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COMPARATIVE ANALYSIS OF PRODUCTION AND SLAUGHTER PARAMETERS OF FAST-GROWING BROILER HYBRIDS

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Abstract: This study aimed to explore how hybrid varieties impact broiler chickens' production and slaughter performance. We applied standard rearing techniques over a 42-day period. The trial involved a total of 420 broiler chickens of the following hybrids: Cobb 500 and Ross 308. Weekly performance tests were conducted, assessing average daily gain, feed consumption, feed conversion rate, mortality, and European Poultry Efficiency Factor. After controlling for final body weights on the 42nd day, a random sample of 12 broilers per genotype, with an equal gender distribution, was selected for slaughter parameter analysis. Following slaughter traits were determined: pre-slaughter weight of chickens, slaughter yield, share of abdominal fat, chicken thigh circumference, and chest angle. The results revealed no significant difference in food consumption between the examined hybrids. Chickens of the Cobb 500 genotype exhibited significantly higher ($p<0.01$) gain and a more favorable feed conversion rate. Due to its better vitality, feed conversion rate, and gain, Cobb 500 chickens demonstrated significantly higher ($p<0.01$) European Poultry Efficiency Factor values. In contrast, Ross 308 chickens displayed statistically significantly lower ($p<0.05$) slaughter yield and chest angle values. At the same time, the proportion of abdominal fat and chicken thigh circumference showed no significant difference between the tested hybrids.

Keywords: broiler hybrids, production performance, slaughter parameters

Introduction

In the Serbian poultry industry, where domestic selection is absent, the evaluation of production and slaughter performances has been limited to foreign fast-growing hybrids designed for poultry meat production for the past thirty years or more. Comparisons of different hybrids, both domestically and

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globally, are standard practices, and the publication of the results from such comparisons typically attracts significant attention and sparks controversy. Various hybrids are used to produce poultry meat; among the most represented in our country are Cobb 500 and Ross 308. A comparative analysis of their production performance in our growing conditions is significant and interesting since it gives us the answer to the question of how much breeding centers in the world have progressed and improved certain production traits in relation to the previous period and other competing companies. Genetic advancements contribute to evident year-to-year improvements in production parameters (Marcos and Fausto, 2016). However, it's crucial to recognize that selection progress aimed at enhancing specific traits may inadvertently lead to the deterioration of other equally important characteristics. In the meat and slaughterhouse industry, there is a particular interest in optimizing the slaughterhouse performance of broilers. Consequently, as highlighted by Hristakiev et al. (2014), there is an ongoing focus on determining these crucial parameters. The quality of the chicken carcass can be evaluated from various aspects, including yield, meat composition, proportion, and content of abdominal fat in the carcass. Additionally, aspects related to the development of chicken breasts and thighs, as the most valuable carcass parts, are of significant importance.

Numerous factors can impact both the production performance and the mentioned quality parameters of chicken carcasses in broiler production. Several studies, including those by Pavlovski et al. (2009) and Lukić et al. (2020), have indicated that genotype can play a significant role. Petričević et al. (2011) further validate in their experiments that, among biological factors, genotype and gender exert the most substantial influence on carcass quality. The objective of our research was to investigate the impact of the more prevalent fast-growing hybrids in our market on production and slaughter performance.

Materials and methods

Sample material and diet

The experiment took place over a 42-day period at the Experimental Poultry Farm of the Institute of Animal Husbandry in Belgrade. Sample material consisted of 210 one-day-old broiler chickens each for the Cobb 500 and Ross 308 hybrids. The birds were housed in six boxes, with 70 chickens per box, and were distributed randomly using a block system to minimize potential environmental

variations. Throughout the experiment, the chickens were provided with the same feed mixtures ad libitum.

A total of four pelleted mixes, purchased from the market, were utilized: Starter for the first two weeks, Grower for the third and fourth weeks, Finisher I for the fifth week, and Finisher II for the sixth week. The chemical composition and microbiological status of the mixtures were monitored in the accredited laboratories of the Institute. The analysis results validated the nutritional declarations by the manufacturers and affirmed the legally regulated quality and health status of the utilized mixtures. The crude protein content in the mixtures was 22.09%, 19.07%, 18.86%, and 17.24%, with calculated metabolic energy values of 12.9, 13.2, 13.5, and 13.8 MJ.

Determination of production and slaughter carcass traits

At the end of each week, the body weights of all broilers were measured, as well as the amount of food consumed. Food consumption, average daily gain, feed conversion, and mortality were monitored at the box level so that in the statistical processing of the data, the box represented the unit of observation. Based on data on body weight, feed conversion, and mortality, the value of the European Poultry Efficiency Factor (EPEF) was calculated according to the formula: EPEF = (Body weight (kg) x vitality (%) x 100)/(Duration of fattening (days) x feed conversion) (g/g)).

To assess carcass quality properties, following the final body weight check on the 42nd day, a random sampling method was employed to select 2 male and 2 female broilers from each box. This process formed a sample of 12 chickens per hybrid. After a 10-hour fasting period, a pre-slaughter body weight measurement was conducted just before slaughter to express relative values of slaughter traits. Post-slaughter and processing, carcasses were cooled and measured, with weights determined excluding poultry offal. The separation of abdominal fat occurred during carcass processing, representing fat tissue not linked to the carcass.

The obtained carcass and abdominal fat weights were then compared with the body weight of chickens before slaughter to determine the proportion of abdominal fat in the carcass. Additionally, within the scope of body conformation measures determined by the method outlined in Pavlovski et al.'s (2006) work, the circumference of chicken thighs at the widest part and the chest angle (expressed in degrees) were measured using a protractor vertically in relation to the back line.

Statistical data processing

Statistical analysis of the results was performed using the program package "STATISTICA" (Stat Soft Inc., 2012). A one-factor analysis of variance and an LSD test were used to determine the statistical significance of differences between mean values.

Results and discussion

At the outset of the test, the initial body weights of chickens were consistent and did not exhibit statistically significant differences between the Cobb 500 and Ross 308 hybrids (41.2g and 42.4g). Table 1 represents the production performance indicators of broiler chickens across the test periods, extending from the start of the experiment to the alteration of the feeding mixture.

Table 1. Production performance from the beginning of the test to the change in the feeding mixture

Period	Hybrid	Production parameters									
		Consumption (g/day)		Gain (g/day)		Conversion (g/g)		Mortality (%)		EPEF	
		x	Sd	x	Sd	x	Sd	x	Sd	x	Sd
1-14 days	Cobb 500	42.03	0.89	33.68^{A}	0.32	1.25^{B}	0.01	0.48	0.83	292.33^{A}	3.61
	Ross 308	40.65	0.90	30.69^{B}	0.54	1.32^{A}	0.02	0.95	1.65	254.19^{B}	4.84
	p-value	n.s.		<0.01		<0.01		n.s.		<0.01	
1-28 days	Cobb 500	85.02	0.78	59.64^{A}	0.11	1.42^{B}	0.01	0.95	0.83	425.34^{A}	5.52
	Ross 308	82.46	0.54	54.85^{B}	0.20	1.50^{A}	0.01	1.43	1.43	371.31^{B}	4.99
	p-value	n.s.		<0.01		<0.01		n.s.		<0.01	
1-35 days	Cobb 500	97.97	0.94	66.38^{A}	0.37	1.47^{B}	0.01	0.95	0.83	453.92^{A}	4.95
	Ross 308	99.24	0.44	63.28^{B}	0.12	1.56^{A}	0.01	1.91	0.83	405.65^{B}	4.29
	p-value	n.s.		<0.01		<0.01		n.s.		<0.01	
1-42 days	Cobb 500	112.76	2.00	70.56^{A}	0.15	1.59^{B}	0.02	1.43	1.43	443.67^{a}	13.44
	Ross 308	112.57	0.12	66.97^{B}	1.09	1.68^{A}	0.02	2.86	1.43	398.54^{b}	17.37
	p-value	n.s.		<0.01		<0.01		n.s.		<0.05	

x – average; Sd – standard deviation; n.s. - not significant

* a-b Mean values in each column without shared labels are significantly different at the 5% level

* A-B Mean values in each column without shared labels are significantly different at the 1% level

Both hybrid types displayed uniform feed consumption throughout the test, with no statistically significant differences observed in this parameter across the

test periods. Notably, the average daily gain was statistically significantly higher ($p<0.01$) in broiler chickens of the Cobb 500 hybrid. On the other hand, the feed conversion ratio was significantly ($p<0.01$) inferior in chickens of the Ross 308 hybrid throughout all test periods. Despite non-statistically significant differences in mortality, broiler chickens of the Cobb 500 hybrid demonstrated higher vitality. Both hybrids maintained good health, with mortality rates below 3%. The European Poultry Efficiency Factor, serving as a comprehensive production indicator, was significantly higher ($p<0.05$) in all test periods for the Cobb 500 hybrid.

Upon comparing the production parameters of the fast-growing line hybrids Cobb-Vantress (2022) and Aviagen Ross 308 (2022), it becomes evident that the Cobb 500 hybrids exhibit a more prominent genetic potential throughout the entire examination period. Notably, these chickens had a lower initial body weight. However, due to lower mortality, improved feed conversion, and higher gains across all experiment phases, the Cobb 500 hybrid demonstrated higher values of the European Poultry Efficiency Factor. The European Poultry Efficiency Factor (EPEF) values showed an increasing trend until the age of 35 days in both hybrids. However, from days 1 to 42, the EPEF value decreased compared to the period from days 1 to 35. Razuki et al. (2011) also assert the preference for concluding the production phase in broilers before the 42nd day of age. Sterling et al. (2006) and Lukić et al. (2022) determined significant differences in production results under the influence of genotype.

To provide a more comprehensive overview of the fundamental production parameters of broiler chickens, the data for each week are presented separately in Table 2. Feed consumption during the initial four weeks did not exhibit statistically significant differences between hybrids. However, significant distinctions emerged in the 5th and 6th weeks ($p<0.05$). Initially, Ross 308 broilers demonstrated superior consumption in the 5th week, followed by Cobb 500 chickens in the 6th week. The average gain of broiler chickens in the first four weeks of the study was significantly higher in Cobb 500 ($p<0.01$). In the 5th week, due to significantly higher feed consumption in the Ross 308 hybrid, there was also a significantly ($p<0.05$) higher gain in these chickens. However, the differences in gain in the 6th week were not statistically significant ($p>0.05$). Throughout all tested weeks, the feed conversion ratio was less favorable in Ross 308 chickens, though the differences were not statistically significant in the 1st, 2nd, 4th, and 6th weeks. Analyzing the data for feed use efficiency in the 3rd and 5th weeks revealed statistically significant differences ($p<0.05$), indicating better conversion in Cobb 500 chickens.

Table 2. Production performance per test-weeks

Period	Hybrid	Production performance					
		Consumption (g/day)		Gain (g/day)		Conversion (g/g)	
		x	Sd	x	Sd	x	Sd
1. week	Cobb 500	22.94	2.65	21.88^{A}	0.64	1.05	0.09
	Ross 308	22.78	1.01	19.37^{B}	0.29	1.18	0.08
	p-value	n.s.		<0.01		n.s.	
2. week	Cobb 500	60.71	1.61	45.48^{A}	0.08	1.34	0.04
	Ross 308	58.51	2.73	42.00^{B}	0.80	1.39	0.04
	p-value	n.s.		<0.01		n.s.	
3. week	Cobb 500	104.36	1.60	69.95^{A}	0.86	1.49^{b}	0.01
	Ross 308	104.18	4.70	65.33^{B}	0.36	1.59^{a}	0.06
	p-value	n.s.		<0.01		<0.05	
4. week	Cobb 500	150.74	0.83	101.24^{A}	1.07	1.49	0.01
	Ross 308	143.47	4.90	92.71^{B}	0.14	1.55	0.05
	p-value	n.s.		<0.01		n.s.	
5. week	Cobb 500	149.77^{b}	1.55	93.33^{b}	1.46	1.60^{b}	0.02
	Ross 308	164.01^{a}	6.42	97.00^{a}	1.36	1.69^{a}	0.04
	p-value	<0.05		<0.05		<0.05	
6. week	Cobb 500	183.39^{a}	2.87	91.48	2.78	2.01	0.09
	Ross 308	172.61^{b}	5.31	85.38	7.09	2.03	0.10
	p-value	<0.05		n.s.		n.s.	

x – average; Sd – standard deviation; n.s. – not significant

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The average daily gain of Cobb 500 hybrid broiler chickens saw an increase from the study's commencement until the 4th week of age. Subsequently, after reaching 28 days of age, this parameter experienced a decline. In contrast, broiler chickens of the Ross 308 hybrid displayed more moderate gain values throughout the test. However, the increase persisted for an extended period, specifically until the 5th week of age, following which the average daily gain decreased in the final week. Consistent with our findings, Pascalau et al. (2017) and Tudorache et al. (2022) also observed notable differences in production outcomes influenced by genotype. A comparison of the production results from our test with those of Petričević et al. (2011) and Bjedov et al. (2011) underscores

the evident genetic and overall progress of both hybrids over the past period. Considering the outcomes of the selection work in the last two decades and the results achieved in terms of broiler body weight and feed utilization efficiency, in line with the projections of Marcos and Fausto (2016), it is anticipated that fast-growing hybrids will attain an average body weight of 2.34 kg at 29 days of age within the next 10 years.

Table 3 displays the observed characteristics of carcass parameters. Although the pre-slaughter weight of chickens, the share of abdominal fat, and the circumference of chicken thighs were higher in Cobb 500 hybrid broiler chickens, the identified differences were not statistically significant. However, the carcass yield and chest angle, recognized as crucial indicators of conformation, were significantly lower in broiler chickens of the Ross 308 hybrid.

Table 3. Slaughter carcass traits of the hybrids

Hybrid	Sex	Salughter parameters									
		Pre-slaughter weight (g)		Yield (%)		Abdominal fat (%)		Chicken thigh circumference (mm)		Chest angle	
		x	Sd	x	Sd	x	Sd	x	Sd	x	Sd
Cobb 500	♂	3076.5	246.6	74.5	1.48	1.08	0.23	170.5	5.79	128.2	0.98
	♀	2652.2	120.5	74.7	0.79	1.19	0.58	154.8	6.28	129.2	1.33
	♂+♀	2864.4	288.7	74.6[a]	1.14	1.13[a]	0.42	162.7	10.00	128.6[a]	1.23
Ross 308	♂	3103.5	286.8	73.5	1.48	0.92	0.24	165.3	6.44	127.7	1.97
	♀	2462.5	250,0	73.8	0.76	0.95	0.37	154,0	10.75	123.2	4.62
	♂+♀	2783.0	421.7	73.6[b]	1.15	0.94[b]	0.3	159.7	10.32	125.4[b]	4.12
p-value		n.s.		<0.05		n.s.		n.s.		<0.05	

x – average; Sd – standard deviation; n.s. - not significant

* a-b Mean values in each column without shared labels are significantly different at the 5% level

The higher absolute values of chicken thigh circumference as an important characteristic of carcass conformation among the observed hybrids can be partially explained by the higher pre-slaughter body weight of the Cobb 500 broiler. Bearing in mind the fact that the increased content of abdominal fat is becoming an increasing problem in the production of chicken meat and that it has a high and positive correlation with the total amount of fat in the carcass, it

is evident that broiler chickens of the Cobb 500 genotype had less favorable values compared to Ross 308. In addition, a higher proportion of abdominal fat in female chickens in both hybrids was observed. Significant differences in important slaughter parameters under the influence of genotype were confirmed in the research of Nikolova and Pavlovski (2009) and Abdullah et al. (2010). The obtained slaughter parameters are in accordance with the results of Hristakieva et al. (2014), who report a significantly higher yield in the Cobb 500 hybrid.

Conclusion

The production performances of both hybrids suggest the potential to achieve impressive results. The European Poultry Efficiency Factor values for both hybrids indicate that the broiler chicken production cycle should ideally conclude at 35 days. A comparative analysis of the two fast-growing (heavy-line) hybrids showed that the Cobb 500 broilers exhibited significantly superior production and slaughter performance.

In the conducted experiment, the Ross 308 hybrid broilers showed lower average gains, higher mortality, and a less favorable feed conversion ratio compared to the Cobb 500 broilers. Notably, the Cobb 500 broilers concluded the trial with a significantly higher relative yield of processed carcass and a more developed breast.

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