

BROILER MEAT QUALITY: THE EFFECT OF REARING SYSTEM AND LENGTH OF FATTENING PERIOD

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Abstract: Broiler meat production in recent years has been oriented towards the implementation of non-commercial rearing systems aimed at improving broiler rearing conditions, enhancing meat quality and improving the environment. This study presents productive and slaughter results of broilers reared under two non-commercial systems, including extensive indoor and free-range systems. Length of fattening period was 63 days. On days 49 and 63 of the experiment, male and female broilers were randomly selected from both rearing systems and slaughtered thereafter to be evaluated and compared for the following traits: dressing percentage and percentage yield of primal carcass cuts, as dependent upon rearing system, length of fattening period and broiler sex. The results showed a higher dressing percentage in broilers slaughtered on day 49, regardless of the higher carcass weight of broilers slaughtered on day 63. Broiler sex had a highly significant effect on the percentage yield of breast, thigh and drumstick in the dressed carcass ($P < 0.01$), whereas the percentage yield of thighs was also statistically highly significantly affected by rearing system ($P < 0.01$). Rearing system, length of fattening period and the interaction of these factors had no significant effect ($P > 0.05$) on the percentage yield of primal cuts (breast, thigh, drumstick, wing, back and pelvis), excepting that of pelvis which was significantly affected by rearing system ($P < 0.05$).

Key words: broilers, slaughter traits, rearing system, length of fattening period, sex.

Introduction

Poultry meat production in recent years has been increasingly oriented towards evaluating different rearing systems and lengths of fattening period, and their effect on meat quality. Attention has been focused on the development of new broiler rearing systems to improve rearing conditions, reduce environmental pollution and enhance meat

quality. Commercial broiler rearing systems involved cheap production of large quantities of meat over a relatively short period of time, but the system had huge disadvantages, including most notably inadequate rearing conditions – high stocking density, lack of natural light and intensive feeding, which led to serious environmental problems.

The reasons underlying the implementation of new broiler rearing systems as a replacement for the existing conventional rearing method come from legal regulations on poultry welfare. European Union countries have long since adopted directives (*VO/EWG 1538/91 and VO/EG 1804/99*) stipulating minimum broiler rearing conditions to be provided in order to satisfy non-commercial and organic poultry production standards (*Ristić, 2003*).

A number of researchers in Serbia have made efforts to define a new broiler fattening technology through research into both newly developed genotypes (*Blagojević et al. 2009*) and new rearing methods, including extensive indoor and free-range rearing systems (*Bogosavljević-Bošković et al., 2008*) and methods involving prolongation of the fattening period (*Mitrović et al., 2004; Bogosavljević-Bošković et al. 2009, 2011*).

This study evaluates and compares broiler meat parameters in Cobb 500 broilers designed for intensive production that were reared under two non-commercial systems i.e. under extensive indoor and free-range systems, over different lengths of the fattening period (49 and 63 days).

Materials and Methods

Cobb 500 hybrid broilers were used in the experiment. During the first 4 weeks, 200 day-old broilers were reared on deep litter floor. On day 28, the broilers were allocated to 2 groups: Experimental Group I (100 broilers) reared indoor at a stocking density of 12 birds/m², and Experimental Group II (100 broilers) reared both indoor at the same stocking density of 12 birds/m² and under free-range system at 1 m²/bird.

Until day 42 of the fattening trial, the test broilers received two complete compound feeds containing 21% protein until day 28 and 19% protein from day 28 to day 42. Thereafter, the feed used until the end of the fattening period comprised 70% ground maize, ground barley and vitamin and mineral supplements and 30% complete feed containing 19% protein.

Length of the fattening period was 49 and 63 days.

At the end of the fattening period, 12 broilers (6 males and 6 females) were randomly selected from each length of fattening period and each rearing system for measurement of body weight and evaluation of slaughter traits during slaughter and dressing processes (according to *Rašeta and Dakić, 1984*).

The data obtained were analysed by standard variation statistics methods. Testing of the significances was performed by the following mathematical model of analysis of variance:

$$Y_{ijkl} = \mu + SG_i + DT_j + P_k + (SGDT)_{ij} + (SGP)_{ik} + (DTP)_{jk} + (SGDTP)_{ijk} + e_{ijkl}$$

i.e. according to the three-factor design 2 x 2 x 2 (2 rearing systems – RS, 2 lengths of fattening period – LF and 2 sexes – S).

The parameters tested were subjected to analysis of variance using Anova, Microsoft STATISTICA Ver. 5.0., *Stat Soft Inc. (1995)*.

Results and Discussion

The data on broiler body weight before slaughter and cooled carcass weight were used to calculate the dressing percentage of broilers. Table 1 presents the dressing percentage of broilers as dependent upon different rearing systems and lengths of fattening period.

Table 1. Dressing percentage of broilers on days 49 and 63 of the fattening trial

Rearing system (1)	Length of fattening, days (2)	Sex (3)		Weight before slaughter, g	Dressed carcass	
					Weight, g	Dressing percentage, %
Non free-range	49	Male	\bar{x}	3023.333	2270.000	75.058
			Cv	4.810	5.791	1.668
		Female	\bar{x}	2502.500	1861.667	74.212
			Cv	11.617	14.048	3.459
	63	Male	\bar{x}	3510.000	2525.833	71.880
			Cv	16.850	18.222	3.802
Female		\bar{x}	2886.667	2118.333	73.385	
		Cv	3.187	3.493	1.587	
Free-range	49	Male	\bar{x}	2771.667	2083.333	75.196
			Cv	9.117	8.831	1.650
		Female	\bar{x}	2641.667	1975.833	74.720
			Cv	8.305	10.016	2.275
	63	Male	\bar{x}	3636.667	2668.333	73.263
			Cv	12.575	14.000	1.499
		Female	\bar{x}	3298.333	2411.667	73.107
			Cv	4.003	5.073	2.565
F_{exp}		F_1	42,24**	26,59**	7,67**	
		F_2	2,71 ^{ns}	1,49 ^{ns}	1,28 ^{ns}	
		F_3	11,44**	15,75**	2,06 ^{ns}	
		F_{12}	1,02 ^{ns}	2,92 ^{ns}	2,32 ^{ns}	
		F_{13}	1,85 ^{ns}	0,25 ^{ns}	3,65 ^{ns}	
		F_{23}	1,15 ^{ns}	2,31 ^{ns}	1,47 ^{ns}	
		F_{123}	0,11 ^{ns}	0,25 ^{ns}	3,23 ^{ns}	

\bar{x} - Average, Cv - Index of variation, ^{ns} - P>0.05; * P<0.05; ** - P<0.01

The analysis of the data given in Table 1 suggests that dressed carcass weight was expectedly highest in male and female broilers reared until day 63 under the free-

range system (2668.33gr and 2411.67gr, respectively), as body weight increased with increasing length of fattening period, resulting in the highest weight before slaughter and, hence, the highest dressed carcass weight in this group of broilers, with only the effect of rearing system and sex on dressed carcass weight being statistically highly significant ($P < 0.01$). The dressing percentage of broilers reared until day 63 was lower than in broilers slaughtered at 49 days of age. The highest dressing percentage was obtained in broilers of both sexes reared under the free-range system until day 49, but the statistically high significance was observed only in the effect of rearing system on the trait ($P < 0.01$), whereas the effect of the other factors tested (sex, length of fattening period, interaction) was not statistically significant ($P > 0.05$). Mello et al. (1996), *Mitrović et al. (2004)* and *Bogosavljević-Bošković et al. (2008)* report that increasing length of fattening period results in an increase in both body weight and dressed carcass weight as well as in a decrease in dressing percentage.

Table 2. Percentage yield of primal carcass cuts of broilers on days 49 and 63 of the fattening trial

Rearing system (1)	Length of fattening, days (2)	Sex (3)	Breast	Drumsticks	Thighs/	Wings	Back	Pelvis	
Non free-range	49	Male	\bar{x}	33,63	13,80	15,66	10,66	9,13	10,66
			Cv	2,83	3,48	5,59	3,20	8,36	10,00
		Female	\bar{x}	34,68	13,23	14,53	10,90	9,33	10,76
			Cv	8,67	9,08	3,47	7,28	6,71	5,73
	63	Male	\bar{x}	34,02	13,78	14,66	10,63	9,15	10,16
			Cv	5,50	8,92	3,18	10,46	9,04	5,85
		Female	\bar{x}	36,48	12,34	13,63	10,24	9,21	10,06
			Cv	4,64	4,52	3,93	5,39	8,46	4,55
Free-range	49	Male	\bar{x}	34,29	13,71	14,97	10,57	8,96	10,88
			Cv	6,13	4,78	2,76	3,57	3,58	5,65
		Female	\bar{x}	36,16	12,48	14,41	10,44	9,15	10,71
			Cv	2,66	2,23	4,52	5,39	9,41	13,79
	63	Male	\bar{x}	34,14	14,14	15,28	10,89	8,74	10,04
			Cv	6,83	6,77	6,06	5,68	6,45	6,14
		Female	\bar{x}	36,14	12,32	13,81	10,12	8,92	10,41
			Cv	4,15	2,77	3,98	6,72	7,00	9,80
F_{exp}		F_1	0,63 ^{ns}	0,72 ^{ns}	9,18 ^{**}	1,01 ^{ns}	0,58 ^{ns}	6,07 [*]	
		F_2	0,78 ^{ns}	0,38 ^{ns}	0,00 ^{ns}	0,29 ^{ns}	1,69 ^{ns}	0,14 ^{ns}	
		F_3	13,62 ^{**}	25,96 ^{**}	27,54 ^{**}	1,45 ^{ns}	0,85 ^{ns}	0,09 ^{ns}	
		F_{12}	1,47 ^{ns}	1,22 ^{ns}	3,97 ^{ns}	0,68 ^{ns}	0,25 ^{ns}	0,00 ^{ns}	
		F_{13}	0,51 ^{ns}	2,18 ^{ns}	1,18 ^{ns}	2,51 ^{ns}	0,06 ^{ns}	0,10 ^{ns}	
		F_{23}	0,04 ^{ns}	0,97 ^{ns}	0,04 ^{ns}	0,83 ^{ns}	0,01 ^{ns}	0,04 ^{ns}	
		F_{123}	0,52 ^{ns}	0,07 ^{ns}	1,97 ^{ns}	0,00 ^{ns}	0,02 ^{ns}	0,45 ^{ns}	

\bar{x} - Average, Cv - Index of variation, ^{ns} - $P > 0.05$; * $P < 0.05$; ** - $P < 0.01$

Table 2 outlines the percentage yield of primal carcass cuts of broilers – thighs, drumsticks, breast, wings, back and pelvis.

Table 2 shows a statistically highly significant effect of broiler sex on the percentage yield of breast, thighs and drumsticks in the dressed carcass ($P < 0.01$), a highly significant effect of growing system ($P < 0.01$) on the percentage yield of thighs, and no statistical significance ($P > 0.05$) of the effect of rearing system, length of fattening period and their interaction on the percentage yield of all primal cuts (breast, thighs, drumsticks, wings, back and pelvis), excepting that of pelvis which was significantly affected by rearing system ($P < 0.05$). The analysis of the percentage yield of primal carcass cuts through the percentage yield of individual meat classes (breast, thighs, drumsticks – class I, wings – class II, back and pelvis – class III) and the effect of the factors tested (rearing system, length of fattening period and broiler sex) indicates that only rearing system had a statistically significant effect ($P < 0.05$) on the percentage yield of class III meat, whereas that of class I and II meat was not significantly affected by these factors ($P > 0.05$) (Table 3).

Table 3. Percentage yield of different classes of broiler meat in the dressed carcass on days 49 and 63

Rearing system (1)	Length of fattening, days (2)	Sex (3)		Class I (breast, thighs, drumsticks)	Class II (wings)	Class III (back, pelvis)
Bez ispušta	49	Male	\bar{x}	63,09	10,66	19,79
			Cv	1,05	3,20	4,56
		Female	\bar{x}	62,44	10,90	20,10
			Cv	2,58	7,28	5,18
	63	Male	\bar{x}	62,47	10,63	19,30
			Cv	2,22	10,46	3,45
Female		\bar{x}	62,46	10,24	19,27	
		Cv	2,35	5,39	5,25	
Sa ispuštom	49	Male	\bar{x}	62,97	10,57	19,84
			Cv	2,02	3,57	2,39
		Female	\bar{x}	63,06	10,44	19,86
			Cv	1,50	5,39	7,64
	63	Male	\bar{x}	63,56	10,89	18,79
			Cv	1,66	5,68	5,31
		Female	\bar{x}	62,26	10,12	19,34
			Cv	2,06	6,72	3,10
F_{exp}			F_1	1,42 ^{ns}	1,01 ^{ns}	6,79*
			F_2	0,86 ^{ns}	0,29 ^{ns}	0,31 ^{ns}
			F_3	1,10 ^{ns}	1,45 ^{ns}	0,63 ^{ns}
			F_{12}	0,01 ^{ns}	0,68 ^{ns}	0,07 ^{ns}
			F_{13}	0,37 ^{ns}	2,51 ^{ns}	0,02 ^{ns}
			F_{23}	0,08 ^{ns}	0,83 ^{ns}	0,06 ^{ns}
			F_{123}	3,29 ^{ns}	0,00 ^{ns}	0,66 ^{ns}

\bar{x} - Average, Cv - Index of variation, ^{ns} - $P > 0.05$; * $P < 0.05$; ** - $P < 0.01$

Milošević et al. (2003), Ristić (2002), Lewis et al. (1997) and Milićević (2006) also determined that increasing length of fattening period induced an increase in major primal cuts (breast, thighs and drumsticks). *Bogosavljević-Bošković et al. (2009, 2011)* report that broilers reared without access to free range had a somewhat higher breast percentage and a lower percentage of thighs and drumsticks as compared to free range broilers. Nevertheless, the effect of rearing system and length of fattening period on the percentage of primal carcass cuts was not statistically significant ($P>0.05$), as opposed to the effect of sex on the percentage of primal carcass cuts which was found to be significant. Namely, the percentage of breast was significantly higher ($P<0.05$) in female broilers, and that of drumsticks and thighs in male broilers, as compared to broilers of opposite sex.

Conclusion

The results on the effect of rearing system and length of fattening period on broiler meat quality (dressing percentage, percentage yield of both primal carcass parts and different class meat) suggest the following:

Increasing length of fattening period induced an increase in both body weight and cooled dressed carcass weight but a simultaneous decrease in dressing percentage. The highest dressing percentage was obtained in broilers of both sexes reared under the free range system until day 49. The effect of rearing system on this trait was statistically highly significant ($P<0.01$), whereas no statistical significance ($P>0.05$) was observed in the effect of the other factors tested (sex, length of fattening period, interaction);

The highest effect on the breast and drumstick percentage of the dressed carcass was exhibited by broiler sex ($P<0.01$), whereas the thigh percentage was affected not only by broiler sex but also by rearing system ($P<0.01$). Rearing system had also a significant effect on pelvis percentage ($P<0.05$);

The proportion of class I and II meat was not affected by the treatments ($P>0.05$), whereas that of class III meat (back and pelvis) showed significant differences between indoor reared broilers and free range broilers ($P<0.5$).

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Kvalitet mesa tovnih pilića: uticaj sistema gajenja i dužine tova

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Rezime

U proizvodnji pilećeg mesa poslednjih godina teži se ka uvođenju neindustrijskih sistema gajenja u cilju poboljšanja uslova uzgoja pilića, dobijanja mesa boljeg kvaliteta i zaštiti životne sredine. U ovom radu prikazani su proizvodni i klanični rezultati tovnih pilića gajenih u dva neindustrijska sistema gajenja: ekstenzivno u živinarniku i gajenjem uz korišćenje slobodnog ispusta. Tov pilića trajao je 63 dana. Iz oba sistema gajenja, 49-og i 63-eg dana tova, metodom slučajnog uzorka odabrani su muški i ženski pilići koji su zaklani i na osnovu podataka sa linije klanja izračunati su i upoređeni: randman trupova pilića i udeo osnovnih delova trupa u zavisnosti od sistema gajenja, dužine trajanja tova i pola pilića.

Rezultati su pokazali da su veći randman klanja imali pilići zaklani 49. dana iako su pilići zaklani 63. dana imali veću masu trupa. Postojao je signifikantno visoko značajan uticaj pola pilića na udeo grudi, bataka i karabataka u obrađenom trupu ($P < 0,01$), dok je na udeo karabataka u obrađenom trupu takođe imao statistički visoko značajan uticaj i sistem gajenja ($P < 0,01$), a uticaji sistema gajenja, dužine trajanja tova i interakcija ovih faktora na udeo svih osnovnih delova (grudi, bataka, karabataka, krila, leđa i karlice) nisu imali statističku značajnost ($P > 0,05$), izuzev na udeo karlice, gde se pokazala statistička značajnost uticaja sistema gajenja ($P < 0,05$).

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