The evaluation of meat yield and physical properties in the Czech goose and the commercial hybrid the Novohradská goose

Eva Tůmová, Linda Uhlířová

Department of Animal Husbandry
Faculty of Agrobiology, Food and Natural Resources
Czech University of Life Sciences Prague
Prague, Czech Republic

Abstract

The aim of this study was to compare meat yield and physical meat properties in two genotypes of goose, i.e. the Czech goose (CG) and the Novohradská goose (NG), in dependence on sex. Slaughter analysis and evaluation of meat quality were conducted at the age of 56 days in 32 goslings (8 of each genotype and sex). Significant interactions between genotype and sex were found in live weight ($P < 0.001$), with the highest slaughter weight in NG males (5 026.25 g) and the lowest in CG females (3 525.00 g), and in carcass weight ($P < 0.001$; CG females 2 197.50 g and NG males 3 257.50 g). Genotype significantly affected thigh meat as a proportion of carcass ($P = 0.048$) with a higher value (15.54%) in the CG. When meat colour parameters were evaluated, the lightness of the thighs ($P = 0.034$) was found to be influenced by sex, with higher values in females. Meat colour parameters in the thighs were demonstrably influenced by genotype – parameter a* ($P = 0.025$), for which higher values were found in the NG (7.57), and b* ($P = 0.031$), with a value of 12.01 in the NG. The pH of the breast was significantly influenced by both genotype ($P = 0.026$; 5.72 in the CH and 5.77 in the NG) and sex ($P = 0.033$), with higher values in males than in females.

Colour, geese, genotype, meat yield, pH, sex

Introduction

There is a long rearing tradition of geese in the Czech Republic. Geese are reared primarily for meat production and feathers, but the liver and goose fat are also important. Hybrid geese are generally used in intensive farming, while the Czech goose (CG) is of particular importance in small-scale rearing.

The Czech goose is a domestic breed, and represents one of genetic resource of this country. It is a meat breed, extremely hardy, and well adapted to local conditions. Its live weight is lower than that of other breeds at around 5.5 kg in adult males and 4.5 kg in adult females. It is a long-living breed. The Czech goose has a high dressing percentage, and its meat is juicy and of excellent quality. This breed is less fatty than other breeds of goose (Mátlová and Gardiánová 2006). The Novohradská goose (NG) is a commercial hybrid combination bred for meat production, derived from populations of Czech, Italian and Rhine geese. In paternal lines, an important criterion of breeding is the live weight at the age of 56 days, which ranges from 5 to 6 kg depending on age. In maternal populations, the weight of goslings at the same age is around half a kilogram less (Jedlička 2006).

Demonstrable differences exist between individual goose genotypes in live weight, and in the weight of the carcass and its individual parts (Isguzar and Pingel 2003; Le Bihan-Duval 2004). Kapkowska et al. (2011) state, that the hybrid combination of goose has a significantly higher live weight, carcass weight and dressing percentage than the Zatorska breed. The live weight of White Koluda® genotype goslings was on average higher by 350 g than that of Zatorska breed goslings. Gumulka et al. (2009) state that the dressing percentage of the commercial hybrid White Koluda® was 76.9% and was

Address for correspondence:
Ing. Linda Uhlířová
Department of Animal Husbandry
Faculty of Agrobiology, Food and Natural Resources
Czech University of Life Sciences
Kamýcká 129, 165 21 Prague 6 – Suchdol, Czech Republic

Phone: +420 224 383 060
E-mail: uhliroval@af.czu.cz
www.maso-international.cz

significantly higher than that of the Zatorska breed (73.7%). The proportion of breast was similar in both genotypes at around 8.6%, while the proportion of thigh meat was higher in the Zatorska breed (8.8%) than in the hybrid goose (7.7%). Isguzar and Pingel (2003) state statistically significant differences between five local Turkish genotypes of goose at the age of 9 weeks, with a live weight ranging from 1 984.2 g to 2 572.0 g. Significant differences were also recorded for the proportions of individual parts of the carcass. Saatci et al. (2009) noted the influence of sex on carcass weight and the weight of individual parts of the carcass, which are significantly higher in males. The dressing percentage, however, is higher in females.

The most valuable meat parts of geese are the breast and the thighs. Analyses of these parts of the carcass play a key role in determining meat quality (Tilki et al. 2005). Meat quality is defined as the capability of meat to be stored and further processed (Le Bihan-Duval 2004) and is the result of interrelations between the genetic potential of the animals and environmental factors (Gumulka et al. 2009). Meat quality is characterised by the physical properties of the meat, i.e. pH and colour. Differences between pH values measured 15, 30 and 45 minutes and 24 hours after slaughter have been recorded. The pH fell only slightly 15 – 45 minutes after slaughter with no statistically significant differences between the values. Significant differences can, however, be seen between the values measured 45 minutes and 24 hours after slaughter. The pH_{45min} ranges from 6.20 to 6.56 and the pH_{24h} from 5.65 to 5.96 in various genotypes of goose (Okruszek et al. 2008). Kirmizibayrak et al. (2011) state an average pH 24 hours after slaughter of 5.79 – 5.82 in breast muscle and 5.96 – 6.04 in thigh muscle in the Turkish domestic goose. The meat colour parameters lie in the ranges of values of 40.24 – 40.50 for L*, 12.85 – 13.06 for a* and 0.95 – 1.04 for b* in the breast and 43.72 – 44.86 for L*, 9.99 – 10.19 for a* and 0.84 – 1.23 for b* in the thighs. Kapkowska et al. (2011) did not record significant differences between the meat colour parameter values recorded for individual goose genotypes, and no significant differences were recorded between the values of pH 24 hours *post mortem*.

The aim of this work was to compare meat yield and physical meat properties in different goose genotypes depending on sex.

Materials and Methods

Meat yield and meat quality were studied in two genotypes of goose fattened under the same conditions.

A total of 120 geese were included in the experiment – 20 male and 20 female geese of the Czech goose breed and 40 male and 40 female geese of the NG genotype. The fattening conditions corresponded to the usual requirements and the goslings were fed complete feed mixes, i.e. VH1 to the age of 4 weeks and VH2 to the end of the fattening period, i.e. 8 weeks of age. The geese were divided into four groups by genotype and sex. Eight from each group, of average weight for the given group, were slaughtered at the age of 56 days.

After slaughter, bleeding and plucking, the offal and abdominal fat were removed from the goslings and the hot carcass weight was determined. The carcasses were weighed and stored for 24 hours in a cooling box at 4 °C. After cold chilling, the breast and thighs were removed and both parts weighed with the skin. For determination of the proportion of thigh meat, the left thigh was boned and the thigh muscle, thigh bones and thigh skin were weighed.

The pH of the breast (*musculus pectoralis major*) and thighs (*biceps femoris*) were determined using bench pH meter 3510 (Jenway, UK). A glass piercing-tip probe was introduced into a cut in the muscle tissue in the direction of the muscle fibres. The meat colour, expressed as L* (lightness), a* (redness) and b* (yellowness), was measured spectrophotometrically with a Minolta SpectraMagic™ NX colorimeter (Konica Minolta Sensing, Inc., Japan) on a cut in the *musculus pectoralis major* and *biceps femoris*. The meat colour and pH were determined 24 hours after slaughter.

The results of the experiment were processed in the program SAS (SAS Institute Inc., Cary, NC, 2003) by multiple analysis of variance with an interaction of genotype and sex.

Results and Discussion

The results for indicators of carcass analysis are given in Table 1. Highly significant interactions ($P < 0.001$) in the live weight of the individual groups are clear from this table. In spite of the fact that the males were heavier than the females in both genotypes,

interactions were expressed, first and foremost, by greater differences in the live weight of the males of the hybrid NG goose in comparison with the Czech goose. The NG was approximately 900 g heavier than the CG; males were around 600 g heavier than females. These results are similar to those observed by Kapkowska et al. (2011). The males had a higher live weight in both genotypes. Similar results were also recorded for the carcass weight, with higher values in the hybrid NG goose. The difference in carcass weight between the individual genotypes was around 600 g and the difference between the sexes around 400 g. Kapkowska et al. (2011) also recorded a significantly higher carcass weight in a commercial hybrid. The dressing percentage was not significantly influenced either by the genotype of goose or by sex. An insignificantly higher dressing percentage was recorded in the NG. An insignificantly higher dressing percentage was found in females in this genotype. In the CG, in contrast, the dressing percentage was insignificantly higher in males. Independent of genotype, an insignificantly higher dressing percentage was found in males. Gumulka et al. (2009) state that the dressing percentage in the hybrid goose White Koluda® was statistically significantly higher than in the Zatorska breed. Kapkowska et al. (2011) state that there were no significant differences between genotypes. Independent of genotype, the dressing percentage was insignificantly higher in females. The same was also found by Saatci et al. (2009) and Tilki et al. (2005). Isguzar and Pingel (2003), in contrast, present an insignificantly higher dressing percentage in males and did not record significant differences between individual goose genotypes. No influence of genotype and sex was recorded in the breast-to-carcass ratio and no significant interactions were found between them. The proportion of breast was insignificantly higher in the CG breed. In both genotypes, the breast-to-carcass ratio was insignificantly higher in females. Kapkowska et al. (2011) state a higher proportion of breast in the hybrid White Koluda® goose. Isguzar and Pingel (2003) and Tilki et al. (2005) found that females had a slightly higher proportion of breast than males. The proportion of thigh was not influenced significantly by either factor. The highest average value was found in the CG. In the NG genotype, the proportion of thigh was insignificantly higher in males. Overall, the proportion of thigh was insignificantly higher in females. This finding is in accordance with the results recorded by Saatci et al. (2009). Isguzar and Pingel (2003) reported significant differences in the thigh-to-carcass ratio between individual genotypes of goose and between the sexes. A higher proportion of thigh was found in females. The proportion of thigh meat was influenced by genotype ($P = 0.048$). A significantly higher proportion of thigh meat was recorded in the CG, particularly in females. In contrast, an insignificantly higher proportion of thigh meat was found in males in the NG. These results are in accordance with those found by Kapkowska et al. (2011). The proportion of thigh meat was significantly higher in the Zatorska breed than in the hybrid combination White Koluda®. A higher proportion of thigh meat was found in females in both genotypes. There are no statistically significant differences between the proportions of abdominal fat, and neither factor was found to have an influence here. Insignificantly higher values were recorded in the NG. The values determined for the individual sexes are almost identical. Saatci et al. (2009) recorded higher proportion of abdominal fat in males. These results indicate that the CG has a later slaughter maturity than the hybrid NG goose, though the two sexes of the individual genotypes should be slaughtered at the same time.

Values for physical properties of meat are given in Table 2. It is clear from the results that no significant interaction was recorded between goose genotype and sex for any of the given physical properties. The pH of the breast 24 hours after slaughter was significantly influenced by both genotype and sex. Statistically significantly higher values were measured in the NG. This finding is in accordance with the work of Gumulka et al. (2009). Okruszek et al. (2008) also state statistically significant differences between individual genotypes of goose, with pH 24 h values ranging from 5.65 to 5.96.

Table 1. Selected carcass analysis indicators

Genotype /sex	Live weight (g)	Hot carcass weight (g)	Dressing percentage (%)	Breast to carcas ratio (%)	Thigh to carcass ratio (%)	Thigh meat to carcass ratio (%)	Abdominal fat to carcass ratio (%)
CG	3677.50^{b}	2333.13^{b}	67.74	12.74	24.63	15.54^{a}	2.83
NG	4581.88^{a}	2970.63^{a}	68.49	11.79	23.42	14.71^{b}	3.29
RMSE	365.46	253.58	1.64	1.34	1.91	1.10	0.88
M	4428.12^{a}	2863.13^{a}	68.24	12.13	23.72	15.18	3.09
F	3831.25^{b}	2440.63^{b}	67.99	12.41	24.33	15.07	3.04
RMSE	506.62	353.66	1.68	1.42	1.98	1.17	0.91
CG M	3830.00^{c}	2468.75^{c}	68.18	12.51	23.97	15.45	2.84
F	3525.00^{d}	2197.50^{d}	67.30	12.98	25.29	15.62	2.82
NG M	5026.25^{a}	3257.50^{a}	68.30	11.75	23.47	14.92	3.34
F	4137.50^{b}	2683.75^{b}	68.67	11.84	23.37	14.51	3.23
RMSE	130.27	106.57	1.66	1.38	1.91	1.12	0.91
Significance							
Genotype	<0.001	<0.001	0.210	0.061	0.084	0.048	0.175
Sex	<0.001	<0.001	0.678	0.567	0.380	0.774	0.841
Genotype x sex	<0.001	<0.001	0.293	0.700	0.303	0.473	0.890

CG – Czech goose, NG – Novohradská goose; a, b, c, d: $P \leq 0.05$; RMSE – root mean square error; M – male, F – female

The pH of the breast was significantly higher in males. The highest pH values (5.77) were recorded in hybrid NG males, the lowest values (5.68) in females of the CG breed. Kirmizibayrak et al. (2011) and Kapkowska et al. (2011), in contrast, found a higher pH 24 hours *post mortem* in the breast in females. No influence of either genotype or sex was found for the pH in the thigh 24 hours after slaughter. This agrees with the results presented by Kirmizibayrak et al. (2011). Meat colour parameters in the breast were not affected by either factor. The value of the L* parameter in the breast muscle was highest in female CG and lowest in males of the same genotype. In the NG, slightly higher values were recorded in females than in males. Okruszek et al. (2008) did not record any influence of genotype on the L* value in the breast muscle. Kapkowska et al. (2011) reported an insignificantly higher L* value in the Zatorska breed. Insignificantly higher values were found in males in both genotypes. Kirmizibayrak et al. (2011), in contrast, found higher L* values in females. The a* value in the breast was higher in the males of both genotypes. This is in accordance with the results presented by Kirmizibayrak et al. (2011) and Kapkowska et al. (2011). The values for the b* parameter in the breast muscle were similar in both genotypes and sexes. However, Kirmizibayrak et al. (2011) and Kapkowska et al. (2011) reported higher values for the b* parameter in males and Okruszek et al. (2008) also found genotype to influence b* in the breast. The effect of genotype on meat colour parameters L* and a* in the thigh is clear from the table. L* values in the thighs were significantly influenced by sex, with higher values being recorded in females. Kirmizibayrak et al. (2011), in contrast, stated that the L* values in the thighs were higher in males. Genotype had a significant influence on the a* parameter in the thigh muscle. Higher values were found in the Novohradská goose. Gumulka et al. (2009) also found higher a* values in the thighs of hybrid geese, though these differences were not, however, statistically significant. The b* parameter in

the thighs was also significantly influenced by genotype, with higher values determined in the hybrid goose. This is in accordance with the results of Gumulka et al. (2009). The b* values in the thigh were insignificantly higher in females in both genotypes. This is in contradiction of the results presented in the work of Kirmizibayrak et al. (2011), who observed higher b* values in the thighs of males.

Table 2. Physical properties of meat 24 hours after slaughter

Genotype /sex	pH breast	pH thighs	Breast L*	Breast a*	Breast b*	Thigh L*	Thigh a*	Thigh b*
CG	5.72[b]	6.30	44.56	11.69	12.41	44.68	5.71[b]	10.58[b]
NG	5.77[a]	6.37	46.09	11.97	12.41	46.73	7.57[a]	12.01[a]
RMSE	0.07	0.25	3.42	2.57	2.15	3.17	2.22	1.75
M	5.77[a]	6.36	44.42	12.13	12.13	44.51[b]	6.80	10.96
F	5.72[b]	6.30	46.22	11.53	12.69	46.90[a]	6.48	11.63
RMSE	0.07	0.25	3.39	2.56	2.13	3.11	2.42	1.87
CG M	5.75	6.40	42.68	12.09	11.62	43.55	5.34	10.16
F	5.68	6.21	46.43	11.30	13.20	45.80	6.08	11.00
NG M	5.77	6.36	46.16	12.18	12.64	45.46	8.26	11.76
F	5.75	6.38	46.02	11.76	12.18	48.00	6.88	12.26
RMSE	0.06	0.25	3.25	2.64	2.14	3.03	2.23	1.78
Significance								
Genotype	0.026	0.462	0.193	0.771	0.997	0.066	0.025	0.031
Sex	0.033	0.391	0.128	0.522	0.465	0.034	0.688	0.299
Genotype x sex	0.450	0.244	0.102	0.849	0.188	0.892	0.189	0.784

CG – Czech goose, NG – Novohradská goose; a, b: $P \leq 0.05$; RMSE – root mean square error; M – male, F – female

Conclusions

The results reported that the NG had a higher live weight and carcass weight than the CG. The dressing percentage was, however, similar for the two genotypes. In view of the insignificantly lower proportion of abdominal fat in the CG, it would be possible to fatten these goslings for a longer period to obtain a higher slaughter weight.

Acknowledgements

The present study was supported by the Ministry of Agriculture of the Czech Republic (Project NAAR No. QI101A164).

References

Gumulka M, Wojtysiak D, Kapkowska E, Poltowicz K, Rabsztyn A 2009: Microstructure and technological meat quality of geese from conservation flock and commercial hybrids. Ann Anim Sci **2**: 205–213

Isguzar E, Pingel H 2003: Growth, carcass composition and nutrient content of meat of different local geese in Isparta region of Turkey. Arch Tierz **1**: 71–76

Jedlička M 2006: Will Czech goose survive the year 2012? Náš chov **11**: 39–41

Kapkowska E, Gumulka M, Rabsztyn A, Poltowitz K, Andres K 2011: Comparative study on fattening results of Zatorska and White Koluda® geese. Ann Anim Sci **2**: 207–217

Kirmizibayrak T, Önk K, Ekíz B, Yalçintan H, Yilmaz A, Yazici K, Altinel A 2011: Effects of Age and Sex on Meat Quality of Turkish Native Geese Raised Under A Free-Range System. Kafkas Univ Vet Fak Derg **5**: 817–823

Le Bihan-Duval E 2004: Genetic variability within and between breeds of poultry technological quality. Worlds Poult Sci **3**: 331–340

Mátlová V, Gardiánová I 2006: State of poultry genetic resources of Czech Republic – Czech goose. Acta fytotechn zootechn **Special issue**: 52–54

Okruszek A, Ksiazkiewicz J, Woloszyn J, Haraf G, Orkusz A, Szukalski G 2008: Changes in selected physicochemical parameters of breast muscles of geese from Polish conservation flocks depending on duration time of the post slaughter period. Arch Tierz **3**: 255–265

Saatci M, Tilki M, Kaya I, Kirmizibayrak T 2009: Effects of fattening lenght, feather colour and sex on some traits in native Turkish geese. II. Carcass traits. Arch Geflűgelk **1**: 61–66

Tilki M, Saatci M, Kirmizibayrak T, Aksoy A 2005: Effect of age on growth and carcass composition of Native Turkish Geese. Arch Geflűgelk **2**: 77–83