Nutritional value of breast and thigh muscle of chukar partridge (*Alectoris chukar*) under intensive fattening conditions

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Abstract

The aim of our study was to evaluate the nutritional value of the breast and thigh muscle of chukar partridge (*Alectoris chukar*) under intensive fattening conditions. Commercial feeding mixtures for broilers were used. Live weight of 60 partridges (birds were not sexed) was controlled during 90 days of fattening. After the fattening was finished, 30 birds were selected to monitor the carcass yield. Breast and thigh muscle were used for chemical analysis of crude protein (Kjeldahl method), total lipids (fat analyser ANKOM^{XT10}), ash (Muffle furnace - 550° C) and gross energy (calorimetry). Average values of live weight were increasing in the course of fattening; at the end of fattening the live weight reached 0.452 kg. The carcass yield, breast muscle yield and thigh yield were evaluated (73.72%, 18.09%, 20.80%, respectively). Chemical analysis showed a highly significant difference ($P \leq 0.01$) between the breast and thigh muscle for crude protein, fat, ash and gross energy. The ash content demonstrated a significant difference ($P \leq 0.05$) between the breast and thigh muscle. This study brings new data on the nutritional value of the meat of chukar partridge that can be used for reccomendation of a suitable feeding mixture.

Meat, chemical analysis, carcass yield, feathered game

Chukar partridges (*Alectoris chukar*) are kept only for hobby purposes. At present, we have little knowledge about the nutrition of partridges. Partridges are not bred for intensive fattening and no feeding mixtures are produced for such purposes. There are only feeding mixtures that do not reflect the exact nutrient and energy demands of rearing birds. Research on the breeding and fattening of partridges is limited compared to other species of birds, although the interest in their meat for human consumption rises (Gulsen et al. 2010).

An optimal composition of the feeding mixture is monitored and recommended (Cufadar et al. 2010a,b; Ozek et al. 2003; Ozek 2004; Ozek 2006). Other authors monitored chukar partridge growth in captivity (Balcioglu et al. 2009; Ozek et al. 2004a). Vitula et al. (2011) determined the gross energy in breast and thigh muscles in different species of feathered game including the chukar partridge. Gulsen et al. (2010) studied the addition of sunflower oil to the diet of growing partridges. Nevertheless, information on the nutritional value of partridge meat is missing. It is expected that intensive fattening will be introduced for chukar partridge, because of the growing interest in this type of breeding. There is a need to know the specific values of partridge body composition.

The aim of this study was to monitor the effect of intensive fattening on the quality of meat of chukar partridge.

Materials and Methods

Meat samples from partridges, namely thigh and breast muscle were used in this study. These samples originated from a biological experiment which was carried out in an experimental barn of the Department of Nutrition, Animal Husbandry and Animal Hygiene, University of Veterinary and Pharmaceutical Sciences

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Brno. The experiment was conducted on 60 birds (birds were not sexed) of chukar partridge and took place under a specified lighting regime (23 h of light + 1 h of darkness) with housing on litter.

Experimental animals were fed with complete feeding mixtures commercially available for fattening broiler chickens (BR 1, BR 2 and BR 3). Feeding mixtures were applied according to the following scheme: BR 1 from the 1st day till the 20th day of age, BR 2 from the 20th day till the 81st day of age and BR 3 from the 81st day to 90th day of age. Dry matter composition of feeding mixtures was as follows: BR 1 contained crude protein (CP) 235.4 g·kg^{-1}, fat 47.8 g·kg^{-1}, ash 58.9 g·kg^{-1} and metabolizable energy (ME) 13.6 MJ·kg^{-1}, BR 2 contained CP 244.9 g·kg^{-1}, fat 100.1 g·kg^{-1}, ash 62.0 g·kg^{-1} and ME 15.3 MJ·kg^{-1}, BR 3 contained CP 245.8 g·kg^{-1}, fat 112.0 g·kg^{-1}, ash 63.6 g·kg^{-1} and ME 15.5 MJ·kg^{-1}. Partridges were fed *ad libitum* and all types of feeding mixtures were granulated. In the course of the fattening period, all experimental animals were checked for their live weight, namely on the 1st, 11th, 20th, 29th, 40th, 50th, 60th, 70th, 81st and 90th days of age. On the 90th day of age, 30 birds were slaughtered and checked for selected indicators (%): the carcass yield (n = 30 samples), breast muscle yield (n = 29) and thigh yield (n = 30). These data were obtained by weighing and calculation. Thirty samples of breast muscles and thirty samples of thigh muscles were analyzed with regard to its dry matter content (g·kg^{-1}); subsequently, the dry matter was analyzed with respect to the following indicators: crude protein (g·kg^{-1}), fat (g·kg^{-1}), ash (g·kg^{-1}), calcium Ca (g·kg^{-1}), phosphorus P (g·kg^{-1}), magnesium Mg (g·kg^{-1}) and gross energy (MJ·kg^{-1}). After determining the pre-dry and dry matter, the sample was homogenized and then subjected to further analyses. The nitrogen content was determined according to Kjeldahl using the Büchi Kjeldahl apparatus (Centec automatika, spol. s.r.o., Czech Republic). The crude protein content was expressed in the sample by multiplying with the factor of 6.25. Fat was determined through the use of ANKOM^{XT10} Fat Analyzer (O.K. Servis BioPro, Czech Republic). Ash was determined by weight after incineration at 550 °C in a muffle furnace under prescribed conditions. Phosphorus, calcium and magnesium were determined from the sample ash according to ČSN 467092-11,12,13. Calcium and magnesium were determined by leaching and subsequent titration and phosphorus by HELIOS α spectrophotometer (Thermo Stientific, England). Gross energy was measured at AC 500 calorimeter (Leco, USA).

Statistical evaluation of chemical analysis results were carried out using the Unistat program (5.6 for Excel), at the level of significance being $P \leq 0.01$ (a highly significant difference) and $P \leq 0.05$ (a significant difference).

Results

Fig. 1 shows the results of monitoring the body weight (kg) during the fattening of partridges from the 1st day till the 90th day of their age. The live weight was increasing throughout the fattening period whereas the increase was not so expressive in the final stage. Deviations from the average body weight grew together with the weight. No animals died during the experiment.

Furthermore, we monitored the carcass yield in the experimental animals. The carcass yield at slaughter age of 90 days was 73.7% (n = 30), breast muscle yield was about 18.1% (n = 29) and thigh yield was 20.8% (n = 30).

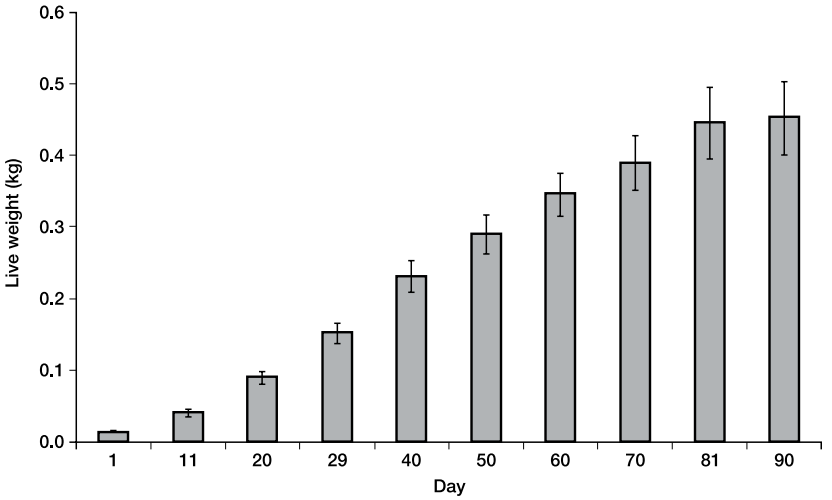

Fig. 1. Body weight development during the fattening of chukar partridge

Table 1. Chemical analysis of the partridge breast and thigh muscle in 100% dry sample (g·kg^{-1})

Chemical indices	Sample	x ± SD
Dry matter*	Breast	272.75 ± 14.17[a]
	Thigh	260.44 ± 8.99
CP (g·kg^{-1})	Breast	922.54 ± 28.34 [a]
	Thigh	845.32 ± 25.75
Fat (g·kg^{-1})	Breast	17.59 ± 11.55 [a]
	Thigh	97.70 ± 30.55
Ash (g·kg^{-1})	Breast	46.33 ± 1.04[a]
	Thigh	49.36 ± 1.77
Ca (g·kg^{-1})	Breast	2.44 ± 0.50[b]
	Thigh	2.18 ± 0.49
P (g·kg^{-1})	Breast	8.75± 0.30[NS]
	Thigh	8.78 ± 0.56
Mg (g·kg^{-1})	Breast	1.29 ± 0.19[NS]
	Thigh	1.32 ± 0.26
GE (MJ·kg^{-1})	Breast	21.21 ± 0.32 [a]
	Thigh	22.50 ± 0.70

* In the original sample mass (g·kg^{-1}), CP – crude protein, GE – gross energy, number of samples analyzed – 30, [a]significant differences between groups ($P \leq 0.01$), [b]significant differences between groups ($P \leq 0.05$), NS – non-significant difference

Table 1 shows that the dry matter content in partridge breast muscle was significantly higher ($P \leq 0.01$) than in the thigh muscle. Compared to the thigh muscle, the breast muscle contained by 4.5% more dry matter. As regards the crude protein content in dry matter, it was significantly higher ($P \leq 0.01$) in the breast muscle than in the thigh muscle (by 8.4%). In contrast, the partridge breast muscle contained by 82% lower ($P \leq 0.01$) amount of fat in dry matter compared to the thigh muscle. Dry matter resulting from the breast muscle showed significantly lower ($P \leq 0.01$) ash content by 6.2% in comparison with the thigh muscle. A higher content of calcium (by 10.7%) in the dry matter was found in the breast muscle compared to the thigh muscle ($P \leq 0.05$). No significant differences were confirmed between the dry matter contents of phosphorus and magnesium when comparing breast and thigh muscles. In the dry matter, the breast muscle contained by 5.7% ($P \leq 0.01$) less gross energy than the thigh muscle.

Discussion

Feeding mixtures for broiler chickens were used to fatten the partridges; these mixtures contained higher levels of energy as well as crude protein compared to recommendations provided by Ozek et al. (2003). Also Cufadar et al. (2010a) recommended a diet with lower values (13% and 10.9 MJ·kg^{-1} for CP and energy, respectively), than were used in our experiment. Higher energy amount could have an effect on the higher carcass yield, breast muscle and thigh muscle weight but it should not affect the live weight, weight gain, carcass properties, feed consumption and conversion (Ozek et al. 2003; Ozek 2004; Cufadar et al. 2010a).

Ozek (2006), however, discovered the influence of a higher CP amount (28%) in the diet on the body weight which decreases with high protein concentrations. Such influence cannot be observed as regards our chosen diet (24% of CP); live weight reached higher values in this period. In their study the partridge weight ranged as follows: 279 g (28% of CP), 280.4 g (18% of CP), 286.1 g (26% of CP), 298.9 g (22% of CP), 304.1 g (24% of CP) and 307.4 g (20% of CP).

Vitula et al. (2011) reported lower dry matter content values for the breast muscle in chukar partridges (271.93 ± 10.68 g·kg^{-1}) compared to dry matter content values for the thigh muscle (274.75 ± 18.03 g·kg^{-1}). They also determined higher value of gross energy (23.03 ± 0.57 MJ·kg^{-1} and 24.22 ± 0.85 MJ·kg^{-1} for breast and thigh muscle, respectively) in dry matter compared to results from our study, and also the gross fat (40.64 ± 24.68 g·kg^{-1} and 161.40 ± 86.98 g·kg^{-1} for breast and thigh muscle, respectively) reached higher values in their experiment than in our study. The CP (924.37 ±

31.11 g·kg^{-1} and 811.96 ± 53.55 g·kg^{-1} for breast and thigh muscle, respectively) value reported by Vitula et al. (2011) corresponded to values obtained in our study.

Gulsen et al. (2010) studied 12-week-old chickens fed a diet without soybean oil in one group and with addition of oil in the second group. They determined body weight (439.75 g), carcass weight (318.81 g), thigh weight (99.21 g), breast weight (107.53 g) and carcass yield (72.52%) in the group without addition of soybean oil. With the addition of oil to the diet, organ weights remained the same except for abdominal fat in their study. The body weight, carcass performance and weight of wings and breasts decreased linearly. Thigh and neck weights were not affected by adding oil to the diet according their results. Compared to our study, the partridges reached higher average body weight values on the 84th day of age than stated by Gulsen et al. (2010). Even the value of carcass yield was higher according to our results; however, lower yield values were obtained with respect to the breast muscles and thigh in our study.

We therefore tried to compare the quality of partridge meat with the quality of meat from broiler and pheasant chickens; a noticeable difference can be seen in the meat composition.

Straková et al. (2011) dealt with comparing the meat from broiler chickens (fattening until the 40th day of age) and pheasant chickens (fattening until the 90th day of age). Suchý et al. (2002) studied the composition of breast and thigh muscle in hens and roosters of broiler chickens in the 42nd and 52nd day of fattening. Večerek et al. 2005 studied variation in the chemical composition of muscles in young pheasants during their growth.

Compared with results of Straková et al. (2011) and Suchý et al. (2002), results of this study show that the partridge meat contains less CP in the breast muscle than pheasant but more than broiler. As for the thigh muscle, it contains more CP than pheasant and broiler. Partridge thigh muscle contains less fat than the thigh muscle of pheasant and broiler. The amount of ash in breast and thigh muscles of partridges is comparable with the muscle of pheasant; partridge muscle contains the highest quantity of calcium and the lowest amount of magnesium. The amount of phosphorus in the partridge muscle is lower than in the muscle of pheasant (Suchý et al. 2002; Straková et al. 2011). The breast and thigh muscle of pheasant contains more CP and phosphorus, and less fat and calcium, compared to broiler chickens (Večerek et al. 2005). Gross energy content in the breast and thigh muscles is the lowest in partridge (23.0 MJ·kg^{-1} and 24.2 MJ·kg^{-1} for breast and thigh muscle, respectively) followed by pheasant (23.1 MJ·kg^{-1} and 25.3 MJ·kg^{-1} for breast and thigh muscle, respectively), the highest values of gross energy are achieved in broiler (23.8 MJ·kg^{-1} and 27.3 MJ·kg^{-1} for breast and thigh muscle, respectively). In all species, higher gross energy values were found in the thigh muscle (Vitula et al. 2011).

The results of our study show the difference between breast and thigh muscles of partridges, both in the carcass yield and chemical analysis. The breast muscle could be considered a more valuable part of the partridge carcass because it contains higher amounts of CP and less fat than thigh muscles (as in the case of broiler or pheasant).

This finding ranks the partridge meat among the nutritionally valued feathered game meat. Results obtained are also interesting due to the fact that no special feeding mixtures for partridges or special breeding methods to improve carcass yield and meat quality were used. Partridges were fed under intensive conditions. It can be assumed that the improvement of these aspects could improve the nutritional value of chukar partridge meat.

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