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Growth and development of young game pheasants *(Phasianus colchicus)*

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Abstract

Fifty game pheasants were kept to 8 weeks in confinement housing and later maintained outdoors in a partially roofed aviary. Pheasants received commercial feed mixtures *ad libitum*. Body weight and dimensions were determined every 4 weeks. Ten pheasants were selected for slaughter at the end of 18 and 20 weeks each. After slaughter, their heads, shanks, feathers, blood, inedible viscera and major internal organs were weighed and digestive tract separated and measured. The carcasses were dissected. Higher body weights and daily gains were found in males than in females on all test days during rearing to 20 weeks of age. Compared to females, males had significantly longer keel from 4 weeks, longer lower thighs and shanks from 8 weeks, and longer trunk with and without neck and greater chest circumference from 12 weeks of age. Older pheasants had a significantly lower proportion of feathers and blood, and higher content of inedible viscera, with significantly relatively shorter (cm 100 g b.w.$^{-1}$) small intestine, caecum and rectum in males than in females. With advancing age, there was a decrease in the proportion of gizzard (significant) and liver, and in males a significant increase in the proportion of testicles.

Keywords: pheasant, growth, body dimensions, carcass components, internal organs, intestine

Zusammenfassung

Wachstum und Entwicklung junger Jagdfasane

Die Untersuchungen erfolgten an 50 Jagdfasanen, die bis zur 8. Lebenswoche im Stall und anschließend im Freien mit teilweise überdachter Voliere gehalten wurden. Die Tiere erhielten industrielles Mischfutter *ad libitum*. Alle 4 Wochen erfolgte die Wägung und Körperformbeurteilung der Tiere. Am Ende der 18. und 20. Woche wurden je 10 Tiere geschlachtet. Nach der Zerlegung wurden Kopf, Federn, Blut, Beine, die nicht essbaren Innereien und die wichtigsten inneren Organe gewogen sowie der Magen- Darmtrakt vermessen. Während des gesamten Versuchsablaufes erreichten die männlichen Tiere höhere Tageszunahmen und Körpergewichte. Ab der 4. Woche erreichten die männlichen gegenüber den weiblichen Tieren einen wesentlich längeren Brustbeinkamm, ab der 8. Woche längere Beine – gemessen sowohl mit als auch ohne Hals – sowie einen größeren Brustumfang. Ältere Fasane wiesen einen wesentlich kleineren Feder- und Blutanteil, einen größeren Anteil nicht essbarer Innereien und männliche Tiere einen signifikant kürzeren

Dünndarm in cm je 100 g Körpergewicht, Blinddarm und Mastdarm auf. Mit fortschreitendem Alter fanden sich bei männlichen Tieren ein kleinerer Muskelmagen- und Leber- sowie ein höherer Hodenanteil.

Schlüsselwörter: Fasan, Wachstum, Körpermaße, Schlachtteilstücke, innere Organe, Darm

Introduction

Growth traits of young game pheasants were investigated by Torgowski *et al*. (1990), Ricard *et al*. (1991), Sarica & Karaçay (1994), Krystianiak & Torgowski (1998), Tepeli *et al*. (1999), Straková *et al*. (2005), Ipek & Dikmen (2007), Đorđević *et al*. (2010), Kuźniacka & Adamski (2010). A study by Straková *et al*. (2005) showed that pheasants have the highest daily weight gains between 41 and 70 days of age (13 g/day) and males have significantly higher ($P<0.01$) gains (12 g/day) than females (9 g/day) between 1 and 90 days of age. Meanwhile, Ipek & Dikmen (2007) found the highest weight gains of pheasants to occur between 4 and 8 weeks of age. Other research demonstrated that pheasants already reach the final length of lower thigh and shank at 12 weeks of age. Keel length increases longer (to 12-16 weeks), and chest length and circumference to 24 weeks of age (Mróz 2003).

Determination of growth rate is one of the ways to monitor the growth of pheasants. Using the formula suggested by Brody, it was shown that the growth rate of pheasants was most intensive up to 4 weeks and steadily decreased up to 8 weeks (Mróz 2003).

In Poland, meat pheasants are usually slaughtered at 16-18 weeks of age when the birds weigh about 1 kg and has full feathering. In addition, pheasants are characterized by high dressing percentage of 69.7-73.7 % when slaughtered at the age of 16-20 weeks. Breast muscle content of game pheasant carcasses ranges from 29.2 to 33.2 % according to age and is markedly higher than in broiler chickens (20.8-24.5 %). The proportion of leg muscles is also high and ranges from 22.0 to 24.7 % in pheasants and from 19.9 to 22.2 % in broiler chickens (Adamski & Kuźniacka 2006, Kokoszyński & Bernacki 2008, Kokoszyński *et al*. 2008, Gornowicz *et al*. 2009).

Pheasant meat is characterized by high nutritive value, as evidenced by high protein content of breast (23.5-25.2 %) and leg muscles (19.4-22.7 %), and low proportion of fat (0.6-1.1 %), especially in breast muscles (Večerek *et al*. 2005, Kuźniacka *et al*. 2007). The content of most amino acids in breast and thigh muscles (in relation to dry matter) is significantly higher ($P\leq0.01$) in pheasants than in broiler chickens (Straková *et al*. 2006).

Growth of pheasants is also reflected in the weight and dimensions of internal organs. Analysis of the weight of crop, oesophagus, gizzard and intestine showed that they grow up to 12 weeks of age, after which they develop their physiological ability. Reproductive organs of pheasants grow to 24 weeks of age with intensive development in February and March, which precedes the onset of lay (Mróz 2003). The structure, weight and length of the digestive tract and other internal organs of pheasants depend, among others, on housing system, nutrition and gender (Marzoni *et al*. 2005, Baohua *et al*. 2010, Kokoszyński *et al*. 2010, Ricard & Petitjean 1989, Hell *et al*. 2003).

The aim of the study was to analyse the weight and body dimensions of young growing game pheasants, and to determine carcass yield, carcass composition and the development of major internal organs.

Material and methods

The study was conducted with 50 game pheasants. The birds were raised for meat. Day-old game pheasant chicks were obtained on 1 June 2008. Eggs for hatching were collected at the 3rd week of the first year of egg production. Birds were kept in confined housing to 8 weeks of age (on plastic mesh floor during the first three weeks and later in pens on straw). From 9 weeks they were maintained outdoors in a partially (one-third) roofed aviary on sand floor. Birds were kept without regard to sex in one group, which initially had 50 pheasants. Stocking density was 3-4 birds/m^2 from 1 to 8 weeks of age and around 1 bird/m^2 from 9 weeks to the end of the experiment. Birds were fed commercial feed mixtures *ad libitum*. They received a diet containing 27.0 % crude protein (CP) and 11.8 MJ metabolizable energy (ME) to 4 weeks, 23.5 % CP and 12.1 MJ ME from 5 to 8 weeks, and 17.0 % CP and 11.5 MJ ME from 9 weeks to the end of the experiment.

Birds were weighed individually on electronic scales (Medicat) at 1 day of age and at the end of 4, 8, 12, 16 and 20 weeks. They were tape-measured with an accuracy of 1 mm for length of trunk with neck (between the first cervical vertebra and posterior superior tuberosity of the ischium), length of trunk (between shoulder joint and posterior tuberosity of the ischium), length of keel (from the anterior to the posterior edge of the keel), chest circumference (behind wings through anterior edge of the keel and middle thoracic vertebra), length of lower thigh (along the lower thigh bone) and length of shank (between tarsal joint and posterior area of the first toe at its base). Five males and five females of body weight similar to the body weight of a given sex were each selected at 18 and 20 weeks of age. This was followed by slaughter, plucking and evisceration. Head, shanks, blood and inedible viscera were separated and weighed. Feathers weight was determined from the difference between preslaughter weight and total weights of uneviscerated carcass after defeathering, head, shanks and blood. The digestive tract was separated after carcass evisceration. The lengths of small intestine, caeca and rectum were tape-measured with an accuracy of 1 mm. Total length of intestine and its segments was converted into 100 g body weight. In addition, proventriculus, gizzard, liver, heart and spleen (and testicles in males) were separated and weighed, and the percentage of these organs in preslaughter body weight was calculated.

Pheasant carcasses were subjected to simple dissection according to the method of Ziołecki & Doruchowski (1989) and separated into breast and leg muscles, neck, wings, skin with subcutaneous fat and abdominal fat. The skeleton and some skeletal muscles (the remainder of the carcass) were left after the dissection.

The data were analysed statistically. Arithmetic means and standard errors (SE) were calculated. Significant differences between the means in particular sexes and on test days were determined using Student's *t*-test.

Results

The mean body weight of male and female pheasants increased with age. The highest body weight gain was found in males between 9 and 12 weeks of age and in females between 5 and 8 weeks of age. Throughout the experiment, i.e. until 20 weeks of growth, males were significantly heavier than females (Table 1).

Compared to females, males had longer keel at the age of 4 weeks and significantly longer shanks and lower thigh 4 weeks later. At 12 weeks of age, males also had significantly ($P \leq 0.05$) longer trunk with and without neck and greater chest circumference.

Sexual dimorphism increased with age. The highest increase in body dimensions occurred up to 12 weeks of age. Lower thigh and shank length increased until 12 weeks of age. Length of trunk with neck and length of trunk increased until 16 weeks, whereas keel length and chest circumference had the highest values at 20 weeks of age when the experiment was terminated, possibly indicating that the growth of these body parts did no cease (Table 1).

Table 1
Body weight and dimensions of game pheasants

Trait		Age, weeks – sex									
		4		8		12		16		20	
		m	f	m	f	m	f	m	f	m	f
Body weight, g	x	203	180*	587	493*	995	782*	1 240	956*	1 355	998*
	SE	6.7	4.2	18.8	22.0	31.9	32.5	43.7	19.2	25.8	27.6
Length of trunk with neck, cm	x	15.3	15.0	25.6	24.8	29.0	26.7*	29.8	26.9*	29.6	26.9*
	SE	0.2	0.3	0.4	0.5	0.5	0.3	0.6	0.3	0.3	0.3
Trunk length, cm	x	10.7	10.7	17.4	16.7	19.4	17.2*	19.6	17.4*	19.4	17.4*
	SE	0.2	0.1	0.5	0.4	0.4	0.4	0.4	0.5	0.3	0.3
Chest circumference, cm	x	14.5	14.3	19.8	19.0	24.3	22.7*	28.0	25.0*	31.2	28.1*
	SE	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.2	0.7	0.6
Keel length, cm	x	7.0	6.6*	9.1	8.4*	10.8	9.3*	11.6	10.5*	12.2	10.8*
	SE	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Lower thigh length, cm	x	7.4	7.2	11.1	10.3*	13.4	12.1*	13.2	11.9*	13.2	11.8*
	SE	0.1	0.1	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1
Shank length, cm	x	4.5	4.4	6.8	6.3*	7.5	6.9*	7.0	6.4*	7.4	6.6*
	SE	0.1	0.1	0.1	0.2	0.1	0.1	0.3	0.3	0.2	0.3

m: males, f: females, *statistically significant differences between males and females of the same age ($P \leq 0.05$)

Table 2
Body weight gains of game pheasants

Trait		Age, weeks				
		1-4	5-8	9-12	13-16	17-20
Body weight gain in males, g/day	x	6.8	13.7	14.6	8.8	4.1
	SE	0.2	0.5	0.8	0.5	0.4
Body weight gain in females, g/day	x	5.9*	11.2*	10.3*	6.2*	1.5*
	SE	0.2	0.5	0.8	0.7	0.3

*statistically significant differences between males and females of the same age ($P \leq 0.05$)

Daily weight gains were significantly higher in males (from 4.1 to 14.6 g) than in females (from 1.5 to 11.2 g). The highest daily weight gains were found between 9 and 12 weeks in males and between 5 and 8 weeks in females. In the final four weeks of evaluation, daily weight gains showed a marked decline, especially in females (Table 2).

Percentage of feathers and blood in the body weight of pheasants at the end of 20 weeks was significantly lower, and that of inedible viscera higher than in 18-week-old birds. The proportion of shanks, feathers and inedible viscera was lower, and that of head higher in males than in females. Significant differences between males and females were only found for inedible viscera (Table 3).

Table 3
Proportion of inedible body parts

Trait		Age, weeks		Sex	
		18	20	males 18 & 20	females 18 & 20
Head, %	x	3.5	3.4	3.5	3.3
	SE	0.1	0.1	0.1	0.1
Shanks, %	x	2.4	2.3	2.4	2.7
	SE	0.1	0.1	0.1	0.1
Feathers, %	x	9.4[a]	8.1[b]	8.7	8.9
	SE	0.2	0.2	0.3	0.3
Blood, %	x	2.4[a]	1.9[b]	2.1	2.1
	SE	0.1	0.1	0.2	0.1
Inedible viscera, %	x	8.3[a]	10.2 b	8.6	10.0*
	SE	0.4	0.5	0.5	0.5

[a,b]statistically significant differences between pheasants of different age ($P \leq 0.05$), *statistically significant differences between males and females of the same age ($P \leq 0.05$)

The mean body weight and carcass weight of male and female pheasants selected for dissection at the age of 20 weeks were higher than in birds at the age of 18 weeks. Statistically significant differences in body weight were only observed between birds of different sexes. Dressing percentage was high and exceeded 69 %. Higher dressing percentage was found in males. The carcasses of older pheasants contained more breast muscles and remainders of the carcass, and less neck, wings, skin with subcutaneous fat and abdominal fat. A significant effect of age was only found for the proportion of skin with fat. Differences in percentage of neck, skin with fat and abdominal fat between males and females were statistically significant ($P \leq 0.05$). Compared to females, the carcasses of males had a higher content of neck, wings, breast and leg muscles, and a lower content of skin with subcutaneous fat, abdominal fat and remainders of the carcass – Table 4.

Table 4
Body weight, dressing percentage and proportion of carcass components of game pheasants

Trait		Age, weeks		Sex	
		18	20	males 18 & 20	females 18 & 20
Body weight before slaughter, g	x	1 114	1 157	1 286	951*
	SE	46.4	69.5	22.8	19.2
Carcass weight, g	x	784	815	910	663*
	SE	34.5	52.5	17.5	17.6
Dressing percentage, %	x	70.4	70.4	70.8	69.7
	SE	0.3	0.7	0.4	0.6
Neck, %	x	4.3	4.2	4.5	3.9*
	SE	0.1	0.1	0.1	0.1
Wings, %	x	11.0	10.7	11.1	10.6
	SE	0.1	0.1	0.1	0.1
Breast muscles, %	x	31.7	33.0	32.5	32.1
	SE	0.5	0.7	0.5	0.8
Leg muscles, %	x	24.6	24.6	24.7	24.5
	SE	0.5	0.5	0.4	0.6
Skin with subcutaneous fat, %	x	7.0[a]	5.8[b]	5.9	7.0*
	SE	0.3	0.1	0.3	0.4
Abdominal fat, %	x	0.2	0.1	0.1	0.2*
	SE	0.05	0.05	0.03	0.04
Remainders of carcass, %	x	21.2	21.6	21.2	21.7
	SE	0.5	0.5	0.5	0.5

[a,b]statistically significant differences between pheasants of different age ($P \leq 0.05$), *statistically significant differences between males and females of the same age ($P \leq 0.05$)

Table 5
Relative lengths of intestines (cm × 100 g b.w.$^{-1}$) of game pheasants

Trait		Age (weeks)		Sex	
		18	20	males 18 & 20	females 18 & 20
Small intestine	x	10.35	9.38	8.48	11.56*
	SE	0.65	0.62	0.29	0.54
Caeca	x	3.21	3.11	2.82	3.57*
	SE	0.16	0.17	0.09	0.13
Rectum	x	0.70	0.69	0.61	0.79*
	SE	0.04	0.05	0.03	0.05
Total intestine	x	14.19	13.19	11.86	15.93*
	SE	0.84	0.81	0.34	0.66

*statistically significant differences between males and females of the same age ($P \leq 0.05$)

Compared to females, males were characterized by significantly shorter relative lengths of the intestine and its segments (Table 5). Older birds had smaller relative lengths of the small intestine, caeca and rectum and smaller total intestine length.

With age, percentage of gizzard in the body of pheasants decreased significantly and the proportion of testicles in males increased significantly. In older birds, the proportion of liver was lower and that of proventriculus and spleen the same. Males had significantly lower content of gizzard and non-significantly lower proportion of proventriculus and liver compared to females – Table 6.

Table 6
Proportion of major internal organs in preslaughter body weight of pheasants

Trait		Age, weeks		Sex	
		18	20	males	females
			18 & 20	18 & 20	
Gizzard, %	x	1.7[a]	1.5[b]	1.5	1.7*
	SE	0.07	0.08	0.08	0.06
Proventriculus, %	x	0.4	0.4	0.3	0.4
	SE	0.02	0.01	0.02	0.02
Liver, %	x	2.0	1.9	1.9	2.0
	SE	0.08	0.03	0.05	0.05
Heart, %	x	0.5	0.5	0.5	0.5
	SE	0.02	0.03	0.02	0.03
Spleen, %	x	0.07	0.07	0.07	0.07
	SE	0.01	0.01	0.01	0.01
Testicles, %	x	0.01[a]	0.05[b]	0.03	-
	SE	0.003	0.008	0.006	-

[a,b]statistically significant differences between pheasants of different age ($P \leq 0.05$), *statistically significant differences between males and females of the same age ($P \leq 0.05$)

Discussion

Male and female game pheasants evaluated in other studies were characterized by lower body weight at 4, 8, 12, 16 and 20 weeks of age compared to those analysed in the present experiment (Adamski & Kuźniacka 2006, Ipek & Dikmen 2007). However, birds evaluated at 20 weeks of age had slightly lower body weight than 17-week-old pheasants kept in aviaries (Ricard *et al*. 1991). Moreover, as in studies by Ricard *et al*. (1991), Sarica & Karaçay (1994) and Adamski & Kuźniacka (2006), the analysed males were heavier than females.

The analysed males and females had longer keel, shorter shanks and generally longer trunk and lower thigh compared to game pheasants investigated by Winnicka (cited from Mróz 2003).

Young pheasants show a high rate of growth, but their daily gains vary according to growth period. Ipek & Dikmen (2007) found the highest daily weight gains of pheasants between 4 and 8 weeks, Ricard *et al*. (1991) and Straková *et al*. (2005) between 6 and 10 weeks, and Sarica & Karaçay (1994) between 7 and 12 weeks of age.

The analysed pheasants were characterized by high dressing percentage. However, the percentage of eviscerated carcass with neck in preslaughter body weight of the pheasants selected for dissection was lower than in 16- and 20-week old male and female pheasants evaluated by Adamski & Kuźniacka (2006). Likewise, Sarica *et al*. (1999) and Straková *et al*. (2005) obtained higher dressing percentage in younger pheasants than those evaluated in

our experiment. In the present study, dressing percentage of pheasants did not change with age. Other authors (Sarica *et al*. 1999, Adamski & Kuźniacka 2006) observed higher dressing percentage in older pheasants. Like in studies by Straková *et al*. (2005) and Adamski & Kuźniacka (2006), males had higher dressing percentage than females.

Decreased proportions of neck and wings were found in the carcasses of older pheasants. Earlier studies (Sarica *et al*. 1999, Adamski & Kuźniacka 2006) also reported the proportion of wings to decrease in the carcasses of older birds. The proportion of breast muscles in carcasses with neck was higher in pheasants aged 20 weeks compared to 18-week-old birds and higher in males than in females, which is in agreement with the findings of Adamski & Kuźniacka (2006). Meanwhile, Torgowski *et al*. (1990) and Straková *et al*. (2005) observed that the content of breast muscles was higher in females than in males. In the carcasses of analysed pheasants, the content of leg muscles did not change with age. In another experiment (Adamski & Kuźniacka 2006), the proportion of leg muscles decreased from 23.9 % in 16-week-old pheasants to 23.0 % in 20-week-old birds. The total content of skin with subcutaneous fat in the analysed pheasants was higher in female than in male breeding pheasants evaluated by Tucak *et al*. (2004). Meanwhile, Adamski & Kuźniacka (2006) found a higher content of skin with subcutaneous fat and abdominal fat in 16- and 20-week-old males and females compared to that reported in our study. The content of abdominal fat in the carcasses of evaluated pheasants was lower (Straková *et al*. 2005), similar (Kokoszyński *et al*. 2008 b) or higher (Sarica *et al*. 1999) than in other experiments.

As in earlier studies with broiler chickens, relative lengths of small intestine, caeca (Amerah & Ravindran 2008, Gabriel *et al*. 2008) and rectum decreased with age. The significantly greater relative lengths of intestines in females than in males is associated with their greater lengths and with lower body weights of the hens. Percentage of gizzard (ventriculus) in the analysed birds was greater than in pheasants of similar age (males 1.16 and 1.33 %, females 1.36 %) studied by Ricard and Petitjean (1989). Meanwhile, Kokoszyński *et al*. (2010) found higher gizzard content in the body of males (1.6 %) and the same content in females (1.7 %) receiving only feed mixtures at 16 weeks of age as in the analysed birds, whereas Marzoni *et al*. (2005) reported higher gizzard content in 120-day-old pheasants (control group 1.9 %, experimental group 1.8 %). The mean values of liver percentage were higher than those reported for pheasants aged about 5 months (males 1.30 and 1.48 %, females 1.38 %) by Ricard and Petitjean (1989) and for 20-week-old birds (control group 1.65 %, caponized group 1.72 %) by Severin *et al*. (2006). Liver content in the analysed females was higher than in males, just as in 16-week-old pheasants fed a diet containing whole wheat grain (Kokoszyński *et al*. 2010). The heart content in males was similar or the same, and in females lower than in earlier research (Ricard & Petitjean 1989, Kokoszyński *et al*. 2010), whereas spleen percentage was lower than in breeding pheasants (males 0.11, females 0.12 %) of similar age investigated by Hell *et al*. (2003).

In conclusion, lower thigh and shank length increased until 12 weeks of age. Length of trunk with neck and length of trunk increased until 16 weeks, whereas keel length and chest circumference had the highest values at 20 weeks of age. Older pheasants had a significantly lower proportion of feathers and blood, and a higher proportion of inedible viscera and relatively shorter intestines. The carcasses of 20-week-old birds contained more breast muscles and less neck and wings. With age, the percentage of gizzard decreased

significantly and the proportion of testicles in males increased significantly. Male pheasants had significantly higher body weights and daily gains than in females. Compared to females, males had significantly longer keel from 4 weeks, longer lower thigh and shank from 8 weeks, and longer trunk with and without neck and greater chest circumference from 12 weeks of age. Dissected males had significantly higher body weight, higher proportion of neck in carcass, and lower proportion of skin with fat and abdominal fat, as well as relatively shorter intestine than females.

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