CARCASS COMPOSITION AND MEAT QUALITY OF GREY PARTRIDGE (*PERDIX PERDIX L.*)

SKŁAD TUSZKI I JAKOŚĆ MIĘSA KUROPATWY SZAREJ (*PERDIX PERDIX L.*)

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ABSTRACT

The aim of the study was to determine the body weight, dressing percentage, carcass composition and physico-chemical and sensory properties of meat from grey partridge (*Perdix perdix* L.). At the age of 32 weeks, male and female grey partridge had similar body weight (301.4 g vs 299.5 g), carcass weight (218.2 g vs 216.0 g) and dressing percentage (72.4% vs 72.1%). Dissection analysis showed non-significant differences in carcass composition between males and females. The carcasses of males contained more leg muscles (17.4%), skin with subcutaneous fat (5.5%) and neck (3.4%), but less breast muscles (30.7%) and wings (8.8%) compared to the carcasses of females (17.0%, 5.3%, 3.3%, 31.1% and 10.7%, respectively). Compared to males, the breast muscles of females were characterized by significantly higher water holding capacity. In addition, females showed significantly ($P \leq 0.05$) lower values of lightness (L*), yellowness (b*) and tenderness of breast muscles compared to males.

Keywords: grey partridge, body weight, carcass traits, pH, water holding capacity, sensory properties

STRESZCZENIE

Celem badań było określenie masy ciała, wydajności rzeźnej, składu tuszki oraz właściwości fizykochemicznych i sensorycznych mięsa kuropatwy szarej (Perdix perdix L.). W wieku 32 tygodni samce i samice kuropatwy szarej miały zbliżoną masę ciała (301,4 g vs 299,5 g), masę tuszki (218,2 g vs 216,0 g) i wydajność rzeźną (72,4% vs 72,1%). Analiza dysekcyjna wykazała nieistotne statystycznie różnice w składzie tuszek miedzy samcami i samicami. Tuszki samców zawierały więcej mięśni nóg (17,4%), skóry z tłuszczem podskórnym (5,5%) i szyi (3,4%), natomiast mniej mięśni piersiowych (30,7%) i skrzydeł (8,8%) niż tuszki samic (odpowiednio: 17,0%, 5,3%, 3,3%, 31,1% i 10,7%). W porównaniu z samcami mięśnie piersiowe

samic charakteryzowały się statystycznie istotnie większą wodochłonnością. U samic stwierdzono ponadto istotnie ($P \leq 0.05$) mniejsze wartości jasności barwy (L*) i wysycenia barwy żółtej (b*) oraz kruchości mięśni piersiowych niż u samców.

Słowa kluczowe: kuropatwa szara, masa ciała, cechy tuszki, odczyn, wodochłonność, właściwości sensoryczne

DETAILED ABSTRACT

Badania wykonano na kuropatwach szarych (Perdix perdix L.). W pierwszych tygodniach życia ptaki przebywały w budynku zamkniętym o regulowanych parametrach środowiska, a następnie w wolierach zewnętrznych. Do 16. tygodni życia kuropatwy żywiono *ad libitum* przemysłowymi mieszankami paszowymi dla bażantów rzeźnych, a następnie ziarnem pszenicy i rzepaku oraz grubo rozdrobnionym ziarnem kukurydzy. Z upływem 32. tygodnia życia wybrano do dysekcji losowo po 10 samców i 10 samic kuropatw. Po uboju i odpierzaniu oznaczono odczyn mięśni piersiowych i nóg (pH_{15}), tuszki wypatroszono i wykonano ich rozbiór. Wyodrębniono: szyję bez skóry, skrzydła, skórę z tłuszczem podskórnym, tłuszcz sadełkowy, mięśnie piersiowe, mięśnie nóg, pozostałość tuszki. Po dysekcji elementy tuszki zważono i obliczono ich procentową zawartość w tuszce patroszonej z szyją. Pobrano ponadto próby mięśni piersiowych i nóg w celu oznaczenia ich wodochłonności i właściwości sensorycznych. Oceniane samce i samice kuropatwy szare w wieku 32. tygodni miały zbliżoną masę ciała, masę tuszki patroszonej z szyją i wydajność rzeźną. Niezależnie od płci stwierdzono podobne umięśnienie piersi i nóg. Tuszki patroszone z szyją samców i samic kuropatwy szarej nie różniły się statystycznie także pod względem procentowej zawartości szyi, skrzydeł, skóry z tłuszczem podskórnym i pozostałości tuszki. W porównaniu do samic, mięśnie piersiowe i nóg samców charakteryzowały się większą kwasowością mierzoną 15 minut po uboju (pH_{15}) i wodochłonnością. Mięśnie piersiowe samic miały ciemniejszą barwę o czym świadczą istotnie mniejsze wartości jasności barwy (L*) i natężenia barwy żółtej (b*) i były mniej smaczne niż u samców, gdyż w ocenie sensorycznej uzyskały niższe noty. Ciemna barwa mięsa, mała kruchość i soczystość mięsa badanych kuropatw może wskazywać na jego mniejszą przydatność kulinarną i do przetwórstwa.

INTRODUCTION

The grey partridge (*Perdix perdix* L.) is a wild bird in the family Phasianidae of the order Galliformes. It is also known as the English Partridge, Hungarian Partridge, or Hun. This middle-sized bird is about 30 cm long and weighs between 290 and 475 g (Meriggi et al. 2007). It is found all over Europe, in the northern part of Asia Minor, and in southern Siberia (Rajski, 1984; Behnke, 1995). Because the species

originated in the steppes, it was relatively easily adapted to the artificial steppes of ploughlands. However, it avoids large, unvarying cultivated areas.

In Poland, the partridge population in 2010 was 388,000, with hunting bags of about 12,000 birds (GUS, 2011). A sudden decline in the population of partridges (about 2.5-fold) occurred in the 1970s and 1980s, when hunting bags decreased from 808,000 in 1975 to 334,000 in 1985 and 26,200 in 1999 (Panek, 2000). In recent years, aviary breeding was started as a result of the decrease in the population of this valuable game bird species.

Partridges are characterized by a rapid rate of growth; when receiving high-value feeds, they reach adult weight by 12 weeks of age. At the end of the growth period, i.e. from 13 weeks of age, partridges can be introduced under natural conditions. In practice, they are usually introduced to hunting grounds in Poland the next spring, when birds are between 8 and 9 months of age, which increases the rate of their survival.

Recent years have seen growing interest in highly nutritious safe food products, which include game bird meat. At present, game birds raised commercially around the world for meat production include pharaoh quail (*Coturnix coturnix*), bobwhite quail (*Colinus virginianus*), chukar partridge (*Alectoris chukker*), ring-necked pheasant (*Phasianus colchicus*) and northern mallard duck (*Anas platyrhynchos*) (Hayes, 2008). In Poland, pharaoh quail and ring-necked pheasants are kept for meat production. Efforts are also being made in Poland to raise grey partridges for slaughter purposes, which is not possible under the current state of law.

The meat of grey partridge, especially breast muscles, are characterized by high protein content and low fat content (Hašcik et al. 2008, Suchý et al. 2009, Sedlanic et al. 2007, Putaala and Hissa, 1995). Partridge meat is considered healthy. In partridges, the energy content of breast muscles is lower than in Japanese quail, similar to that in pheasants, and higher than in guinea fowl and chukar (Vitula et al. 2011).

Partridges are characterized by high dressing percentage. The proportion of eviscerated carcass with neck in preslaughter weight ranges from 64.9% to 71.3% (Hašcik et al. 2008, Večerek et al. 2008, Adamski and Kuźniacka, 2007). Breast muscles constitute from 27.3% to 36.0%, and leg muscles from 20.7% to 20.8% of eviscerated carcass (Adamski and Kuźniacka, 2007, Večerek et al. 2008).

Previous research determined the effect of genotype, sex, system of raising and feeding on the body weight, growth rate, carcass composition, basic chemical composition, and microstructure of partridge meat (Uscebrka et al. 1997, 2006; Pyörnilä et al. 1998, Adamski and Kuźniacka, 2007, Hašcik et al. 2008, Suchý et al. 2009, Vitula et al. 2011, Pis, 2012).

The aim of the study was to determine the body weight, dressing percentage, carcass composition, pH, water holding capacity, colour attributes, and aroma, tenderness, juiciness and palatability of meat from grey partridge (*Perdix perdix* L.).

MATERIALS AND METHODS

The study was conducted with grey partridges (*Perdix perdix* L.) intended for reintroduction. Until 16 weeks of age, birds were maintained at the Game Breeding Centre in Rożniaty, which belongs to the Polish Hunting Association, and later at the Hubertus Hunting Club. During the first weeks of life, partridges were kept in a closed building under a controlled environment and later in outdoor aviaries. Birds were fed *ad libitum* commercial diets for slaughter pheasants until 16 weeks of age. The feed mixture given to partridges contained 26.0% crude protein and 12.1 MJ ME to 2 weeks of age, 21.5% protein and 12.0 MJ ME from weeks 4 to 5, and 17% protein and 11.9 MJ ME per kg from weeks 5 to 16. At the end of 16 weeks, 150 partridges were given to the Hubertus Hunting Club. From 17 to 32 weeks, birds were kept in an aviary (15 m x 25 m, ~2.5 m^2 per bird) and fed wheat grain, rapeseed grain, and coarsely ground maize grain.

At 32 weeks of age, 10 males and 10 females were randomly chosen for slaughter. Following slaughter, defeathering and evisceration, whole carcasses were subjected to simplified dissection according to the method of Ziołecki and Doruchowski (1989). Each carcass was dissected into breast muscles, thigh and lower thigh (leg) muscles, wings with skin, neck without skin, neck skin, and skin with subcutaneous fat. The skeleton with some skeletal muscles were the remainder of the carcass. Individual components were weighed on an electronic scales and their percentage in eviscerated carcass with neck was calculated. The pH of breast and leg (thigh) muscles was measured 15 minutes postmortem (pH_{15}) using a Matthäus pH meter. The electrode was inserted at an angle of 45°, halfway through the muscle thickness. pH values were read on the LCD display.

After carcass dissection, muscle samples were collected to determine water holding capacity, colour and sensory properties. Water holding capacity of breast and leg muscles was determined with a modified version of the method reported by Grau and Hamm (1952). A sample of meat weighing between 280 and 320 mg was placed on a filter paper between two glass plates, which were weighed down with a 2 kg weight for 5 minutes. After that time the sample was weighed again, which enabled water holding capacity to be calculated from the ratio between sample weight after and before squeezing (mg), multiplied by 100%. Colour was determined on freshly cut surface of breast muscles according to the L* (lightness), a* (redness) and b* (yellowness) system, using a Minolta CR 310 chroma meter.

Only breast muscles were subjected to sensory analysis. Intensity and desirability of aroma and taste, and juiciness and tenderness of meat were determined. Meat samples for sensory evaluation were cooked in 0.6% table salt solution, at a water to meat ratio of 2:1. After cooking, the samples were cooled to 60°C and subjected to sensory analysis by a standing committee of 5 evaluators according to a 5-point hedonic scale provided by Baryłko-Pikielna (1975). A 5-point scoring system was used to evaluate aroma and taste intensity (5 = very pronounced, 4 = pronounced, 3 = slightly pronounced, 2 = perceptible, 1 = imperceptible); aroma and taste desirability (5 = very desirable, 4 = desirable, 3 = neutral, 2 = slightly undesirable, 1 = very undesirable); juiciness (5 = juicy, 4 = moderately juicy, 3 = slightly juicy, 2 = slightly dry, 1 = dry); and tenderness (5 = very tender, 4 = tender, 3 = slightly tender, 2 = tough, 1 = very tough).

The numerical data were analysed statistically by calculating arithmetic means (x) and standard deviation (sd). Significant differences between the means for the groups were analysed using Student's t-test.

RESULTS AND DISCUSSION

The mean body weight of 32-week-old male grey partridges (301.4 g) was 1.9 g higher than in females, with a non-significant difference (Table 1). In earlier studies (Hašcik et al. 2008, Putaala and Hissa 1995, Večerek et al. 2008), adult partridges had greater weights ranging between 371.2 g and 405.0 g. The lower body weight of the analysed birds was probably due to the introduction of restricted, low-protein feeding after the birds were given to the hunting club. This system of feeding is recommended when partridges will be introduced to hunting grounds. Increasing the aviary area (reducing stocking density) to 2.5 m^2 probably also had an effect on body weight. In young partridges aged 12 weeks, Adamski and Kuźniacka (2007) found higher body weight in male than female gray partridges (295 g vs 282 g), which was consistent with our findings. In another experiment (Hašcik et al. 2008), adult *Perdix perdix* males were lighter than females (371.2 g vs 405 g).

Table 1. Body weight and carcass composition of grey partridge
Tabela 1. Masa ciała i skład tuszki kuropatwy szarej

Trait − cecha	Sex − characteristics Płeć − charakterystyki			
	Male - Samce		Female - Samice	
	mean	sd	mean	sd
Body weight (g)	301.4	63.6	299.5	56.2
Carcass weight (g)	218.2	55.7	216.0	56.7
Dressing percentage (%)	72.4	4.3	72.1	6.8
Neck (%)	3.4	1.5	3.3	1.2
Wings (%)	8.8	2.8	10.7	2.5
Breast muscles (%)	30.7	5.3	31.1	6.8
Leg muscles (%)	17.4	1.2	17.0	0.8
Skin with fat (%)	5.5	1.1	5.3	0.3
Remainders (%)	34.2	4.1	32.6	5.1

No statistically significant differences were found

The weight of eviscerated carcass with neck and dressing percentage of males and females were similar, which contributed to non-significant differences in these traits between the sexes. Slightly higher values of these traits were found in males.
In studies by Hašcik et al. (2008) and Večerek et al. (2008), the ratio of eviscerated carcass with neck to preslaughter weight of partridge (dressing percentage) ranged from 64.9% to 69.1%, which is less than in birds evaluated in our study. Like in our study, Biesiada-Drzazga (2011) obtained higher dressing percentage for male

(71.8%) compared to female game pheasants (68.9%). Similar or higher dressing percentage was characteristic of broiler chickens (from 72.2% to 74.5%) and young slaughter pheasants (from 72.1% to 74.3%) investigated by Adamski and Kuźniacka (2005), Azizi et al. (2011), Kokoszyński and Bernacki (2008), and Sarica et al. (1999).

The sex of birds had no significant effect on percentage of neck in eviscerated carcasses with neck in 32-week-old partridges. Adamski and Kuźniacka (2007) found neck content to be the same in males (3.4%) and lower in females (3.8%) aged 12 weeks as in our study. Compared to males, the carcasses of females were characterized by non-significantly higher percentage of wings and breast muscles. In pheasants, Biesiada-Drzazga (2011) and Kokoszyński et al. (2012) observed, like in our study, a higher content of breast muscles in female than male carcasses. In another experiment (Adamski and Kuźniacka 2007), the carcasses of 12-week-old male grey partridges were characterized by a significantly higher percentage of breast muscles compared to female carcasses (36.0% vs 32.7%). In a study by Večerek et al. (2008), the proportion of breast muscles in grey partridge carcasses was 27.3%, which is less than in our experiment. In the analysed partridges, the proportion of breast muscles was similar to that in pheasants evaluated by Kokoszyński et al. (2012). Male carcasses contained 0.4% more leg muscles than female carcasses, with a non-significant difference. A higher content of leg muscles was found in carcasses of 12-week-old male (20.8%) and female (20.7%) grey partridges investigated by Adamski and Kuźniacka (2007). The remainder of the carcass constituted 34.2% in males and 32.6% in females, i.e. much more than the values noted by Adamski and Kuźniacka (2007) in 12-week-old partridges (males 24.4%, females 26.8%). Another experiment (Wilkanowska and Kokoszyński 2011) found percentage of the remainder of the carcass to increase with age in Pharaoh quail, which was contrary to the results of this study.

The sex of partridges had no significant effect on pH_{15} of breast and leg muscles (Table 2). Higher acidity (pH_{15}) of breast and leg muscles was determined in females than in males. The higher pH_{15} of female muscles contributed to higher water holding capacity of their meat. The high pH_{15} values were associated with the low glycogen content of meat at slaughter, which prevented sufficient acidification of meat (decrease in pH) and may suggest the low resistance of the analysed birds to preslaughter stress.

Table 2. Reaction (pH_{15}) and water holding capacity (WHC) of breast and leg muscles of grey partridge
Tabela 2. Odczyn (pH_{15}) i wodochłonność (WHC) mięśni piersiowych i nóg Kuropatwy szarej

Trait - cecha	Sex - characteristics Płeć - charakterystyki			
	Male - Samce		Female - Samice	
	mean	sd	mean	sd
pH_{15} – breast muscles	6.32	0.49	6.45	0.28
pH_{15} – leg muscles	6.49	0.49	6.55	0.34
WHC – breast muscles (%)	71.1 a	3.9	77.9 b	3.8
WHC – leg muscles (%)	78.8	4.3	79.8	2.9

Means in rows with different letters differ significantly (P≤ 0.05)

Table 3. Colour of breast muscles of grey partridge
Tabela 3. Barwa mięśni piersiowych kuropatwy szarej

Trait - cecha	Sex - characteristics Płeć - charakterystyki			
	Male - Samce		Female - Samice	
	mean	sd	mean	sd
L* – lightness	43.9 a	3.1	39.8 b	0.5
a* – redness	18.7	1.2	17.5	0.6
b* – yellowness	2.6 a	1.4	0.6 b	0.4

Means in rows with different letters differ significantly (P≤ 0.05)

The L* (lightness) and b* (yellowness) values of breast muscles were significantly lower in females than in males (Table 3). In females, non-significantly lower redness (a*) values were found. Similar to partridges analysed in our study, higher L* and b* values of muscles were reported by Hofbauer et al. (2010) and Kokoszyński et al. (2012) in pheasants, and by Doktor and Połtowicz (2009) in broiler chickens. As in our study with partridges, Kokoszyński et al. (2012) obtained higher L*, a* and b* values in male than in female pheasants.

Table 4. Sensory properties of breast muscles of grey partridge
Tabela 4. Właściwości sensoryczne mięśni piersiowych kuropatwy szarej

Trait - cecha	Sex - characteristics Płeć - charakterystyki			
	Male - Samce		Female - Samice	
	mean	sd	mean	sd
Aroma – intensity	3.6	0.6	3.4	0.6
Aroma – desirability	3.6	0.5	3.4	0.6
Juiciness	3.2	0.7	3.1	0.7
Tenderness	3.4 a	0.5	3.0 b	0.7
Palatability – intensity	3.6	0.5	3.2	0.6
Palatability – desirability	3.6	0.5	3.4	0.6

Means in rows with different letters differ significantly (P≤ 0.05)

During sensory evaluation, cooked meat from breasts of 32-week-old partridges received the scores from 3.0 to 3.6 pts. (Table 4). Compared to females, breast muscles of males had higher scores for all sensory properties, i.e. aroma and taste intensity and desirability, as well as tenderness and juiciness. Significant differences between males and females were only found for meat tenderness. Using a 5-point scale for assessing sensory properties of breast muscles, Winnicka (cited after Mróz 2003) obtained higher scores for these sensory properties of breast muscles in pheasants, and Dziadek and Gornowicz (2003) in broiler chickens. Unlike the results of the present experiment, Kokoszyński et al. (2012) obtained higher scores for tenderness and taste intensity and desirability of breast muscles in female than in male pheasants.

In conclusion, male and female grey partridges aged 32 weeks had similar body weight and dressing percentage. Dissection analysis demonstrated no statistically significant differences in percentage of carcass tissue components. Compared to males, breast muscles of females were characterized by significantly higher water holding capacity as well as significantly darker colour and tenderness.

REFERENCES

Adamski, M., Kuźniacka, J., (2005) The effect of age and sex on slaughter traits of pheasants (*Phasianus colchicus* L). Animal Science Papers and Reports, 24, suppl. 2, 11-18.

Adamski, M., Kuźniacka, J., (2007) Effect on sex, slaughter value and tissue composition in 12-week-old grey partridge. Animal Science 1 (Proceedings), 9.

Azizi, B., Sadeghi, G., Karimi, A., Abed, F., (2011) Effects of dietary energy and protein dilution and time of feed replacement from starter to grower on broiler chickens performance. Journal of Central European Agriculture, 12 (1), 44-52.

Behnke, H., (1995) Galliformes: pheasant and partridge – breeding and introduction. Oficyna Wydawnicza “Wydawnictwo Świat”, Warsaw.

Biesiada-Drzazga, B., Socha, S., Janocha, A., Banaszkiewicz, T., Koncerowicz, A., (2011) Assesment of slaughter value and quality of meat in common game pheasants (Phasianus colchicus). Żywność. Nauka. Technologia. Jakość, 1 (74), 79-86. (In Polish).

Doktor, J., Połtowicz, K., (2009) Effect of transport to the slaughterhouse on stress indicators and meat quality of broiler chickens. Annals of Animal Science, 9 (3), 307-317.

Dziadek, K., Gornowicz, E., (2003) Relationship between genotype and meat sensory quality in broiler chickens. Roczniki Naukowe PTZ Przeglądu Hodowlanego, 68, 133-139.

Grau, R., Hamm, R., (1952) Eine einfache Methode zur Bestimmung der schaft Wasserbindng im Fleisch. Fleischwirtschaft, 4, 295-297.

GUS - Central Statistical Office (2011) Concise Statistical Yearbook of Poland, 337.

Hašcik, P., Kacániová, M., Fikselová, M., Pavlicová, S., Kulišek, V., Vavrišinova, K., Shubhadeep Roychoudhury., Arpášova, H.M., (2008) Morphological, nutritional and biochemical indicators of pectorals of Perdix perdix from farm breeding. Fleischwirtschaft International, 4, 84-86.

Hayes, L.B., (2008) How to begin and survive a commercial gamebird farm. Leland Hayes Gamebird publications, 1-32.

Hofbauer, P., Frans, J., Smulders, M., Vodnansky, M., Paulsen, P., El-Ghareeb, W.R., (2010) A note on meat quality traits of pheasants (Phasianus colchicus). European Journal of Wildlife Research 56 (5), 809-813.

Kokoszyński, D., Bernacki, Z., (2008) Comparison of slaughter yield and carcass tissue composition in broiler chickens of various origin. Journal of Central European Agriculture, 9 (1), 11-16.

Kokoszyński, D., Bernacki, Z., Duszyński, Ł., (2012) Body conformation, carcass composition and physicochemical and sensory properties of meat from pheasants of different origin. Czech Journal of Animal Science 57 (3), 115-124.

Mróz, E., (2003) Pheasants. Ed. Hoża, Warszawa (in Polish).

Meriggi, A., Della-Stella, R.M., Brangi, A., Ferloni, M., Masseroni, E., Merli, E., Pompilio, L., (2007) The reintroduction of grey and red-legged partridges (Perdix perdix and Alectoris rufa) in central Italy: a metapopulation approach. Italian Journal of Zoology 74 (3), 215-237.

Panek. M., (2000) Situation of grey partridge population in Poland in the years 1998-2000. Proceedings II National Conference ”Small game as a component of biodiversity of the natural environment”. Włocławek, September 7-9, pp. 145-154 (In Polish).

Pis, T., (2012) Growth and development of chicks of two species of partridge: the grey partridge (Perdix perdix) and the chukar (Alectoris). Brit. Poult. Sci. 53 (1), 141-144.

Putaala, A., Hissa, R., (1995) Effects of hand-rearing on physiology and anatomy in the Grey partridge. Wildlife Biology 1 (1), 27-31.

Pyörnilä, A.E.I., Putaala. A.P., Hissa, R.K., (1998) Fibre types in breast and leg muscles of hand-reared and wild grey partridge (Perdix perdix). Canadian Journal of Zoology. 76 (2), 236-242.

Rajski, A., (1984) Zoology. Vol. 2, Statistical part. PWN Warszawa.(In Polish)

Sarica, M., Karaçay, N., Camci, Ö., (1999) Slaughter age and carcass traits of pheasants. Archiv für Geflügelkunde 63 (4), 182-184.

Sedlanic, C., Dobranic, Z., Njari, V., Blazeka, B., (2007) Yield and chemical indicators of meat quality in wild poultry (Croatia). Veterinarska Stanica 38(3), 159-165.

Suchý, P., Mas, N., Vitula, F., Straková, E., Šerman, V., Steinhauser L., Večerek, V., (2009) Differences in meat nutritional composition of six wildfowl varieties. Krmiva, 51 (2), 63-74.

Uscebrka, G., Zikic, D., Ristic, Z., Bozic, A., (1997) Yield and meat quality of partridges (Perdix perdix L.). 2. Parameters of meat quality of legs and breast of one-year partridges reared under farm conditions. Brown hare and partridges in present agroecosystem, Hunters Association of Vojvodina, Novi Sad, 266-271.

Uscebrka, G., Zikic, D., Stojanovic, S., (2006) Histochemical characteristics of breast and leg muscles in farm bred partridges (Perdix Perdix L.). Proceedings of XII European Poultry Conference. Verona, Italy, September 10-14.

Večerek, V., Šerman., V., Vitula, F., Straková, E., Suchý, P., Mas, N., Lukac, Z., (2008) Slaughter value of selected breeds of wildfowl. Krmiva 50 (6), 335-344.

Vitula, F., Suchý, P., Straková, E., Karásková, K., Zapletal, D., Kroupa, L. (2011) Energy value of meat in selected species of feathered game. Acta Veterinaria Brno, 80. 197-202. DOI:10.2754/avb201180020197.

Wilkanowska, A., Kokoszyński, D., (2011) Comparison of slaughter value in Pharaoh quail of different ages. Journal of Central European Agriculture, 12 (1), 145-154. DOI: 10.5513/JCEA01/12.1.891

Ziołecki, J., Doruchowski, W., (1989) Estimation methods of poultry slaughter value. Edited by Poultry Research Center Poznań, 1-22. (In Polish)