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EFFECT OF NAKED OAT ON FATTENING AND SLAUGHTER PARAMETERS AND SELECTED BLOOD PARAMETERS OF WHITE KOŁUDA® GEESE*

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The effect of naked oat on fattening and slaughter parameters and selected blood parameters of White Kołuda® oat-fed geese was determined. Birds were fed a plant-based concentrate diet according to rearing period as well as grass forage to 12 weeks of age. During the fattening period (13-15 weeks) control birds received whole oat grain and the experimental birds were fed naked oat. At the end of fattening, 16 birds (8♂♂+8♀♀) with close to average body weight were selected from each group and slaughtered. During the slaughter, blood was collected for further analyses. The carcasses were subjected to slaughter analysis. Breast meat was analysed for the content of higher fatty acids and cholesterol. Blood plasma was analysed for total cholesterol, HDL cholesterol, ALT, AST, ALP and thyroid hormone levels. Geese fattened with naked oat showed significantly lower final body weight and weight gains with better oat conversion per kg weight gain. Lower weight of chilled carcass and lower dressing percentage were also observed. Total cholesterol and HDL cholesterol tended to increase, whereas alanine aminotransferase (AST) increased significantly. Oat variety had no effect on plasma thyroid hormone levels. The results of the present study show that fattening geese with naked oat containing considerably less crude fibre content has a negative effect on fattening and slaughter parameters.

Key words: White Kołuda® geese, naked oat, fattening parameters

Due to chemical composition of grain, oat is one of the most valuable cereals. It is used for forage purposes, as well as in food, cosmetic and pharmaceutical industry. Oat protein is rich in exogenous amino acids compared to the other cereals and has high biological value (Gąsiorowski, 2003). Oat contains at least two to three times more fat than the majority of other cereals (Piątkowska et al.,

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2010). It is also a good source of dietary fibre. Oat is a perfect component of concentrate mixtures for horses, cattle and geese as well. Its use as swine and poultry forage is restricted, especially due to high fibre content. However, new naked oat cultivars that are introduced to cultivation enable to use this grain equally with wheat and corn. Studies by Fabijańska et al. (2003) demonstrated that 50% percentage of naked oat grain in complete feed mixture for fatteners is a safe dose. Oat grain is commonly used in the final period of goose fattening due to a specific anatomical structure of their gastrointestinal tract that enables them to benefit from crude fibre-rich forage (Yang et al, 2009). The use of oat grain during the period of three-week goose fattening has an essential effect on final results of slaughter geese rearing. Oat fattening not only has the effect on final body weight, but also influences carcass colouration and primarily chemical composition of meat, that in turn shapes its tastiness. Currently, in the national registry there are 25 common oat cultivars and five cultivars of naked oat. Oat cultivars that are planted differ between themselves in terms of yield quantity (Sulewska et al., 2010) and chemical composition (Piątkowska et al., 2010). Studies conducted by Gąsiorowska et al. (2011) showed that, apart from oat cultivar, also seeding density and weather conditions during plant development period have a significant effect on nutritional ingredient content in grain. In the available Polish and global subject literature there is no data concerning the influence of particular oat cultivars on blood parameters and slaughter trait indicators of oat geese. The previously conducted studies on cholesterol level, enzyme activity and other physiological parameters of blood concerned the period of growth of geese or liver fattening (Woszczyk et al., 1977; Mazanowski and Kontecka, 2000).

Material and methods

Experimental material consisted of 200 White Kołuda® goslings maintained in accordance with oat fattening technology and welfare requirements. Up to 12 weeks of rearing, the goslings were fed a plant-based concentrate mixture appropriate for the rearing period. Apart from the concentrate, the goslings were also fed cut green forage, mainly consisting of rye and grass, with concomitant access to pasture. After 12 weeks of age, the birds were allocated to two groups with the same number of animals (50♂♂ + 50♀♀) and fattening with oats was started. Geese in control group received whole grain of common oat cultivar Furman, whereas birds from the experimental group were fed grain of naked oat cultivar Nagus. During the experiment, body weight after 12 and 15 weeks of life and oat consumption in groups in the period of fattening were controlled. At the end of fattening (the 15th week), 16 birds (8♂♂+8♀♀) from each group were slaughtered and the blood was collected for further analyses. The carcasses were subjected to slaughter analysis according to the method presented by Ziołecki and Doruchowski (1989). Analysis of higher fatty acids in breast meat samples was

conducted using gas chromatography method on a long column (105 m). Cholesterol content in meat was assessed with the use of GC method. Total cholesterol, HDL, ALT, AST and ALP assessments in blood plasma were performed by colorimetric method, using POINTE SCIENTIFIC diagnostic kits. Thyroid hormone content in blood plasma was determined by radioimmunological method, with the use of RIA T3 and RIA T4 kits.

The obtained results were subjected to statistical verification using SAS 9.4 software.

Results

Results of the assessments of basic nutrient content in grain of oat cultivars applied in goose fattening in the third experiment are presented in table 1. Grain of naked oat cultivar Nagus was characterized by statistically significantly higher protein, fat and starch content and lower content of fibre and ash compared to grain of oat cultivar Furman (P≤0.01). Total protein content was higher by 12.1%, fat content – by 45.5% and starch – by 20.8%, whereas fibre and ash content were, respectively, 3- and 1.4-fold lower compared to the hulled cultivar. Differences in nutrient content in oat grain had the effect on production results.

Table 1. Basic nutrient content of oat grain (g/kg dry matter)

Item	Group		SEM
	I	II	
Crude protein	131.59A	149.68B	4.08
Crude fat	56.12A	103.06 B	10.50
Crude fibre	99.36A	30.96B	15.59
Starch	559.01A	705.72B	32.81
Ash	31.02A	22.45B	1.36

A, B – values in rows with different letters differ significantly (P≤0.01).

Geese fattened with naked oat (group II) showed statistically significantly lower final body weight (P≤0.05) and weight gains (P≤0.01) with oat conversion per kg weight gain lower by 11.8% (table 2).

Results of the conducted slaughter analysis are demonstrated in table 3. Statistically significantly lower weight of chilled carcass and lower dressing percentage were also observed in group II. Percentage of breast and leg muscles and breast skin was similar in both groups. Analysis of the participation of edible

giblets in a carcass showed a significantly lower participation of gizzard in group II compared to group I.

Table 2. Results of fattening geese

Item	Group		SEM
	I	II	
Body weight at 12 wks (g)	5116.62	5121.88	32.01
Body weight at 15 wks (g)	6576.77 a	6119.97 b	49.43
Weight gain (g)	1415.15 A	997.92 B	29.91
Conversion of oats (kg/kg)	1.7	1.5	-

a, b, A, B – values with different letters differ significantly at P≤0.05 and P≤0.01, respectively.

Table 3. Effect of oat cultivar on slaughter analysis of oat-fattened geese

Item	Group		SEM
	I	II	
Carcass weight (g)	3987.0 a	3786.9 b	49.5
Dressing percentage	65.56 a	62.12 b	0.48
Breast muscles (%)	18.80	18.86	0.18
Leg muscles (%)	14.37	14.37	0.13
Breast skin (%)	6.52	6.12	0.11
Leg skin (%)	5.77 a	5.31 b	0.11
Abdominal fat (%)	5.30	5.04	0.16
Liver (%)	1.75	1.73	0.04
Gizzard (%)	3.53 a	3.07 b	0.07
Heart (%)	0.54	0.57	0.01

a, b – values with different letters differ significantly (P≤0.05).

Analysis of profile of fatty acids in breast meat lipids did not demonstrate any statistically significant differences in the content of a sum of saturated and unsaturated fatty acids. In group II, a decreasing tendency in the content of polyunsaturated fatty acids PUFA *n-6* and PUFA *n-3* compared to group I was observed. In lipids of breast meat of geese fattened with oat cultivar Nagus (group

II), a statistically significantly lower content of CLA c9-c11 acid and epa were demonstrated in comparison with the group that was fed grain of oat cultivar Furman (table 4).

Table 4. Effect of oat cultivar on fatty acid profile of breast muscle lipids in oat-fattened geese

Fatty acid	Group		SEM
	I	II	
c8	0.002	0.004	2.357
c10	0.011	0.010	0.002
c12	0.039	0.038	0.003
c14	0.289	0.279	0.007
c16	18.660	19.263	0.900
c16-1	2.255	1.950	0.118
c18	7.625	7.190	0.313
c18-1	32.081	32.960	6.568
c18-2	21.531	22.166	1.445
gamma18-3	0.050	0.054	0.011
c20	0.060	0.067	0.009
c18-3	1.911	1.772	0.171
CLA c9-c11	**0.021 a**	**0.010 b**	0.002
CLA t9-t11	0.008	0.096	0.003
c22	0.027	0.031	0.013
c20-4	14.69	13.131	3.450
c22-1	0.025	0.021	0.015
epa	**0.164 a**	**0.012 b**	0.012
dha	0.454	0.453	1.078
SFA	26.350	26.881	3.853
UFA	73.651	73.120	7.115
MUFA	34.360	34.93	7.910
PUFA	38.835	37.71	7.984
PUFA-6	36.273	35.35	0.164
PUFA-3	2.530	2.35	0.918
DFA	80.911	80.31	0.022
UFA/SFA	2.812	2.720	0.013
MUFA/SFA	1.310	1.300	0.019
PUFA/SFA	1.483	1.410	0.003
PUFA 6/3	14.714	15.400	6.080

a, b – values with different letters differ significantly ($P \leq 0.05$).

The application of naked oat grain, that contain significantly more crude protein, raw fat and starch as well as 3 times less crude fibre compared to grain of oat cultivar Furman (group I), in goose fattening (group II) did not affect the total cholesterol content in goose breast meat. The observed differences in value of this parameter between the groups did not demonstrate statistical significance (table 5).

Table 5. Effect of oat cultivar on cholesterol content of breast muscles in oat-fattened geese (mg/g)

Item	Group		SEM
	I	II	
Total cholesterol	0.439	0.447	0.002

Results of the assessments of content of selected goose blood parameters are presented in table 6. In the group of birds fattened with naked oat grain (group II), tendencies to an increase in total cholesterol and HDL levels were observed. Thyroid hormone content in blood plasma of geese was at similar level in both groups (P≥0.05) with a tendency to increase the values of the studied parameters in group II.

Table 6. Biochemical components in blood plasma of geese

Item	Group		SEM
	I	II	
Total cholesterol (mg/dl)	116.37	120.25	2.48
HDL (mg/dl)	81.90	86.39	2.75
ALT (IU/L)	22.87	26.36	1.13
AST (IU/L)	72.60A	96.15B	4.56
ALP (IU/L)	117.13	124.58	5.88
Thyroxine (T4)	25.99	27.40	1.08
Triiodothyronine (T3)	4.45	4.76	0.20

A, B – values with different letters differ significantly at P≤0.01.

Discussion of the results

Due to its chemical composition, oat is one of the most valuable cereals. It is a valuable source of the highest quality protein (Brand et al., 2004) and nutritional fibre with particular physiological impact (Brennan and Cleary, 2005). It is also rich in polyunsaturated fatty acids, mineral ingredients and vitamins. Whole oat grain is traditionally used in the last three weeks of oat geese fattening. A technology of "oat goose" developed in the Institute of Animal Production takes into consideration, among others, limited concentrate feeding with the use of large amounts of green forage composed of grass and leguminous plants, and in the last three weeks prior to slaughter geese receive only oat grain. Fattening, during which geese eat whole oat grain to their fill, is aimed to achieve not only optimal body weight increases, but primarily to store and fill with fat the subcutaneous tissue, mainly breast and abdominal muscles – the so-called abdominal fat. The fat of oat geese is a source of polyunsaturated fatty acids, vitamins and mineral ingredients that are valuable for the organism. Thanks to feeding geese with whole oat grain, better meat tastiness is obtained, carcass appearance and quality improve that undoubtedly influences its commercial value. In the study by Bielińska et al. (2010) on the effect of nutrition system on dressing percentage of White Kołuda® geese it was found that feeding concentrate, without limitations, to oat geese, W-31 cross-breds, between 4 and 14 weeks of life and then giving them oat in the period of 3 weeks, significantly increases carcass weight and the percentage of abdominal fat. In turn, experiments conducted by Kłopotek (2016) demonstrated that production effects of goose fattening, carcass quality, fatty acid profile in meat depend on physical form of oat grain. The author concluded that the best effects are obtained during goose fattening with whole oat grain in comparison with crushed and ground oat grain. Ground grain and crushed grain stayed in the gastrointestinal tract of geese for the shortest period of time. The best effects of digestion measured by the time of traversing the gastrointestinal tract were noted in case of feeding whole oat grain, and body weight gains indicated the optimal consumption of all the nutritional fractions of fibre.

Naked oat protein has a favourable composition of amino acids, especially lysine, methionine, threonine and tryptophan (Biel et al., 2006). Naked oat contains more fat compared to hulled oat (Maciejewicz-Ryś and Sokół (1999). However, analysis of results obtained in the conducted studies revealed that low crude fibre level in goose diet has a negative effect on rearing results and slaughter parameters. Geese fattened with naked oat grain containing by approximately 69% less crude fibre compared to grain of Furman cultivar had significantly lower weight gain, final body weight and dressing percentage. Due to a specific structure of their gastrointestinal tract, geese have the greatest ability to use crude fibre among all the poultry species (Zhang et al., 2013). Oat hulls have a positive effect on intestinal peristalsis, water metabolism in the gastrointestinal tract and increase starch digestibility as well (Hetland and Svihus, 2001). In the study by He et al. (2015), in which corn straw, wheat straw and rice straw were used in goose

fattening, it was observed that fibre with various physical and chemical properties had the effect on forage intake and the development of gastrointestinal tract, especially gizzard. Amerah et al. (2009) demonstrated a significant increase in relative weight of glandular stomach of broiler chickens after the introduction of sawdust to concentrate mixtures. Lin et al. (2017) observed that in the study conducted on male geese fattened with forage of different crude fibre content (2.5% and 6.1%), the birds which obtained forage with higher fibre content, had bigger body weight, higher weight gains and better forage consumption. In turn, diet with low crude fibre content had a negative effect on development of gastrointestinal tract. Similar results were obtained in the present studies. Geese that were fed oat grain with low crude fibre content had significantly lower relative gizzard weight. The development of muscular stomach is stimulated by dietary fibre. Hetland and Svihus (2001) as well as Hetland et al. (2003) demonstrated that the introduction of oat hulls to the composition of mixture increased relative weight of gastrointestinal tract in chickens, including muscular stomach. Similar results were achieved by Gonzalez-Alvarado et al. (2008, 2010) who observed that in studies on the effect of various fibre sources in broiler chicken forage, the addition of oat hulls significantly increased relative weight of glandular stomach. It can be assumed that fibre contained in forage stays in the muscular stomach (gastric mill) for a longer time and leads to an increase in gastric muscular wall (Jimenez-Moreno et al., 2009). Aminotransferases are an important indicator of liver function (Melaren et al., 1965). In the present studies conducted in geese that were fed oat grain cultivar Nagus with very low fibre content, a significant increase in aspartate aminotransferase (AST) and alanine aminotransferase (ALT) as well as alkaline phosphatase (ALP) content in blood plasma was detected. Similar results were achieved by Li et al. (2017), who observed that geese which received forage with low fibre content were characterized by statistically significantly higher ALT and AST blood serum content. In conclusion, it can be stated that fattening geese with naked oat containing considerably less crude fibre has a negative effect on fattening and slaughter parameters.

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SUMMARY

The effect of naked oat on fattening and slaughter parameters and selected blood parameters of White Kołuda® oat-fed geese was determined. Birds were fed a plant-based concentrate diet according to rearing period as well as grass forage to 12 weeks of age. During the fattening period (13-15 weeks) control birds received whole oat grain and the experimental birds were fed naked oat. At the end of fattening, 16 birds (8♂♂+8♀♀) with close to average body weight were selected from each group and slaughtered. During the slaughter, blood was collected for further analyses. The carcasses were subjected to slaughter analysis. Breast meat was analysed for the content of higher fatty acids and cholesterol. Blood plasma was analysed for total cholesterol, HDL cholesterol, ALT, AST, ALP and thyroid hormone levels. Geese fattened with naked oat showed significantly lower final body weight and weight gains with better oat conversion per kg weight gain. Lower weight of chilled carcass and lower dressing percentage were also observed. Total cholesterol and HDL cholesterol tended to increase, whereas alanine aminotransferase (AST) increased significantly. Oat variety had no effect on plasma thyroid hormone levels. The results of the present study show that fattening geese with naked oat containing considerably less crude fibre content has a negative effect on fattening and slaughter parameters.

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