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MAJOR CARCASS PARTS OF BROILER CHICKEN FROM DIFFERENT GENOTYPE, SEX, AGE AND NUTRITION SYSTEM

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Abstract: The aim of this paper was to examine the influence of sex, age and nutrition system on mass and yield of major parts in broiler chicken carcass from different genotypes. Research material was one-day chicken of Hubbard Classic and Cobb 500 genotypes fattened 49 days in production conditions. The chicken used two nutrition systems. The first nutrition system had higher level of energy and E : P ratio, while the second had higher level of proteins and lower values of E : P ratio in all phase of nutrition. Chicken were separated by sex, and by method of random selection were selected and slaughtered 40 male and 40 female chicken (total 240) in 35t^{h}, 42nd and 49th day of age. Major parts of carcass (breasts, thighs and drumsticks) were separated and was calculated their mass, yield and variance. The computer program STATISTICA 6 statistically processed all dates. Differences in mass and yield of breasts, thighs and drumstick were statistically significant ($P<0.05$) at chicken with different age. The chicken at 49t^{h} day of age had significantly higher mass of major carcass parts than the chicks at 42nd and 35th day of age. Genotype had influence only on yield of breasts, namely chickens of Cobb 500 genotype had significant ($P<0.05$) bigger yield of breast then chickens of Hubbard genotype. The male chickens had statistically significant ($P<0.05$) bigger main parts mass of carcass and bigger thighs yield then female chickens. The nutrition system basically had not effect on major edible parts of carcass, except on thighs yield, which were significantly ($P<0.05$) bigger at chicken that have used mixtures with higher level of proteins and lower values of E : P ratio.

Key words: major carcass parts, genotype, sex, age, nutrition system

Introduction

Industry of poultry products is changing its conception according to needs of customers and processing industry. If only a few decades ago, the poultry

products offer was mainly on whole carcass in processing "ready to grill", today there is need for separate carcass offer, or partial carcass parts. Therefore, the accent in broiler production is putting on the quality and yield of the major carcass parts (breasts and fillets without bones, thighs and drumsticks). There are several factors, which have an influence on these parts: line, sex, age, health, nutrition, body weight, carcass estimation and period of terminated nutrition before slaughtering *(Moran, 1977; Siegel, 1984)*. *Souza et al. (1995)* have estimated slaughtering characteristics of four commercial broiler lines: Arbor Acres, Hubbard, Cobb and Ross in the same nutrition conditions. For Hubbard chicken, they have noticed larger proportion of thighs and drumsticks compared to Ross line where there was larger proportion of breasts. Females of Ross line had bigger proportion of breasts than males in research studies of *Rondelli et al. (2003)*. There were no significant differences in females' yield of thighs and drumsticks, but the proportion of breasts was the much bigger compared with males. On the other hand, males showed significantly larger proportion of thighs and drumsticks then females. Age of slaughtering has effect on most of carcass parts of commercial chickens. This conclusion among the others, have proved *Albuquerque et al. (2003)* who considered that chickens sacrificed on 49 and 56 day of age had bigger proportion of breasts with bones and breast meat than the chickens slaughtered on 42 day. *Brake et al. (1993), Rabello (1996)* and *Young et al. (2001)* before now noticed larger parts of breasts in older chicken. *Rezaei et al. (2004)* concluded that less proteins in nutrition, had not big influence on breasts' meat proportion, but it had significant impact on increasing the percentage of abdominal fat. Addition of lysine in food, much bigger than the recommended, increased the yield of breast meat. *Shanin and Elazeem (2005)* did not established sex and genotype influence on the different carcass parts proportion, expressed in carcass weight percentage. The nutrition had significantly differences only for breasts and thighs. Chickens that were feeding by mixtures enriched with raw fibres, but with less proteins, showed significantly less yields of breasts and thighs in their carcass.

The aim of this study was to compare the influence of different hybrid, sex, age and nutrition system on mass and yield (proportion) of major carcass parts (breasts, thighs and drumsticks) for broiler chickens.

Materials and Methods

The experiment was carried out in a farm for intensive broiler chickens breeding, with all necessary equipment and all microclimatic conditions met for chicken fattening. As materials were used 2400 one-day chicken of genotypes Cobb 500 and Hubbard Classic, put in 16 separate boxes, which were assorted by random selection of 150 in one box. They were consisting four different treatments (two hybrids and two nutrition systems) with three repetitions in one treatment.

Chicken were fed *ad libitum* with two different energetic and protein mixtures. In mixture 1 the content of energy and the energy : protein ratio was on higher level than in mixture 2 which had bigger percent of protein and lower of energy : protein ratio (table 1). Both mixtures were used in chicken fattening in few nutrition phases: starter (1-2 week), grower (3 week), finisher 1 (4-6 week) and finisher 2 (7 week).

Table 1. Chemical composition of mixtures used in experiment

Chemical composition	Starter	Grover	Finisher 1	Finisher 2
Mixture 1				
ME, kcal/kg	3069.08	3197.20	3225.20	3212.30
Crude protein (%)	23.03	22.04	21.06	19.20
Energy : Protein rate	133.27	145.04	153.14	167.35
Mixture 2				
ME, kcal/kg	3047.38	3107.70	3099.52	3100.58
Crude protein (%)	23.54	22.55	22.02	21.95
Energy : Protein rate	129.47	137.83	140.76	141.24

At the end of 5^{th}, 6^{th} and 7^{th} fatting week, by random method, were selected chickens for slaughtering from each treatment and according to their sex 10 male and 10 female chickens were taken per treatment or 80 fattening chickens were sacrificed each week. After slaughtering cold carcasses were processed according to poultry meat quality regulation. Whit cutting the carcass, the breasts, thighs and drumsticks were separated as most important major edible parts and their yield and proportions were confirmed. The computer program STATISTICA 6 was used to determined average values and variability measures. The standard deviation was shown as variability parameter in this study. In addition, variability analysis was done in order to determine characteristics, which express significant differences (F-test).

Results and Discussion

Chickens of genotype Cobb 500 had bigger breasts, while Hubbard chickens had bigger thighs, but these differences were not statistically significant (Table 2).

Males had significantly bigger breasts, thighs and drumsticks than females. Chicken of age 49^{th} day had significantly bigger breasts, thighs and drumsticks than chickens of age 42^{nd} and 35^{th} day, as chickens of age 42^{nd} day had significantly bigger major carcass parts than the chicken at age of 35^{th} day. The chickens that were fed with mixture 1 had slightly bigger breasts and drumsticks and similar mass thighs compared to chicken fed with mixture 2, but the differences were not statistically significant.

Table 2. Mass of breast, thighs and drumsticks at chickens with different genotype, sex, age and system of nutrition

Factors	Breasts, g		Thighs, g		Drumsticks, g	
	x	sd	x	sd	x	sd
Genotype						
Cobb 500	412.44	110.69	195.63	50.06	213.98	53.28
Hubbard	392.18	101.25	201.27	51.99	211.59	47.10
Sex						
Male	430.71	108.75	219.57	52.18	228.94	50.08
Female	369.86	93.93	174.32	37.23	194.32	43.71
Age						
35 day	291.57	48.73	150.20	25.51	161.85	25.59
42 day	399.82	46.22	198.46	36.23	210.63	22.49
49 day	515.83	65.53	246.70	34.45	265.87	31.24
Nutrition system						
Mixture 1	408.37	115.38	197.08	52.16	215.78	54.07
Mixture 2	396.25	96.56	199.82	50.00	209.79	46.02
Significant (F-test)						
Genotype	N.S.		N.S.		N.S.	
Sex	*		*		*	
Age	*		*		*	
Nutrition system	N.S.		N.S.		N.S.	

* - Statistically significant differences (P<0,05)
NS - No statistically significant differences

Mass of breasts, thighs and drumsticks are traits of middle variability. Standard deviations were lowest at examination of age influence, while at other examinations, standard deviations were slightly higher.

Cobb 500 chicken had significantly bigger yield of breasts than Hubbard chicken (Table 3). Thighs yield was bigger in Hubbard, while drumsticks yield was slightly bigger in Cobb 500. The differences in thighs and drumsticks yields for the chicken Cobb 500 and Hubbard were not statistically significant.

Male chickens had significantly larger thighs yield than females. Cocks, had also, larger breasts and drumsticks yields than hens, but the differences were not statistically significant. Breasts, thighs and drumsticks yields in percent of body mass were a lot bigger in chicken at age of 49^{th} day, compared to chicken at age of 42^{nd} and 35^{th} day. Chicken fed with mixture 1 had greater breasts and drumsticks yields than chicken fed with mixture 2, but the stated differences were not statistically significant. Chicken fed with mixture 2 had significantly bigger thighs yields than chicken fed with mixture 1.

Table 3. Yield of breast, thighs and drumsticks at chickens with different genotype, sex, age and system of nutrition

Factors	Breasts, %		Thighs, %		Drumsticks, %	
	x	sd	x	sd	x	sd
Genotype						
Cobb 500	20.43	1.87	9.73	1.03	10.63	0.77
Hubbard	19.31	2.05	9.95	1.29	10.50	0.97
Sex						
Male	19.95	1.86	10.16	1.30	10.59	0.72
Female	19.80	2.23	9.48	0.88	10.54	1.03
Age						
35 day	18.57	2.02	9.59	1.35	10.32	1.18
42 day	19.66	1.50	9.72	1.29	10.35	0.54
49 day	21.39	1.47	10.22	0.70	11.03	0.55
Nutrition system						
Mixture 1	19.94	2.18	9.66	0.78	10.60	0.77
Mixture 2	19.80	1.89	10.02	1.45	10.53	0.97
Significant (F-test)						
Genotype	*		N.S.		N.S.	
Sex	N.S.		*		N.S.	
Age	*		*		*	
Nutrition system	N.S.		*		N.S.	

* - Statistically significant differences (P<0,05)
NS - No statistically significant differences

Yields are traits that can be found in high level related with body mass before slaughtering as with mass of major carcass parts. Chicken body mass before slaughtering, as breasts, thighs and drumsticks mass in this research had great influence on expressing statistically significant differences in breasts, thighs and drumsticks yields. Breasts, thighs and drumsticks yields are characteristics with low to middle values. Standard deviations received from this research present the middle variability of yields in major carcass parts.

The highest variances (Table 4) in analyses of variance in mass of major carcass parts were established for influence of age, while the lowest for influence of nutrition system. Significantly variance under influence of genotype was established only in breasts mass. In analyses of variance for yields of major carcass parts was obtained the highest variances under influence of age and sex.

Table 4. Variance of genotype, sex, age and system of nutrition at major edible parts of carcass extended in absolute and relative values

Traits/ Factors	Variance			
	Genotype	Sex	Age	System of nutrition
Mass of breast, g	2.18	21.21	341.94	0.77
Mass of thighs, g	0.73	58.24	176.97	0.17
Mass of drumsticks, g	0.13	32.11	304.16	0.85
Yield of breast, %	19.30	0.34	56.75	0.29
Yield of thighs, %	2.04	21.95	6.65	5.91
Yield of drumsticks, %	1.35	0.20	19.42	0.43

Genotype did not have significant influence on major carcass parts mass, which is not in accordance with *Szalkowska and Meller (1997)* research, who concluded high genotype impact on body weight, breasts mass and drumsticks mass. Chicken Cobb 500 had significant ($p<0,05$) bigger breasts yields than chicken Hubbard, while significant differences in thighs and drumsticks yields among genotype were not noticed, anyway, drumsticks yield in genotype Cobb 500 compared to Hubbard were slightly bigger. This is in accordance with results from *Santos et al. (2004)* and *Marcato et al. (2006)* researches who concluded significantly larger breasts and drumsticks yield in chicken of Cobb genotype than in the other genotypes.

Males had significantly ($p<0,05$) bigger breasts, thighs and drumsticks than females. The differences in male and female breasts and drumsticks yields were not statistically significant. Studies about sex influence on the slaughtering characteristics of broiler chickens, done by *Rondelli et al. (2003)* showed that males had larger breasts and drumsticks yields than females, which is the same as the results from the presented researches. *Mendes et al. (2004)* did a research and the results were that cocks had significantly bigger mass of whole thigh and yield of thigh meat, but less mass of breasts meat and abdominal fat, compared to hens. *Santos et al. (2004)* also confirmed the influence of sex on major carcass parts mass, and because of that, male chicken had larger thighs and drumsticks, but female chicken had greater values in breasts and abdominal fats.

Male chicken had significantly bigger ($p<0,05$) thighs yield then female, while breasts and drumsticks yield was slightly bigger in cocks, but not statistically significant. *Young et al. (2001)* found out that female carcass had significantly larger breasts and fillets yield, and less thighs and drumsticks yield, compared to male carcass. In *Hopić et al. (1997)* study, related to this thesis, it was confirmed that chicken sex has great impact only on thighs yield, but not on breasts and drumsticks proportion, which was statistically insignificant under sex influence. *Bogosavljevic-Boskovic et al. (2006)* concluded that cocks had statistically meaningful bigger drumsticks yield than hens.

Chicken of 49th day age had significantly ($p<0,05$) bigger breasts, drumsticks and leg mass and yield than chicken at age of 42nd and 35th day. Chicken of 42nd day age had a lot weightier major carcass parts and significantly bigger breasts proportion than chicken of 35th day. *Albuquerque et al. (2003)* did confirm the influence of age of slaughter on commercial proportion of major edible carcass parts. Chicken slaughtered on 49th and 56th day of age had larger breasts and breast meat proportion when compared to chicken slaughtered on 35th and 42nd day of age. Bigger breasts proportions with increasing the age of chicken were noticed by many authors *(Brake et al., 1993; Rabello, 1996; Young et al., 2001)*.

Differences in breasts, thighs and drumsticks mass of chicken from different genotypes and nutrition systems were not statistically significant. These results are not compatible with the results drawn from the study of *Corzo et al. (2005),* who concluded that there is statistically significant influence of the genotype and nutrition system on breasts proportion on chicken at age of 42nd day, and significant influence of genotype, sex and nutrition system on breasts proportion on chicken at age of 56th day. Chicken fed with mixture 2 (lower energy : proteins ratio and higher percent of protein) had significantly bigger ($p<0,05$) thighs yield than chicken fed with mixture 1. This conclusion is the same as the results from *Bartov and Plavnik (1998)* study who thought that bigger yields of different meat parts were as a result of food influence with lower energy : proteins ratio and higher level of lysine in meals.

Conclusion

Based on the conducted researches in this thesis, the following conclusions could be drawn:

- Genotype did not have significant influence on mass of major carcass parts, but only had influence on breasts yield in gain of genotype Cobb 500.
- Male chicken had significantly bigger breasts, thighs and drumsticks mass, also bigger drumstick yield than female. Male had at the same time larger breasts and drumsticks yield than female, but these differences were not statistically significant.
- Age impact was statistically significant, so the chicken at age of 49th day had a lot bigger mass and proportion of breasts, thighs and drumsticks than chicken at age of 42nd and 35th day, as the chicken at age of 42nd days had significantly larger mass and major carcass parts proportion than chicken at age of 35th day.
- The differences in breasts, thighs and drumsticks mass of chicken from different nutrition systems were not statistically significant. Chicken fed with mixture 2 had significantly bigger thighs yield than chicken fed with mixture 1, while for the other carcass parts there were not any significant differences.

Glavni delovi trupa brojlerskih pilića različitih genotipova, pola, uzrasta i sistema ishrane

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Rezime

Cilj ovog rada je ispitivanje uticaja pola, uzrasta i sistema ishrane na masu i prinos glavnih delova trupa brojlerskih pilića različitih genotipova. Ispitivanje je izvedeno na jednodnevnim pilićima Hubbard Classic i Cobb 500 genotipova koji su tovljeni 49 dana u proizvodnim uslovima. Pilići su hranjeni u okviru dva sistema. Prvi sistem ishrane je imao viši nivo energije i odnosa E : P, dok je u drugom sistemu bio viši nivo proteina i niže vrednosti odnosa E : P u svim fazama ishrane. Pilići su odvojeni po polu i metodom slučajnog uzorka odabrano je i zaklano 40 muških i 40 ženskih pilića (ukupno 240) u uzrastu od 35, 42 i 49 dana. Najvažniji delovi trupa (grudi, batak i karabatak) su odvojeni od trupa i izračunata je njihova masa, prinos i variranje. Za statističku obradu dobijenih podataka korišćen je program STATISTICA 6.

Razlike u masi i prinosu grudi, bataka i karabataka su bile statistički signifikantne ($P<0.05$) kod pilića različitog uzrasta. Pilići u uzrastu od 49 dana su imali signifikantno veću masu glavnih delova trupa od pilića u uzrastu od 42 i 35 dana. Genotip je imao uticaj samo na prinos grudi, pilići Cobb 500 su imali signifikantno ($P<0.05$) veći prinos grudi od pilića Hubbard genotipa. Pilići muškog pola su imali statistički signifikantno ($P<0.05$) veće mase glavnih delova trupa i više prinose bataka u odnosu na piliće ženskog pola. Sistem ishrane u osnovi nije uticao na glavne jestive delove trupa, osim na prinos bataka, koji je bio signifikantno ($P<0.05$) viši kod pilića koji su hranjeni smešom sa višim nivoom proteina i nižim vrednostima odnosa E : P ratio.

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