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The effect of sex and slaughter age on growth, slaughter, and carcass characteristics in Lindovskaya geese reared under breeder conditions

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Abstract: The study was conducted to determine growth, slaughter, and carcass characteristics of Lindovskaya geese. While a total of 237 goslings, 101 males, and 136 females were used to determine their growth characteristics, 16 male geese in total were used for the detection of the slaughter and carcass characteristics. Each slaughter group (12 weeks and 16 weeks old) consisted of 8 male geese. It was determined that the effect of sex on body weight values by week was significant ($P < 0.05$). In addition to this, the body weights of male geese were higher than the body weights of the female geese in all weeks. In the study, it was determined that the effect of the slaughter age on the weights of slaughter, head, blood, intestinal fat, and abdominal fat was significant ($P < 0.05$). Additionally, the values of the geese slaughtered at 16 weeks were higher compared to the geese slaughtered at 12 weeks. It was detected that the effect of slaughter age on the weight of the hot carcass, cold carcass, neck, breast and back, and other parts were significant ($P < 0.05$). Moreover, it was concluded that these values increased as the slaughter age increased. As a result, it can be said that slaughter age at 16 weeks was more preferable than at 12 weeks under breeder conditions. Additionally, it has been revealed that Lindovskaya geese need to be reared under controlled conditions, with regular care and feeding, to obtain better results.

Key words: Growth, Lindovskaya geese, sex, slaughter age, slaughter and carcass traits

1. Introduction

In recent years, the demand for healthier, higher quality, and better-tasting animal products has gradually increased. Goose meat is one such product, whereby its quality characteristics and fatty acid content are quite different from other poultry. Additionally, geese, which are among the alternative poultry animals, have different characteristics such as high growth rate, disease resistance, and qualified feathers [1,2].

The geese from different breeds have been recently reared in Turkey as well but their number is not known exactly. These breeds include primarily Emden and Toulouse, which are classified as heavier breeds with the largest sizes and body weights [3], and Chinese and Lindovskaya (Linda) geese. Linda geese are the result of breeding Russian native geese reared in the Nizhny Novgorod with Chinese, Adler, Solnechnogorsk, and Gorky geese. Linda geese comprise more than 60% of Russia's goose population and have been acknowledged as a registered breed since 1994. Linda geese have heavy bodies and white feathers. Additionally, they have a

cone-like bump on their forehead called a knob, which is larger in male adult geese compared to females. A slight flap in the neck called a dewlap is smaller compared to the African and Toulouse geese. While the average body weight was 8–9 kg and 6.5–7 kg for adult males and females, respectively, the average body weight at 10 weeks was about 5 kg [4,5].

In Turkey, several studies have been conducted to determine the growth and slaughter carcass characteristics of the native geese [6–10]. However, no study investigating the growth and slaughter carcass characteristics of Lindovskaya geese has been found to date.

This study was conducted to determine the effect of sex and slaughter age on growth, slaughter, and carcass traits of Lindovskaya geese reared under breeder condition.

2. Materials and methods

2.1. The study area, animals, and data collection

The study was conducted on a private farm in the village of Kibritli in the province of Burdur. In this study, a total of

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237 1-day-old Lindovskaya goslings were used, including 101 male and 136 female goslings. Wing numbers were affixed to the goslings after hatching and their sexes were determined after day 1.

The geese were reared and fed by breeders. The goslings were kept under 24 h of light every day for the 1st week. From the 2nd week onwards, the daily photoperiod was 16 h of light and 8 h of darkness. The pen temperature was 32–34 °C in the first week, and then it was incrementally decreased by 3–5 °C until it reached 19–20 °C by week 4. During this period, the goslings were fully feathered and sent to graze. They were fed with vegetation having a feed value. All goslings were fed a chick starter until they were 3 weeks old, and then triticale, corn product, and sugar beet were also given to the geese in addition to grazing between 3 and 16 weeks of age. The nutrient content of the feed (Table 1) was determined according to the method reported by the AOAC [11]. The metabolizable energy level of the feed was calculated based on Titus and Fritz [12]. Feed and water were given ad libitum.

In the study, the body weight of the goslings, hatched on different days between 2 and 16 weeks was determined by correcting with the interpolation method. Feed consumption and conversion efficiency were not analyzed since the group feeding was applied in the experiment under breeder conditions. A total of 16 male geese, including 8 at 12 weeks and 8 at 16 weeks, were slaughtered, and some carcass traits were measured. The slaughtering was performed on the farm where the study was conducted. The study was ended in week 16. After measuring the slaughter weight of the geese, the slaughter was performed by blood-letting, without causing unnecessary distress to them by ensuring good welfare conditions. The feathers were plucked manually with the dry method without using any chemicals or technology, taking extra care. To determine slaughter characteristics; the head, foot, blood, liver, heart, gizzard, intestinal, and abdominal fat weight was recorded. The percentages of these parts were found based on full preslaughter weight. Then, the hot carcass weight was weighed and recorded. The carcasses were kept at 4 °C for 24 h and the cold carcass weight was weighed

and recorded. The weight of the leg, breast, wing, neck, and back was recorded. The cold carcass percentage was calculated as the ratio between the cold carcass weight and slaughter weight. The carcasses were cut into parts as described by Barbut et al. [13] and Sarica et al. [14].

This study was approved by Burdur Mehmet Akif University, Local Ethics Commission of Experimental Animals (Decision no: MAKU-HADYEK/2017-349).

2.2. Statistical analysis

To determine the effect of sex on the growth characteristics and the effect of slaughter age on the slaughter-carcass characteristics, the t-test was used in the comparison of 2 independent groups with the help of Minitab [15] software.

3. Results

Table 2 shows how the sex of Linda geese affected body weight values. It was determined that the effect of sex on body weight values by week was significant ($P < 0.05$). In addition to this, the body weights of the male geese were higher compared to the female geese in all weeks.

The effect of the slaughter age on slaughter characteristics of the Lindovskaya geese was presented in Table 3. According to the table, the effect of the slaughter age on the weights of slaughter, head, blood, and abdominal fat was significant ($P < 0.05$) and values of the geese slaughtered at 16 weeks were higher than values of the geese slaughtered at 12 weeks. While the effect of slaughter age on the foot, liver, gizzard and abdominal fat ratios among the slaughter characteristics was significant ($P < 0.05$); it was determined that as the slaughter age increased, the foot, liver, gizzard and intestinal ratios decreased, and the abdominal fat ratios increased.

The effect of the slaughter age on the carcass characteristics of the Lindovskaya geese was presented in Table 4. It was concluded that the effect of slaughter age on the weight of hot carcass, cold carcass, neck, breast, back, and others was significant ($P < 0.05$) and these values increased as the slaughter age increased. It was determined that the effect of slaughter age on the ratios of wing, leg, breast, and back was statistically significant ($P < 0.05$). Additionally, while wing and leg ratios of the geese

Table 1. Nutrient composition of additional goose feeds in dry matter.

Item	Dry matter %	Crude ash %	Ether extract %	Crude protein %	Crude fiber %	N-free extract	Metabolic energy* (MJ/kg)
Starter feed	92.00	10.26	4.20	17.31	3.96	64.25	11.14
Triticale	93.17	1.45	2.17	10.85	1.95	83.55	12.19
Concentrate feed	97.69	38.22	21.17	15.12	1.51	23.95	9.87
Corn by-product	66.73	24.05	9.90	12.04	3.02	50.96	10.14

*Titus and Fritz [1971]; ME (MJ/g) = 133.06 (crude protein) + 232.91 (ether extract) – 4.68 (crude fiber) + 122.77 (nitrogen-free extract)

Table 2. The effect of sex on the body weight values in Lindovskaya geese by age in weeks, g.

Weeks	n	Male ($X \pm S_x$)	n	Female ($X \pm S_x$)
Hatching	101	85.53 \pm 0.86 ^a	136	83.14 \pm 0.69 ^b
2 weeks	91	334.21 \pm 8.00 ^a	129	298.10 \pm 6.50 ^b
4 weeks	90	729.20 \pm 18.00 ^a	128	619.50 \pm 13.00 ^b
6 weeks	87	1271.70 \pm 24.00 ^a	126	1060.10 \pm 22.00 ^b
8 weeks	87	1862.20 \pm 30.00 ^a	117	1596.60 \pm 27.00 ^b
10 weeks	86	2564.20 \pm 38.00 ^a	117	2191.30 \pm 35.00 ^b
12 weeks	86	3308.30 \pm 47.00 ^a	116	2824.70 \pm 43.00 ^b
14 weeks	80	3504.40 \pm 42.00 ^a	106	2953.90 \pm 38.00 ^b
16 weeks	78	3607.00 \pm 35.00 ^a	106	3019.10 \pm 31.00 ^b

Means within the same row with different superscripts differ significantly ($P < 0.05$).

Table 3. The effect of the slaughter age on slaughter characteristics of Lindovskaya geese ($X \pm S_x$).

Characteristics	12 weeks (n = 8)		16 weeks (n = 8)	
	Weight (g)	%	Weight (g)	%
Slaughter weight	3298.00 \pm 57.00 ^B		3605.60 \pm 21.00 ^A	
Head weight	154.25 \pm 3.30 ^B	4.68 \pm 0.06	163.63 \pm 2.80 ^A	4.54 \pm 0.09
Feet weight	114.38 \pm 2.50	3.47 \pm 0.06 ^a	113.38 \pm 2.10	3.15 \pm 0.07 ^b
Blood weight	290.10 \pm 14.00 ^B	8.81 \pm 0.43	353.60 \pm 26.00 ^A	9.83 \pm 0.78
Liver weight	76.75 \pm 2.20	2.33 \pm 0.07 ^a	71.25 \pm 3.00	1.98 \pm 0.08 ^b
Heart weight	22.50 \pm 1.10	0.68 \pm 0.03	24.75 \pm 0.96	0.69 \pm 0.03
Gizzard weight	149.50 \pm 6.60	4.54 \pm 0.19 ^a	131.50 \pm 6.60	3.65 \pm 0.19 ^b
Intestinal weight	174.90 \pm 4.30	5.31 \pm 0.15 ^a	154.80 \pm 8.50	4.30 \pm 0.25 ^b
Abdominal fat weight	13.25 \pm 1.00 ^B	0.40 \pm 0.03 ^b	36.10 \pm 5.30 ^A	1.00 \pm 0.14 ^a

Differences between average weights (A, B) and percentages (a, b) are shown by different letters on the same line ($P < 0.05$).

slaughtered at 12 weeks were higher; the geese slaughtered at 16 weeks had higher values for the breast and back ratios.

4. Discussion

No study was found conducted on the growth, slaughter, and carcass characteristics of the Lindovskaya geese reared for recent years in Turkey. Also, there are scarcely any studies about these geese in the world. Therefore, the values obtained from these geese will be compared with different geese breeds. In this study, the hatching weight and the body weight values at 2, 4, 6, 8, and 10 weeks were found to be lower compared to the values of the Lindovskaya geese reported by Imambaeva [16] and the values of the native Turkish geese reported by Boz et al.

[17]. In this study, the body weight values determined at 10 weeks were found to be lower compared to the live weight value of 5 kg determined by Kudryavets et al. [4] in Lindovskaya geese at 10 weeks. The live weights determined at 12 weeks were found to be higher compared to the live weights of the native goose of Isparta, which are mixed-fed, reported by Isguzar and Pingel [18]. These differences were associated with breed, origin, care, and feeding differences. The hatching weight values determined in the male and female geese were detected to be lower compared to 92.30–94.71 g reported by Boz et al. [17] and 92.95–98.41 g reported by Saatci et al. [19] and for the native geese and in parallel to 82.70 g and 87.80 g reported by Hrouz [20] for the Bohemian male and female

Table 4. The effect of the slaughter age on carcass characteristics of Lindovskaya geese, ($X \pm S_x$).

Characteristics	12 weeks (n = 8)		16 weeks (n = 8)	
	Weight (g)	%	Weight (g)	%
Hot carcass	1964.00 \pm 45.00 ^B	59.53 \pm 0.69	2230.00 \pm 38.00 ^A	61.83 \pm 0.85
Cold carcass	1958.00 \pm 45.00 ^B	59.36 \pm 0.70	2213.00 \pm 39.00 ^A	61.36 \pm 0.88
Wing weight	339.10 \pm 8.50	17.33 \pm 0.24 ^a	342.50 \pm 6.00	15.51 \pm 0.36 ^b
Leg weight	523.50 \pm 16.00	26.74 \pm 0.54 ^a	520.00 \pm 12.00	23.50 \pm 0.36 ^b
Neck weight	269.80 \pm 8.80 ^B	13.77 \pm 0.27	305.60 \pm 7.80 ^A	13.84 \pm 0.42
Breast weight	397.90 \pm 11.00 ^B	20.33 \pm 0.38 ^b	507.50 \pm 16.00 ^A	22.92 \pm 0.50 ^a
Back weight	426.60 \pm 12.00 ^B	21.77 \pm 0.24 ^b	537.50 \pm 21.00 ^A	24.24 \pm 0.63 ^a

Differences between average weights (A, B) and percentages (a, b) are shown by different letters on the same line ($P < 0.05$).

geese. In this study, the abovementioned body weights of the male geese were higher than the female geese in all weeks ($P < 0.05$). A similar situation was reported by Boz et al. [17] for the native Turkish geese and by Nowicka and Przybylski [3]. On the contrary, Tilki et al. [21] reported that there was no effect of sex from hatching 8 weeks and the body weights of the male geese were higher compared to the female geese as from 8 weeks. This difference may be associated with the fact that the breed and the number of animals in the study were different. In this study, as from the hatching, the daily body weight gain increased until 12 weeks and the highest daily live weight gain was determined as 45.00–53.10 g between 10 and 12 weeks. The live weight values determined among the weeks were lower than the values reported by Tilki et al. [21] and Saatci et al. [22] for the native Turkish geese. This difference was caused by breed, origin, care, and feeding differences.

According to the results of the study, it was determined that the effect of the slaughter age on the slaughter weight was statistically significant ($P < 0.05$). The slaughter weight values at 12 and 16 weeks were lower than the values reported by Tilki et al. [7] for the native Turkish geese at the same age and fed by concentrated feed. While the week 12 slaughter weight of current the study was found to be lower, the slaughter weight values determined in week 16 were higher compared to the values reported by Kirmizibayrak et al. [8] for the native Turkish geese at the ages of 6–8 months grazing freely under the village conditions. Additionally, week 16 slaughter weight was also lower compared to the same study at the age of 18–20 months. These lower values might be due to differences in the origin of geese and the slaughter age. Also, it was thought that rearing under breeder conditions affects this situation.

The head, blood, and abdominal fat weights among the slaughter characteristics, were found to be higher in

the geese slaughtered at 16 weeks compared to the geese slaughtered at 12 weeks. No significance was determined in the other characteristics. In the study as the age increased, the abdominal fat weight and ratio increased. A similar situation was also reported by Tilki et al. [7]. However, the abdominal fat weights determined in this study were lower than the values reported by Tilki et al. [9] and Saatci et al. [23] for the native Turkish geese. The most important reason for this situation was different slaughter age, care, and feeding.

It was determined that as the slaughter age increased, the foot, liver, gizzard, and intestinal ratios decreased, and the intestinal and abdominal fat ratios increased. It made us think that growing curves tend to increase fast, growing with the increased nutritional value of pasture in extensive production. In addition to this, it was reported that abdominal fat ratios could vary significantly by the production system [24].

While the head, foot, blood, and intestinal ratios determined at 12 and 16 weeks in this study were higher than the ratios reported by Tilki et al. [7] for the male geese, the heart, gizzard, intestinal and abdominal fat ratios were lower. Also, in this study, the head, foot, blood, liver, gizzard, and intestinal ratios were higher than the ratios reported by Kirmizibayrak et al. [8] for the male geese; on the other hand, the heart ratio was found to be lower. It is thought that this difference was associated with the materials and the methods used in the studies.

The hot and cold carcass weights of the geese slaughtered at 16 weeks were found to be higher compared to the hot and carcass weights of the geese slaughtered at 12 weeks. Although the hot and cold carcass yield of the geese slaughtered at 16 weeks was higher compared to the geese slaughtered at 12 weeks, no statistical difference was found between groups. In this study, the hot and cold

carcass dressing percentages determined at 12 and 16 weeks were found to be lower than the values reported by Celik and Bozkurt [25] for the native Turkish geese reared in Muş Province and reported by Kirmizibayrak [6], Tilki et al. [7], Boz et al. [10], and Saatci et al. [23] for the native Turkish geese reared in Kars Province of Turkey. It is highly possible that this difference was caused by the slaughter age and breeding style.

In this study, the weights of the wing, leg, neck, breast, and back parts in week 12 were found to be lower than the values reported by Murawska and Bochno [26] for the same age in Koluda geese. The ratio of the parts with high values (leg and breast) was determined as 47.07% at 12 weeks and 46.42% at 16 weeks, whereas the ratio of the parts with low value (wing, neck, back) was determined as 52.87% at 12 weeks and 53.59% at 16 weeks. This increase on behalf of breast and back based on slaughter age might be associated with a reaction to physiological and tissue growth. Murawska and Bochno [26] determined that the ratio of the parts with a low value of the Koluda geese, in both sexes, slaughtered at 12 weeks was 43% and the ratio of the parts with a high value was 57%. The most important reason for these differences was caused by breed, sex, care, and feeding differences. In addition to this, Kirmizibayrak et al. [8] reported that the ratio of the high-value parts of the male native Turkish geese in mixed ages with a high value was 53.30% and the ratio of the low-value parts as 39.32%. The most important reason for these differences was the

differences in breed, slaughter age, calculation method, and care and feeding.

Consequently, it was determined that the effect of sex on the growth characteristics of the Lindovskaya geese was significant and the male geese had a higher body weight compared to the female geese. It was found in this study that the slaughter, hot carcass, and cold carcass weights of the Lindovskaya geese slaughtered at 16 weeks were higher compared to the geese slaughtered at 12 weeks. This research was the first study determining the effect of sex and slaughter age on growth, slaughter, and carcass characteristics in Turkey. It can be said that a slaughter age of 16 weeks was more preferable than 12 weeks, taking into consideration the results for hot carcass weight, cold carcass weight, hot carcass percentage, and cold carcass percentage. Additionally, it was revealed that Lindovskaya geese needed to be intensively reared under controlled conditions, with regular care and feeding, to obtain better results in both yield and economy. For this and similar purposes, the studies to be conducted in different regions with different breeds will bring new initiatives to the geese breeding in Turkey as they will provide valuable information on behalf of genetic and environment interaction.

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