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Influence of the system of rearing on cholesterol level and its fraction in blood serum of slow-growing chickens

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Abstract: *Influence of the system of rearing on cholesterol level and its fraction in blood serum of slow-growing chickens*. The experiment was carried out on 936 slow-growing chickens from the crossbreed of Cobb cock with Greenleg Partridge hen. Chicks were randomly divided into two groups: controlled group (BW) with no access to the field and experimental group (W) with access to grass fields since their fourth week of life. In blood serum overall cholesterol, lipoproteins with high density (HDL), triacylglycerols (TG) level was marked. The concentration of lipoproteins with low density was calculated while using the Friedewald et al. formula (1972). No statistically significant influence of sex and system of breeding on cholesterol and its fractions level in blood serum of crossbreed chickens was observed.

Key words: broiler chickens, slow-growing chicken, blood

INTRODUCTION

In Poland most poultry meat production is based on fast growing chickens kept in an intensive system (Polak et al. 2010). The fast growth rate while the whole body develops at different rates very often results in numerous dysfunctions such as: syndrome of sudden heart death, ascites, limb dysfunctions – which, consequently, have a bad influence on chicken health and most of all – according to consumers – on the meat quality (Julian 2005, Olkowski et al. 2008). Society is more and more interested in conditions in which domestic animals are kept. In highly developed countries for many years a rising interest in a healthy diet has been noticed, with paying special attention to comfort of life of domestic animals and high standards of animal welfare in order to achieve high quality products (Sundrum 2001). Morphological and biochemical blood tests are of great importance in animal treatment, it is one of basic measures used in condition assessment, for example, of a cat or a dog (Kliszcz 2010). While looking at birds, unfortunately, there are only some physiological norms available in the literature, insufficient to form a complete picture of biochemical and hematological indicators or the amount of lipid compounds in blood serum of birds (Krasnodębska-Depta and Koncicki 2000, Mazurkiewicz 2005, Gryzińska et al. 2010).

A lot of various factors may influence levels of biochemical and hematological indicators in blood, among other things: sex, age, species, race, diet, physiological condition and rearing system (Mazurkiewicz 2005). Blood plays a distinct role in a proper function of animal organisms. It takes part in transporting nutrients, thermoregulation, homeostasis,

defense reactions (Elagib et al. 2008). In blood, besides morphological elements, we can find a lot of other chemical compounds which take part in a proper body function. Cholesterol and triacylglycerol's are transported in body fluids as lipoprotein particles which are classified according to their density, chylomikrons, lipoproteins with very low density (VLDL), lipoproteins with intermediate density (IDL), lipoproteins with low density (LDL), lipoproteins with very high density (HDL). The basic function of lipoproteins is transporting lipids from the place of their origin to their destination.

The purpose of the conducted research was to establish the influence of breeding system on the level of cholesterol and its fractions in a blood serum of slowly growing chickens.

MATERIAL AND METHODS

The research was conducted on an experimental farm of University of Life Sciences RZD Wilanów-Obory in 2011. Procedures used in the research were in accordance with the ones established by the ethical commission 27/2009 on 16 April 2009. The research was conducted on 936 chickens from crossbreeding of Cobb male with Greenleg Partridge kept until their 63rd day of life. One-day chickens were randomly divided into two groups: BW (controlled) and W (experimental) in five repetitions each. An indicator which diversified the groups was the ability to use grass fields since the 4th week of life: the experimental group (W). The fields were 3 m wide and 5 m long. Half of the field area was under roof. The field was dry with permeable soil, full of sunlight, with plants: *Lolium perenne* L. (40%), *Festuca rubra* L. (50%) and *Poa pratensis* L. (10%). There was also a sandy spot in the field for the birds to take sand baths. During the period of breeding a four-step system of feeding was implemented while using food blends starter, grower 1, grower 2 and finisher (Table 1). Birds had an unlimited access to food and water.

During the experiment after each week an individual body weight, food intake and death rate of chickens was checked. On the 63rd day of breeding there were chosen from each group 24 cocks and 24 hens with body weight about average for each sex in a group. Blood samples were taken from wing veins using sterilized syringes and needles. After 30–60 min since blood taking, the blood samples were spun for 10 min with 3,000 of spins per min. In the obtained blood serum the concentration of overall cholesterol, lipoproteins of high density (HDL), triacylglycerol's (TG) was marked. The concentration of lipoproteins with low density was calculated while using the Friedewald et al. formula (1972).

$$LDL = \frac{CHOL - TG}{2.2 - HDL} \text{ (mmol/l)}$$

For marking overall cholesterol, HDL, triglycerides commercial sets by CORMAY Company were used.

The obtained results were worked out statistically while using variance analysis of the smallest squares method in a statistic program SPSS 19.0 (SPSS Inc., Chicago, IL, USA). Values of the examined traits as given in the tables and standard errors od of the means (SEM).

TABLE 1. Feed mixture composition and nutritional value according to producer's

Specification	Starter (1–11)	Grower I (12–24)	Grower 2 (25–37)	Finisher (38–63)
Content (%)				
Corn	10.00	11.40	10.00	10.00
Wheat	53.00	55.00	59.60	60.80
Soybean meal	30.60	27.40	23.20	21.60
Feeding limestone	1.19	1.20	1.11	0.97
Sodium bicarbonate	0.20	0.14	0.14	0.16
NaCl	0.24	0.28	0.28	0.26
Stimulator	0.01	0.01	0.01	0.01
Dicalcium phosphate	1.18	0.78	0.70	0.64
Soybean oil	2.10	2.40	3.60	4.40
Methionine 84% calcium salt	0.48	0.42	0.36	0.28
Lysine	0.36	0.34	0.36	0.28
Threonine	0.14	0.13	0.14	0.10
Premix C196 PX05802 0.5%	0.50	0.50	0.50	0.50
Nutritional value				
ME (kcal)	2 990.20	3 047.19	3 125.72	3 217.10
Fat	3.67	4.00	5.14	5.92
Protein	21.99	20.78	19.26	18.51
Fiber	3.60	2.55	2.45	2.41
Ash	5.83	5.35	4.96	4.67
Lysine	1.38	1.28	1.19	0.97
Methionine + cystine	1.08	1.01	0.92	0.76
Available phosphorus	0.45	0.38	0.36	0.35

Provided per kilogram of diet: STARTER: vitamin A 11.00 K UL; organic phosphorus 0.59%; calcium 0.98%; phosphorus available 0.45%; calcium chloride 0.24%; sodium 0.15%; chlorine 0.27%; potassium 0.90%; magnesium 0.17%; manganese 142.32 mg; copper 31.59 mg; selenium 0,41 mg; iron 191.51 mg; sulfur 0.34%; zinc 116.80 mg; lysin 1.36%; methionine 0.31%; GROWER I vitamin A 11.00 K UL; organic phosphorus 0.51%; calcium 0.87%; phosphorus available 0.38%; calcium chloride 0.28%; sodium 0.15%; chlorine 0.29%; potassium 0.85%; magnesium 0.16%; manganese 141.84 mg; copper 30.82 mg; selenium 0.41 mg; iron 174.55 mg; sulfur 0.32%; zinc 115.03 mg; lysin 1.26%; methionine 0.30%; GROWER II vitamin A 11.00 K UL; organic phosphorus 0.48%; calcium 0.81%; phosphorus available 0.36%; calcium chloride 0.28%; sodium 0.15%; chlorine 0.30%; potassium 0.77%; magnesium 0.16%; manganese 141.40 mg; copper 30.21 mg; selenium 0.40 mg; iron 165.98 mg; sulfur 0.30%; zinc 113.79 mg; lysin 1.17%; methionine 0.28%; FINISHER vitamin A 11.00 K UL; vitamin D3 3.00 K UL; vitamin E 40.00 mg; organic phosphorus 0.73%; calcium 0.35%; calcium chloride 0.26%; sodium 0.15%; chlorine 0.27%; potassium 0.74%; magnesium 0.15%; manganese 140.80 mg; copper 29.92 mg; selenium 0.40 mg; iron 159.92 mg; sulfur 0.28%; zinc 113.14 mg; lysin 1.06%; methionine 0.27%.

RESULTS AND DISCUSSION

Production results in both groups during 63-day period of breeding are presented in Table 2. The influence of system rearing (with outdoor access) on the final body weight of chickens was observed. Rooster's with access to the fields had a distinctly larger ($P < 0.01$) body weight when compared to rooster's the from the controlled group. On the 63rd day of breeding cocks weighed on average 2,134 g and hens 1,684 g. The conducted statistic analysis did not show any significant differences in food intake or death rate. However, higher intake of food and higher death rate was noticed in the experimental group (W) – having the ability to use the fields (Table 2). Similar results were obtained in research by Castellini et al. (2002), Nielsen et al. (2003) and Fanatico et al. (2005).

The analysis of all known in literature biochemical tests of blood serum established that birds in comparison to other animal species have different values for those indicators. Only some physiological norms available in the literature are insufficient to form a complete picture of both biochemical and hematological indicators. Moreover, we must pay attention to individual differences in single bird populations. In some cases an individual bird may be still placed within reference values even if it is sick (Piasecki and Krasoń 2012).

TABLE 2. Influence of the system of rearing on production results of broiler slow-growing chicken

Specification	Sex	BW (g)	FCR (%)	Mortality (%)
W	♂	$2\,171^{A}$	2.34	3.52
	♀	1 688		
BW	♂	$2\,098^{B}$	2.30	3.50
	♀	1 680		

BW – body weight; FCR – feed conversion ratio; A,B – means with the different subscripts differ significantly at $P \leq 0.01$.

No statistically significant influence of sex or breeding system on cholesterol and its fractions level was observed in blood serum of slowly growing chickens (Table 3). The highest concentration of overall cholesterol was noticed in a blood serum of cocks with the ability to use the field (2.317 mmol/l). The growth tendency was observed for chickens from the experimental group (W) depending on their sex. The highest level of triacylglycerol's (0.867 mmol/l) was observed in the controlled group of chickens (BW). Brodacki et al. (2006) in their research did not observe any influence of a breeding system on overall cholesterol and triacylglycerol's level in a blood serum of turkeys. Kirkpinar et al. (2011) for broiler chickens and Gryzińska et al. (2010) in a blood serum of polar hens observed the influence of sex on cholesterol and level. Mostly cholesterol and its fractions level is influenced by various food additives. Research conducted by Dehkordi et al. (2010) proved significant differences in overall cholesterol and triacylglycerol's level in a group of chickens fed with a standard food blend. Toghyani et al. (2011) observed the influence of cinnamon, Traesel et al. (2011) the mixture of ethereal oils form oregano, salvia, rosemary and chili. Research conducted by Gryzińska et al. (2010) proved that with age overall cholesterol, triacylglycerol's and lipoproteins with low density (LDL) level decreases in blood serum. Just the opposite is for lipoproteins with

TABLE 3. Cholesterol and its fractions and triglycerides in the blood serum of chickens slow-growing based on gender and rearing system (mmol/l)

Specification	Sex	CHOL	SEM	TG	SEM	HDL	SEM	LDL	SEM
W	♂	2.317	0.214	0.780	0.060	1.627	0.165	0.653	0.071
BW		2.140		0.867		1.433		0.667	
W	♀	2.307		0.737		1.607		0.667	
BW		2.037		0.747		1.393		0.610	

CHOL – cholesterol; TG – triglycerides; HDL – high-density lipoprotein; LDL – low-density lipoprotein.

high density (HDL) which concentration is the highest in blood of the youngest birds. Krasnodębska-Depta and Konwicki (2002) studied the influence of a short-term heat stress on some chosen biochemical indicators in turkey blood. They observed that after 6, 26 and 50 h of heat stress in a group of turkeys, a statistically significant increase of triacylglycerol's appeared. There was not observed any influence on overall cholesterol level. Wójcik et al. (2011) and Czech et al. (2012) proved that a longer before-slaughter transport has a significant influence on overall cholesterol concentration in blood serum of chickens.

CONCLUSIONS

The influence of system rearing (with outdoor access) on the final body weight of chickens was observed. In the conducted research no statistically significant influence of sex and system of breeding on cholesterol and its fractions level in blood serum of crossbreed chickens was observed.

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Streszczenie: *Wpływ systemu utrzymania na zawartość cholesterolu i jego frakcji w surowicy krwi kurcząt wolno rosnących.* Doświadczenie przeprowadzono na 936 kurczętach wolno rosnących pochodzących z krzyżowania koguta Cobb oraz kury Zielononóżki kuropatwianej. Pisklęta losowo przydzielono do dwóch grup: kontrolnej

(BW) niemającej dostępu do wybiegu oraz grupy doświadczalnej (W), korzystającej z trawiastych wybiegów począwszy od 4. tygodnia życia. W surowicy oznaczono stężenie cholesterolu całkowitego, lipoprotein o dużej gęstości (HDL), triacylogriceloli (TG). Zawartość lipoprotein o małej gęstości (LDL) wyliczono na podstawie wzoru Friedewald et al. 1972. Nie wykazano statystycznie istotnego wpływu płci oraz systemu utrzymania na zawartość cholesterolu i jego frakcji w surowicy krwi kurcząt mieszańca.

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