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EFFECT OF COVERED OR HULLESS BARLEY ADDITION ON PERFORMANCE, DIGESTIBILITY AND SLAUGHTER VALUE OF BROILER CHICKENS

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ABSTRACT

The aim of the study was to evaluation of introduction of covered or hulless barley instead of part of wheat on rearing performance, digestibility of diets and the slaughter results of broiler chickens. The experiment (growth trial) was carried out on 126 Hubbard Flex chickens which were divided into 3 groups of 42 birds per group (7 replications with 6 chickens, 3 ♀ and 3 ♂). The control group (K) fed of wheat- soybean diet, whereas in the experimental diets a part of the wheat was replaced by 20% of covered barley (JO) or 20% of hulless barley (JNO). At the 42 days of age, 24 birds (4 ♀ and 4 ♂ from each group) were slaughtered and designed for slaughter analysis and partial dissection. The digestibility trial was carried out on 18 day old broilers. The digestibility coefficients of basal nutrients of diets fed in starter period were determination by total collection method. The chickens fed a diet containing covered barley characterized greater of body weight at 21 day ($P \leq 0.05$) and better body weight gain in the starter period (1 to 21 days), than received diet with hulless barley. In the grower period, the body weight and body weight gain in groups become even. Similarly results obtained also for whole fattening period. The feed efficiency in each period of rearing of chickens was similarly. The dry matter and N-free-extractives the chickens digested significantly better ($P \leq 0.05$) from diet containing hulless barley, however the crude protein and crude fat from control diet. There were no significant differences between the groups in the digestibility of crude ash and phosphorus. The introduction of 20% hulless barley to the diet significantly ($P \leq 0.05$) decrease slaughter yield, however increase the share of skin with subcutaneous fat in the carcass, in relation to the chickens fed diet containing covered barley. The use of 20% of both barley (covered and hulless) has not significantly effect on musculature of chickens. Fatty acid composition of lipid fraction of breast muscle was similar in groups except of mirystoleic and behenic acid, which were significantly higher ($P \leq 0.05$) in breast muscle of chickens fed with diet containing 20% hulless barley. The better palatability characterized breast muscle of chickens fed diet containing hulless barley. On the body weight, body weight gain, slaughter yield and fatness account of chickens, the better profitable was covered barley , whereas on the quality of meat was hulless barley.

Key words: broiler chickens, barley, performance, digestibility, slaughter results, meat quality

INTRODUCTION

Basic feed energy components for chickens include cereals, mainly wheat and maize, whereas soybean meal is the chief protein source. Due to the high costs of these often imported feed ingredients, using wheat for humans consumption, and uncertainty hidden behind genetically-modified feeds, domestic feed components are more and more often being considered in the production application. These include barley, triticale, oat or rye. However, these cereals contain a considerable amount of nondigestible substances by poultry. Antinutrients present in wheat are mainly arabinoxylans, while beta-glucans prevail in barley [Kucharski et al. 2002]. These substances increase the viscosity of the digesta in the avian gut. In order to improve the conversion of ingredients by poultry from feed containing nondigestible substances, the enzyme preparations are added to the diets, which are subjected to various technological treatments, and cultured varieties containing less antinutrient ingredients are being developed [Koreleski et al. 2000, Fabijańska et al. 2002].

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Nutrients content in the grain is strongly dependent on the cereal plant species; however, under certain conditions it may be modified by cultivar, soil, fertilizing, weather, technological treatments and so forth [Zbroszczyk et al. 2010, Krajewski et al. 2013]. This implies that there is a need for permanent monitoring of chemical composition and nutritional value of poultry feed cereals, especially as the market is offering new cultivars and new technologies are being implemented. This may lead to considerable differences in the composition of various feeds, which pertains to antinutrients in particular. Therefore, it is recommended to be constantly aware of any changes in the chemical composition of barley grain as a feed cereal component, its potential in poultry feeding, and its impact on quality of animal products.

The aim of the study was to evaluate the effects of covered or hulless barley meal applied as feed component in place of a part of wheat on rearing performance, digestibility, carcass yield and meat quality of broiler chickens.

MATERIAL AND METHODS

The feeding trial involved diets prepared for broiler chickens in which a part of wheat meal was substituted with covered or hulless barley meal. The growth experiment was carried out on 126 Hubbard Flex broilers assigned to 3 groups, 42 birds each (7 replications, 6 chickens each, including 3 males and 3 females). The chickens were kept in metal cages placed in a climate-controlled room. The diets (in a mash form) and water were provided ad libitum throughout the trial. The control group (K) fed of wheat- soybean diet, whereas in the experimental diets a part of the wheat was replaced by 20% of covered barley cv. Antek (JO) or 20% of hulless barley cv. Rastik (JNO). Hulless Rastik barley had been purchased in the Plant Breeding and Acclimatization Institute (IHAR) in Radzików, Poland, whereas covered Antek barley was bought from a specialist cereal grain producer. The material was assayed for basic chemical profile (according to procedures by AOAC, 2005), total phosphorus (colorimetric method with eikonogen as a reducing agent) and total and soluble beta-glucans (enzymatic method in IHAR, according to the procedure AACC 32-23, 2000). From day 1 until 21 days of age, the chickens fed the starter diets, followed by the grower applied from day 22 to 42. Recipes of diets were balanced on the data given in the Poultry Nutrition Recommendations (2005) and are presented in Table 1.

During the experiment, body weight was measured at day 1, 21 and 42 of age and feed intake was established. Based on these results, body weight gains were calculated for the first rearing period, i.e. 1 to 21 days of age, for the second period, i.e. from 22 to 42 days, and the whole rearing period, from 1 through 42 days; feed intake was estimated over the same periods. On the completion of the trial, following a 14-hour fasting, 24 birds were slaughtered, 8 from each group (4 males and 4 females). The birds were plucked, eviscerated and giblets weighed. Carcasses were cooled at 4°C for 24 hours and dissected according to the method described by Ziołecki and Doruchowski [1989]. The weight of each element of the carcass was determined. The data were then used to calculate carcass dressing percentage, proportion of giblets against the body weight and carcass elements against cooled carcass weight. Breast muscles were sampled in order to determine basic physico-chemical properties and to carry out sensory evaluation.

Basic nutrients were assayed according to the procedure described by AOAC [2005], whereas the lipid fraction composition and percentage of fatty acids was analyzed using a CHROM 5 gas chromatopraph according to methods reported by Matyka [1976]. The sensory evaluation was carried out as described by Baryłko-Pikielna and Matuszewska [2009], scoring each attribute from 1 to 5 points. In the last week of the first rearing period, a digestibility test was carried out in order to determine digestibility coefficients of dry matter, total phosphorus and basic nutrients of the diets used in this period.

The test pattern was the same as the growth experiment. The study was carried out using a balance method with a total collection of excreta, which was collected for 3 days from the trays under each cage. The excreta were purified from impurities, dried at 60°C, weighed, ground and prepared for analysis according to Yi et al. [1996]. Basal nutrients, dry matter and total phosphorus content in feeds and excreta were determined according to the AOAC [2005] procedure. Fecal nitrogen was precipitated with lead acetate according to Hartfiel [1961]. Based on these results, the digestibility coefficients of the previously mentioned components were calculated according to the equation proposed by Guevara et al. [2008].

The resulting data of the experiment were statistically processed in a one-way analysis of variance (ANOVA). The significance of differences between group means were tested using Duncan's multiple range test. The calculations were done with Statistica software package v. 12, StatSoft Inc. [2014].

RESULTS AND DISCUSSION

The chemical composition of covered and hulless barley is presented in Table 2. The levels of dry matter, organic matter, N-free extracts and crude fat was similar in both barley cultivars, while hulless barley contained more crude protein. A considerably difference between both cultivars was found in the content of crude fiber.

The total content of beta-glucans in barley grain of the hulless cultivar was higher than that of the covered

Table 1. Composition and nutritive value of experimental diets, %

Tabela 1. Skład surowcowy i wartość pokarmowa mieszanek doświadczalnych, %

Components Składniki	Starter period – Okres starter			Grower period – Okres grower		
	Group – Grupa					
	K	JO	JNO	K	JO	JNO
Wheat meal – Śruta pszenna	61.66	40.20	40.20	64.3	44.00	44.00
Soybean meal – Śruta poekstrakcyjna sojowa	29.98	30.50	30.50	26.44	26.15	26.15
Covered barley meal – Śruta z jęczmienia oplewionego	–	20	–	–	20	–
Hulless barley meal – Śruta z jęczmienia nieoplewionego	–	–	20	–	–	20
Rapeseed oil – Olej rzepakowy	4.50	5.40	5.40	5.40	6.00	6.00
L-lysine (99%) – L-lizyna	0.16	0.14	0.14	0.19	0.18	0.18
DL- methionine (99%) – Metionina	0.23	0.24	0.24	0.21	0.21	0.21
Limestone – Kreda pastewna	1.45	1.44	1.44	1.50	1.50	1.50
Salt – Sól pastewna	0.35	0.35	0.35	0.36	0.36	0.36
Calcium monophosphate 1-Ca – Fosforan 1-Ca	1.17	1.23	1.23	1.10	1.10	1.10
Mineral-vitamin premix (0.5%) – Premiks mineralno-witaminowy	0.50	0.50	0.50	0.50	0.50	0.50
Nutritive value of diets – Wartość pokarmowa mieszanek						
Metabolizable energy, MJ · kg^{-1} – Energia metaboliczna, MJ · kg^{-1}	12.52	12.50	12.62	12.82	12.74	12.85
Crude protein, % – Białko ogólne, %	21.13	21.01	21.21	19.81	19.81	20.01
Crude fibre, % – Włókno surowe, %	2.93	3.28	2.78	2.87	3.24	2.74
Crude fat, % – Tłuszcz surowy, %	6.54	6.57	6.55	6.48	6.61	6.59
Lysine, % – Lizyna, %	1.20	1.20	1.21	1.14	1.16	1.15
Methionine, % – Metionina, %	0.54	0.55	0.55	0.50	0.51	0.52
Available phosphorus, g · kg^{-1} – P przyswajalny, g · kg^{-1}	0.42	0.43	0.43	0.39	0.40	0.40
Calcium total, % – Ca ogólny, %	0.93	0.93	0.94	0.92	0.92	0.92
Na total, % – Na ogólny, %	0.16	0.16	0.16	0.16	0.16	0.16

Table 2. Chemical composition of covered and hulless barley

Tabela 2. Skład chemiczny jęczmienia oplewionego i nieoplewionego

Nutrients – Składniki pokarmowe	Covered barley Jęczmień oplewiony	Hulless barley Jęczmień nieoplewiony
Dry matter, % – Sucha masa, %	89.12	90.07
Crude ash, % – Popiół surowy, %	2.20	2.03
Organic matter, % – Substancja organiczna, %	86.92	88.04
Crude protein, % – Białko ogólne, %	10.76	13.17
Crude fibre, % – Włókno surowe, %	3.62	1.07
Crude fat, % – Tłuszcz surowy, %	1.45	1.47
N-free extractives, % – BAW, %	71.09	72.33
Crude phosphorus, g · kg^{-1} – Fosfor ogólny, g · kg^{-1}	4.61	4.60
β-glucan total, % s.m – β-glukan całkowity, % s.m	3.16	3.72
Soluble β-glucan, % s.m – β-glukan rozpuszczalny, % s.m	1.75	1.89

one. The soluble beta-glucan was higher in hulless cultivar too. The content of basic nutrients in hulless and covered barley was generally close to the values given in the Poultry Nutrition Recommendations (2005). Higher differences were found in both protein and crude fiber. Both barley cultivars evaluated in our research differed from those estimated by Szumiało and Rachoń [2006]. According to Wiewióra [2006], the content of protein, fiber and starch in barley grain depends on the variety and the year of harvest. Janocha [2011] reports that hulled barley contained from 10.39 to 11.74% of total protein, 1.84 to 2.12% crude fat and 3.52 to 4.8% of crude fiber, and Rastik naked barley contained 11.9 to 12.13%, 1.72 to 2.57% and 2.03 to 2.34% of protein, fat and fiber, respectively.

The major factors that have a significant effect on beta-glucan content in barley grains are plant cultivar and growth conditions. The content of beta-glucans in the barley cultivars evaluated in this study was higher than that reported by Boros et al. [1996] and Koreleski et al. [2000], both for covered and hulless barley. Also Knudsen [1997] reported lower beta-glucan levels in naked barley.

The results of chicken rearing are presented in Table 3. Body weight of day-old chicks was similar in groups and quite high. The diets differentiated the body weight and growth rate during the first rearing period (Table 3). Significantly greater body weight on day 21 and better body weight gains from 1 to 21 days were found in chickens fed diet containing covered barley. In the second rearing period, both body weight and body weight gains equalized, and chickens fed a diet containing hulless barley even attained a higher body weight and body weight gains than those fed diet with covered barley. There were no significant differences between groups in body weight gains also the all rearing period. Similar results on chickens have been reported by Kwiecień and Winiarska-Mieczan [2010]. Table 3 shows the efficiency of feed in each rearing period. In the starter period, a diet containing hulless barley resulted in poorer conversion compared to that with covered barley. The differences between these groups were not statistically confirmed though. There were no significant differences between groups in feed conversion during the grower and the all rearing period, although the control diet was quantitatively most efficiently used in each studied period.

Hulless barley grain contains significant amounts of soluble fiber fractions, which in water enhanced viscosity solutions, thereby hindering protein and amino acid absorption, as well as fat, and even vitamins and minerals. Poorer absorption of these nutrients as a result of an excessive quantity of this sugar fraction in the digestive tract adversely affects the production performance of young poultry. Results obtained by Sharifi et al. [2012] indicate a decrease in the productivity of broiler chickens along with an increasing amount of NSPs soluble in diets containing hulless barley. According to Mathlouthi et al. [2002], feeding broiler chickens with a wheat-barley diet during the period 3 to 25 days of age resulted in a decrease in body weight gains and feed intake, and an increase in feed conversion rates compared to maize diet. The results obtained by Janocha [2011] show that chickens fed diet with a 30% covered barley had a higher body weight compared to those receiving a naked barley diet.

Table 4 shows the digestibility coefficients for dry matter, total phosphorus and basic nutrients of diets fed during the starter period. The dry matter and N- free extractives were significantly better digested from the hulless barley diet, while the total protein and crude fat were significantly better digested from the control mixture. There were no significant differences between groups in the digestibility of crude ash and total phosphorus.

According to Janocha [2011], crude fat and N-free extractives from diets containing covered barley fed during the grower period were digested better than those which contained naked barley and did not depend on the amount of that cereal in the feed. However, the digestibility of total protein – according to this author – depended on the barley content in the diets, and this was the case for both cultivars studied. Reduced intestinal and total digestibility of protein, fat, starch and organic matter in the case of diets containing hulless barley has been indicated by Sharifi et al. [2012].

The results of the slaughter analysis are presented in Table 5. The significantly higher ($P \leq 0.05$) carcass yield was observed for chickens fed diet with the 20% hulled barley. The slaughter yield of broiler chickens fed diet with 30 or 40% hulled barley reported by Janocha [2011] ranged from 74.66 to 76.03%, and the introduction of the same amount of naked barley decreased the parameter. Also Koreleski et al. [2000] found a 1% lower slaughter yield in chickens fed diet with 20% (starter) and 58.64% (grower) of ground hulless barley. Similar conclusions were drawn by Bekta and Fabijańska [2004], who applied starter and grower with 58.9% and 63.6%, respectively, of barley cv. Rastik. Carcass yields similar our data in broiler chickens receiving diets containing hulless barley were reported by Kamińska [2003], Pisarski et al. [2004] and Pisarski et al. [2006].

There was no significant difference between the groups (Table 5) in weight proportions of individual carcass components, with the exception of the skin including subcutaneous fat, which was highest in carcasses of broilers receiving hulless barley and the lowest in chickens fed with covered barley. Chickens from control group had the best musculature, whereas whose fed covered barley were poorest in musculature.

According to Pisarski et al. [2006], chickens fed diet with 45% (starter) and 50% (grower) of naked barley had significantly worse muscular performance than those fed hulled barley (46.70%) and deposited more abdominal fat. Bekta and Fabijańska [2004] found no difference in the content of muscles and internal organs in broiler chickens as a result of introducing diets containing 58.90 and 63.60% hulless Rastik barley. In studies conducted by Koreleski et al. [2000], in which starter diets contained 10 or 20% barley and grower diets 40 or 59% of barley found that increasing the proportion of barley in the diets to 40/59% resulted in deterioration of chickens rearing results and slaughter yield and increase the content of abdominal fat in the carcass.

Table 6 shows the content of basic nutrients in the breast muscle of broiler chickens. There was no significant difference between the groups in the contents of the basic nutrients, except crude ash, which was significan-

Table 3. Results of broiler performance

Tabela 3. Wyniki odchowu kurcząt

Specification – Wyszczególnienie	Experimental groups – Grupy doświadczalne			SEM
	K	JO	JNO	
Body weight of chickens, g – Masa ciała kurcząt, g				
On day 21 (♀+♂) – 21. dzień	729 ab	750 a	698 b	9.8
On day 42 (♀+♂) – 42. dzień	2212	2229	2256	28.7
Body weight gain of chickens, g – Przyrosty masy ciała kurcząt, g				
1–21 days of life – 1.–21.dnia życia	680 ab	700 a	649 b	9.6
22–42 days of life – 22.–42. dnia	1483	1479	1558	25.4
1–42 days of life – 1.–42. dnia	2163	2179	2208	28.6
Feed/gain ratio, kg · kg^{-1} – Zużycie paszy, kg · kg^{-1}				
1–21 days of life – 1.–21. dnia życia	1.37	1.49	1.55	0.04
22–42 days of life – 22.–42. dnia	1.67	1.81	1,71	0.04
1–42 days of life – 1.–42. dnia	1.57	1.71	1.66	0.03

a, b – means in rows followed by different letters are significantly different (P ≤ 0.05); SEM – pooled standard error of mean.
a, b – średnie w rzędach oznaczone różnymi literami różnią się istotnie (P ≤ 0,05); SEM – błąd średniej arytmetycznej.

Table 4. Apparent digestibility of basic nutrients, dry matter and total phosphorus in diets on starter period,%

Tabela 4. Strawność pozorna podstawowych składników pokarmowych, suchej masy oraz fosforu ogólnego z mieszanek na okres starter, %

Specification – Wyszczególnienie	Experimental groups – Grupy doświadczalne			SEM
	K	JO	JNO	
Dry matte – Sucha masa	69.42b	70.07b	72.93a	0.58
Crude ash – Popiół surowy	45.07	45.63	44.92	0.94
Crude protein – Białko ogólne	86.09a	58.52b	59.26b	3.17
Crude fat – Tłuszcz surowy	86.62a	62.87c	72.50b	2.40
N-free-extractives – BAW	66.18b	67.51ab	70.19a	0.65
Crude phosphorus – Fosfor ogólny	59.58	60.05	62.63	0.68

a, b – means in rows followed by different letters are significantly different (P ≤ 0.05); SEM – pooled standard error of mean.
a, b – średnie w rzędach oznaczone różnymi literami różnią się istotnie (P ≤ 0,05); SEM – błąd średniej arytmetycznej.

Table 5. Results of slaughter analysis of broiler chickens

Tabela 5. Wyniki analizy rzeźnej kurcząt

Specification – Wyszczególnienie	Experimental groups – Grupy doświadczalne			SEM
	K	JO	JNO	
Body weight before slaughter, g – Masa ciała przed ubojem, g	2151	2245	2234	58.57
Cold carcass weight, g – Masa tuszki schłodzonej, g	1552	1653	1604	43.54
Slaughter yield, % – Wydajność rzeźna, %	72.20 ab	73.68 a	71.71 b	0.37
Content in cold carcass, % – Udział w tuszce schłodzonej, %				
Breast muscles – Mięśnie piersiowe	24.86	24.86	23.85	0.57
Thigh muscles – Mięśnie udowe	12.15	10.87	11.96	0.34
Shank muscles – Mięśnie podudzi	9.38	8.78	9.45	0.18
Muscles total – Mięśnie ogółem	46.39	44.51	45.26	0.81
Abdominal fat – Tłuszcz sadełkowy	1.59	1.71	1.55	0.09
Skin with subcutaneous fat – Skóra z tłuszczem podskórnym	9.81 ab	9.51 b	11.14 a	0.29
Content in body weight, % – Udział w masie ciała, %				
Heart – Serce	0.47	0.48	0.47	0.01
Liver – Wątroba	1.81	1.79	1.70	0.05
Stomach – Żołądek	1.57	1.55	1.43	0.05
Edibles total – Podroby razem	3.85	3.82	3.60	0.07

a, b – means in rows followed by different letters are significantly different (P ≤ 0.05); SEM – pooled standard error of mean.
a, b – średnie w rzędach oznaczone różnymi literami różnią się istotnie (P ≤ 0,05); SEM – błąd średniej arytmetycznej.

Table 6. Chemical composition of breast muscle, %

Tabela 6. Podstawowy skład chemiczny mięśnia piersiowego

Specification – Wyszczególnienie	Experimental groups – Grupy doświadczalne			SEM
	K	JO	JNO	
Dry matter – Sucha masa	25.23	25.40	25.42	0.10
Crude ash – Popiół surowy	1.15 b	1.14 b	1.19 a	0.01
Crude protein – Białko ogólne	22.92	22.91	23.21	0.09
Crude fat – Tłuszcz surowy	1.22	1.30	1.46	0.12

a, b – means in rows followed by different letters are significantly different ($P \leq 0.05$); SEM – pooled standard error of mean.
a, b – średnie w rzędach oznaczone różnymi literami różnią się istotnie ($P \leq 0,05$); SEM – błąd średniej arytmetycznej.

Table 7. Fatty acid composition of the lipid fraction of breast muscules (% in total acids)

Tabela 7. Skład kwasów tłuszczowych frakcji lipidowej mięśni piersiowych (% sumy kwasów)

Fatty acids Kwasy tłuszczowe	Experimental groups – Grupy doświadczalne			SEM
	K	JO	JNO	
$C_{14:0}$	0.28	0.28	0.29	0.006
$C_{14:1}$	0.07 b	0.08 ab	0.09 a	0.003
$C_{16:0}$	18.87	18.97	19.48	0.137
$C_{16:1}$	3.26	3.42	3.46	0.074
$C_{18:0}$	4.68	4.43	4.63	0.112
$C_{18:1}$	53.86	54.82	53.88	0.278
$C_{18:2}$	15.37	14.63	14.67	0.168
$C_{18:3}$	1.88	1.80	1.76	0.038
$C_{20:0}$	0.15	0.15	0.13	0.075
$C_{20:1}$	0.42	0.42	0.41	0.019
$C_{20:2}$	0.13	0.10	0.12	0.006
$C_{20:3}$	0.10	0.09	0.09	0.005
$C_{20:4}$	0.60	0.48	0.59	0.046
$C_{22:0}$	0.11 b	0.15 ab	0.19 a	0.011
Others – Inne kwasy	0.22	0.18	0.22	0.009
Σ SFA	24.09	24.19	24.70	0.221
Σ UFA	75.69	75.84	75.08	0.318
Σ MUFA	57.61	58.73	57.84	0.224
Σ PUFA	18.08	17.11	17.24	0.213
PUFA/MUFA	0.31	0.29	0.30	0.005
UFA/SFA	3.15	3.14	3.05	0.037
PUFA n-6/PUFAn-3	8.65	8.56	8.85	0.170

a, b – means in rows followed by different letters are significantly different ($P \leq 0.05$); SEM – pooled standard error of mean.
a, b – średnie w rzędach oznaczone różnymi literami różnią się istotnie ($P \leq 0,05$); SEM – błąd średniej arytmetycznej.

tly higher in the muscles of chickens fed diet with hulless barley.

According to Pisarski et al. [2004], introduction of 35% naked barley instead of wheat to broiler chickens diets did not affect the chemical composition of the muscle. In another experiment, Pisarski et al. [2006] found that the use of 45/50% hulless Rastik barley in diets reduced the total protein content, and increased raw fat in the breast muscles.

The profiles of fatty acids in the lipid fraction of the breast muscles are shown in Table 7. Significant differences between the groups were found for myristoleic acid (C14:1) and behenic acid (C22:0). In the lipid fraction of the breast muscle in the group fed the 20% hulless barley, a significantly higher proportion of myristoleic acid was found than in the chickens muscle from control group (wheat-soybean). Also the level of acid of C22:0 in chicken muscles of this group was highest. There were no significant differences in content of other fatty acids or the sum of saturated, mono- and polyunsaturated acids in breast muscle. Pisarski and Zięba [2003] report that the fatty acids profile of chicken muscles did not depend on the type of cereal in the diet, however in other studies, Pisarski et al. [2006] report that the proportion of palmitoleic and oleic acids in the lipid fractions of abdominal and intramuscular fat of chickens fed with naked barley was significantly higher than those fed diet with hulled barley, and the level of linoleic acid was lower. No such relationship was found in our studies.

The results of breast muscle sensory evaluation are shown in Figure 1. Breast muscles of each group were not significantly different in aroma, juiciness and tenderness, whereas significant differences were found in the palatability. Significantly less tasty were the muscles of chickens from the control group, and the most palatable were the muscles of the chickens fed diet with hulless barley.

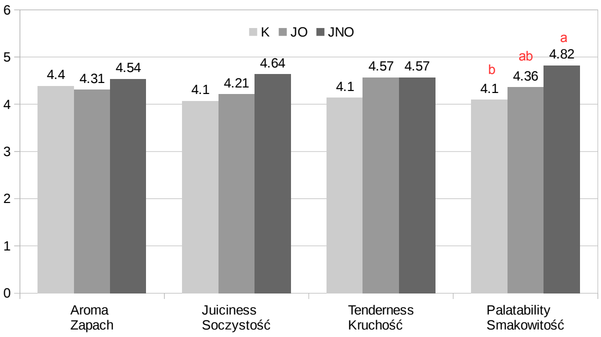

Fig. 1. Results of breast muscles sensory evaluation (score); a, b – means followed by different letters are significantly different ($P \leq 0.05$)

Rys. 1. Wyniki oceny organoleptycznej mięśni piersiowych (pkt); a, b – średnie oznaczone różnymi literami różnią się istotnie ($P \leq 0.05$)

Results of a study by Pisarski et al. [2006] show a positive effect of naked barley on the taste characteristics of breast and leg muscles, while the organoleptic evaluation by Janocha [2011] showed a negative effect of naked barley on the sensory properties of broiler chicken meat.

CONCLUSIONS

Hulless barley grain introduced in the amount of 20% to the diet instead of a part of wheat meal, significantly reduced chickens weight gains during the starter rearing period, however, no was observed such decrease when the covered barley was added. Lower body weight gain of younger chickens could have been due to higher beta-glucans (total and soluble) in hulless barley, to which younger birds may be more susceptible. The lack of significant differences between chickens from particular groups during the second rearing period indicates that it is preferable to use hulless barley for the grower period. It can be recommended to use instead of part of wheat meal for older chickens, also because of the beneficial effect on the sensory characteristics of the breast muscles.

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WPŁYW ZASTOSOWANIA JĘCZMIENIA OPLEWIONEGO LUB NIEOPLEWIONEGO NA WYNIKI PRODUKCYJNE, STRAWNOŚĆ ORAZ WARTOŚĆ POUBOJOWĄ KURCZĄT BROJLERÓW

STRESZCZENIE

Celem badań była ocena wpływu wprowadzenia obłuszczonego lub nagoziarnistego jęczmienia zamiast części śruty pszennej na wyniki produkcyjne, strawność mieszanek oraz wyniki rzeźne kurcząt brojlerów. Doświadczenie wzrostowe przeprowadzono na 126 kurczętach Hubbard Flex rozdzielonych do 3 grup po 42 ptaki w grupie (7 powtórzeń po 6 kurcząt, 3 ♀ i 3 ♂). Grupa kontrolna (K) żywiona była mieszanką pszenno-sojową, natomiast do mieszanek doświadczalnych zamiast części śruty pszennej wprowadzono 20% śrutowanego jęczmienia oplewionego (JO) lub 20% jęczmienia nagoziarnistego (JNO). W 42. dniu życia ubito 24 ptaki (4 ♀ i 4 ♂ z każdej grupy), które przeznaczono do analizy rzeźnej i częściowej dyrekcji. Strawność mieszanek wykonano na 18-dniowych kurczętach brojlerach. Współczynniki strawności podstawowych składników pokarmowych mieszanek określono metodą bilansową z całkowitą kolekcją odchodów. Kurczęta żywione mieszanką zawierającą jęczmień oplewiony charakteryzowały się większą masą ciała w 21. dniu życia ($P \leq 0{,}05$) oraz lepszymi przyrostami w okresie starter (1 do 21 dni) niż otrzymujące mieszankę zawierającą jęczmień nieoplewiony. W okresie grower masa ciała jak i przyrosty masy ciała były wyrównane. W całym okresie odchowu wyniki były podobne. Wykorzystanie paszy w każdym okresie odchowu było zbliżone. Sucha masa i BAW (związki bez-azotowe wyciągowe) były istotnie lepiej trawione ($P \leq 0{,}05$) z mieszanki zawierającej jęczmień nieoplewiony, natomiast białko ogólne i tłuszcz surowy z mieszanki kontrolnej. Nie stwierdzono istotnych różnic między grupami w strawności popiołu surowego i fosforu ogólnego. Wprowadzenie 20% jęczmienia nieoplewionego istotnie ($P \leq 0{,}05$) obniżyło wydajność rzeźną, natomiast zwiększyło udział skóry z tłuszczem podskórnym w tuszce w porównaniu do grupy otrzymującej mieszankę z jęczmieniem oplewionym. Zastosowanie 20% śruty z obydwu jęczmieni nie miał wpływu na umięśnienie kurcząt. Skład kwasów tłuszczowych frakcji lipidowej mięśnia piersiowego był zbliżony w grupach z wyjątkiem kwasu mirystooleinowego i behenowego, których było istotnie więcej ($P \leq 0{,}05$) w mięśniu piersiowym kurcząt żywionych dietą zawierającą 20% jęczmienia nieoplewionego. Lepszą smakowitością charakteryzował się mięsień piersiowy kurcząt żywionych mieszanką z jęczmieniem nieoplewionym. Na podstawie masy ciała przyrostów masy ciała, wydajności rzeźnej i otłuszczenia lepszy okazał się jęczmień oplewiony, natomiast ze względu na jakość mięsa jęczmień nieoplewiony.

Słowa kluczowe: kurczęta brojlery, jęczmień, wyniki produkcyjne, strawność, wyniki rzeźne, jakość mięsa