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Research Article

Zoometrical Body Measurements and Their Relation with Liveweight in Native Turkish Geese

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Abstract: The aims of this study were to determine the body measurements of native Turkish geese and to define the relationship between these measurements and liveweight. The differences in head diameter and neck length between the sexes became significant at 10, 12, 14 and 16 weeks of age ($P < 0.05$-0.01). The beak and wing lengths increased with age and were longer in males than in females at 12, 14 and 16 weeks of age. The effect of sex on body and trunk length was significant at 14 and 16 weeks ($P < 0.05$-0.01). Chest depth, girth and width increased with age.

The positive correlations (0.88-0.97) of liveweight with head diameter, neck length, body length, trunk length, chest girth, wing length and metatarsus length at 2 weeks of age were highly significant. The most reliable prediction from the regression analyses was between liveweight and body length + chest girth in weeks 2 and 8 ($R^2 = 94\%$). Our study presents the body measurements and the correlations between these measurements and liveweight in geese of different ages. These correlations might be used to evaluate the liveweight of studied geese population and for selection based on liveweight.

Key Words: Geese, body measurement, liveweight, correlation, regression

Yerli Kazlarda Zoometrikal Beden Ölçüleri ve Bu ölçülerle Canlı Ağırlık Arasındaki İlişkiler

Özet: Çalışma farklı yaşlardaki erkek ve dişi yerli kazlarda beden ölçülerini belirlemek ve bu ölçülerle canlı ağırlık arasındaki ilişkileri tespit etmek amacıyla yapılmıştır. Cinsiyetler arasında baş çapı ve boyun uzunlukları bakımından 10, 12, 14 ve 16. haftalık yaşlarda istatistiksel olarak önemli farklılıklar bulunmuştur ($P < 0,05$-$0,01$). Gaga ve kanat uzunlukları yaş ile birlikte artmış ve 12, 14 ve 16 haftalık yaşlarda erkeklerde dişilerden daha yüksek düzeyde belirlenmiştir. Vücut ve gövde uzunluğu üzerine cinsiyetin etkisi 14 ve 16 haftalık yaşlarda istatistiksel olarak önemli bulunmuştur ($P < 0,05$-$0,01$). Göğüs derinliği, göğüs çevresi ve göğüs genişliği yaş ile birlikte artmıştır.

Canlı ağırlık ile baş çapı, boyun uzunluğu, vücut uzunluğu, gövde uzunluğu, göğüs çevresi, kanat uzunluğu ve metatarsus uzunluğu arasında 2 haftalık yaşta yüksek derecede önemli ($P < 0,01$-$0,001$) pozitif korelasyonlar (0,88-0,97) belirlenmiştir. Yapılan regresyon analizi sonucunda en güvenilir tahmin 2 ve 8. haftalarda canlı ağılık ile beden uzunluğu + göğüs çevresi ölçümleri arasında bulunmuştur ($R^2 = \%\ 94$). Sonuç olarak çalışmada, farklı yaşlardaki yerli kazların vücut ölçüleri belirlenmiş ve bu ölçülerin canlı ağırlıkla arasındaki ilişkiler ortaya konulmuştur. Kolaylıkla ölçülebilen beden ölçüleri canlı ağırlık belirlemesinde ve canlı ağırlık için yapılacak olan seleksiyonda kriter olarak kullanılabilecek düzeydedir.

Anahtar Sözcükler: Kaz, beden ölçüleri, canlı ağırlık, korelasyon, regresyon

Introduction

Growth is a complicated progress and enlargement in size is the most straightforward form of it as manipulated by genetic and environmental factors. These factors are expressed with the species, breeds and sexes. Body growth in livestock may be evaluated with body components such as liveweight and body measurements. Brody (1) stated that growth rate shows variation according to organs and tissue.

Waterfowl undergo fast growth in the first weeks of life. The waterfowl species vary in growth rates and generally males grow faster than females. Especially in

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geese, males exceed females by more than 10% up to the age of 8 weeks (2,3).

Growth in geese can be assessed and defined in several ways, including body measurement. It was reported that measurements of body parts are useful for assessing liveweight in geese (1,2,4). Szabone Willin (5) reported a positive correlation between liveweight and head length, beak length, chest girth, body length, trunk length, neck length, wing length, metatarsus length and diameter at different weeks of age in geese.

According to Lilja (6), digestive organs and liver in geese develop quickly compared to the late development of wings and some non-edible parts of the body. Chelmonska et al. (7) reported that the zoometrical measurements of geese at the age of 12 weeks allow the characterization of carcass conformation, and the carcass fatness can be estimated using multiple regression equations. Breeders need some techniques to select animals for their breeding aims. Examining the relationship between liveweight and measurements of body parts in geese can help breeders to select animals at early ages (5).

Goose production is regarded as a regional livestock sector in Turkey and is mostly practiced in eastern and northern parts of Turkey. Thus, many studies were performed in these regions and the mature liveweight of native geese was defined as 4-6 kg (8-10). The present study aimed to determine the body measurements of native Turkish geese for both males and females at different weeks of age and to define the relationship between these measurements and liveweight. This definition may yield a selection criterion based on the relationship between body weight and some easily measurable body parts.

Materials and Methods

Birds and Management

The study was carried out at the research farm of Kafkas University. The animals comprised 45 male and 42 female native Turkish geese. Goslings were wing-tagged after hatching and sex was determined after week 10. One-day-old goslings were placed in brooder batteries. At the age of 2 weeks they were transferred into a shelter run, with both sexes together. All 87 goslings were kept in metal pens with sawdust bedding and 0.4-0.8 m^2 floor space was allowed for each animal from 2 to 16 weeks (11). All goslings were fed a starter diet (22% CP and 2900 kcal/kg metabolizable energy) until 6 weeks old. Thereafter, they were offered a grower diet (until the end of 16 weeks) with 15% CP and 2900 kcal/kg metabolizable energy as recommended for geese by the National Research Council (12). Food and water were offered *ad libitum*.

Body measurements

Goslings were weighed fortnightly, from 2 weeks of age until 16 weeks of age. Zoometrical body measurements were taken just after each weighing. In this study beak length was defined as length of the upper beak rim, and head length as the distance between the end of the beak and the end of the condylus occipitale. In addition, beak and head diameter were measured using calipers. Neck length was measured between the first and the last cervical vertebrae and trunk length between the first dorsal vertebra and the pygostyle. Body length was measured between the first cervical vertebra and the pygostyle. The length and diameter of the tibia and metatarsus were measured on the right leg. Chest depth was measured between the first back vertebra and the sternum. Chest width was measured as the distance between the right and left glenoid cavity. Chest depth and width were quantified using a pair of measuring compasses. Wing length was established as the linear measurement from the *caput humeri* to the end of the third *carpal digit* (5).

Statistical Analysis

The relative growth in the body parts changed over time and the values for the 2 sexes were analyzed separately. The significance of differences between the sexes was determined by *t*-test and correlation coefficients were calculated between live weight and various body measurements. Regression predictions were applied between liveweight and easily measurable body parts (body length and chest girth). SPSS 10.0 was used for the statistical analyses.

Results

Head length and diameter, beak length and diameter, wing length, neck length, body length and trunk length at

different weeks of age in both males and females are presented in Table 1. The differences in head diameter and neck length between the sexes became statistically significant at 10, 12, 14 and 16 weeks of age ($P < 0.05$-0.01). The beak and wing length increased with age, and were found longer in males than in females at 12, 14 and 16 weeks of age ($P < 0.05$-0.01). Beak diameter was significantly greater in males than in females at 8, 10, 12, 14 and 16 weeks of age ($P < 0.05$-0.01). The effect of sex on body and trunk length was significant at 14 and 16 weeks of age ($P < 0.05$-0.001). Head length was not affected by sex at different weeks of age ($P > 0.05$).

The means of chest depth, chest girth, chest width, tibia length and diameter, and metatarsus length and diameter according to different weeks of age are presented in Table 2. Chest depth, girth and width increased with age. Chest depth was affected by sex at 10, 12, 14 and 16 weeks of age ($P < 0.05$). In addition, chest girth was affected by sex at 16 weeks ($P < 0.05$); chest width was affected by sex at 12, 14 and 16 weeks of age ($P < 0.05$-0.01). Metatarsus length was significantly higher in males than in females at 14 and 16 weeks ($P < 0.05$). Tibia length and diameter were higher in males than in females in all age groups but not always significantly so.

Table 3 shows the correlation coefficients between the liveweight and various body measurements. The correlations of liveweight with head diameter, neck length, wing length, body length, trunk length, and chest girth and metatarsus length at 2 weeks of age were highly significant ($P < 0.01$-0.001). There were significant positive correlations of beak length, body length, and chest girth and metatarsus diameter with liveweight at 16 weeks of age ($P < 0.05$-$P < 0.001$).

Regression equations between liveweight and body measurements are presented in Table 4. The most reliable prediction was between liveweight and body length + chest girth at 2 and 8 weeks (R^2 = 94%). The lowest R^2 was found at 10 weeks between the liveweight and chest girth (R^2 = 44%).

Table 1. Zoometrical body measurements in geese at different weeks according to sex.

Zoometrical measurements	Sex	Weeks							
		2	4	6	8	10	12	14	16
Head length	M	4.78 ± 0.02	5.82 ± 0.08	6.90 ± 0.46	7.80 ± 0.26	8.35 ± 0.31	8.51 ± 0.01	8.88 ± 0.07	8.95 ± 0.12
(mm)	F	4.72 ± 0.02	5.72 ± 0.09	6.70 ± 0.26	7.61 ± 0.04	8.30 ± 0.12	8.36 ± 0.07	8.46 ± 0.20	8.50 ± 0.74
		-	-	-	-	-	-	-	-
Head diameter	M	2.56 ± 0.09	2.81 ± 0.11	3.19 ± 0.11	3.57 ± 0.11	3.72 ± 0.04	3.77 ± 0.07	3.75 ± 0.04	3.79 ± 0.02
(mm)	F	2.50 ± 0.07	2.75 ± 0.10	3.12 ± 0.22	3.44 ± 0.11	3.53 ± 0.05	3.53 ± 0.07	3.56 ± 0.02	3.58 ± 0.06
		-	-	-	-	*	*	**	**
Beak length	M	3.52 ± 0.04	4.78 ± 0.14	5.76 ± 0.40	6.46 ± 0.16	6.70 ± 0.26	7.24 ± 0.02	7.47 ± 0.02	7.50 ± 0.16
(mm)	F	3.50 ± 0.04	4.68 ± 0.13	5.60 ± 0.37	6.05 ± 0.26	6.70 ± 0.31	6.85 ± 0.15	6.96 ± 0.04	7.04 ± 0.05
		-	-	-	-	-	*	**	*
Beak diameter	M	2.06 ± 0.03	2.44 ± 0.07	2.84 ± 0.16	3.36 ± 0.09	3.44 ± 0.04	3.40 ± 0.04	3.39 ± 0.02	3.43 ± 0.04
(mm)	F	2.06 ± 0.03	2.43 ± 0.06	2.94 ± 0.18	3.08 ± 0.05	3.20 ± 0.02	3.24 ± 0.06	3.25 ± 0.02	3.25 ± 0.05
		-	-	-	*	**	*	**	*
Wing length	M	12.60 ± 0.37	24.40 ± 0.19	38.20 ± 0.34	46.50 ± 0.22	46.10 ± 1.63	48.80 ± 0.37	49.10 ± 0.24	50.80 ± 0.37
(cm)	F	12.30 ± 0.30	24.00 ± 0.00	37.40 ± 0.24	46.30 ± 0.34	46.30 ± 0.80	47.10 ± 0.40	48.00 ± 0.32	49.40 ± 0.24
		-	-	-	-	-	*	*	*
Neck length	M	12.10 ± 0.19	14.50 ± 0.16	19.70 ± 1.04	21.00 ± 0.91	22.50 ± 0.50	23.10 ± 0.89	23.40 ± 0.40	24.80 ± 0.20
(cm)	F	11.90 ± 0.19	14.00 ± 0.52	18.40 ± 1.63	19.40 ± 1.86	20.20 ± 0.97	21.90 ± 0.55	22.10 ± 0.33	23.20 ± 0.58
		-	-	-	-	*	*	*	*
Body length	M	32.10 ± 0.76	37.20 ± 0.73	42.80 ± 2.70	46.20 ± 1.30	52.60 ± 1.70	55.90 ± 0.93	59.24 ± 1.20	62.00 ± 2.50
(cm)	F	31.30 ± 0.68	36.70 ± 0.80	40.40 ± 3.40	43.70 ± 1.20	50.80 ± 1.90	53.90 ± 1.20	57.34 ± 1.10	58.50 ± 1.60
		-	-	-	-	-	-	*	*
Trunk length	M	20.00 ± 0.82	21.70 ± 0.89	24.20 ± 1.27	26.80 ± 0.84	32.30 ± 0.80	34.80 ± 0.20	36.10 ± 0.10	38.20 ± 0.20
(cm)	F	19.40 ± 0.66	21.70 ± 1.03	23.30 ± 0.77	26.00 ± 0.00	32.40 ± 0.40	33.80 ± 0.37	34.90 ± 0.10	36.10 ± 0.10
		-	-	-	-	-	-	**	***

- : $P > 0.05$ (Non-significant) *: $P < 0.05$. **: $P < 0.01$. M: Male, F: Female

Table 2. Zoometrical body measurements in geese at different weeks according to sex.

Zoometrical measurements	Sex	Weeks							
		2	4	6	8	10	12	14	16
Chest depth	M	4.60 ± 0.19	6.50 ± 0.00	8.94 ± 1.00	10.50 ± 0.16	10.70 ± 0.20	11.10 ± 0.10	11.20 ± 0.20	11.80 ± 0.37
(cm)	F	4.50 ± 0.22	6.20 ± 0.27	9.00 ± 0.82	10.30 ± 0.34	10.10 ± 0.10	10.40 ± 0.19	10.54 ± 0.16	10.80 ± 0.12
		-	-	-	-	*	*	*	*
Chest girth	M	20.80 ± 0.49	27.40 ± 0.68	36.20 ± 2.70	38.40 ± 1.20	41.20 ± 0.58	42.20 ± 0.98	43.40 ± 0.99	45.20 ± 1.20
(cm)	F	20.60 ± 0.40	26.90 ± 0.51	34.80 ± 2.60	36.80 ± 0.85	39.80 ± 1.50	40.60 ± 0.68	40.52 ± 0.50	41.14 ± 0.76
		-	-	-	-	-	-	-	*
Chest width	M	4.80 ± 0.12	6.40 ± 0.10	9.20 ± 1.01	11.00 ± 0.45	12.30 ± 0.66	12.45 ± 0.44	12.80 ± 0.12	13.00 ± 0.50
(cm)	F	4.80 ± 0.12	6.34 ± 0.10	9.20 ± 1.02	10.90 ± 0.70	11.16 ± 0.58	11.21 ± 0.53	11.30 ± 0.12	11.70 ± 0.20
		-	-	-	-	-	*	**	*
Tibia length	M	10.10 ± 0.46	11.60 ± 0.10	13.30 ± 0.37	14.40 ± 0.40	15.40 ± 0.37	15.70 ± 0.12	15.80 ± 0.20	16.00 ± 0.16
(cm)	F	10.00 ± 0.42	11.40 ± 0.10	13.30 ± 0.12	13.90 ± 0.40	14.50 ± 0.27	15.20 ± 0.20	15.30 ± 0.12	15.50 ± 0.27
		-	-	-	-	-	-	-	-
Tibia diameter	M	0.94 ± 0.00	1.10 ± 0.02	1.47 ± 0.12	1.77 ± 0.10	1.76 ± 0.07	1.79 ± 0.03	1.80 ± 0.01	1.86 ± 0.02
(mm)	F	0.93 ± 0.00	1.09 ± 0.02	1.44 ± 0.17	1.65 ± 0.14	1.69 ± 0.06	1.75 ± 0.01	1.77 ± 0.02	1.83 ± 0.03
		-	-	-	-	-	-	-	-
Metatarsus length	M	5.90 ± 0.24	7.00 ± 0.16	7.30 ± 0.30	7.50 ± 0.27	7.70 ± 0.12	8.20 ± 0.12	8.50 ± 0.16	8.80 ± 0.12
(cm)	F	5.70 ± 0.20	6.90 ± 0.19	7.00 ± 0.16	7.40 ± 0.19	7.60 ± 0.10	7.90 ± 0.24	8.10 ± 0.19	8.40 ± 0.10
		-	-	-	-	-	-	*	*
Metatarsus diameter	M	0.85 ± 0.02	1.05 ± 0.01	1.26 ± 0.34	1.62 ± 0.16	1.73 ± 0.17	1.79 ± 0.01	1.84 ± 0.00	1.88 ± 0.03
(mm)	F	0.86 ± 0.02	1.04 ± 0.01	1.34 ± 0.14	1.47 ± 0.15	1.67 ± 0.17	1.76 ± 0.02	1.80 ± 0.01	1.81 ± 0.03
		-	-	-	-	-	-	-	-

- : P > 0.05 (Non-significant) *: P < 0.05. **: P < 0.01. M: Male, F: Female

Table 3. Correlation coefficients between liveweight and zoometrical body measurements in geese.

Age (weeks)	Liveweight (g)	Head diameter	Beak length	Beak diameter	Neck length	Wing length	Body length	Trunk length	Chest depth	Chest girth	Chest width	Metatarsus length	Metatarsus diameter
2	682	0.88**	0.24	0.24	0.97***	0.95***	0.97***	0.89***	0.24	0.93***	0.24	0.95***	0.14
4	1574	0.71*	0.70*	0.44	0.55	0.38	0.83**	0.21	0.21	0.86***	0.33	0.40	0.31
6	2561	0.54	0.71*	0.61	0.63*	0.32	0.84**	0.33	0.78**	0.84**	0.75*	0.42	0.69*
8	3314	0.42	0.78**	0.37	0.67*	0.34	0.97***	0.34	0.77**	0.92***	0.42	0.28	0.73*
10	3719	0.69*	0.48	0.58	0.67*	0.63*	0.93***	0.27	0.56	0.67*	0.46	0.39	0.28
12	3966	0.51	0.54	0.67*	0.59	0.67*	0.77**	0.42	0.72*	0.79**	0.38	0.32	0.50
14	4123	0.54	0.59	0.61	0.41	0.34	0.73*	0.50	0.47	0.87**	0.49	0.16	0.48
16	4232	0.54	0.70*	0.47	0.57	0.23	0.89***	0.44	0.52	0.78**	0.51	0.06	0.64*

*: P < 0.05, **: P < 0.01, ***: P < 0.001

Table 4. Prediction equations from the regression analyses for liveweight.

Weeks	Prediction equations	Constant	Body length (cm)	Chest girth (cm)	R^2 (%)
2	$Y = a + b_1x_1$	-33.5	23.9		93.7
2	$Y = a + b_2x_2$	- 61.0		37.9	86.6
2	$Y = a + b_1x_1 + b_2x_2$	-57.9	19.0	8.7	94.3
4	$Y = a + b_1x_1$	-51.0	39.0		68.5
4	$Y = a + b_2x_2$	-6.0		51.5	73.9
4	$Y = a + b_1x_1 + b_2x_2$	-64.0	11.3	38.3	74.7
6	$Y = a + b_1x_1$	-15.0	51.1		71.2
6	$Y = a + b_2x_2$	-10.0		59.3	70.9
6	$Y = a + b_1x_1 + b_2x_2$	-27.0	30.5	24.3	71.5
8	$Y = a + b_1x_1$	-31.0	73.1		94.4
8	$Y = a + b_2x_2$	-43.0		87.7	83.8
8	$Y = a + b_1x_1 + b_2x_2$	5.0	79.7	-8.9	94.5
10	$Y = a + b_1x_1$	-94.0	71.9		86.1
10	$Y = a + b_2x_2$	-20.0		91.7	44.4
10	$Y = a + b_1x_1 + b_2x_2$	-43.0	73.0	-2.7	86.1
12	$Y = a + b_1x_1$	-89.0	73.6		58.5
12	$Y = a + b_2x_2$	-41.0		96.4	62.3
12	$Y = a + b_1x_1 + b_2x_2$	-118.0	15.2	78.1	62.6
14	$Y = a + b_1x_1$	-12.0	70.9		53.8
14	$Y = a + b_2x_2$	-7.0		98.4	75.6
14	$Y = a + b_1x_1 + b_2x_2$	-150.0	7.8	91.1	75.9
16	$Y = a + b_1x_1$	-6.0	70.2		78.9
16	$Y = a + b_2x_2$	-56.0		99.1	61.4
16	$Y = a + b_1x_1 + b_2x_2$	-53.0	67.7	4.5	78.9

Discussion

Defined measurements of body parts and the relationship between these traits and liveweight were demonstrated in native Turkish geese. Head length and head diameter showed an increasing trend with age. In different weeks, they were higher in male geese than in female geese during the period evaluated although not always significantly so. Head length in this study was higher than that reported by Szabone Willin (5) for hybrid geese. Head measurements in this study were similar to the values reported by Szabone Willin (5) at 2 and 4 weeks of age, but lower than those reported by the same author (13) at 6, 8, 10, 12, 14 and 16 weeks of age.

Beak length showed extremely intensive growth until 10 weeks of age, and it was almost constant after this time. An intensive increase in beak diameter was not observed after 8 weeks of age.

Male geese exhibited significantly longer neck lengths than female geese at 10, 12, 14 and 16 weeks of age ($P < 0.05$). The rapid growth of neck length was observed from week 2 to week 10, and 10-week lengths were 22.50 and 20.20 cm in males and females, respectively (Table 1). In general, neck length measurements found in this study were lower than those reported by Szabone Willin (5). Wing lengths grew rapidly until 8 weeks of age and showed a slower increase until week 16.

Males grew faster than females in later weeks in terms of body and trunk length; these measurements also showed growth with age. Increases in trunk length slowed around 10 weeks of age, but body length continued to grow until the end of 16 weeks. The results

of trunk length in our study were in agreement with those reported by Szabone Willin (5) at 2 weeks of age, but they were lower at 16 weeks of age.

Chest depth, girth and width are the most important traits in terms of the reflection of growth. Sex factor generated a significant variation in chest depth after 10 week of age, in chest girth at 16 weeks and chest width after 12 weeks of age. In the present study, enlargements in chest depth and width were extremely intensive until 10 weeks of age, and were lower than those reported by Larzul et al. (14). Rapid growth in chest width was observed from week 2 to 8 and it was lower than that reported by Grunder et al. (15). As stated by Larzul et al. (14), there was a significant effect of sex on chest girth at 16 weeks of age; male geese (45.20 cm) had greater measurements than female geese (41.14 cm). Chest girth in our study was similar to the values reported by Szabone Willin (5), Larzul et al. (14) and Grunder et al. (15) at 16 weeks of age. However, the values were lower than those reported by Szabone Willin (5) at 2 weeks of age, and by Chelmonska et al. (7) at 4, 8, 12 and 16 weeks of age. Tibia length, tibia diameter and metatarsus diameter were not affected by sex at different weeks of age ($P > 0.05$). However, metatarsus lengths for males were much higher than those for females at 14 and 16 weeks of age ($P < 0.05$). Corresponding metatarsus length was similar to the values reported by Chelmonska et al. (7) at 4 weeks of age, but it was lower at 8, 12 and 16 weeks of age.

The correlation (0.69-0.88) of liveweight with head diameter was positively significant at 2, 4 and 10 weeks of age ($P < 0.05$-0.01). Although significant correlations between liveweight and beak length were defined at 4, 6, 8 and 16 weeks of age ($P < 0.05$-0.01), a significant correlation of liveweight with beak diameter was only found at 12 weeks of age ($P < 0.05$). The determined phenotypic correlation between liveweight and beak length in the present study was in agreement with Szabone Willin (5). The major period of growth was reflected by the high correlation between the liveweight and neck, trunk and body lengths at many weeks (Table 3) as stated by Szabone Willin (5).

Chest measurements are regarded as reliable criteria to evaluate the liveweights of most livestock. Chest depth, girth and width were positively correlated with liveweight, but the strongest correlations were observed between chest girth and liveweights (0.67-0.93). These correlations were similar to those reported by Szabone Willin (5) and Larzul et al. (14). Significant correlations of liveweights with metatarsus diameter and metatarsus length were perceived in various weeks ($P < 0.001$), as stated by Szabone Willin (5) and Larzul et al. (14).

As can be seen in Table 4, the highest R^2 values were determined between liveweight and body length + chest girth and liveweight and body length in weeks 2, 8, 10 and 16 ($R^2 > 80\%$); chest girth by itself gave an accurate estimation of liveweight for weeks 2, 4, 6, 8, 14 ($R2 > 70\%$). Regression analyses showed that easily measurable body parts (chest girth and body length) can help in the determination of body weight.

The present data demonstrated that sex influenced most of the characteristics in native Turkish geese. Generally, values from male geese were higher than those from females and, as expected, measurements increased with age. Outcomes from the present study could not be compared with the results for native Turkish geese because of the absence of such studies. Our study examined native Turkish geese in terms of zoometrical body measurements and their correlations with liveweight. These easily measurable body parts, which were correlated with liveweight, can be used as a criterion to assess body weight. The study also allowed a comparison of the results from native Turkish geese with those of other goose breeds. Furthermore, the data acquired might be extendable to poultry equipment manufacturers to produce special apparatus for geese, such as feed boxes, water cups, brooding and breeding batteries. During the period of this study the researchers were acutely aware of the necessity for such equipment designed for geese.

References

1. Brody, S.: Bioenergetics and Growth. Reinhold Publication Corporation, New York, 1945.
2. Pingel, H.: Genetics of growth and meat production in waterfowl. In: Crawford, R.D. Ed. Poultry Breeding and Genetics. Elsevier, Amsterdam. 1990; 691-703.
3. Shalev, A.: Comparative growth and efficiency of various avian species. In: Hunton, P. Ed. Poultry Production, Elsevier, Amsterdam. 1995; 53-69.
4. Schneider, K.H., Pingel H.: The response of a male goose to the selection for growth. 8th International Waterfowl Symposium, Budapest, Hungary. 1989; 75-79.

5. Szabone Willin, E.: Changing of body measurements and the correlation of these with body weight from 0-16 weeks of age in geese. Allattenyesztes es Takarmanyozas, 1997; 46: 409-414.

6. Lilja, C.: A comparative study of postnatal growth rate and organ development in some species of birds. Growth, 1983; 47: 317-339.

7. Chelmonska, B., Chrzanowska, M., Lukaszewicz, E.: Comparison of body weight and zoometrical measurements of hybrids derived from reciprocal crossbreeding of Greylag and White Italian geese. 10th European Symposium on Waterfowl, Halle, Germany. 1995; 355-359.

8. Tilki, M., Saatcı, M., Kırmızıbayrak, T., Aksoy, A. R.: Effect of age on growth and carcass composition of native Turkish geese. Arch. Geflügelk., 2005: 69; 77-83.

9. Arslan, C., Saatci, M.: Bulky feeds in the intensive fattening of goslings. I. Effects of grass, alfalfa and sugar beet pulp on growth, slaughter performance and some blood parameters in geese. Rev. Med. Vet., 2003: 154; 633-638.

10. Tilki, M., İnal, Ş.: Türkiye'de yetiştirilen değişik orijinli kazların verim özellikleri. II. Büyüme özellikleri. Turk. J. Vet. Anim. Sci., 2004; 28: 157-163.

11. Ensminger, M.E.: Poultry Science. Interstate Publishers, Inc., Danville, 1992: 369-376.

12. NRC: Nutrient Requirements of Poultry. Ninth Revised Edition, National Academy Press, Washington. 1994.

13. Szabone Willin, E.: Growing characteristics in dual-purpose hybrid geese. The First Vietnamese-Hungarian Workshop on Small Animal Production for the Development of Sustainable Integrated Farming Systems, Ho Chi Minh City, Vietnam. 1998; 84-88.

14. Larzul, C., Rouvier, R., Rousselot-pailley, D., Guy, G.: Estimation of genetic parameters for growth, carcass and overfeeding traits in a White geese strain. Genet. Sel. Evol. 2000; 32: 415-427.

15. Grunder, A.A., Pawluczuk, B., Fortin, A., Chambers, J.R.: Heritabilities and phenotypic and genetic correlations of live and carcass traits and carcass parts in ganders. Arch. Geflugelkd. 1989; 53: 157-162.