the participation quota of the cut parts in the whole carcasses structure have presented in Table 3, and this data show that:

- average values for breast with bone and skin at chickens from both sexes were of 29.20%, at Lc batch and 27.87%, at Lexp batch, with higher values in male chickens (28.22%, at Lexp, respectively 29.62%, at Lc) and lower values at female chickens (27.42%, at Lexp, respectively 28.76%, at Lc). The test for analysis of variance revealed the presence of statistical differences between average values obtained at Lc and Lexp (P≤0.05 or P≤0.01), in all cases, but differences between chickens of different sex not proved statistically [9, 12];

- for thighs, were obtained higher values at female chickens (16.44%, at Lexp and 16.90%, at Lc), compared with male chickens (15.49%, at Lexp and 16.10%, at Lc). Analysis of variance revealed presence of statistical differences between the two batches, and for each batch between male chickens with female chickens [9, 12];

Table 3 Participation quota of the cut parts from the whole carcasses structure

Specification	Lc			Lexp.		
	Males (n=15)	Females (n=15)	Both sexes (n=30)	Males (n=15)	Females (n=15)	Both sexes (n=30)
Breast with bone and skin $\overline{X} \pm s_{\overline{x}}$ (%)	^{a}29.62 ±0.18	^{a}28.76 ±0.35	^{a}29.20 ±0.21	^{d}28.22 ±0.27	^{b}27.42 ±0.47	^{d}27.87 ±0.28
V%	2.38	4.73	3.95	3.71	6.68	5.44
Wings $\overline{X} \pm s_{\overline{x}}$ (%)	^{a}9.58 ±0.18	^{d}8.85 ±0.14	9.24 ±0.10	^{a}9.49 ±0.16	^{c}8.86 ±0.13	9.18 ±0.10
V%	7.08	6.25	6.15	6.53	5.87	5.93
Thighs $\overline{X} \pm s_{\overline{x}}$ (%)	^{ad}16.10 ±0.09	^{a}16.90 ±0.11	^{a}16.51 ±0.10	^{cd}15.49 ±0.15	^{ab}16.44 ±0.14	^{c}15.97 ±0.13
V%	2.24	2.57	3.41	3.63	3.40	4.59
Drumsticks $\overline{X} \pm s_{\overline{x}}$ (%)	13.61 ±0.15	13.48 ±0.40	13.55 ±0.34	13.66 ±0.21	14.01 ±0.49	13.83 ±0.36
V%	4.31	11.45	13.59	5.88	13.47	14.06
Back, head, neck and legs $\overline{X} \pm s_{\overline{x}}$ (%)	^{b}31.10 ±0.31	^{b}32.01 ±0.39	^{b}31.66 ±0.25	^{a}33.14 ±0.53	^{a}33.27 ±0.44	^{a}33.21 ±0.34
V%	3.79	4.68	4.34	6.17	5.11	5.57

Mann Whitney-test: ^{ab}significant differences *P*≤0.05; ^{ac}distinguished significant differences *P*≤0.01; ^{ad}high significant differences *P*≤0.001

n-carcass numbers; $\overline{X}$ -mean; $\pm s_{\overline{x}}$ - standard error; V%-coefficient of variation

- for drumsticks, values ranged between 13.48% (female chickens from Lc batch) and 14.01% (female chickens from Lexp batch). No were statistically significant differences (P>0.05), between chickens of different sex or the two batches;

- the participation quota of the wings in the whole carcasses structure had lower values at female chickens (8.85%, at Lc and 8.86%, at Lexp) and more higher values at male chickens (9.58%, at Lc and 9.49%, at Lexp). After application the test of variance analysis were present various stages of statistical significance between chickens of different sex (P≤0.001, at Lc and P≤0.01, at Lexp);

- participation percentage for other components of the carcass (head, neck, back and legs), was statistically between the studied hybrids (P≤0.05), but no are statistical differences between the two sex (P>0.05).

For expressed the carcass quality and meat production, after manually deboning was calculated the meat/bones ratio for carcass and for important parts of the carcass (Table 4).

At broiler chickens for both sexes, the meat:bones ration for carcass was between 4.11:1 (Lexp) to 4.28:1 (Lc), with higher values at female chickens (4.22:1, at Lexp and 4.44:1, at Lc) and lower values at male chickens (4.00:1, at Lexp and 4.16:1, at Lc). Were not statistically (P>0.05) the differences between batches or sex of chickens.

Table 4 The meat/bones ratio

Specification	Lc			Lexp.		
	Males (n=5)	Females (n=5)	Both sexes (n=10)	Males (n=5)	Females (n=5)	Both sexes (n=10)
[1]Carcass $\bar{X} \pm s_{\bar{X}}$ (g)	1877.36 ±89.68	1660.26 ±43.22	1768.86 ±9.26	1767.37 ±64.45	1562.46 ±41.30	1664.92 ±49.68
V%	10.68	5.82	10.59	8.15	5.91	9.44
[2]Carcass deboned $\bar{X} \pm s_{\bar{X}}$ (g)	1514.36 ±80.70	1352.98 ±37.18	1433.67 ±49.78	1414.57 ±56.76	1262.89 ±33.99	1338.73 ±40.15
V%	11.92	6.14	10.98	8.97	6.02	9.48
Bones in carcass $\bar{X} \pm s_{\bar{X}}$ (g)	^{a}363.00 ±9,03	^{b}307.28 ±7.00	335.14 ±10.74	^{a}352.80 ±7.80	^{b}299.57 ±8.18	326.18 ±10.35
V%	5.56	5.10	10.13	4.94	6.11	10.03
[4]Meat:bone ratio $\bar{X} \pm s_{\bar{X}}$	4.16:1 ±0.12	4.40:1 ±0.07	4.28:1 ±0.08	4.00:1 ±0.07	4.22:1 ±0.06	4.11:1 ±0.06
V%	6.28	3.42	5.56	4.16	3.09	4.39
Breast						
[3]Total weight $\bar{X} \pm s_{\bar{X}}$ (g)	^{a}611.43 ±22.18	^{b}524.55 ±17.36	567.99 ±19.65	^{a}555.40 ±22.14	^{b}477.88 ±18.23	516.64 ±18.70
V%	8.11	7.40	10.94	8.91	8.53	11.45
Meat + skin $\bar{X} \pm s_{\bar{X}}$ (g)	^{a}553.03 ±20.94	^{b}475.64 ±16.58	514.33 ±18.03	^{a}496.52 ±21.00	^{b}428.04 ±17.59	462.28 ±17.23
V%	8.47	7.79	11.08	9.46	9.19	11.79
Bones $\bar{X} \pm s_{\bar{X}}$ (g)	^{a}58.40 ±1.28	^{b}48.91 ±0.84	53.66 ±1.74	^{a}58.88 ±1.16	^{b}49.84 ±0.66	54.36 ±1.63
V%	4.90	3.86	10.25	4.41	2.98	9.50
[4]Meat:bone ratio $\bar{X} \pm s_{\bar{X}}$	^{a}9.46:1 ±0.17	^{a}9.72:1 ±0.20	^{a}9.59:1 ±0.13	^{b}8.42:1 ±0.20	^{b}8.58:1 ±0.24	^{d}8.50:1 ±0.15
V%	4.02	4.51	4.27	5.24	6.33	5.58
Thighs + drumsticks						
[3]Total weight $\bar{X} \pm s_{\bar{X}}$ (g)	^{a}609.42 ±19.80	^{b}545.84 ±8.95	577.63 ±14.74	572.33 ±22.29	530.00 ±8.28	551.17 ±13.24
V%	7.26	3.66	8.07	8.71	3.49	7.60
Meat + skin $\bar{X} \pm s_{\bar{X}}$ (g)	^{a}519.29 ±17.86	^{b}467.53 ±7.72	493.41 ±12.59	478.94 ±20.33	452.23 ±6.80	465.58 ±11.04
V%	7.69	3.69	8.07	9.49	3.36	7.50
Bones $\bar{X} \pm s_{\bar{X}}$ (g)	^{a}90.13 ±2.13	^{b}78.31 ±1.40	84.22 ±2.31	^{a}93.39 ±2.01	^{b}77.77 ±1.64	85.58 ±2.88
V%	5.28	3.99	8.66	4.81	4.70	10.62
[4]Meat:bone ratio $\bar{X} \pm s_{\bar{X}}$	^{a}5.76:1 ±0.09	5.97:1 ±0.06	^{a}5.86:1 ±0.06	^{b}5.12:1 ±0.12	^{a}5.82:1 ±0.06	^{b}5.47:1 ±0.13
V%	3.64	2.18	3.39	5.04	2.49	7.64

Mann Whitney-test: ^{ab}significant differences $P \leq 0.05$; ^{ac}distinguished significant differences $P \leq 0.01$; ^{ad} high significant differences $P \leq 0.001$;

[1]carcass weight without head, neck and legs; [2]carcass deboned with skin; [3]weight before deboning; [4]grams meat/1 gram bones; n-carcass number; $\bar{X}$ -mean; $\pm s_{\bar{X}}$ -standard error; V%-coefficient of variation

For breast, the meat:bones ratio, at genotype „Ross-308" had values of 9.59:1 versus 8.50:1, at genotype „Lohmann Meat", and at thighs + drumsticks were values of 5.86:1 versus 5.47:1. Thus, for the cut parts from the carcass, meat quantity was influenced by the genotype, and differences between the studied batches had degrees different of statistical significance ($P \leq 0.001$, for breast and $P \leq 0.05$, for thighs + drumsticks) [12, 14].

If we refer to sex, were found higher values in the case of the female chickens (breasts: Lc-9.72:1 and at Lexp-8.58:1; thighs + drumsticks: Lc-5.97:1 and Lexp-5.82:1), compared with male chickens (breast: Lc-9.46:1 and at Lexp-8.42:1; thighs + drumsticks: Lc-5.76:1 and Lexp-5.12:1). but are not statistically differences ($P > 0.05$), except the Lexp batch in case of thighs + drumsticks ($P \leq 0.05$).

CONCLUSIONS

The values for slaughter yield were influenced of genotype and the chickens sex, both before and after refrigeration.

The genotype had positive influence on the quota of participation the breasts and thighs from the whole carcasses structure, with higher values at genotype „Ross-308”, compared with genotype „Lohmann Meat”, but for the carcass remnants (head, neck, back and legs) situation was reversed.

If we refer to the sex, the values obtained at females were higher for wings and thighs, as compared with males, that had yield higher for breasts, drumsticks and carcass remnants.

The meat:bones ration for carcass was higher at Lc batch, compared with Lexp batch ($P > 0.05$) and at female chickens compared with male chickens ($P > 0.05$).

Meat quantity from breasts and thighs + drumsticks was influenced by the genotype, but the sex not statistically influences this differences, except the Lexp batch for thighs + drumsticks.

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