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The Effect of Hullless Oats and Barley on the Content of Abdominal Fat and Its Fatty Acid Profile in Broiler Chicken

Wpływ nagoziarnistego owsa i jęczmienia na zawartość tłuszczu sadełkowego i profil jego kwasów tłuszczowych u kurcząt brojlerów

Both dietary oats and barley grains contain a substantial quantity of fibre, which hampers their use as fedstuffs for broiler chickens, demanding diets high in energy. Energy value of husked cereals can be improved by either dehulling or producing hullless cultivars, which results in a lowered level of insoluble fibre as well as increased crude protein and ether extract contents. Unfortunately, the level of soluble fibre, mainly beta-glucans, affecting resorption of nutrients in guts is elevated, too (Boros et al.,1996; Edney, Tipples, 1997; Fabijańska et al. 2002). In consequence, hullless cultivars of oats and barley can be fed to broiler at higher rates than the husked grains, especially if supplemented with appropriate dietary enzymes.

Apart from the promising effects of hullless cultivars on the productive results of broilers fattening one should consider their impact on some specific characteristics of broiler carcass. Since the husked grains, especially oats, are of dietetic importance for lipid metabolism (Anderson, Chen, 1979; Bartnikowska, Lange, 2000), it should be established if alteration of nutrients proportion, resulting from the lack of hull, has no adverse effect on body lipids characteristics. Such an effect, impairing n6/n3 FA ratio in broiler fat, was noted with the mechanically dehulled oats, compared to the husked grains (Kamińska et al., 1999).

The aim of the present study was to examine the effect of hullless oats and barley of Polish cultivars (Akt and Rastik) upon the abdominal fat deposition, its share in carcass and the fatty acid profile.

MATERIAL AND METHODS

The experiment was carried out involving cobb broiler chickens fattened in wire-cages till 42nd day of life, under the same, standard environmental conditions. One-day-old chicks were allocated at random into 4 groups consisting of 27 individuals each (3 replications x 9 birds) and fed feed formulas containing: 1 – husked oats; 2 – hullless oats; 3 – husked barley; 4 – hullless barley. Starter concentrates were fed 1st through 14th day, grower – 15th through 35th and finisher – 36th through 42nd days. Finishing feed formulas were the same as the growing ones but did not contain coccidiostat. The formulas are given in Table 1.

Table 1. Formulas of complete feeds for broilers (%)

Ingredient	S1	S2	S3	S4	G/F/1	G/F2	G/F3	G/F4
Corn ground	25,5	25,5	25,5	25,5	30,5	30,5	30,5	30,5
Wheat ground	20,0	20,0	20,0	20,0	20,0	20,0	20,0	20,0
Oats ground	15,0				15,0			
Hullless oats ground		15,0				15,0		
Barley ground.			15,0				15,0	
Hullless barley ground				15,0				15,0
Soybean meal, solv. 46%	30,0	30,0	30,0	30,0	22,0	22,0	22,0	22,0
Fish meal, 70%	3,0	3,0	3,0	3,0	4,0	4,0	4,0	4,0
Soybean oil	2,0	2,0	2,0	2,0	4,0	4,0	4,0	4,0
Dicalcium phosphate	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
Calcium carbonate	1,5	1,5	1,5	1,5	1,5	1,5	1,5	1,5
Sodium chloride	0,5	0,5	0,5	0,5	0,5	0,5	0,5	0,5
Mineral-vitamin premix	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0
Nutritive value:								
ME (kcal/kg)	2895	3054	3015	3047	3051	3210	3171	3203
Crude protein (%)	22,1	22,5	22,2	22,5	19,6	20,0	19,7	20,0
Crude fibre (%)	4,14	2,72	3,05	2,75	3,96	2,53	2,86	2,57

S – starter, G/F – grower and finisher

On the last day of fattening all the broilers were scaled and then 4 cockerels and 4 hens from each group, of the average body weight (for given sex and group) were selected. The selected broilers were slaughtered after 8 hours' starvation and then underwent simplified carcass analysis described by Ziołecki, Doruchowski, 1989. The influence of experimental factors was determined on the basis of abdominal fat weight (AFW), its share in chilled carcass (AFS) and fatty acids profile (FAP). Fatty acids profile was examined by gas chromatography method in INCO 505 unit with the column fulfilled with 10%LAC 3R-728 + 1%H_3PO_4 at the temperature of 180°C, within 120 minutes. Every FAP was expressed as the percentage of FA sum.

All the experimental data underwent a multifactorial analysis of variance.

Table 2. The effect of hullless grains on the examined characteristics

Specification	Oats		Barley	
	husked	hullless	husked	hullless
Carcass characteristics:				
BW (g)	2115^{A} (188.2)	2371^{B} (139.7)	2308^{A} (154.5)	2421^{B} (135.6)
AFW (g)	27.6 (8.1)	31.2 (8.3)	26.7 (7.6)	29.1 (10.9)
AFS (%)	1.70 (0.34)	1.85 (0.36)	1.66 (0.33)	1.64 (0.31)
FA P (% of sum):				
C14:0	0.457 (0.036)	0.448 (0.042)	0.468 (0.046)	0.460 (0.055)
C16:0	22.41 (1.17)	21.64 (1.13)	21.94 (2.01)	21.67 (0.98)
C18:0	4.65 (0.44)	4.70 (0.53)	4.95 (0.41)	4.93 (0.56)
C20:0	0.250^{a} (0.011)	0.306^{b} (0.018)	0.285 (0.023)	0.311 (0.012)
C16:1	4.14 (0.32)	4.17 (0.26)	4.30 (0.37)	4.19 (0.41)
C18:1	39.15 (0.35)	39.10 (0.28)	39.04 (0.29)	39.23 (0.25)
C18:2	26.72 (0.94)	27.24 (0.86)	25.73^{a} (0.78)	26.78^{b} (0.67)
C18:3	1.923 (0.14)	1.996 (0.16)	2.184 (0.22)	2.247 (0.18)
C20:4	0.251 (0.054)	0.382 (0.096)	0.325 (0.087)	0.181 (0.099)
SFA	27.72 (1.13)	27.09 (1.22)	27.64 (0.98)	27.37 (1.25)
MUFA	43.29 (0.32)	43.27 (0.31)	43.34 (0.29)	43.42 (0.19)
PUFA	28.89 (0.97)	29.62 (0.88)	28.24^{a} (0.74)	29.21^{b} (0.69)

^{A,B} Significant at $P \leq 0.01$; ^{a,b} Significant at $P \leq 0.05$
In brackets SE values are given

DISCUSSION

The concentrates containing hullless oats and barley significantly ($P \leq 0.01$) increased broiler chickens body weight, however, their impact on abdominal fat, weight and its share in chilled carcass was not remarkable (Table 2). The abdo-

minal fat weight in chickens given hulless grains was higher than in broilers fed husked cereals. However, due to substantial variability within treatments (rather typical for a deposit fat) no differences were of statistical significance. Anyway, some alteration in abdominal fat weight seems to be obvious and it results from alternated energy value of feed formulas. Relatively higher differences in energy value of feeds containing husked or hullless cultivars of oats (compared to barley) accounts for the increase of the abdominal fat share in carcass by 9%. To precise, one should state that the mentioned increase was not significant, either.

The impact of oats and barley cultivars on the fatty acids profile of abdominal fat was not substantial, either. The significant differences were noted exclusively with respect to FA C20:0 in chickens given oats and with C18:2 in broiler fed barley. In both cases in chickens given concentrate containing hullless grains the share of mentioned FA was higher ($P \leq 0.05$) than in these fed husked grains.

Apart from the changes in the profile of individual fatty acids, some alterations in total saturated (SFA) and unsaturated (MUFA and PUFA) fatty acids were noted, either. Feeding chickens hullless grains of oats and barley resulted in decreased SFA and increased PUFA levels. With respect to barley the increase of PUFA was significant at $P \leq 0.05$.

However it is obvious that the composition of feed (proportion of nutrients) usually affects lipid metabolism, including fatty acids profile, the lack of evident reaction in presented experiment is believed to be due to the low content (15%) of oats or barley in the concentrate. The results obtained are difficult to confront with the relevant literature data, since most of papers dealing with hullless grains do not focus on the effect of dehulling *per se* but refer to corn or wheat as standard feedstuffs. Besides, because of pragmatic reasons, the most popular investigations are these dealing not with abdominal fat of information value only, but with the fat of edible broiler parts (e.g. Kosieradzka et al., 1999; Siedlecki et al., 1999).

CONCLUSIONS

1. The abdominal fat weight and its share in the chilled carcasses of broiler chickens fed hullless oats or barley did not differ statistically from the values for chickens given husked grains, however, they were slightly higher.

2. The profile of individual fatty acids of broiler chickens abdominal fat did not depend on the cultivars of oats and barley. The only exceptions were FA C20:0 and C18:2; the share of arachidic acid increased in chickens fed hullless oats and the share of linoleic in broilers given hullless barley.

3. Hullless grains fed to chickens slightly lowered the share of SFA and increased PUFA, significant with respect to barley.

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STRESZCZENIE

W doświadczeniu na brojlerach cobb, odchowywanych w klatkach do 42 dnia życia, badano wpływ oplewionych i nagoziarnistych odmian owsa i jęczmienia na udział tłuszczu sadełkowego w tuszce i profil kwasów tłuszczowych. Jednodniowe pisklęta przydzielono losowo do 4 grup i żywiono mieszankami zawierającymi 15%: 1 – owsa, 2 – owsa nagoziarnistego, 3 – jęczmienia; 4 – jęczmienia nagoziarnistego. Jakkolwiek mieszanki z udziałem odmian nagoziarnistych znacząco ($P \leq 0,01$) zwiększyły masę ciała brojlerów, ich wpływ na udział tłuszczu sadełkowego w tuszce okazał się nieistotny statystycznie; w grupie żywionej owsem nagoziarnistym udział ten był większy zaledwie o niespełna 9%, a w grupie otrzymującej jęczmień bez plewek – nawet nieco mniejszy niż w odpowiednich grupach żywionych odmianami oplewionymi. Również udział większości kwasów tłuszczowych tłuszczu sadełkowego nie zależał istotnie od odmiany zboża. Wyjątek stanowiły kwasy C20:0 i C18:2, udział kwasu arachidowego zwiększył się istotnie po skarmieniu owsa nagoziarnistego, a kwasu linolowego – po podaniu jęczmienia nagoziarnistego, który istotnie zwiększył także udział sumy PUFA.