

Determination of Morphological Characteristics of Tumbler Pigeons Reared in Kırıkkale Province

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ABSTRACT

The aim of this research was to determine the morphological characteristics of Kırıkkale tumbler pigeons. For this purpose, morphological characteristics were determined in 80 pigeons from 7 different breeders in Kırıkkale province. The body weight ($P<0.05$), body length ($P<0.001$), wing length ($P<0.05$), head width ($P<0.01$), and beak depth ($P<0.001$) were significantly influenced by sex. Male pigeons had higher values than female pigeons for these traits. Age group affected body weight, chest width, and chest depth. Although age group II was higher than age group I in terms of body weight, the age group I was higher than age group II in terms of chest width and chest depth ($P<0.05$). As a result of the study, it was determined that most of Kırıkkale tumbler pigeons had brown-eyed (89.53 %) and small muff (78.48 %), and there was a high rate of individuals with gray plumage color (35.16 %) without a crest (45.35 %). Body weight, body length, wing length, thoracic perimeter, and head width values of Kırıkkale tumbler pigeons were lower than the study for Squadron flyer but higher than the Alabadem and Muradiye Dönek pigeons. Kırıkkale tumbler pigeons had similar values to Ankara tumbler pigeons in terms of morphological characteristics. It can be suggested that the genetic relationship level between Ankara pigeons and Kırıkkale pigeons should be clarified by genetic studies.

Keywords: Breeding, Morphological characteristics, Tumbler pigeon, Kırıkkale

Kırıkkale İlinde Yetiştirilen Taklacı Güvercinlerde Morfolojik Özelliklerin Belirlenmesi

ÖZ

Bu araştırmanın amacı Kırıkkale taklacı güvercinlerinin morfolojik özelliklerini belirlemektir. Bu amaçla Kırıkkale ilinde 7 farklı yetiştiriciden 80 güvercinde morfolojik özellikler belirlenmiştir. Canlı ağırlık ($P<0.05$), vücut uzunluğu ($P < 0.001$), kanat uzunluğu ($P<0.05$), baş genişliği ($P<0.01$) ve gaga derinliği ($P<0.001$) cinsiyetten önemli ölçüde etkilenmiştir. Bu özelliklerde erkek güvercinler dişi güvercinlerden daha yüksek değerlere sahip olmuştur. Yaş grubu canlı ağırlık, göğüs genişliği ve göğüs derinliğini etkilemiştir. Canlı ağırlık bakımından yaş grubu II, yaşlı grubu I'den daha yüksek olmasına rağmen, göğüs genişliği ve göğüs derinliği bakımından yaş grubu I, yaş grubu II'den daha yüksek olmuştur ($P<0.05$). Bu araştırmanın sonucu olarak Kırıkkale taklacı güvercinlerinin çoğunun kahverengi gözlü (% 89.53) ve yıldız paçalı olduğu (% 78.48), gri dona sahip (% 35.16) ve tepesiz (% 45.35) bireylerin oranının yüksek olduğu belirlenmiştir. Kırıkkale taklacı güvercinlerinin vücut ağırlığı, vücut uzunluğu, kanat uzunluğu, göğüs çevresi ve baş genişliği değerleri filo güvercinleri için yapılan çalışmaya göre daha düşük, Alabadem ve Muradiye Dönek güvercinlerine göre yüksek olmuştur. Kırıkkale taklacı güvercinleri morfolojik özellikler yönünden Ankara taklacı güvercinlerine benzer değerlere sahiptir. Ankara güvercinleri ile Kırıkkale güvercinleri arasındaki genetik yakınlık düzeyi, genetik çalışmalarla netleştirilmesi önerilebilir.

Anahtar Kelimeler: Morfolojik özellikler, Taklacı güvercin, Kırıkkale, Yetiştiricilik.

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INTRODUCTION

It has been reported that the rock pigeon (*Columba livia*) was domesticated 3000-5000 years ago and there are more than 350 pigeon breeds in the world today (Stringham et al. 2012, Vickrey et al. 2018). There were many indigenous animal genetic resources with high disease resistance and adaptability in Turkey. One of these animal genetic resources is pigeon breeds/genotypes. The breeds of pigeons in Turkey are classified into nine main groups as diver (dalıcı), tumbler (taklacı), roller (makaracı), spinner (dolap dönücü), fleet flyer (filo uçucusu), high flyer (yüksek uçucu), racing/homer (postacı), ornamental/show (form/süs), and singer (ötücü) (Yılmaz et al. 2013). Pigeon breeding is carried out in small flocks in Turkey. For some breeders, the priority is to care for and see the performance of their birds, and they conduct their bird breeding as financial support. For some other breeders, it is just for hobby purposes and they see their birds as psychological support (Israili and Iqbal, 2017). In addition, small markets for breeder sales are established on certain days of the week, specific to the region, where the experiences of the breeders are shared. Tumbler pigeon genotypes are grown in almost every region of Turkey. Artificial selection by breeders in the desired traits (cranio-facial structures, skeletal differences, plumage color, vocalizations, flight behaviors) revealed high variation in pigeon genotypes in terms of morphological characteristics (Helms and Brugmann, 2007, Vickrey et al. 2018). Artificial selection is conducted according to the flight performance and aerial-display abilities of the tumbler pigeons. The number of studies, which was conducted on tumbler pigeon genotypes bred in Turkey is so scarce (Atasoy et al. 2013). Therefore, the aim of this research is to determine the morphological characteristics of Kırıkkale tumbler pigeons.

MATERIAL and METHODS

Birds

The material of this research consisted of 80 tumbler pigeons (42 male and 38 female) in the hands of 7 breeders in Kırıkkale province. Kırıkkale province is located at 39°50'30" N 33°31'22" E (Anonymous-1, 2022). No changes were applied to the care and management conditions of the pigeons. The age groups of the pigeons were determined according to the private enterprise records. The age groups of pigeons were classified into two groups: 12 - 24 months of age pigeons were as age group I, and 36 months of age and above pigeons were as age group II. The determination of morphological characteristics in pigeons was carried out between March 2018 and January 2019.

Morphological characteristics

Each pigeon was individually examined for morphological characteristics (plumage color, head type, eye color, head crest, presence or absence head, and body marks, wing and tail marks, and the presence or absence of muffs). Wing and tail feather numbers were determined. Wing feathers were enumerated as primary, axillary, and secondary (p-a-s), respectively. Plumage color was determined in consultation with local breeders. Likewise, the classification of eye color, crest type of the pigeons were evaluated as a result of common declarations of the breeders (Erdem et al. 2021, Özbaşer et al. 2021). Feathered feet classification in pigeons adapted from Domyan et al. (2016), and breeders' local nomenclature was given in parentheses.

Morphometric characteristics

Body weight, body length, wing span, wing length, tail length, thoracic perimeter, chest width, chest depth, head length, head width, beak length, beak depth, and tarsus diameter were determined individually for Kırıkkale tumbler pigeons. The body weights of the pigeons were taken with a precision digital scale sensitive to 0.01 g. A metal ruler was used to determine body length, a measuring tape was used to determine trunk length, wing span, wing length, thoracic perimeter, and tail length. A digital caliper was used to determine the head length and head width, beak length and depth, chest width and depth, and tarsus diameter (Figure 1) (Atasoy et al. 2013, Erdem et al. 2021).

Statistical analysis

Data were tested for normality of distribution using the Box Plot, and the outlier data was removed from the data set. The data set was analyzed by The Generalized Linear Model (GLM). Significance of the difference between means was determined by Tukey's test. The statistical significance of the difference between the two groups' means was verified by the Student-T test (age groups and sexes). Statistical analyses were performed using SPSS. Data were presented as means \pm standard error (Sx). A value of $P < 0.05$ was considered statistically significant (Dawson and Trapp, 2004).

RESULTS

Morphological Characteristics

As a result of breeding selection for different purposes in indigenous pigeon genotypes, various plumage colors and patterns, vocalizations, and flight displays have emerged. Three eye colors were determined in this genotype as brown ('kahverengi' in Turkish) (89.53 %) (Figure 2a), black ('siyah' in Turkish) (8.14 %) (Figure 2b) and grayish-blue ('mısır or çakır' in Turkish) (2.33 %) (Figure 2c) (Table 1). There was no crest ('takkasız' in Turkish) in almost

half of the pigeons (45.35 %) of this genotype. It was determined that 10.47 % of the examined pigeons crested ('takkalı' in Turkish) (Figure 3a), and 41.86 % of pigeons tufted ('perçemli' in Turkish) (Figure 3b). In addition, it was determined that these two feather structures were found together in 2.32 % of them (crested and tufted) ('takka-perçemli' in Turkish) (Figure 3c) (Table 2). Six plumage colors (gray/boz, smoky/dumanlı, azure/gök, yellow/sarı, white/beyaz or süt beyaz, black/arap) were determined in this pigeon genotype. Gray (plumage color and wing tips were fawn-colored, and the tail feathers was gray or brown, which was called 'boz') (35.16 %) (Figure 4a), smoky (plumage color was ash or smoky-colored, which was called 'dumanlı') (20.88 %) (Figure 4b), azure (plumage color was white or azure-colored, the wings are light gray, the tail is gray, and the wingtips are dusky, which was called 'gök') (19.78%) (Figure 4c), yellow (plumage color is off-white with gray stripes along the wing, which was called 'yellow'), (14.29 %) (Figure 4d), white (plumage color was white, which was called 'beyaz or süt beyaz') (6.59 %) (Figure 4e), black (plumage color was black, which was called 'arap') (3.30 %) (Figure 4f) were classified as the plumage colors (Table 1). Head and body marks were classified into six groups as whiskered or beak-feathered ('bıyıklı' in Turkish) (15.05 %) [(the presence of a few curled hairs at the junction of the beak and head. It can be unilateral or bilateral. The uni-lateral one was called as single-whiskered ('tek bıyıklı' in Turkish), the bi-lateral one was called as double-whiskered ('çift bıyıklı' in Turkish)] (Figure 5a), speckled ('benekli' in Turkish) (12.90 %) (It is the presence of small round-like areas on a part of the body or on the wing of a different color from the plumage color) (Figure 5b), white tail or shoved ('ak kuyruk or sokuşturmalı' in Turkish) (11.83 %) [(One or more of the tail feathers are white in pigeons with a dark plumage color - the white tail is named

according to the number of white tail feathers, such as single shoved, three shoved and five shoved ('tek sokuşturmalı, üç sokuşturmalı or beş sokuşturmalı' in Turkish)] (Figure 5c), grizzled ('kırçılı' in Turkish) [(It is the heterogeneous distribution of white feathers in dark plumage colored pigeons (4.30%)] (Figure 5d) and barred (The colored line extending along the wing, different from the wing color, was called as 'kalemlı' in Turkish) (2.15 %) (Figure 5e) (Table 1). It was determined that there were three types of feathered-feet in Kırıkkale tumbler pigeons: small-muff (yıldız paça) (78.48 %) (Figure 6a), grouse (silik paça) (11.40%) (Figure 6b) and large-muff (bol paça) (10.12%) (Figure 6c). When the rates were evaluated, it was determined that small muff had the highest rate in this genotype. In the present study, Kırıkkale tumbler pigeons divided into four groups 10-1-11 (45.35%), 10-1-12 (36.05%), 10-1-10 (17.44%), 10-1-13 (1.16 %) according to the number of primary-axial-secondary wing feathers. Also, this genotype was divided into three groups 12 (83.72 %), 13 (11.63 %), 14 (4.65 %), according to the number of tail feathers (Table 2).

Morphometric Characteristics

The body weight was significantly influenced by age group and sex. The body weight of male pigeons was significantly higher than those of female pigeons ($P < 0.05$). Also, age group II was heavier than age group I ($P < 0.05$). Chest width and chest depth were found to be significantly different between age groups. Age group I was higher than the age group II in terms of chest width and chest depth ($P < 0.05$). Sex significantly affected body length, wing length, head width, and beak depth in Kırıkkale tumbler pigeons. Body length ($P < 0.001$), wing length ($P < 0.05$), head width ($P < 0.01$) and beak depth ($P < 0.001$) of male pigeons were higher than those of female pigeons (Table 3).

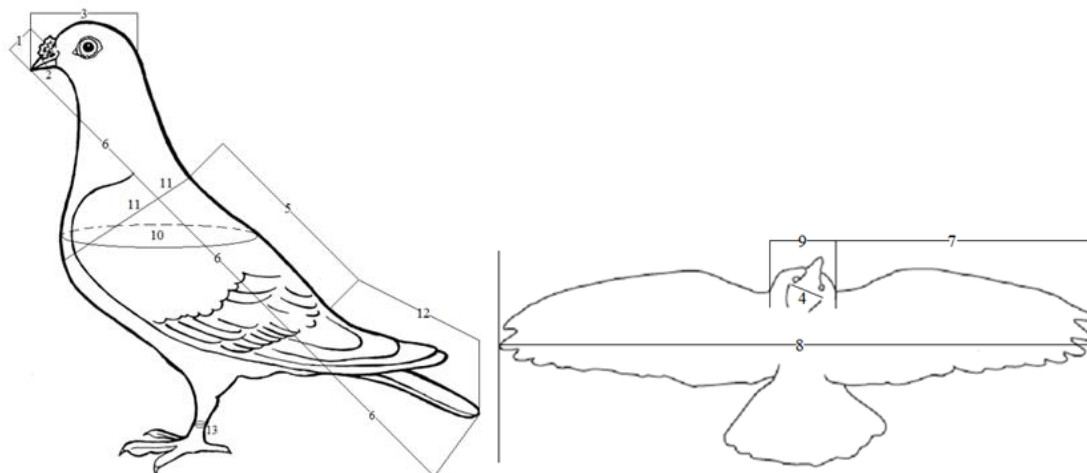


Figure 1: Morphometric body measurement regions (Erdem et al. 2021).

(1 - Beak length; 2 - Beak depth; 3 - Head length; 4 - Head width; 5 - Trunk length; 6 - Body length; 7 - Wing length; 8 - Wing span; 9 - Chest width; 10 - Thoracic perimeter; 11 - Chest depth; 12 - Tail length; 13 - Tarsus diameter)



a

b

c

Figure 2: Eye colors of the Kırıkkale tumbler pigeons a. Brown b. Black c. Grayish-blue



a

b

c

Figure 3: Head-feather type of the Kırıkkale tumbler pigeons a. Crested b. Tufted c. Crested and tufted



a

b

c



d

e

f

Figure 4: Plumage colors of the Kırıkkale tumbler pigeons a. Gray b. Smoky c. Azure d. Yellow e. White f. Black



a

b

c



d

e

Figure 5: Head and body marks of the Kırıkkale tumbler pigeons a. Whiskered b. Speckled c. White-tail d. Grizzled e. Barred



a

b

c

Figure 6. Fetahered feet types of the Kırıkkale tumbler pigeons a. Small muff b. Grouse c. Large muff

Table 1. Eye color, plumage color, head and body mark in Kırıkkale Tumbler pigeons (%).

Morphological characteristics	Ratio (%)
Eye color	
Brown (Kahverengi)	89.53
Black (Siyah)	8.14
Grayish-blue (Mısıır)	2.33
Plumage Color	
Gray (boz)	35.16
Smoky (dumanlı)	20.88
Azure (gök)	19.78
Yellow (sarı)	14.29
White (beyaz/süt beyaz)	6.59
Black (arap)	3.30
Head and body mark	
Unmarked	53.77
Whiskered (bıyıklı)	15.05
Speckled (benekli)	12.90
White tail (ak kuyruk)	11.83
Grizzled (kırçılı)	4.30
Barred (kalemlı)	2.15

Table 2. Table 2. Head-feather type, feathered-feet type, number of wing and tail feathers in Kırıkkale Tumbler pigeons (%).

Morphological characteristics	Ratio (%)
Head-feather type	
Non-crested (Düz)	45.35
Tufted (Perçemli)	41.86
Crested (Takkalı)	10.47
Crested and tufted (Takka perçemli)	2.32
Feathered-feet type	
Small muff (Yıldız paça)	78.48
Grouse (Silik paça)	11.40
Large muff (Bol paça)	10.12
Number of wing feather	
10-1-11	45.35
10-1-12	36.05
10-1-10	17.44
10-1-13	1.16
Number of tail feather	
12	83.72
13	11.63
14	4.65

Table 3. Morphometric characteristics of Kırıkkale tumbler pigeons ($X \pm S\bar{x}$)

Age group	Sex	n	Body weight (g)	Body length (cm)	Wing Span (cm)	Wing length (cm)	Tail length (cm)	Thoracic perimeter (cm)	Chest width (mm)	Chest depth (mm)	Head length (mm)	Head width (mm)	Beak length (mm)	Beak depth (mm)	Tarsus diameter (mm)
I	Male	16	321.04±5.82	34.14±0.25	68.44±0.75	30.72±0.34	14.06±0.16	20.29±0.17	50.72±0.68	58.11±1.01	47.96±0.39	19.62±0.29	15.40±0.25	5.12±0.09	4.81±0.01
	Female	24	309.93±4.75	33.83±0.21	67.10±0.61	31.24±0.28	13.55±0.13	20.15±0.13	51.26±0.56	59.52±0.83	48.38±0.32	18.55±0.24	15.80±0.20	4.99±0.08	4.70±0.08
II	Male	26	338.18±4.56	35.03±0.12	67.78±0.59	30.01±0.27	13.99±0.13	20.69±0.13	50.74±0.53	57.55±0.79	48.66±0.31	18.99±0.23	15.75±0.20	5.42±0.07	4.88±0.08
	Female	14	323.96±6.22	33.57±0.27	67.66±0.81	30.56±0.37	13.93±0.17	20.22±0.18	48.54±0.73	55.83±1.08	48.16±0.42	18.25±0.31	16.16±0.27	4.82±0.09	4.67±0.10
TOTAL															
Age group	I	40	315.48±3.75	33.99±0.16	67.77±0.48	30.36±0.22	13.80±0.11	20.22±0.11	50.99±0.44	58.81±0.65	48.17±0.25	19.09±0.19	15.60±0.16	5.05±0.06	4.76±0.06
	II	40	331.07±3.86	34.30±0.17	67.72±0.50	30.90±0.23	13.96±0.11	20.45±0.11	49.64±0.45	56.69±0.67	48.41±0.26	18.62±0.19	15.95±0.16	5.12±0.06	4.77±0.06
Sex	Male	42	329.61±3.69	34.59±0.12	68.11±0.48	30.98±0.22	14.02±0.10	20.49±0.11	50.73±0.43	57.83±0.64	48.31±0.25	19.31±0.19	15.58±0.16	5.27±0.06	4.84±0.06
	Female	38	316.94±3.91	33.70±0.17	67.38±0.51	30.29±0.23	13.74±0.11	20.18±0.11	49.90±0.46	57.68±0.68	48.27±0.26	18.31±0.20	15.98±0.16	4.90±0.06	4.68±0.06
Grand mean		80	323.28±2.69	34.14±0.12	67.74±0.34	30.63±0.16	13.88±0.08	20.34±0.08	50.31±0.32	57.75±0.47	48.29±0.18	18.85±0.14	15.78±0.12	5.09±0.04	4.76±0.04
P															
Age group			*	—	—	—	—	—	*	*	—	—	—	—	—
Sex			*	***	—	*	—	—	—	—	—	**	—	***	—

DISCUSSION

Morphological Characteristics

Pigeon genotypes, one of our indigenous genetic resources, are important in terms of their unique flight display characteristics, and adaptability to the region where they are raised. For this reason, it is necessary to define the morphological characteristics of indigenous genotypes (i.e. eye color, crest structure, plumage color, muff type, body morphometric traits) and compare them with other indigenous pigeon genotypes (Atasoy et al., 2013; Erdem et al., 2021). In the present study, brown (kahverengi) (89.53 %), black (siyah) (8.14 %) and grayish-blue (çakır) (2.33 %) eye colors were determined in Kırıkkale tumbler pigeons. In the studies conducted in other indigenous breeds, it was stated that the Ankara tumbler pigeons had grayish-blue (çakır) (51.76 %), dark grayish-blue (nar/koyu çakır) (25 %), gray (gri) (18.59 %), dark brown (üzüm/koyu kahverengi) (7.04 %) light brown (açık kahverengi) eye colors, and the Squadron flyer pigeons had dark brown (kehribar/kahverengi) (26.62 %), yellow (23.02 %), dark grayish-blue (nar/koyu çakır) (18.71%), grayish-blue (çakır) (15.83%), gray (10.06 %) and crimson/dark red (5.76 %) eye colors. In another study conducted on Bursa Oynarı pigeons, it was reported that the majority of the pigeons had dusty rose (gül kuruşu) eye color (67.44 %). In the same study, it was reported that pigeons also had white (23.26 %) (beyaz) and dark dusty rose (koyu gül kuruşu) colored eyes (9.3 %). When the researches were examined, the eye color of grayish blue was defined as the 'çakır' in Kırıkkale tumblers, Ankara tumblers and Squadron flyer pigeons, and 'gülkuruşu' in Bursa Oynarı pigeons and Mulakat pigeons (Atasoy et al. 2013, Özbaşer et al. 2016, Balcı et al. 2018, Özbaşer et al. 2020). Atasoy et al. (2013) emphasized that pigeons with grayish-blue (çakır) eye color were preferred in the selection of breeding animals in the tumbler pigeons in Ankara. Crest structure in pigeons was defined as the growth of head or neck feathers towards the top of the head (Shapiro et al. 2013). In the studies carried out in Turkey, the crest structure in pigeon genotypes were determined in Ankara tumblers (8.54 %), Edremit Kelebek roller (46 %), and Alabadem pigeons (100 %). The absence of crest in Ankara tumbler pigeons was found to be 78.89%, while it was 43.35% in Kırıkkale tumbler pigeons. These rates are quite high for both genotypes. These findings show that there was a high rate of absence of a crest in Kırıkkale tumblers, similar to Ankara tumblers (Atasoy et al. 2013, Erdem et al. 2018, Erdem et al. 2021). The plumage colors of Kırıkkale tumbler pigeon were divided into six groups as gray (boz) (35.16 %), smoky (dumanlı) (20.88 %), azure (gök) (19.78 %), yellow (sarı) (14.29 %), white (beyaz) (6.59 %), and black (arap) (3.30 %). Similar to this finding, the plumage color of the tumbler pigeons

reared in Ankara was divided into six groups gray (boz - 47.77 %), blue (gök - 17.56 %), smoky (dumanlı - 16.07 %), siyah (black - 9.05%), white (beyaz - 7.04 %) and shiny (yanardöner - 2.51 %) (Atasoy et al. 2013). The fact that gray plumage color ratios in these two genotypes were higher than other plumage color ratios shows that breeders give importance to plumage color as well as flight characteristics while applying selection. In Turkish pigeon breeds/genotypes, one or a few feathers on the wing/tail were white, it was called shoved (sokuşturmalı). This mark was defined according to the number of white primaries on the wing or the tail such as single-shoved (tek-sokuşturmalı), double-shoved (çift-sokuşturmalı), or five-shoved (beş-sokuşturmalı). If this mark was found as a wing mark in Ankara tumblers and squadron flyer pigeons, it was defined as grizzle color-wing (kır-kanat) (6.03 %) and shoved-wing (sokuşturmalı/arans) (29.03 %), respectively. In the present study, it was determined that one or more of the tail primaries in pigeons are white, which is called the white-tail (ak-kuyruk/sokuşturmalı) (11.83 %). This situation is called white tail (ak-kuyruk) or mirror tail (ayna-kuyruk) in Ankara tumbler pigeons (15.58 %) and silver-tail (gümüş-kuyruk) in squadron flyer pigeons (19.35 %) (Atasoy et al. 2013, Özbaşer et al. 2016). In addition, the white-wing and white-tail marks with red plumage color in the Cakal pigeon genotype can be interpreted as a breed character (Özbaşer et al. 2020). Another common point morphologically between Ankara tumblers and Kırıkkale tumblers is that some pigeons have lines on the wing that are different from the wing color. This wing mark is called barred (kalemlı) in Kırıkkale tumbler pigeons and aleph (elifli/kuşaklı) in Ankara tumbler pigeons (Atasoy et al. 2013). These marks were defined as 'strips' in the Oriental pigeon genotype reared in the Marmara region (Özbaşer et al. 2020).

The feathered-feet was defined as the abnormal growth and distribution of the feathers extending towards the foot (Baptista et al. 2009, Kabir, 2015). Although foot feathering in poultry species is a desirable trait in ornamental birds, it is found in many indigenous pigeon genotypes bred for flight display performance purposes (Ankara tumblers, Edremit kelebek rollers, Mulakat and Oriental pigeons) (Atasoy et al. 2013; Erdem et al. 2018, Özbaşer et al. 2020). Bortoluzzi et al. (2020) defined the absence of feathers on the feet (non feather- legged) as 'scale'. Also, he stated that some feather-legged birds had short and tight foot feathers, and some had long foot feathers similar to wing feathers. On the other hand, the foot feathering in pigeons was divided into four groups as scale, grouse, small muff, and large muff (Domyan et al. 2016, Boer et al. 2019). In Kırıkkale tumbler pigeons, foot feathering was divided into three groups as small muff (yıldız paça) (78.48 %), grouse (silik paça) (11.40 %), and large muff (bol

paça) (10.12 %). This situation was classified into four groups as grouse (normal paça), small muff (kılıç paça), medium muff (sote paça), and large muff (bol paça or Kayseri paça) in Ankara tumbler pigeons, and it was emphasized that all pigeons had muffs (paçalı) (100 %). The situation of having trotters in all Kırıkkale tumbling pigeons was similar to Ankara tumbling pigeons. The feather-legged ratio in the tumbler pigeons bred in Kırıkkale province (all pigeons have feathered-feet) (100 %) was similar to the tumbler pigeons bred in Ankara province (100 %). In this genotype, the number of the wing primary-axial-secondary feathers (p-a-s) were divided into four groups as 10 - 1 - 11 (45.35 %), 10 - 1 - 12 (36.05 %), 10-1-10 (17.44 %), (10-1-13) (1.16 %). Wing primaries were determined as 9-1-13 (50.84%), 9-1-12 (22.91 %), 9-1-11 (12.85 %), 9-1-14 (10.05 %) and 9-1-10 (3.35 %) in Ankara tumbler pigeons. The number of wing primaries was reported as 8-1-9 (87%), 9-1-9 (13%) in the Mülakat pigeons, 11-1-11(87%), 10-1-11 (13%) in the Oriental pigeons, and 9-1-10 (87%), 8-1-10 (13%) in the Çakal pigeons. Three groups were determined according to the number of tail primaries (12 - 83.72 %, 13 - 11.63 %, 14 - 4.65) in Kırıkkale tumbler pigeons. Similarly in the previous research, Ankara tumblers were divided into three groups in terms of the number of tail primaries (12- 85.43 %, 13 - 9.04 %, 14 - 5.53 %) (Atasoy et al. 2013, Özbaşer et al. 2020).

Morphometric Characteristics

Body weight, wing length, thoracic perimeter, and head width of Kırıkkale tumbler pigeons, which was obtained in this study (323.28g, 30.63 cm, 20.34 cm, and 18.85 mm) were lower than the study for Squadron flyer pigeons (428.85 g, 31.34 cm, 22.11 cm, and 21.35 mm), but higher than the Alabadem (231.17 g, 31.56 cm, 19.78 cm, and 18.67 mm) and Muradiye döneke pigeons (319.74 g, 29.30 cm, 19.34 cm, 18.20 mm) (Erdem et al., 2021 Özbaşer et al., 2016; Özbaşer et al., 2021). In the present study, it was determined that Kırıkkale tumbler pigeons (323.28 g, 34.14 cm, 67.74 cm, 30.63 cm, 20.34 cm, and 4.76 mm) had similar values to Ankara tumbler pigeons (321.62 g, 34.95 cm, 68.82 cm, 31.55 cm, 19.70 cm, and 4.01 mm) in terms of body weight, body length, wing span, wing length, thoracic perimeter, and tarsus diameter (Atasoy et al., 2013). Body weight, body length, wing length, head width and beak depth were significantly affected by sex. However wingspan, tail length, thoracic perimeter, chest width and depth, head length, beak length and tarsus diameter were not affected by sex. Body weight ($P < 0.05$), body length ($P < 0.001$), wing length ($P < 0.05$), head width ($P < 0.01$) and beak depth ($P < 0.001$) of male pigeons were significantly higher than that of female pigeons. These results were consistent with the other studies emphasizing that the effect of sex difference is statistically significant in terms of body weight, body length, wing length, head width,

and beak depth in Ankara tumbler pigeons and Muradiye Döneke pigeons (Atasoy et al. 2013, Özbaşer et al. 2021). Body weight, chest width, and chest depth were significantly affected by age group. However body, length, wing span, wing length, tail length, thoracic perimeter, head length, head width, beak length, beak depth, tarsus diameter were not affected by age group. Although age group II was higher than age group I in terms of body weight ($P < 0.05$), age group I was higher than age group II in terms of chest width ($P < 0.05$), and chest depth ($P < 0.05$). This might be due to the different management conditions applied by the breeders in different enterprises. Body development could be affected by the aerial-display and racing performance in pigeons. Mercieca et al. (2017) reported that speed and racing performance in pigeons changed positively or negatively depending on external (diet, geographical and environmental factors) and internal factors (health, innate homing ability, and body condition).

CONCLUSION

It is obvious that the nomenclature of head-feather type, eye color, plumage color, body mark and feathered-feet type are disparities in pigeons according to the region. These definitions varies according to the regions, and it is created by the breeders in that region. The high rate of absence of crest, high rate of gray plumage color, and feathered-feet of all the pigeons in Kırıkkale tumblers were completely overlap with the morphological findings in Ankara Tumblers. The high ratio of gray plumage color in both genotypes (Ankara tumbler and Kırıkkale tumbler) shows that breeders give importance to plumage color as well as aerial-display characteristics in artificial selection. In addition to these findings, when Kırıkkale tumbler pigeons and Ankara tumbler pigeons were compared in respect to body structure, it was determined that these two pigeons had very close mean values in terms of body weight, body length, wing span, wing length, thoracic perimeter and tarsus diameter. For these reasons, the degree of similarity between Ankara tumblers and Kırıkkale tumblers should be clarified by genetic studies. The number of morphological studies carried out on tumbler pigeon genotypes in Turkey should be increased. The morphological and molecular characteristics of indigenous pigeon genotypes should be determined throughout the country.

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