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The effect of gender on growth performance, live weight gain, growth pattern modeling and, survival rate in Turkish native geese of the Kars region

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ABSTRACT

Objective: This study presents a comprehensive investigation into the impact of gender on various aspects of growth performance in Turkish native geese, specifically in the Kars region.

Materials and Methods: A total of 62 goslings, comprising 25 males and 37 females, were monitored over 12 weeks. The study focused on growth performance, live weight gain, survival rates, and growth pattern modeling.

Results: In the course of our investigation, the acquired findings have brought to light a discernible gender effect during specific measurement periods, wherein a notable influence of sex on growth performance was observed. Males consistently manifested markedly higher live weights in comparison to females during weigh-ins. This gender-related disparity was statistically significant on both the hatching day ($p<0.01$) and throughout the period spanning weeks 6 to 12 ($p<0.05$), underscoring substantial differences in growth performance between the two genders. Remarkably, male geese displayed significantly higher daily live weight gains during weeks 5 to 6 ($p<0.01$). Linear regression analyses emphasized gender's influence on live weight gain, with female geese demonstrating an R^2 value of 0.9044 ($p<0.001$) and male geese showing an R^2 value of 0.8912 ($p<0.001$). Gompertz growth models unveiled distinctive growth patterns. In females, an R^2 value of 0.9300 highlighted their growth trajectory, while males exhibited an R^2 value of 0.9194. Survival rates after a 12-week period were 81.7% for females and 80.0% for males.

Conclusion: In conclusion, this meticulous exploration of the impact of gender on growth trajectories underscores the significant role it plays.

Keywords: *Geese, Gender, Growth, Survival rate, Weight gain*

INTRODUCTION

Over millennia, humans have harnessed aquatic birds for diverse purposes, consuming their meat, utilizing fatty tissue for lighting and heating, and employing feathers for insulation. The goose, exemplifying adaptability, plays a dual role—providing delicious meat and valuable fat reserves for cooking. Goose eggs offer impressive nutritional benefits, and their ability to produce fatty livers, down, and feathers showcases their multifaceted utility. Thriving globally in diverse environments, geese have seamlessly integrated into various sectors, heightening their significance. While the consumption of goose byproducts may not be paramount, its popularity has notably risen in recent decades, reflecting a noteworthy shift in consumer preferences (Buckland and Guy, 2002;

Johnsgard, 2010; Scanes and Christensen, 2020; Kozák, 2021; Ni et al., 2022).

In Türkiye's poultry farming, a hierarchy prevails with broiler chickens, layer hens, turkeys, geese, and ducks. The limited demand for goose products nationwide, mostly in specific regions, is a key factor. Challenges like reduced egg yields, difficulties in obtaining fertilized eggs, and complexities in incubation contribute to the intricate landscape. The lack of dedicated scientific studies on geese further complicates the issue. Despite not being driven primarily by market demand, goose husbandry is practiced in various regions, notably in Northeastern Anatolia, Southern Anatolia, Western Black Sea, and Central Anatolia, including provinces like Kars, Muş, Ardahan, and Kütahya. Small-scale goose farming is a prevalent phenomenon across Turkish provinces (Saatcı et al., 2021).

When juxtaposed against other poultry farming practices in Türkiye, the domain of goose husbandry emerges as conspicuously marginalized. Geese, regarded comprehensively from their anatomical constituents such as feet and head, feathers to intestines, are reared exclusively within extensive husbandry systems across the national landscape. Nonetheless, recent years have borne witness to an augmented interest in goose meat consumption, subsequently galvanizing the establishment of enterprises in Kars and Ardahan, each boasting capacities ranging from 3,000 to 5,000 head. These ventures are dedicated to harnessing pasture-based feeding modalities fortified by supplemental grain provisions, thus strategically addressing the escalating demand for goose-derived culinary offerings (Kırmızıbayrak, 2018; Saatcı et al., 2021).

Research on post-hatch growth performance and live weight gain in Turkish native geese from the Kars region up to the 12th month remains limited (Saatcı et al., 2011; Tilki et al., 2011; Arslan, 2012; Önk and Kırmızıbayrak, 2022). While gender's influence on growth performance has been a general focus, studies with weekly weigh-ins are notably sparse (Saatcı et al., 2011; Tilki et al., 2011; Önk and Kırmızıbayrak, 2022). Furthermore, the survival rate and growth pattern modeling of Turkish native geese have not received comprehensive attention. To address these gaps, our study aims to comprehensively investigate the impact of gender on various aspects: growth performance, live weight gain, survival rate, and growth pattern modeling in Turkish native geese raised in the Kars region.

MATERIALS and METHODS

Ethical statement

The geese included in this research were managed in accordance with the legal provisions and regulations of Türkiye. Furthermore, the study was initiated after securing authorization from the Kafkas University Local Ethics Committee for Animal Experiments (KAÜ-HADYEK/2020-179).

Location

The study was conducted in the province of Kars, which is located at coordinates 40°36'18''N and 43°5'48''E, at an altitude of 1760 meters above sea level. Kars province is situated in the easternmost region of Türkiye and shares a border with Armenia. Our study was conducted at the Goose Unit within the Faculty of Veterinary Medicine at Kafkas University, Kars, Türkiye.

Animal and feeds

A total of 62 goslings, consisting of 25 males and 37 females, were included in this study. Goslings hatched simultaneously were integrated into the research. These goslings were reared under standard conditions in the Goose Unit, without additional interventions or modifications in feeding practices.

During the initial four weeks (starter phase), all goslings were provided ad libitum access to diets containing 22% crude protein and 3000 kcal/kg of metabolizable energy. Subsequently, up to 12 weeks of age (finisher phase), they continued ad libitum feeding with diets containing 18% crude protein and 3100 kcal/kg of metabolizable energy (Table 1). The geese were also allowed pasture grazing during daylight hours, with unrestricted access to water throughout the study.

Upon hatching, artificially incubated goslings were carefully dried, weighed, and wing-tagged for easy identification. The weighing of geese began in May and weekly weighing were conducted up to 12 weeks of age. Additionally, any mortalities during the specified periods were recorded to determine the survival rate. Data from deceased geese were excluded from the analysis.

Statistical analyses

The Independent Samples T-Test was employed to assess the impact of gender on daily or weekly increases in growth performance and live weight. The evaluation of growth performance, whether

involving daily or weekly live weight augmentation, encompassed data derived from the surviving population of geese throughout the entirety of the study. Furthermore, linear regression models predicated on gender were constructed to elucidate the influence on live weights, complemented by Gompertz growth curve models. An analysis of Kaplan-Meier survival curves was conducted, grounded in records documenting the longevity of both deceased and surviving individuals, aligned with the progression of sampling weeks. These analyses were executed utilizing GraphPad Prism® version 9.5.1 (GraphPad Software Inc., San Diego, CA, USA). The presentation of data was structured as mean values ± standard deviation (SD), and statistical significance was established at a threshold of $p<0.05$.

Table 1. Composition of basal diets for the starter and finisher phases

Ingredients	Starter	Finisher
	%	%
Barley	6.10	6.00
Vegetable oil	4.40	5.50
Wheat bran	4.60	5.70
Wheat	6.40	5.50
Corn	40.00	48.20
Corn gluten. 62% HP	3.50	-
Soy meal. 44%	32.00	26.10
Dicalcium phosphate	1.50	1.50
L-threonine	0.09	0.09
Marble dust	0.81	0.81
Salt	0.35	0.35
Vitamin - Mineral mixture[1]	0.25	0.25
Nutrient analysis		
Dry matter (%)	89.7	89.8
Crude protein (%)	22.0	18
Metabolized energy (Kcal/kg)	3000	3100
Calcium (%)	0.78	0.76
Phosphorus (%)	0.42	0.40

[1]: The provided supplementation consisted of 1,000,000 IU of Vitamin A and 400,000 IU of Vitamin D3. In terms of minerals, the mixture included 30 mg of iron (iron sulfate monohydrate), 1.5 mg of iodine (calcium iodide anhydride), 0.5 mg of cobalt (cobalt carbonate monohydrate), 5 mg of copper (copper sulfate pentahydrate), 80 mg of manganese (manganese oxide), 80 mg of zinc (zinc oxide), and 0.3 mg of selenium (sodium selenite). This vitamin-mineral combination was provided per kilogram of diet.

RESULTS

Notably, during the weighing weeks, males consistently demonstrated significantly higher live weights compared to females. In the context of Turkish native geese, a statistically significant gender difference in growth performance was observed both on the hatching day ($p<0.01$) and during weeks 6 to 12 ($p<0.05$). On the hatching day, female and male geese displayed initial average live weights of 79.4 g and 90.4 g, respectively. Over the 12-week period, their live weights experienced substantial increases, reaching 3140.1 g for females and 3414.3 g for males. These findings underscore the influence of gender on the growth performance of Turkish native geese. A comprehensive overview of the growth performance based on gender and the total dataset for the entire 12-week period since hatching in Turkish native geese is provided in Table 2. The study demonstrates that gender significantly affects the growth performance of Turkish native geese, particularly during specific weeks of their development.

According to the obtained results, numerical variations have been discerned in the daily live weight gain attributed to gender in Turkish native geese. Particularly, a statistically significant higher daily live weight gain was observed in males during the period spanning weeks 5 to 6, in comparison to their female geese ($p<0.01$). However, for the remaining time intervals, the gender-associated impact on daily live weight gain did not attain statistical significance. Remarkably, the zenith of daily live weight gain in Turkish native geese was attained during the time frame of weeks 3 to 4, with females and males registering figures of 68.9 g and 73.3 g, respectively. Furthermore, an evident trend of gradual attenuation in daily live weight gain was observed following the 7th week (Table 3).

Notably, male geese consistently exhibited higher live weight increments compared to their female counterparts throughout consecutive weighing weeks. This observation underscores a noteworthy difference in growth performance between male and female geese. Nevertheless, it is interesting to highlight that from the 7th week onwards until the 12th week, a distinct and statistically significant disparity emerged between the live weight gain of male and female geese ($p<0.05$). These findings underscore the significance of gender in shaping the patterns of live weight gain among Turkish native geese and are further detailed in Table 4.

During the 6th week, male geese displayed a notably superior rate of live weight gain compared to their female geese, and this distinction held statistical significance ($p<0.05$). The comprehensive statistical disparities pertaining to weekly live weight gain and its association with gender within the context of Turkish native geese are comprehensively detailed in Table 5.

Table 2. Gender-based changes in growth performance of Turkish native geese over a 12-week period

Weeks	Female		Male		P value	Total	
	Mean ± SD	n	Mean ± SD	n		Mean ± SD	n
0#	79.4 ± 13.2	30	90.4 ± 12.8	20	**	83.8 ± 14.0	50
1	194.4 ± 43.6	30	212.2 ± 60.2	20	NS	201.5 ± 51.0	50
2	414.2 ± 109.8	30	449.9 ± 143.0	20	NS	428.5 ± 124.1	50
3	702.5 ± 163.8	30	778.6 ± 169.5	20	NS	733.0 ± 168.6	50
4	1185.3 ± 228.2	30	1291.6 ± 274.7	20	NS	1227.8 ± 250.7	50
5	1646.7 ± 307.7	30	1758.8 ± 323.4	20	NS	1691.5 ± 315.5	50
6	1876.9 ± 337.5	30	2068.8 ± 318.1	20	*	1953.6 ± 340.1	50
7	2276.9 ± 379.6	30	2546.8 ± 412.3	20	*	2384.8 ± 411.1	50
8	2609.1 ± 371.6	30	2885.9 ± 460.1	20	*	2719.8 ± 427.3	50
9	2795.3 ± 382.3	30	3068.1 ± 468.5	20	*	2904.4 ± 435.7	50
10	2908.8 ± 368.3	30	3201.0 ± 471.9	20	*	3025.7 ± 433.1	50
11	3026.5 ± 401.2	30	3302.4 ± 529.2	20	*	3136.8 ± 471.7	50
12	3140.1 ± 392.6	30	3414.3 ± 504.7	20	*	3251.0 ± 456.9	50

#: Hatching weight, *: $p<0.05$, **: $p<0.01$, NS: Not significant, SD: Standard deviation

Table 3. Daily live weight gain based on gender in Turkish native geese over a 12-week period

Weeks	Female		Male		P value	Total	
	Mean ± SD	n	Mean ± SD	n		Mean ± SD	n
0-1	16.4 ± 4.9	30	17.4 ± 7.6	20	NS	16.8 ± 6.1	50
1-2	31.4 ± 10.1	30	34.0 ± 13.2	20	NS	32.4 ± 11.3	50
2-3	41.2 ± 11.2	30	47.0 ± 10.7	20	NS	43.5 ± 11.2	50
3-4	68.9 ± 12.1	30	73.3 ± 27.8	20	NS	70.7 ± 19.8	50
4-5	65.9 ± 21.7	30	66.7 ± 31.1	20	NS	66.2 ± 25.6	50
5-6	32.9 ± 11.7	30	44.3 ± 15.4	20	**	37.4 ± 14.3	50
6-7	57.1 ± 13.9	30	68.3 ± 37.9	20	NS	61.6 ± 26.5	50
7-8	47.5 ± 14.2	30	48.4 ± 17.9	20	NS	47.9 ± 15.7	50
8-9	26.6 ± 9.6	30	26.0 ± 14.4	20	NS	26.4 ± 11.6	50
9-10	16.2 ± 14.7	30	19.0 ± 16.9	20	NS	17.3 ± 15.5	50
10-11	16.8 ± 14.4	30	14.5 ± 17.5	20	NS	15.9 ± 15.6	50
11-12	16.2 ± 7.7	30	16.4 ± 10.6	20	NS	16.3 ± 8.9	50

**: $p<0.01$. NS: Not significant, SEM: Standard deviation

Table 4: Daily live weight gain in Turkish native geese up to the week of weighing

Weeks	Female		Male		P value	Total	
	Mean ± SD	n	Mean ± SD	n		Mean ± SD	n
0-1	16.4 ± 4.9	30	17.4 ± 7.6	20	NS	16.8 ± 6.1	50
0-2	23.9 ± 7.2	30	25.7 ± 9.8	20	NS	24.6 ± 8.3	50
0-3	29.7 ± 7.9	30	32.8 ± 7.9	20	NS	30.9 ± 7.7	50
0-4	39.5 ± 8.6	30	42.9 ± 9.7	20	NS	40.9 ± 8.7	50
0-5	44.8 ± 7.9	30	47.7 ± 9.1	20	NS	45.9 ± 8.8	50
0-6	42.8 ± 7.6	30	47.1 ± 7.5	20	NS	44.5 ± 7.9	50
0-7	44.8 ± 6.5	30	50.1 ± 8.3	20	*	47.0 ± 8.3	50
0-8	45.2 ± 5.9	30	49.9 ± 8.2	20	*	47.1 ± 7.5	50
0-9	43.1 ± 5.2	30	47.3 ± 7.4	20	*	44.8 ± 6.8	50
0-10	40.4 ± 5.1	30	44.4 ± 6.7	20	*	42.0 ± 6.1	50
0-11	38.3 ± 5.1	30	41.7 ± 6.9	20	*	39.6 ± 6.1	50
0-12	36.4 ± 4.6	30	39.6 ± 6.0	20	*	37.7 ± 5.4	50

*: p<0.05, NS: Not significant, SEM: Standard deviation

Table 5: Gender-dependent variation in weekly live weight gain in Turkish native geese

Weeks	Female		Male		P value	Total	
	Mean ± SD	n	Mean ± SD	n		Mean ± SD	n
0-1	115.0 ± 34.9	30	121.8 ± 53.3	20	NS	117.7 ± 42.8	50
0-2	219.8 ± 70.0	30	237.7 ± 92.3	20	NS	227.0 ± 79.3	50
0-3	288.4 ± 78.1	30	328.7 ± 75.4	20	NS	304.5 ± 78.8	50
0-4	482.8 ± 84.9	30	513.0 ± 194.5	20	NS	494.9 ± 138.4	50
0-5	461.4 ± 152.2	30	467.1 ± 217.5	20	NS	463.7 ± 179.1	50
0-6	230.1 ± 81.9	30	310.0 ± 107.6	20	**	262.1 ± 100.1	50
0-7	400.0 ± 97.5	30	478.0 ± 265.3	20	NS	431.2 ± 185.5	50
0-8	332.3 ± 99.7	30	339.1 ± 125.6	20	NS	335.0 ± 109.6	50
0-9	186.2 ± 67.5	30	182.2 ± 100.8	20	NS	184.6 ± 81.5	50
0-10	113.6 ± 103.4	30	132.9 ± 118.5	20	NS	121.3 ± 108.9	50
0-11	117.7 ± 101.1	30	101.5 ± 122.4	20	NS	111.2 ± 109.2	50
0-12	113.6 ± 53.9	30	114.9 ± 74.9	20	NS	114.1 ± 62.2	50

**: p<0.01, NS: Not significant, SEM: Standard deviation

In this study, a simple linear regression analysis was conducted to assess the weekly growth performance data of Turkish native geese up to a 12-week period. For female geese, the simple linear regression analysis revealed an R^2 value of 0.9044, indicating a substantial explanatory power of approximately 90.44% for the weekly growth performance variations (p<0.001). The regression equation was computed as Y=287.1*X+35.33, where Y represents the weekly growth performance and X denotes the weeks. Similarly, for male geese, the simple linear regression analysis yielded an R^2 value of 0.8912, signifying an explanatory capability of around 89.12% for the weekly growth performance patterns (p<0.001).

The derived regression equation was Y=314.6*X+40.84. These findings underscore the significant impact of gender on the weekly growth performance of Turkish native geese. The growth rate for female geese increased by an average of

287.1 g over the 12-week period, while male geese exhibited a growth rate of 314.6 g. This analysis contributes to a better understanding of the gender-related disparities in growth performance (Figure 1A).

Investigating the trajectory of weekly growth performance among female geese, the application of the Gompertz growth model yielded noteworthy parameters: An asymptotic maximum weight of 3361 g, an initial weight of 53.52 g, a rate constant of 0.3401, and a coefficient of determination (R^2) amounting to 0.9300. These parameters unveil valuable insights into the developmental trajectory and distinctive attributes characterizing the growth pattern of female geese throughout the observed weeks. Similarly, in the context of male geese, the weekly growth performance was examined using the Gompertz growth model, leading to the identification of the following parameters: an asymptotic maximum weight of 3657 g, an initial weight of 52.01 g, a rate constant of 0.3486, and a coefficient of determination (R^2) of 0.9194. These elucidated parameters provide a comprehensive understanding of the dynamic growth patterns and inherent characteristics exhibited by male geese during the observed weeks (Figure 1B). The equations of the obtained simple linear regression model and Gompertz growth model in our study are presented in Figure 1A and Figure 1B, respectively.

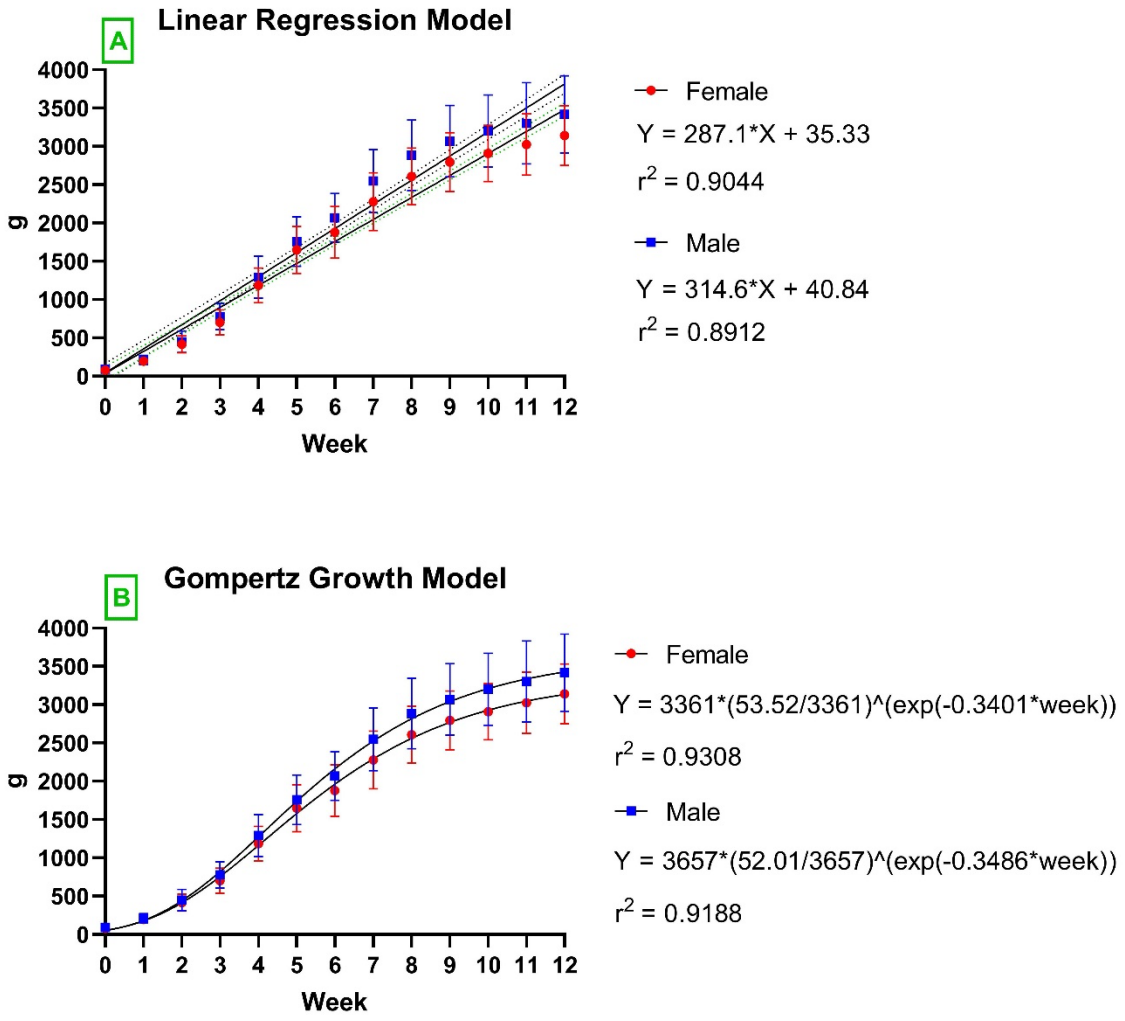

Figure 1. Equations of the simple linear regression model (A) and the Gompertz growth model (B) obtained based on the live weights determined over the 12-week period in Turkish native geese.

Following a comprehensive 12-week monitoring period of Turkish native geese, it was determined that the survival rates stood at 81.7% for females and 80.0% for males, revealing no statistically significant distinction between the genders ($p>0.05$). Noteworthy is the observation that the mortality rate exhibited a prominent increase during the initial 4-week interval. The application of the Kaplan-Meier survival curves to the Turkish native geese dataset spanning 12 weeks yielded

significant insights into their survival dynamics (Figure 2).

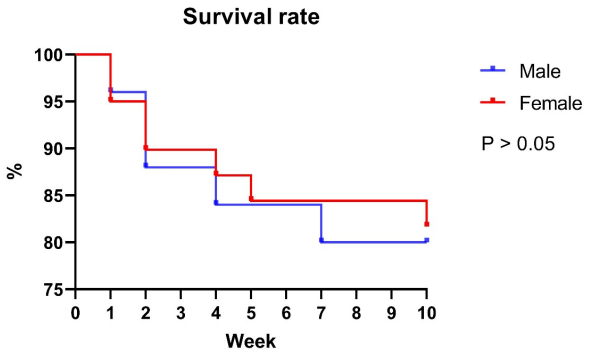

Figure 2. Kaplan-Meier survival curves on the 12-week dataset of Turkish native geese. The survival rates of Turkish native geese were 81.7% for females and 80.0% for males during the 12-week period, with no significant difference between genders ($p>0.05$). The noticeable increase in mortality rates during the first 4 weeks was noteworthy.

The statistical examination, exemplified by the Log-rank (Mantel-Cox) test, resulted in a Chi-square value of 0.02819, accompanied by a corresponding p-value of 0.87. Additionally, the Hazard Ratio (Mantel-Haenszel) was computed as 0.9043, along with a 95% Confidence Interval (CI) that ranged from 0.2794 to 2.927. This interval quantifies the degree of uncertainty around the Hazard Ratio estimate.

DISCUSSION

Goose farming is vital for Kars province, Türkiye, given its favorable conditions. The region's climate and terrain make it ideal for native goose breeding, offering economic and cultural benefits. Goose meat is integral to local cuisine, and goose feathers contribute to crafts and textiles, supporting trade. Sustainable goose farming is essential for Kars' agricultural and animal husbandry sectors (Kırmızıbayrak, 2001; Saatcı et al., 2021; Kırmızıbayrak, 2002; Demir et al., 2013; Kırmızıbayrak, 2018). Studies regarding the growth and fattening performance of Turkish native geese raised in Kars and its surrounding regions are considerably limited (Sahin et al., 2008; Tilki et al., 2009; Arslan and Tufan, 2009; Tilki et al., 2011; Saatcı et al., 2011; Arslan, 2012; Önk and Kırmızıbayrak, 2022). The prevalence of family-owned goose farms has limited comprehensive studies in the past. However, recent years have seen increased importance and popularity of goose farming in Kars and its vicinity. To address this, we conducted a study evaluating growth performance (Table 2), live weight gain (Table 3-5), and survival rates in Turkish native geese. Weekly growth data were recorded from hatching to 12 weeks, and live weight gains were analyzed using a linear regression equation (Figure 1). A Gompertz growth model was constructed (Figure 1), and Kaplan-Meier survival curves (Figure 2) were determined. This comprehensive approach enriches our understanding of the growth and survival dynamics of Turkish native geese.

In the province of Yozgat, the termination of a 12-week period yielded recorded live weights for male and female native geese at 3663.2 g and 3373.8 g, respectively, while for white male and female geese, the corresponding figures stood at 3331.5 g and 3215.4 g. Notably, no statistically significant gender-based impact was discernible. Furthermore, the aspect of gender evinced an absence of statistical significance concerning live weight gain up to the culmination of the 12-week duration (Boz and Sarıca, 2021). Within the context of Konya province, the native geese manifested weight variations spanning from 3522.7 g to 3984.7 g post a 12-week interval, thereby suggesting a modulating influence of gender upon growth performance. In respect to the trajectory of daily live weight gain, a statistically significant gender-based influence became apparent during the 8th and 9th weeks (Tilki and İnal, 2004). In a study undertaken on Turkish native geese native to the Kars region, it was revealed that subsequent to a 12-week period, male and female individuals achieved live weights of 3800.4 g and 3337.9 g, correspondingly. Furthermore, a statistically noteworthy gender-based influence on growth performance emerged during the 8th to 12th week interval. Additionally, the influence of gender exhibited statistical significance concerning daily live weight gain throughout the 6th to 8th, as well as the 10th to 12th weeks (Tilki et al., 2011). In alignment with this context, alternative studies conducted within the Kars region reported distinct live weights at 12 weeks of age. These weights were documented as 3569.0 g and 3256.1 g (Önk and Kırmızıbayrak, 2022), along with 4112.1 g and 3856.2 g (Saatcı et al., 2011) for males and females, respectively. However, it is noteworthy that the gender effect displayed variations when juxtaposed with prior investigations (Saatcı et al., 2011; Önk and Kırmızıbayrak, 2022). Reports on the impact of gender on live weight in native geese from the Kars region have yielded conflicting results (Tilki et al., 2004; Kırmızıbayrak and Boğa Kuru, 2018). Within

the realm of studies conducted on native geese in Kars, the average live weight at the 12-week mark has been reported as 3425.8 g (Arslan, 2012) and 3572.3 g (Kırmızıbayrak et al., 2011). In our conducted study, the live weights of Turkish native geese at the culmination of the 12-week period were determined to be 3140.1 g for females, 3414.3 g for males, and a total mean of 3251.0 g (Table 2). This gender effect reveals distinct growth trajectories, particularly diverging between weeks 5 and 6 (Table 3). Male geese, especially from the 7th week onwards, demonstrated a notable advantage in cumulative live weight gain (Table 4). The statistical significance of this gender-based difference reinforces its relevance. The dataset differs from previous studies on native geese, likely due to factors such as rearing conditions, nutrition, genetics, and the environment. To ensure the accuracy of similar investigations, meticulous elimination or consideration of these factors is essential for a more precise understanding of growth performance. By mitigating their impact, a substantial improvement in live weight gain can be anticipated.

Growth assumes paramount significance within the realm of animal husbandry, playing a pivotal role in bolstering economic returns. From the moment of hatching to the attainment of maturity, both physiological and morphological transformations occur, influencing weight and volume dynamics (Kaplan and Gürcan, 2018; Tirink et al., 2022; Boğa Kuru and Kırmızıbayrak, 2023). Vigilant growth tracking is crucial for effective herd management, directly impacting economic gains. The use of growth curves, depicting changes in body weight or length over time, is pervasive and pivotal. Growth curve modeling serves to understand the trajectory of biological systems over time, revealing the intricate interplay between genetic potential and environmental conditions. These models offer valuable insights for breeders, aiding in predicting growth patterns, determining optimal feed quantities, calibrating medication dosages, and identifying opportune moments for market entry. Nonlinear models like exponential, logistic, von Bertalanffy, Brody, and Gompertz models are effective due to their sigmoidal structures, accurately characterizing growth dynamics (Bahreini Behzadi et al., 2014; Do and Miar, 2020; Tirink et al., 2022). Moreover, growth curve modeling has found utility in goose research, facilitating comparisons among diverse breeds such as the Linda goose, Turkish native goose, Jilin White goose, Landes goose, Pomeranian goose, and Steinbacher goose (Önder et al., 2017; Ibtisham et al., 2017; Hrncar et al., 2021; Kaya and Yurtseven, 2021; Tirink et al., 2022; Wang et al., 2023). In our study, both simple linear regression and the Gompertz growth model assessed the weekly growth performance data of Turkish native geese over 12 weeks (Figure 1). For female geese, simple linear regression revealed a significant gender effect (R^2=0.9044, $p<0.001$), with a weekly growth rate increase of 287.1 g, while male geese showed 314.6 g. Further analysis using the Gompertz model for female geese yielded parameters such as an asymptotic maximum weight of 3361 g, an initial weight of 53.52 g, a rate constant of 0.3401, and an R^2 value of 0.9300, providing insights into their growth trajectory. Similarly, for male geese, the Gompertz model revealed parameters like an asymptotic maximum weight of 3657 g, an initial weight of 52.01 g, a rate constant of 0.3486, and an R^2 value of 0.9194, offering a comprehensive understanding of their dynamic growth patterns. Growth curve modeling, especially in livestock like geese, proves valuable in elucidating growth dynamics, providing insights for breeders and researchers.

In the context of a study focused on geese, it becomes evident that various factors play a role in influencing the first-year survival rates. Specifically, the survival rates among Greylag geese exhibit a notable range, spanning from 65% to as high as 92%. Furthermore, a distinct survival rate of 74% has been documented during the first year (Nilsson and Persson, 1993). Parallel investigations into Barnacle geese have showcased survival rates varying between 54% and 83% (Owen and Black, 1989). Analogously, a comprehensive evaluation conducted within a goose farming context has divulged a survival rate of 65%, which notably falls below the expected benchmark (Shen and Saeheaw, 2023). In our research on Turkish native geese in the Kars region, a detailed 12-week examination revealed a survival rate of 81.7% for female geese and 80.0% for male geese (Figure 2). Statistical analysis showed no significant difference between these groups. Notably, higher mortality was observed in the initial 4 weeks, emphasizing the need for intensive monitoring and strict control measures during this crucial period. This strategic approach has the potential to significantly reduce overall mortality, ensuring the well-being and sustained survival of the geese population.

CONCLUSION

As a result, this study, which investigated the gender effect on the growth performance of geese, provides significant findings. The analyses conducted reveal that gender has a statistically significant impact on growth performance during certain periods. Disparities in live weight at hatching signify that gender influences growth potential in early stages. Analysis of weekly live weight gain indicates gender's influence on growth rates during specific periods, particularly observing an increase in males around the 6th week. Simple linear regression analysis reveals that a substantial portion of weekly growth performance variation can be attributed to gender. Moreover, while survival rates do not significantly differ by gender, a notable mortality peak in the first 4 weeks is evident. Thus, this research meticulously delves into the growth performance of Turkish native geese in the context of gender, underscoring gender's role in shaping their growth trajectories. These findings underscore the necessity for further research in geese farming, genetic studies, and growth management.

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