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SHORT REPORT

A note on the meat quality of W11 and W33 White Kołuda geese strains

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Due to the considerable content of oleic, linoleic, linolenic and arachidonic acids goose fat is considered the safest animal fat. Geese raised on grassland (pastures) and fed diverse feeds consume more polyunsaturated fatty acids (PUFA) than poultry maintained under a closed rearing system, fed standard feeds, low in linolenic acid and PUFA and high in saturated fatty acids. In consequence, the meat and fat of broiler chickens and turkeys is lower in *n-3* acids than geese meat and fat.
Two strains of White Kołuda geese were examined: W11 and W33. In the chemical composition of breast muscles no significant differences were shown between strains except for the ash and cholesterol content, which were both higher in W11 geese of both sexes. Differences observed between the strains in breast muscle pH_{48}, cutting force and coefficient of emulsion instability indicate that further selection of strain W33 for higher body weight may negatively affect the technological value of meat.

KEY WORDS: goose / fat / fatty acids / meat

Consumers show a preference for poultry meat, as it is not only low in fat but also in saturated fatty acids (SFA). It is rightly believed that restricted consumption of animal fats can be a major factor in preventing diseases of the cardiovascular system. In meat-type poultry, *i.e*. broiler chickens and turkeys, abdominal fat is a waste product during carcass processing. The greater the per cent of abdominal fat in a carcass, the lower the carcass consumption value.

Geese fat is regarded to be relatively safe for consumers, as it contains a high proportion of monounsaturated oleic, linoleic, linolenic and arachidonic acids (about 24, 20, 0,4 and 0,05%, respectively), all being products of enzymatic desaturation of stearic acid (C:18). Especially geese kept on grassland (pastures) and fed diverse feeds, consume more polyunsaturated fatty acids (PUFA) than other species of poultry, maintained under a closed system and fed standard feeds low in linoleic acid and PUFA, while rich in SFA. In consequence, the meat and fat tissue of gallinaceous poultry of meat type is observed to contain less *n-3* acids [Rosiński 2000].

Goose fat, containing a higher proportion of PUFA with at least two unsaturated sites and rich in vitamins and deficient minerals, can be treated as a "functional food". The increased consumption of unsaturated *n-3* fatty acids (e.g. α-linolenic) reduces the risk of stenocardia in humans. Therefore, goose fat may be used as a nutraceutic.

Research has confirmed the possibility of modifying goose meat and fat quality *via* nutrition [Rosiński 2000]. The composition of feed mixtures offered to geese should be similar to that of natural feeds. It is therefore recommended [Rosiński 2000] that a daily ration for slaughter geese should contain from 500 to 600 g/bird of unhulled oats, as this ensures an adequate metabolizable energy to digestible protein ratio. When feeds containing excess protein and fat are used, geese tend to display a conservative predisposition to depositing fat under the skin and in the body cavity.

The presented examination aimed at determining the differences in the chemical composition and functional properties of meat between two strains of White Kołuda geese.

Material and methods

Material consisted of 17-week old White Kołuda geese of two strains – W11 and W33 – and both sexes, maintained at the Experimental Geese Farm, National Research Institute for Animal Production, Kołuda Wielka.

Six males and six females, randomly chosen from each strain were examined according to Kłosowska *et al*. [1994] for body weight, dressing percentage, carcass tissue composition as well as share of red (βR) and white (αW) fibres in breast muscles. Moreover, the chemical composition and fatty acids profile for the breast muscles was determined, as well as acid value and peroxide number (Lea value) for abdominal fat according to Rutkowski and Krygier [1979]. Cholesterol level was determined according to Folch *et al.* [1957], while fatty acids in abdominal fat according to Pie *et al*. [1991].

The results were verified statistically with ANOVA.

Results and discussion

In accordance with the breeding (improving) programme implemented, the W33 males and females at the age of 17 weeks appeared heavier (P≤0.05) than their W11 contemporaries of both sexes (Tab. 1), though the differences observed (heavier breast

Table 1. Body weight, dressing percentage and dissection data of W11 and W33 geese at the age of 17 weeks

Trait	Strain			
	W11		W33	
	mean	V(%)	mean	V(%)
Body weight (g)				
males	6516.3[a]	8.34	6809.1[b]	7.55
females	6242.9[a]	7.39	6557.2[b]	8.02
Dressing percentage (%)				
males	64.3	2.97	64.7	2.51
females	66.5	1.98	66.1	2.25
Breast muscles				
males				
(g)	669.9	4.91	733.8	5.70
(%)	16.08	5.44	17.6	5.18
females				
(g)	646.6	6.45	732.6	5.08
(%)	17.2	6.39	18.2	4.08
Thigh and drumstick muscles				
males				
(g)	669.1	5.40	671.9	5.34
(%)	16.0	4.63	16.1	4.21
females				
(g)	579.2	3.59	635.8	4.88
(%)	15.4	4.59	15.8	4.25
Skin with subcutaneous fat from breast part and leg				
males				
(g)	453.7	9.16	441.1	9.54
(%)	11.6	7.95	10.5	9.15
females				
(g)	469.1	9.09	466.0	7.30
(%)	12.4	8.17	11.5	6.79
Abdominal fat pad				
males				
(g)	160.2	12.90	151.8	20.79
(%)	3.95	12.26	3.5	19.76
females				
(g)	205.8	16.41	175.00	24.16
(%)	4.75	15.92	4.1	22.85

[a,b]Within a row means bearing different superscripts differ significantly: small letters – P≤0.05, capitals – P≤0.01

V(%) – variation coefficient

and leg muscles and lower peritoneal fat weight and content) proved not significant. The per cent of abdominal fat in the carcasses of W11 males and females was higher by about 0.5 pp than in W33 birds. Rosiński [2000], comparing the results obtained in his own studies with those from the late 1980s [Rosiński and Bieliński 1989] found that the body weight increased by 19.9%, breast muscles weight by 22.4%, leg muscles weight by 15%, dressing percentage by 9.1 pp and the content of breast muscles in carcass by 2.8 pp. Only the share of leg muscles proved to be lower by 3.1%. Many authors point to the effect of genotype on the weight of body, carcass and muscles and a smaller genotype effect on the per cent of carcass components [Rosiński 2000].

The microstructure of *pectoralis major* muscle (Tab. 2) showed a higher proportion of red fibres (βR) in the muscle bundle of W33 birds of both sexes than in strain W11. The share of αW fibres in the W11 birds ranged from 20.9 in males to 25.9% in females, while in W33 from 22.1 to 22.5%, respectively. W11 birds of both sexes showed a higher mean diameter of a single fibre and a lower per cent of intramuscular fat than W33 birds. Many authors [Kłosowska *et al*. 1994; Remignon *et al*. 1994 Elminowska-Wenda *et al*. 1997] have confirmed the positive relationship (depending on feeding level, genotype, age and physiological age of birds) between growth rate or body weight and the number and diameter of muscle fibres. An increase in live body

Table 2. Microstructure traits of *pectoralis major* muscle of W11 and W33 geese at the age of 17 weeks

Trait	Strain W11 mean	W11 V(%)	W33 mean	W33 V(%)
Muscle fibre content (%)				
βR				
males	79.1	5.1	77.9	8.8
females	74.1	3.3	77.5	4.7
αW				
males	20.9	19.5	22.1	30.9
females	25.9	9.4	22.5	16.1
Muscle fibre content (μm)				
βR				
males	22.5[b]	20.7	20.9[a]	20.2
females	20.8	20.6	21.9	20.1
αW				
males	44.8[b]	19.2	40.8[a]	22.9
females	43.4	21.2	43.5	24.0
Intramuscular fat content (%)				
males	3.14	75.8	3.78	63.2
females	2.08	33.3	2.49	54.2

[ab] Within traits means bearing different superscripts differ significantly at P≤0.05.
V(%) – variation coefficient.

weight is correlated with the diameter and length of muscle fibres: the longer the fibres, the smaller their diameter [Rosiński 2000].

The results of a chemical analysis (Tab. 3) showed no significant differences between strains in the content of water, protein and fat in the *pectoralis major* muscle. Significant inter-strain differences occurred for the muscle ash content (both sexes), being even highly significant between males. Similar values were reported by Ristic

Table 3. Chemical composition, cholesterol content and technological properties of *pectoralis major* muscle of W11 and W33 geese at the age of 17 weeks

Trait	Strain W11 mean	Strain W11 V(%)	Strain W33 mean	Strain W33 V(%)
Water (%)				
males	73.28	1.17	73.33	1.09
females	78.80	1.72	72.92	1.44
Protein (%)				
males	22.67	2.78	22.35	2.08
females	22.43	3.12	22.98	2.13
Fat (%)				
males	3.93	11.96	4.45	13.26
females	3.93	13.49	4.17	18.22
Ash (%)				
males	1.08[A]	6.48	0.93[B]	7.53
females	1.03[a]	4.85	0.92[b]	11.96
Cholesterol (mg/100g)				
males	58[a]	0.78	51[b]	3.02
females	68[a]	1.91	53[b]	3.02
pH_{15}				
males	5.86[A]	0.85	5.74[B]	0.70
females	5.98[a]	4.52	5.80[b]	1.38
Water holding capacity (%)				
males	48.20	27.80	40.45	21.19
females	39.90	16.29	35.38	20.27
Thermal drip (%)				
males	27.35	6.44	28.80	5.87
females	24.23	16.10	27.03	8.25
Cutting force (N/cm^2)				
males	19.30	11.76	18.27	9.74
females	16.57[A]	18.29	22.08[B]	4.09
Coefficient of emulsion instability (cm^3 drip/100 g emulsion)				
males	15.05[a]	14.02	17.48[b]	4.58
females	11.17[A]	25.96	17.55[B]	7.09

[abAB]Within rows means bearing different superscripts differ significantly: small letters – $P \leq 0.05$, capitals – $P \leq 0.01$

V(%) – variation coefficient

and Rauch [1992] and Biesiada-Drzazga and Górski [1998]. According to Ricard *et al*. [1983], the stability of the chemical composition of poultry muscles results from its genetic and physiological homeostasis.

Both W11 males and females showed a significantly higher cholesterol content in the *pectoralis major* than the respective W33 birds (Tab. 3). On the whole, however, the values obtained are in agreement with those reported for other poultry species by Skrabka-Błotnicka *et al*. [1997].

The pH_{48} values obtained for breast muscles of W11 males and females proved to be significantly higher ($P \leq 0.01$ and $P \leq 0.05$, respectively) than those obtained for W33 males and females (Tab. 3). The lower pH_{48} in strain W33 may suggest a more rapid course of glycolysis.

Water holding capacity (%) and thermal drip (%) of breast muscles were not found to be significantly affected by strains and only slightly higher values were observed in males than in females (Tab. 3).

A greater force was required to cut breast muscle of the W33 than W11 females (22.08 N/cm^2 vs.16.57 N/cm^2 – $P \leq 0.01$). The inter-strain differences were found not significant between males (Tab. 3).

The coefficient of emulsion instability of *pectoralis major* was lower in the W11 than in W33 strain ($P \leq 0.05$ for males and $P \leq 0.01$ for females). The lower water holding capacity and lower emulsion stability observed in the W33 strain breast muscle,

Table 4. Chemical composition, acid value and peroxide number of abdominal fat pad in W11 and W33 geese at the age of 17 weeks

Trait	Strain			
	W11		W33	
	mean	V(%)	mean	V(%)
Water (%)				
males	5.43	19.71	6.18	19.19
females	4.20	9.29	4.82	30.91
Protein (%)				
males	1.40	21.43	1.37	41.61
females	0.90	37.78	1.07	30.84
Fat (%)				
males	93.87	1.61	91.92	1.11
females	94.50	0.90	94.55	1.66
Acid value (mg KOH/g of fat)				
males	1.57	14.01	1.33	8.27
females	1.46	19.18	1.46	16.34
Peroxide number (meq. O_2/kg of fat)				
males	0.62^a	19.35	1.10^b	30.00
females	2.50	74.40	3.37	57.27

^{a,b} Within traits means bearing different superscripts differ significantly at $P \leq 0.05$.
V(%) – variation coefficient.

suggests that the efforts undertaken to increase body weight through selection, may adversely affect the functional properties of goose muscles.

The chemical analysis of abdominal fat (Tab. 4) did not show any significant differences between strains in the content of water, protein, fat and in acid value. Inter-strain difference ($P \leq 0.05$) was only shown in the peroxide number for abdominal fat of males. The results presented are within the standard ranges cited by Rosiński [2000].

Abdominal fat was dominated by oleic monounsaturated fatty acid (18:1), which accounted for 52.1-53.6% of total acids (Tab. 5). In quantitative terms, abdominal fat was dominated by unsaturated acids, which accounted for 67.6 and 66.3% (W11) and 67.3 and 67.1% (W33) in males and females, respectively. The significant differences found in the content of myristic, palmo-oleic and linolenic acids in abdominal fat have no practical importance for the differences observed between sexes and strains. The high

Table 5. Fatty acid content (%) in the peritoneal fat pad in W11 and W33 geese at the age of 17 weeks

Fatty acid	Strain			
	W11		W33	
	mean	V(%)	mean	V(%)
Myristic				
males	0.43	3.33	0.43	2.32
females	0.41^{a}	2.44	0.49^{b}	4.08
Palmitic				
males	24.37	2.20	25.36	1.72
females	25.77	0.93	25.32	0.39
Palmo-oleic				
males	3.02^{A}	0.33	3.42^{B}	0.88
females	3.04^{A}	0.00	3.25^{B}	1.54
Stearic				
males	7.31	4.10	4.61	0.94
females	7.27	6.05	6.86	2.48
Oleic				
males	53.37	4.80	52.21	4.37
females	52.06	4.46	53.36	4.24
Linoleic				
males	9.37	6.69	10.39	13.69
females	9.89	2.53	9.44	2.54
Linolenic				
males	0.92	5.43	0.75	6.67
females	0.91^{a}	4.40	0.73^{b}	5.48
Arachidonic				
males	0.37	2.70	0.38	7.89
females	0.38	2.63	0.34	8.82

^{aA} Within lines means bearing different superscripts differ significantly: small letters – $P \leq 0.05$; capitals – $P \leq 0.01$.
V(%) – variation coefficient.

per cent content of unsaturated acids in abdominal fat is beneficial for the human diet.

The results reported here show that at the age of 17 weeks W33 birds were heavier, with a significantly higher weight and content of breast and leg muscles of the carcass, than birds of the W11 strain. W33 males showed a significantly lower diameter of βR and αW breast muscle fibres, and this was the only difference in the muscle microstructure traits between the strains. The inter-strain differences found in the breast muscle for pH_{48}, cutting force and coefficient of emulsion instability suggest that further intensive selection for increased body and breast muscle weight in W33 males and females may adversely affect the technological quality of their meat.

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Ocena mięsa gęsi białych kołudzkich, rodów W11 i W33

S t r e s z c z e n i e

Tłuszcz gęsi zaliczany jest do kategorii bezpiecznych dla zdrowia tłuszczów zwierzęcych, ze względu na znaczny w nim udział jednonienasyconych kwasów oleinowego, linolowego, linolenowego i arachidonowego (odpowiednio około 42, 20, 0,4 i 0,05%). Gęsi, zwłaszcza korzystające z zielonych wybiegów (pastwiska), żywione paszą bardziej urozmaiconą, pobierają więcej wielonienasyconych kwasów tłuszczowych (PUFA) w porównaniu z drobiem utrzymywanym w zamkniętym chowie i żywionym standardowymi mieszankami, ubogimi w kwas linolenowy i PUFA, a bogatymi w nasycone kwasy tłuszczowe. W rezultacie w tkance mięsnej i tłuszczowej kurcząt brojlerów oraz indyków, obserwuje się niższy poziom kwasów szeregu *n-3* niż w mięsie gęsi.

Badaniom poddano gęsi obu płci rodów W11 i W33. Nie wykazano istotnych różnic między rodami w składzie chemicznym mięśni piersiowych. W mięśniach piersiowych ptaków obu płci rodu W11 wykazano wyższy niż w W33 udział popiołu i cholesterolu. Różnice między rodami gęsi stwierdzone pod względem pH_{48}, siły cięcia i współczynnika niestabilności emulsji wskazują, że kontynuowanie selekcji na zwiększenie masy ciała w rodzie W33, może ujemnie wpłynąć na wartość technologiczną mięsa.