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The Stereological and Morphometrical Analysis of Metapodium in Tuj and Morkaraman Sheep

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Abstract: *This recent study aimed to evaluating metapodium as morphometrical and stereological in the Morkaraman and Tuj sheep races. For this purpose, one-year old 40 Morkaraman (20 female, 20 male) and 40 Tuj (20 female, 20 male), in total metapodium of 80 sheep were used. Following maceration, 17 morphometrical and 3 stereological, totally 20 measurements were obtained from each metapodium. The average maximum length of metacarpus and metatarsus of the female Morkaraman sheep were determined as 137.98 mm and 146.99 mm, respectively. In the male Morkaraman sheep these values were found respectively as 132.76 mm and 142.21 mm, respectively. Besides, the average maximum length for the female and male metacarpus was determined as 133.15 and 133.80 mm respectively. Also, it was respectively found in their metatarsus as 143.87 ve 143.12 mm. Some statistically differences was investigated between metapodium in the analysis of gender and race. To sum up, it was detected that gender was more effective than race on metapodium morphometry of Morkaraman and Tuj sheep. Furthermore, it was uncovered that more bone marrow can be obtained from metapodium of female than metapodium of male Morkaraman and Tuj sheep.*

Keywords: *Metapodium, morphometry, stereoloji, sheep, gender.*

1. INTRODUCTION

Morkaraman and Tuj sheep, which are raised as a combined race on the purpose of meat, milk and wool production, are the main breeds of Eastern Anatolia [1]. Bones of sheep, which are critical in the life of mankind, are widely encountered in archaeological excavations. In the literature, it has been asserted that the data can be determined on the history of the domestication of sheep and also, comments can be made about the population through fossils by analyzing cattle and sheep's metapodium [2, 3]. It has been reported that metapodium is used on the separation of the sheep and goat bones belonging to the Neotithis period [4]. Onar *et al.* (2008) [5] and Pazvant *et al.* (2015) [6] have researched sheep and goats metapodium, which was obtained from the excavations in Istanbul and Eastern Anatolia, as osteometric.

Bones are essential fat sources in animals. Fats in cavum medullare and substantia spongiosa generate fat tank in the animal bones. Mandibula and skeleton apendiculare are essential oil tanks. In the literature, it has been reported that medullar bone fat is more in animals which have less body fat and undernourish [7]. It is underlined that stated medullar and spongios fats will be used in the case of long-term starvation [8-10]. Consequently, in terms of bone fat, if an animal has healthy and good condition, cavum medullare of mandibula and long bones can preponderate from other animals, which are sick and have poor condition [11]. In the case of severe starvation, bone fat in Ungulata is the most recently used; for this reason, bone fat in Ungulata is a criterion in assessment of the body condition [10, 12].

In the assessment of the amount of bone marrow in the bones, knowing the volume of the cavum medullare is of capital importance [13]. The stereological methods which are 'gold standard' are often preferred for volume calculation. "Cavalieri principle" is the most preferred stereological method. Even if this principle is mostly used to estimate the volume of organs such as the brain and liver [14, 15], it is also used in computed tomography and combined bone studies [16].

2. Materials and Methods

In this recent study, one-year old 40 Morkaraman (20 female, 20 male) and 40 Tuj (20 female, 20 male), in total metacarpus and metatarsus of 80 sheep were used. Within the aim of providing similar nutritional conditions, metapodium was obtained from Kars Kardesler Town. Before the osteometric measurements, metapodium had been boiled for five hours and for to be free from fat, metapodium was maceration by had been waited for 12 hours in 50% hydrogen peroxide [17]. Weight (W) of the metacarpus (MC) and the metatarsus (MT) was determined with digital precision scales (Precise Switzerland 0.0001) by considering gender differences. After this process, 16 osteometric parameters were determined from all samples with the help of digital calipers (0.01, BTS-UK), as set out below (Figure 1-4) [3, 18, 19].

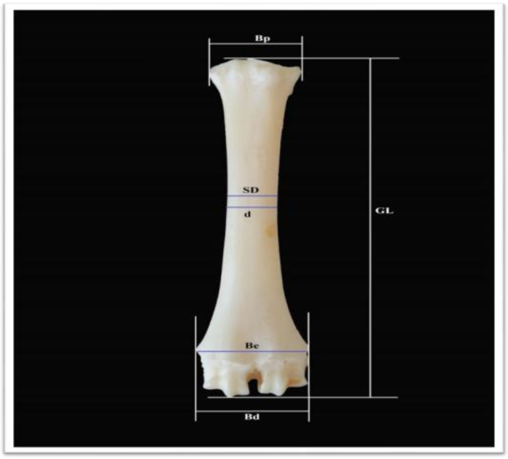

Fig1. *Measurement point on metapodium-1*

Fig2.*Measurement point on metapodium-2*

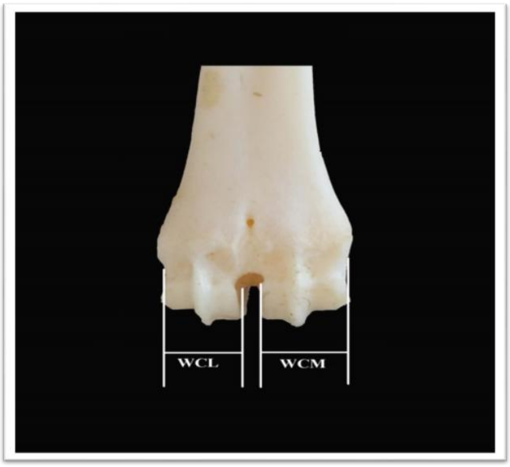

Fig3.*Measurement point on metapodium-3*

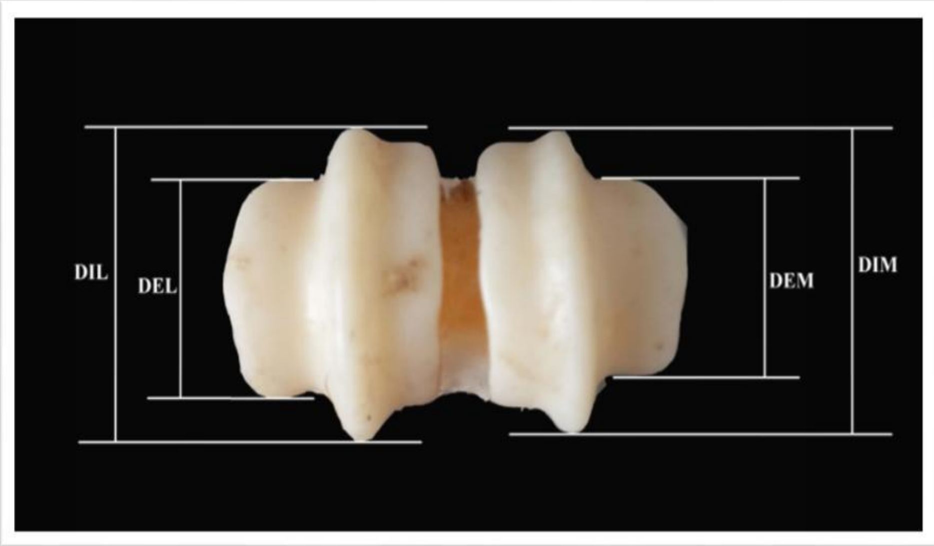

Fig4.*Measurement point on metapodium-4*

2.1.Morphometric Measurements

Morphometric measurements were determined as the maximum length (GL), the maximum width of the proximal end (Bp), the maximum depth of the metaphysis (Be), the maximum width of the metaphysis (De), the smallest width of the diaphysis (SD), the smallest depth of the diaphysis (DD), the width of the mid-point of the diaphysis (d),the depth of the mid-point of the diaphysis (e), the maximum width of the distal end (Bd), the depth of the distal end (Dd), the anteroposterior diameter of the internal trochlea of the condylus lateralis (DIL), the anteroposterior diameter of the external trochlea of the condylus lateralis (DEL), the anteroposterior diameter of the internal trochlea of the condylus medialis (DIM), the anteroposterior diameter of the external trochlea of the condylus medialis (DEM), the mediolateral width of the condylus lateralis (WCL) and the mediolateral width of the condylus medialis (WCM).

Besides, for the evaluation of the differences, metapodial slenderness index (SD / GL × 100) [19-21] and metapodial index (DEM / dd × 100) (Lallemand, 2002; Guintard, 1998) were calculated by benefiting from metapodial measurements.

2.2.Stereological measurements

As stereological the cavum medullary (MV) and bone volume (BV) was measured by using the Cavalieri principle. All metapodial volume (TV) has been reached by collecting these two values. The ten by samples were used according to male, female and breed for stereological measurements. For stereological measurements of metapodium, firstly, it was sliced as transversal, slice of 0.5 cm thickness, with the help of an electric saw machine [17]. Following the slicing process, each section was numbered consecutively. Sections were photographed by placing on a flat ground (Canon 600D). Photographs were separately processed to point counting on Image J program (Figure 5).

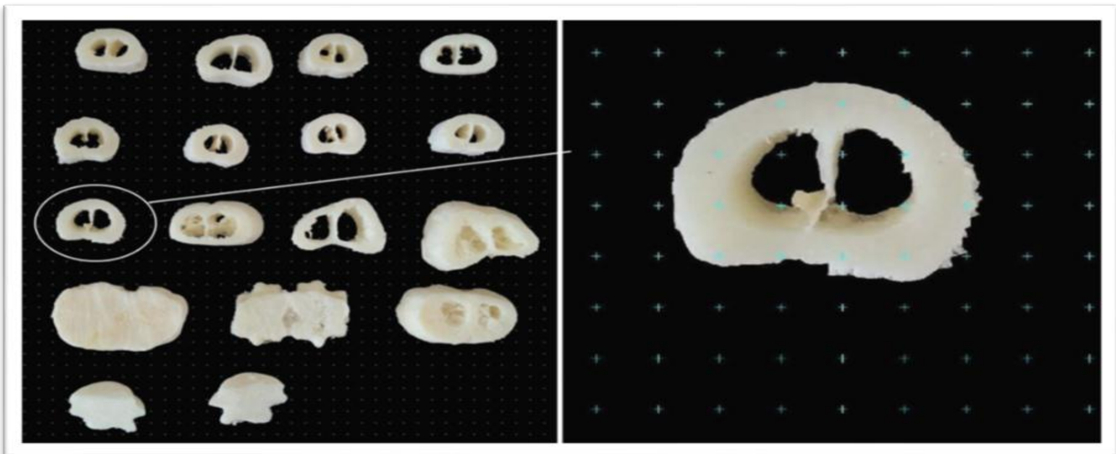

Fig5.*Point-counting on sections*

After point counting process, not only medullar volume but also bone tissue volume was determined by using following formula [22-24].

V= t × [((SU) × d)/SL]2 × ΣP

V: Volume, t: slice thickness (0.5 cm), SU: the represented length by the scale which shows to enlarge an image, d: distance between two points on the dotted field measurement ruler, SL: the length of the scale in the image is measured with a ruler ΣP: total number of counted points.

In order to challenge of the calculated volume, coefficient error (CE) was computed by using the following formulas.

1. Noise = 0.0724×(b/√ a)× √n×ΣP

Noise: Complexity (Noise) value, **b / √ a:** Standard value, **n:** Number of the Sections, **ΣP:** the total number of the counted points.

2. $Var_{SRS}(\sum_{i=1}^{n} a) = (3\times\sum(P_i^{\,2} - Noise) - 4\times\sum P_i \times P_{i+1} + \sum P_i \, x \, P_{i+2})/12$

Var_{SRS}: the total areea change, $\sum_{i=1}^{n} \boldsymbol{a}$: the total fields changes which are occured in n number sections, ∑**Pi:** the counted dots listed in n numbered sections

3. $CE\ (\sum P) = \frac{\sqrt{Toplam\ varyans}}{\Sigma P}$

Total variance = Noise + VarSRS

P: Number of the points

It was sure that the value of CE had been taken less than 10%, which is the reliability limit in the study.

2.3.Statistical Analysis

2-t test (p≤ 0.05), which is a parametric test in the SPSS statistical package program (version 16.0), was performed for analysis, identifier values of the measurements and calculations, which are obtained in the study (average-x, standard deviation-SD),with regard to gender and orientation. Furthermore, the variation coefficient (% CV) of the data was calculated in the same program for Pearson's correlation coefficient and morphometric values.

3. Results

As a first step in the study, coefficient error and descriptive data of the morphometric data are shown in Tables 1 and 2.According to this, Bd in metacarpus and De in matatarsus of the female Morkaraman sheep; De in metacarpus and metatarsus of the male Morkaraman sheep; Be in metacarpus and WCM in metatarsus of the female Tuj sheep; and DIL in metacarpus and DEM in metatarsus of the male Tuj sheep had the highest variation coefficient.

In the study, the descriptive data which was obtained from Tuj and Morkaraman sheep's metapodium was shown in Table 2.

In this recent study, metapodium was compared according to gender and race. It was seen that the gender differences, which were determined in metacarpus of Morkaraman sheep W, GL, Bp, d, SD, De, Be, Dd, DEM, DIM, DIL, BV ve TV, and in metatarsus of it GL, Bp, SD, DD, Bd, De, Be, Dd, DIM, DIL, WCM ve WCL parameters, were seen statistically significant (P< 0.05).

In this study, the correlation analysis was done in order to determine the relation of metapodial parameters with each other and findings were presented in Table 4-7. According to this, when the obtained data was analyzed overall, in terms of P<0,01 and P<0,05, statistically significant results were reach in metacarpus of the female Morkaraman sheep respectively as in the ratio of 4.71% and 2.1%, and in their metatarsus as 7.89% and 9.47%. These values were in the ratio of 4.21% and 4.21% for the male Morkaraman sheep metacarpus and 2.63% and 5.26% for their metatarsus. When viewed the metapodium correlation data of the Tuj sheep, according to P<0,01 and P<0,05, percentage values were diagnosed respectively as 21.05% and 7.89% for the female metacarpus and 20.53% and 9.47% for the female metatarsus. Besides, these values were diagnosed in the male metacarpus as 11.5% and 10.53% and in the male metatarsus as 3.68% and 5.26%.

In the study, metapodial slenderness index was found as follows: for the Morkaraman metacarpus as10.48 and for the metatarsus as 8.84. The metapodial index was 10.05 for the Tuj sheep metacarpus and 9.08 for metatarsus. The metapodial index was determined as following: for the Morkaraman metacarpus as 75.82 and for the metatarsus as 71.93. Furthermore, these values were respectively 74.9 and 72.03 for Tuj metacarpus and metatarsus.

Table 1.*Morphometric coefficient error of the metapodium of the Tuj and Morkaraman sheep*

	Morkaraman				Tuj			
	Female		Male		Female		Male	
Parametre	**MC**	**MT**	**MC**	**MT**	**MC**	**MT**	**MC**	**MT**
GL	2,56	3,38	2,61	2,06	5,35	6,12	4,63	3,99
Bp	2,20	3,39	2,56	2,88	5,10	5,10	4,85	2,31
D	3,64	7,48	2,42	2,91	5,19	6,11	4,10	3,07
E	4,37	5,92	3,43	4,66	5,20	4,23	3,16	4,00
SD	5,36	6,76	3,64	1,27	6,33	5,27	5,12	2,57
DD	7,33	5,46	4,01	2,95	2,91	4,95	5,08	2,49
Bd	12,93	4,16	2,03	2,62	4,90	4,88	3,98	3,86
De	8,17	10,13	9,71	6,50	10,89	5,98	9,72	4,81
Be	4,23	14,81	3,63	3,26	11,67	4,80	4,87	3,73
Dd	9,17	7,33	3,61	3,57	8,13	8,08	4,14	3,90
DEM	4,35	6,08	2,66	1,69	4,15	4,13	5,51	9,30
DIM	2,47	3,28	3,42	1,47	4,51	5,02	3,85	4,98
DEL	3,08	6,01	3,92	3,81	5,21	4,58	3,97	4,47
DIL	2,06	2,28	2,85	3,73	5,23	5,10	14,22	4,35
WCM	2,99	3,83	4,49	2,20	3,85	11,69	7,00	5,86
WCL	3,22	4,91	2,59	3,72	4,80	4,94	7,26	3,64

Table 2.*The data of the metapodium of the Morkaraman and Tuj sheep (W: g, BV, MV, TV: cm^3, The others values: mm)*

	Morkaraman								Tuj							
	Female				Male				Female				Male			
	MC		MT		MC		MT		MC		MT		MC		MT	
	Mean	**sd**	**Mean**	**sd**	**Mean**	**sd**	**Mean**	**sd**	**Mean**	**sd**	**Mean**	**sd**	**Mean**	**sd**	**Mean**	**sd**
W (g)	32.86	1.70	33.59	4.14	29.93	1.35	30.94	1.21	32.09	3.58	35.63	4.84	31.11	3.15	32.72	3.26
GL (mm)	137.98	3.53	146.99	4.97	132.76	3.46	142.21	2.93	133.15	7.13	143.87	8.81	133.80	6.20	143.12	5.71
Bp (mm)	26.91	0.59	23.60	0.80	27.59	0.71	24.91	0.72	26.00	1.33	23.36	1.19	26.58	1.29	23.84	0.55
d	14.90	0.54	13.08	0.98	14.31	0.35	12.52	0.36	15.45	0.80	13.53	0.83	14.76	0.61	13.06	0.40
e	11.37	0.50	12.40	0.73	11.59	0.40	12.39	0.58	11.55	0.60	12.77	0.54	11.53	0.36	12.84	0.51
SD	14.75	0.79	13.10	0.89	13.64	0.50	12.46	0.16	14.88	0.94	13.30	0.70	14.51	0.74	12.75	0.33
DD	10.82	0.79	11.46	0.62	11.00	0.44	11.98	0.35	10.62	0.31	11.66	0.58	11.13	0.57	11.79	0.29
Bd	27.47	3.55	27.02	1.12	29.42	0.60	28.15	0.74	27.89	1.37	26.49	1.29	28.51	1.13	26.96	1.04
De	13.39	1.09	13.67	1.38	14.78	1.43	15.06	0.98	13.97	1.52	14.23	0.85	15.44	1.50	15.33	0.74
Be	29.78	1.26	27.51	4.07	31.36	1.14	30.46	0.99	28.39	3.31	28.70	1.38	31.02	1.51	29.08	1.09
Dd	16.54	1.52	16.56	1.21	18.47	0.67	18.56	0.66	17.37	1.41	16.58	1.34	17.79	0.74	18.09	0.70
DEM	12.99	0.57	12.55	0.76	13.50	0.36	12.63	0.21	13.14	0.55	12.39	0.51	13.19	0.73	12.54	1.17
DIM	18.65	0.46	18.77	0.62	19.26	0.66	19.29	0.28	18.35	0.83	18.58	0.93	18.85	0.73	18.74	0.93
DEL	12.10	0.37	11.62	0.70	12.37	0.48	11.86	0.45	12.24	0.64	11.59	0.53	12.33	0.49	11.61	0.52
DIL	17.88	0.37	17.89	0.41	18.50	0.53	18.48	0.69	17.80	0.93	17.52	0.89	19.35	2.75	17.76	0.77
WCM	13.48	0.40	13.16	0.50	13.69	0.61	14.03	0.31	13.26	0.51	13.47	1.57	14.42	1.01	13.30	0.78
WCL	12.81	0.41	11.83	0.58	12.94	0.34	12.45	0.46	12.71	0.61	11.65	0.58	14.11	1.02	12.12	0.44
BV	17.83	1.03	17.82	3.39	14.90	1.79	17.56	1.67	14.12	4.31	15.45	5.01	19.15	3.22	18.50	2.95
MV	4.05	0.82	4.27	1.12	3.35	0.54	4.01	0.68	3.50	1.44	3.63	1.38	3.96	0.49	4.18	1.07
TV	21.88	1.56	22.09	4.45	18.25	2.19	21.57	2.28	17.63	5.69	19.07	6.17	23.11	3.56	22.67	3.46

Table 3. *The data according to general and gender of the metapodium of the Morkaraman and Tuj sheep, '*': P<0.05 (W: g, BV, MV, TV: cm^3, The others values: mm)*

					Morkaraman				Tuj			
	MC		MT		MC		MT		MC		MT	
	Mork.	Tuj	Mork.	Tuj	Female	Male	Female	Male	Female	Male	Female	Male
W	31.40	31.60	32.27	34.18	32.86*	29.93	33.59	30.94	32.09	31.11	35.63	32.72
GL	135.37	133.48	144.60	143.50	137.98*	132.76	146.99*	142.21	133.15	133.80	143.87	143.12
Bp	27.25*	26.29	24.25*	23.60	26.91*	27.59	23.60*	24.91	26.00	26.58	23.36	23.84
D	14.61*	15.10	12.80*	13.29	14.90*	14.31	13.08	12.52	15.45*	14.76	13.53	13.06
E	11.48	11.54	12.40*	12.80	11.37	11.59	12.40	12.39	11.55	11.53	12.77	12.84
SD	14.20	14.70	12.78	13.02	14.75*	13.64	13.10*	12.46	14.88	14.51	13.30*	12.75
DD	10.91	10.88	11.72	11.72	10.82	11.00	11.46*	11.98	10.62*	11.13	11.66	11.79
Bd	28.44	28.20	27.59*	26.73	27.47	29.42	27.02*	28.15	27.89	28.51	26.49	26.96
De	14.09	14.70	14.37	14.78	13.39*	14.78	13.67*	15.06	13.97*	15.44	14.23*	15.33
Be	30.57	29.71	28.98	28.89	29.78*	31.36	27.51*	30.46	28.39*	31.02	28.70	29.08
Dd	17.50	17.58	17.56	17.33	16.54*	18.47	16.56*	18.56	17.37	17.79	16.58*	18.09
DEM	13.25	13.17	12.59	12.47	12.99*	13.50	12.55	12.63	13.14	13.19	12.39	12.54
DIM	18.96	18.60	19.03	18.66	18.65*	19.26	18.77*	19.29	18.35	18.85	18.58	18.74
DEL	12.23	12.28	11.74	11.60	12.10	12.37	11.62	11.86	12.24	12.33	11.59	11.61
DIL	18.19	18.57	18.19*	17.64	17.88*	18.50	17.89*	18.48	17.80	19.35	17.52*	17.76
WCM	13.58	13.84	13.60	13.39	13.48	13.69	13.16*	14.03	13.26*	14.42	13.47	13.30
WCL	12.87*	13.41	12.14	11.88	12.81	12.94	11.83*	12.45	12.71*	14.11	11.65	12.12
BV	16.36	16.64	17.69	16.97	17.83*	14.90	17.82	17.56	14.12*	19.15	15.45	18.50
MV	3.70	3.73	4.14	3.90	4.05	3.35	4.27	4.01	3.50	3.96	3.63	4.18
TV	20.06	20.37	21.83	20.87	21.88*	18.25	22.09	21.57	17.63	23.11	19.07	22.67

Table 4. *The correlation data of the metapodium of the female Morkaraman sheep, '*': P<0.05, '**': P<0.01*

MC→ MT↓	W	GL	Bp	d	e	SD	DD	Bd	De	Be	Dd	DEM	DIM	DEL	DIL	WCM	WCL	BV	MV	TV
W		-0.145	-0.271	0.066	0.013	0.125	-0.2	-0.067	-0.129	0.306	0.223	-0.311	-0.197	-0.046	-0.439	-0.533	-0.316	-0.468	-0.304	-0.469
GL	-0.456		0.027	-0.21	-0.536	0.037	-0.391	-0.624	-0.495	-.820**	-.822**	0.452	0.491	-0.103	0.59	-0.143	0.109	0.247	-0.593	-0.15
Bp	-0.164	0.326		0.6	-0.145	0.562	-0.208	0.337	-0.011	-0.019	0.059	0.199	-0.131	-0.623	-0.072	0.355	0.294	0.404	0.739	0.656
d	-0.168	0.17	0.631		0.256	.861**	0.274	0.281	0.437	0.49	0.319	-0.197	-0.3	-0.434	-0.474	0.094	0.12	-0.704	-0.087	-0.508
e	-0.348	0.243	0.372	0.487		0.04	.778**	0.628	0.094	0.386	0.233	-0.243	-0.197	0.461	-0.381	0.121	-0.139	0.231	-0.546	-0.136
SD	-0.012	0.204	.734*	.949**	0.415		0.163	-0.047	0.312	0.348	0.272	-0.372	-0.448	-0.523	-0.507	-0.272	-0.269	-0.073	0.254	0.087
DD	-0.161	0.37	.741*	.675*	0.531	.754*		0.408	0.404	0.39	0.386	-0.177	-0.059	0.577	-0.522	-0.155	-0.319	0.052	-0.31	-0.128
Bd	-0.22	0.326	.824**	0.613	.781**	.678*	.776**		0.106	0.327	0.395	0.13	-0.153	0.216	-0.366	0.327	0.255	-0.09	0.151	0.02
De	0.03	-0.344	0.394	0.348	0.322	0.281	0.552	0.397		.788**	.682*	-0.205	-0.237	0.126	-0.38	0.008	0.001	-0.393	0.068	-0.222
Be	0.433	-0.426	0.353	0.205	0.32	0.225	0.251	0.446	0.602		.866**	-0.522	-0.527	0.036	-.676*	-0.085	-0.214	-0.436	0.133	-0.216
Dd	-0.227	-0.275	-0.074	0.068	0.398	-0.077	0.322	0.107	.728*	0.35		-0.503	-0.561	0.015	-.823**	-0.279	-0.395	-0.185	0.476	0.13
DEM	-0.184	.706*	0.41	-0.028	0.344	0.11	0.337	0.549	-0.201	-0.172	-0.396		.867**	0.307	0.561	0.429	.665*	-0.234	-0.688	-0.517
DIM	-0.195	0.63	0.629	0.491	0.077	0.598	0.361	0.475	-0.3	-0.264	-.699*	.632*		0.408	0.537	0.298	0.49	-0.323	-0.8	-0.634
DEL	-0.246	0.177	-0.13	-0.198	0.303	-0.131	-0.235	0.193	-0.627	-0.257	-0.407	0.45	0.241		0.018	-0.118	-0.103	0.006	-0.774	-0.404
DIL	-0.555	0.386	0.442	0.587	0.507	0.576	0.294	0.558	-0.296	-0.174	-0.275	0.285	0.618	0.596		0.562	0.594	0.158	-0.181	0.008
WCM	-0.209	0.417	.839**	.643*	.662*	.757*	.870**	.951**	0.324	0.25	0.016	0.599	0.592	0.174	0.572		.823**	-0.043	-0.025	-0.042
WCL	-0.322	0.377	.692*	.635*	.837**	.685*	.804**	.924**	0.288	0.321	0.235	0.419	0.358	0.261	.655*	.909**		-0.494	-0.252	-0.458

BV	-0.297	-0.334	0.141	0.607	0.375	0.597	0.538	0.324	0.332	0.01	0.503	-0.451	0.053	0.277	.825*	0.467	0.573		0.415	.877*
MV	-0.462	-0.104	0.266	0.73	0.344	0.709	0.596	0.286	0.239	-0.181	0.381	-0.448	0.268	0.018	.945**	0.478	0.568	.924**		0.801
TV	-0.342	-0.281	0.174	0.646	0.372	0.633	0.56	0.319	0.313	-0.038	0.479	-0.456	0.108	0.216	.867*	0.476	0.579	.995**	.956**	

Table 5. *The correlation data of the metapodium of the male Morkaraman sheep, '*': P<0.05, '**': P<0.01*

MC→ MT↓	W	GL	Bp	d	e	SD	DD	Bd	De	Be	Dd	DEM	DIM	DEL	DIL	WCM	WCL	BV	MV	TV
W		0.34	-0.116	.678*	-0.11	0.259	-0.01	0.152	0.095	0.608	.730*	0.452	.857**	0.593	.813**	0.208	-0.337	0.08	0.074	0.081
GL	.649*		0.312	-0.092	0.424	0.468	-0.37	.907**	0.167	.729*	0.222	0.038	0.592	0.365	0.335	0.385	0.48	-0.254	0.51	-0.081
Bp	-0.526	-0.568		-0.354	0.008	.698*	-0.556	0.565	-0.46	0.297	-0.291	-0.044	-0.011	0.29	0.19	0.073	0.287	-0.148	0.412	-0.02
d	-0.096	-0.02	0.489		-0.184	0.14	0.373	-0.265	-0.046	0.227	0.386	0.585	0.469	0.39	0.314	-0.098	-0.603	-0.477	-0.617	-0.544
e	-0.332	-0.288	-0.245	0.064		0.316	0.332	0.327	-0.151	-0.014	0	-0.391	0.026	-0.353	-0.213	0.517	.749*	0.447	0.28	0.433
SD	0.209	0.417	-0.16	0.203	-0.026		-0.131	.639*	-0.456	0.42	-0.008	-0.099	0.412	0.246	0.351	0.409	0.33	-0.432	-0.251	-0.417
DD	0.466	0.042	-0.477	0.05	0.591	-0.016		-0.454	-0.048	-0.614	0.186	-0.231	-0.281	-0.415	-0.459	0.088	-0.13	-0.129	-0.692	-0.276
Bd	-0.459	-0.155	0.205	0.529	0.096	0	-0.373		-0.047	0.612	-0.019	-0.118	0.458	0.27	0.289	0.301	0.5	-0.349	0.341	-0.201
De	0.125	0.511	-0.368	0.125	-0.255	0.359	-0.239	0.435		0.004	0.604	-0.252	0.168	-0.202	-0.079	0.011	0.156	0.017	0.202	0.066
Be	0.167	-0.011	0.4	0.323	-.722*	0.03	-0.363	0.238	0.229		0.203	0.51	.803**	.782**	.755*	0.358	0.042	-0.114	0.453	0.017
Dd	0.51	.697*	-0.111	0.236	-0.516	0.029	-0.002	-0.184	0.422	0.413		-0.068	0.568	0.118	0.434	0.271	-0.014	0.429	0.162	0.389
DEM	-0.309	-0.225	0.553	0.155	0.1	-0.033	-0.17	-0.095	-0.57	0.113	-0.1		0.276	.795**	0.37	-0.307	-.695*	-0.291	0.122	-0.209
DIM	-0.099	-0.021	0.619	.818**	-0.074	-0.012	-0.024	0.243	0	0.424	0.447	0.491		0.494	.856**	0.358	-0.007	-0.023	0.158	0.018
DEL	0.527	0.557	-0.101	-0.059	-.759*	0.02	-0.22	-0.187	0.477	.653*	.830**	-0.079	0.245		0.624	0.127	-0.445	-0.282	0.233	-0.174
DIL	0.348	0.544	0.028	0.33	-0.519	0.475	-0.117	-0.106	0.589	0.522	.804**	-0.123	0.447	.742*		0.293	-0.178	0.318	0.356	0.346
WCM	0.489	0.594	-0.598	-.725*	-0.35	0.007	0.012	-.659*	0.189	-0.143	0.452	-0.282	-0.503	0.529	0.277		0.547	0.546	-0.099	0.42
WCL	0.429	0.27	-0.233	-0.056	0.237	0.321	0.53	-.661*	-0.401	-0.541	0.014	-0.064	-0.171	-0.285	-0.016	0.26		0.444	0.574	0.504
BV	-0.185	-0.147	-0.669	-0.425	0.377	-0.265	-0.303	0.357	0.178	-0.53	-0.617	0.332	-0.29	-0.194	-0.631	-0.11	-0.562		0.676	.983**
MV	0	-0.202	-0.392	-0.3	0.328	0.066	-0.053	0.085	0.241	-0.603	-0.65	0.012	-0.214	-0.344	-0.348	-0.183	-0.233	.865*		0.799
TV	-0.135	-0.167	-0.603	-0.399	0.373	-0.172	-0.237	0.285	0.204	-0.569	-0.645	0.244	-0.275	-0.244	-0.563	-0.135	-0.478	.988**	.931**	

Table 6. *The correlation data of the metapodium of the female Tuj sheep, '*': P<0.05, '**': P<0.01*

MC → MT↓	W	GL	Bp	d	e	SD	DD	Bd	De	Be	Dd	DEM	DIM	DEL	DIL	WCM	WCL	BV	MV	TV
W		0.237	.784**	.891**	.890**	.874**	-0.177	.860**	0.484	-0.404	0.59	0.09	.817**	0.442	.841**	.793**	.846**	0.676	0.585	0.661
GL	0.237		.672*	0.197	0.566	0.536	-0.044	0.417	-0.557	0.117	-0.207	-0.138	0.083	-0.113	0.139	0.481	0.431	0.292	0.568	0.365
Bp	.784**	.672*		.738*	.872**	.835**	-0.029	.824**	0.127	-0.325	0.356	-0.035	0.622	0.28	.662*	.809**	.824**	0.597	0.749	0.642
d	.891**	0.197	.738*		.799**	.857**	-0.184	.787**	0.551	-0.42	.633*	0.117	.819**	0.337	.829**	.737*	.865**	0.679	0.617	0.671
e	.890**	0.566	.872**	.799**		.970**	-0.294	.790**	0.108	-0.213	0.25	0.022	0.626	0.153	0.624	.826**	.772**	0.494	0.516	0.505
SD	.874**	0.536	.835**	.857**	.970**		-0.389	.750*	0.115	-0.291	0.26	-0.073	0.585	0.077	0.621	.760*	.772**	0.582	0.585	0.589
DD	-0.177	-0.044	-0.029	-0.184	-0.294	-0.389		0.264	0.27	0.422	0.499	-0.055	0.1	0.581	0.284	0.159	0.173	-0.443	-0.328	-0.419
Bd	.860**	0.417	.824**	.787**	.790**	.750*	0.264		0.453	-0.129	.712*	-0.049	.776**	.654*	.913**	.927**	.962**	0.683	0.675	0.688
De	0.484	-0.557	0.127	0.551	0.108	0.115	0.27	0.453		-0.385	.841**	0.258	.704*	.732*	.682*	0.377	0.485	0.542	0.263	0.477
Be	-0.404	0.117	-0.325	-0.42	-0.213	-0.291	0.422	-0.129	-0.385		-0.224	-0.077	-0.384	-0.144	-0.308	-0.076	-0.253	-0.72	-0.662	-0.713
Dd	0.59	-0.207	0.356	.633*	0.25	0.26	0.499	.712*	.841**	-0.224		0.093	.753*	.801**	.894**	0.51	.720*	0.603	0.467	0.575
DEM	0.09	-0.138	-0.035	0.117	0.022	-0.073	-0.055	-0.049	0.258	-0.077	0.093		0.514	0.178	0.1	0.065	0.063	0.516	0.347	0.479
DIM	.817**	0.083	0.622	.819**	0.626	0.585	0.1	.776**	.704*	-0.384	.753*	0.514		.673*	.884**	.747*	.845**	0.776	0.665	0.757
DEL	0.442	-0.113	0.28	0.337	0.153	0.077	0.581	.654*	.732*	-0.144	.801**	0.178	.673*		.726*	0.585	0.625	0.662	0.463	0.618
DIL	.841**	0.139	.662*	.829**	0.624	0.621	0.284	.913**	.682*	-0.308	.894**	0.1	.884**	.726*		.772**	.929**	0.719	0.633	0.705
WCM	.793**	0.481	.809**	.737*	.826**	.760*	0.159	.927**	0.377	-0.076	0.51	0.065	.747*	0.585	.772**		.908**	0.633	0.609	0.634
WCL	.846**	0.431	.824**	.865**	.772**	.772**	0.173	.962**	0.485	-0.253	.720*	0.063	.845**	0.625	.929**	.908**		0.79	0.776	0.795
BV	0.676	0.292	0.597	0.679	0.494	0.582	-0.443	0.683	0.542	-0.72	0.603	0.516	0.776	0.662	0.719	0.633	0.79		.942**	.996**

MV	0.585	0.568	0.749	0.617	0.516	0.585	-0.328	0.675	0.263	-0.662	0.467	0.347	0.665	0.463	0.633	0.609	0.776	.942**		.967**
TV	0.661	0.365	0.642	0.671	0.505	0.589	-0.419	0.688	0.477	-0.713	0.575	0.479	0.757	0.618	0.705	0.634	0.795	.996**	.967**	

Table 7. *The correlation data of the metapodium of the male Tuj sheep, '*': P<0.05, '**': P<0.01*

MC→ MT↓	W	GL	Bp	d	e	SD	DD	Bd	De	Be	Dd	DEM	DIM	DEL	DIL	WCM	WCL	BV	MV	TV
W		.778**	0.19	-0.119	0.109	-0.32	0.241	0.04	.747*	0.277	.708*	0.238	0.241	0.55	-0.419	-0.014	-0.027	0.448	0.402	0.46
GL	.921**		0.356	-0.034	0.354	-0.229	0.307	0.074	0.444	0.366	0.392	0.365	0.233	0.3	-0.148	-0.013	0.044	0.467	0.082	0.434
Bp	0.206	0.131		0.189	.861**	0.194	.715*	.904**	0.047	.868**	0.138	.677*	.674*	0.544	0.148	.800**	.761*	0.204	-0.087	0.173
d	-0.013	-0.075	-0.226		0.035	.926**	0.047	0.425	-0.524	0.092	-0.189	0.157	0.172	-0.001	-0.331	-0.086	-0.023	0.588	0.082	0.544
e	0.087	-0.066	0.162	0.106		0.083	.862**	.708*	0.105	.923**	0.217	.858**	0.568	0.514	0.169	.829**	.883**	0.309	-0.182	0.256
SD	-0.052	-0.054	-.832**	0.406	-0.147		0.027	0.4	-.705*	0.144	-0.29	0.212	0.284	0.085	-0.347	0.062	0.139	0.394	-0.163	0.335
DD	0.46	0.58	-0.241	-0.102	-0.051	0.2		.652*	0.331	.904**	0.593	.729*	0.328	0.414	0.214	.687*	.678*	0.602	0.142	0.565
Bd	0.319	0.183	.673*	-0.131	0.457	-0.459	0.147		-0.053	.749*	0.094	0.522	0.562	0.442	0.137	.707*	.652*	0.16	-0.049	0.138
De	-0.272	-0.481	0.127	-0.127	0.216	-0.125	-0.237	0.549		0.162	.775**	0.11	0.063	0.325	0.042	0.071	0.017	0.34	0.654	0.396
Be	0.145	0.221	0.47	-0.117	-0.52	-0.251	0.225	0.483	0.204		0.437	.802**	0.554	.649*	0.02	.805**	.813**	0.391	-0.116	0.339
Dd	-0.116	-0.356	0.427	0.029	0.294	-0.35	-0.464	0.626	.852**	0.176		0.245	0.076	0.424	-0.092	0.127	0.083	0.713	0.537	0.718
DEM	0.285	0.078	0.378	0.132	.909**	-0.323	-0.122	0.605	0.295	-0.308	0.426		.644*	.648*	-0.275	.782**	.860**	0.471	0.012	0.428
DIM	0.427	0.458	0.543	-0.278	-0.249	-0.398	0.077	0.534	0.176	.763*	0.174	0.081		.787**	-0.252	.662*	.721*	0.114	0.162	0.125
DEL	0.192	0.194	0.619	0.101	0.466	-.695*	0.003	0.569	0.076	0.075	0.422	0.518	0.091		-0.534	0.627	.676*	0.048	-0.116	0.028
DIL	0.386	0.327	0.125	0.073	0.627	0.121	-0.012	0.462	0.073	-0.102	0.103	.673*	0.325	0.102		0.036	-0.035	-0.111	0.269	-0.064
WCM	0.49	0.494	0.58	-0.501	0.023	-0.475	0.53	.765**	0.211	.654*	0.196	0.145	0.621	0.382	0.137		.954**	0.095	-0.051	0.079
WCL	0.4	0.389	0.522	-0.584	0.367	-0.575	0.511	.714*	0.185	0.268	0.155	0.4	0.358	0.506	0.196	.884**		0.069	-0.212	0.034
BV	0.462	0.612	0.468	-0.286	0.29	-.828*	0.643	0.43	-0.307	0.644	-0.643	0.742	.871*	0.524	-0.146	0.6	0.697		0.652	.995**
MV	-0.645	-0.363	-0.069	-0.283	-0.312	-0.581	-0.197	-0.39	0.041	-0.137	-0.231	-0.321	0.235	0.178	-0.326	-0.196	-0.005	0.346		0.727
TV	0.195	0.41	0.378	-0.331	0.151	-.884*	0.486	0.246	-0.249	0.506	-0.619	0.533	.814*	0.5	-0.223	0.451	0.592	.958**	0.602	

4. DISCUSSION

The variation coefficients of morphometric data were calculated in this recent study. Obtained data was presented in Table VIII and IX as comparatively with the knowledge in the literature. According to this, CV% values were seen to be changed as follows, in the Morkaraman female sheep's metacarpus between 2.06 and 12.93 and in metatarsus between 2.28 and 14.81. In the male Morkaraman sheep's CV% values were diagnosed as between 2.03 and 9.71 in metacarpus and between 1.27 and 6.50 in metatarsus. 8-9

When the female Tuj sheep was analyzed, CV% values were determined to be changed as follows: in metacarpus between 2.91 and 11.67, and in metatarsus between 4.13 and 11.69. In the male Tuj sheep CV% values were specified to be changed as: in metacarpus between 3.16 and 14.22, and in metatarsus between 2.31 and 9.30. When the comparison has been done with the literature, it was observed that the obtained data was less than the data which was stated by Bacınoğlu (2006) [17], Lallemand (2002) [2], Guintard and Lallemand (2003) [3], Pazvant et al. (2015) [6]. Furthermore, the obtained data had a similar average with the data which was remarked by Davis (1996) [24] and Onar et al. (2008) [5].

Onar et al. (2008) [5] made an osteometric study on adult sheep and goats metapodium which was obtained from archeological excavations. In their study, Onar et al. (2008) [5] stated that in the adult sheep metacarpus the highest and lowest CV% values were respectively belong to De and Bd, in the metatarsus DD and Bd. In the same study, it has been reported that in adult goats' metacarpus the highest and lowest CV values were respectively GL and Bd, in metatarsus these values were belonged to e and Bd. In their study, Pazvant et al. (2015) [6] reported that for the sheep the highest and lowest CV% values were belonged to DD and Dp (this value was not measured in our study) with Dd in metacarpus and DD and Bd in metatarsus. In the same study, CV% values belonged to Bd and WCM in the goat metacarpus and De and DIL in the metatarsus. In this recent study, it was analyzed that the highest and lowest CV% values were De and Bp in Morkaraman sheep metacarpus and Be and DIM in metatarsus. In Tuj sheep, the highest and lowest CV% values were specified as De and DD for the metacarpus and as WCM and Bp for the metatarsus.

In the study, data was analyzed by gender and race in order to the significance control. In the analysis, especially in terms of the gender, it was concluded the differences in the most of metapodium parameters were statistically significant. Besides, it was seen that the gender had more effects on morphometry then the race.

In their study, Onar et al. (2008) [5] reported that the slenderness index of sheep metacarpus and metatarsus were respectively 11.06 and 9.18. Furthermore, the slenderness index of goat metacarpus and metatarsus were respectively 15.02 and 11.57. In their study, Pazvant et al. (2015) [6] stated that the metapodial slenderness index values were reported in sheep metacarpus and metatarsus as respectively 11.70 and 9.45 and in goat metacarpus and metatarsus these values were respectively 14.89 and 11.11. In this recent study, in Morkaraman sheep metacarpus and metatarsus the slenderness index was respectively 10.48 and 8.84. Also, in Tuj sheep metacarpus and metatarsus the slenderness index was found as 10.05 and 9.08.

The correlation analysis was performed in order to determine the relationship degree of the obtained data in the study with each other. In his study, which was done on Kivircik sheep metapodium, Bacinoglu (2006) [17] reported that GL value had a high correlation with other parameters. In the same study, the researcher highlighted that in the female Kivircik sheep, other correlations were statistically significant except the correlation between DEM and SD. At the same time, Bacinoglu (2006) [17] mentioned about statistically meaningless correlation only in SD and d parameters in the male Kivircik sheep metapodium between the depth and width dimensions. According to findings which were obtained in this recent study, the above-mentioned general correlation evaluation was unable to be done in Morkaraman and Tuj sheep metapodium.

In this recent study, the bone tissue and cavum medullare volume of the metapodium was calculated by using Cavalieri Principle, is a stereological method for calculating the volume. When viewed proportionally, Bacinoglu (2006) [17] reported the MH/TH value as 13.39% and 12.27% in the female Kivircik sheep metacarpus and metatarsus, also as 16.19% and 15.28% in the make Kivircik sheep. In this study, these values were determined in the female Morkaraman metacarpus and metatarsus as 18.49% and 19.32%, and for the male sheep as 18.37% and 18.59%. Besides, MV/TV values were found as 19.86% and 19.01% for the female Tuj sheep and as 17.12% and 18.41% for the male sheep. In this case, it can be stated that the Morkaraman and Tuj sheep breeds' metapodium has more bone marrow than the Kivircik sheep breeds'. Furthermore, in his study, Bacinoglu (2006) [17] stated that the ratio of MV/TV was higher in the male Kivircik sheep than in the female Kivircik sheep. In this recent study, it was found that for both sheep breeds, the ratio of MH/TH was higher in the female members than the males.

As a result, Turkey in Eastern Anatolia ovine livestock in a place found it Morkaraman and Tuj sheep breed in metapodium of evaluated, by introducing the mean value of what was going on, the reference values were obtained.

Consequently, Morkaraman and Tuj breeds have a place in ovine livestock in Eastern Anatolia, Turkey. Morphometric and stereological aspects of metapodium in Morkaraman and Tuj sheep were evaluated. Also, the reference values were obtained by introducing the average values. Metapodial data was evaluated in terms of gender and racial factors and the importance control was made. In addition, the variation coefficients of the data were calculated and the degree of changes was determined based on the impact factors. Results were compared with other sheep breeds in the literature. All these evaluations have shown that the fender is more effective than the race on the Morkaraman and Tuj sheep metapodium morphometry. Besides, in this recent study, it is concluded that more bone marrow can be obtained from the female sheep metapodium than the male sheep metapodium. It is expected that the study contributes to the literature with these state conclusions.

Table 8. *Comparison of knowledge of the study with literature metacarpus CV%, a: Bacinoglu 2006, b: Pazvant ve ark. 2014, c: Onar ve ark. 2008*

Morkaraman				Tuj				Kvırcık[a]				Lallemand 2002				Guintard ve Lallemand 2003				Davis 1996		Yenikapı[b]		Anzaf Kalesi[c]	
Female		Male		Female		Male		Female		Male		Female		Male		Female		Male		Female					
Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV
Bd	12.93	De	9.71	Be	11.67	DIL	14.22	SD	7.77	SD	8.2	d	15.04	d	19.61	d	15.04	d	19.61	DEM	5.8	DD	12.03	De	7.84
Dd	9.17	WCM	4.49	De	10.89	De	9.72	DEM	7.33	e	7.92	SD	14.52	SD	18.85	SD	14.52	SD	18.85	DEL	5.4	SD	11.92	DD	7.34
De	8.17	DD	4.01	Dd	8.13	WCL	7.26	Dd	7.23	DD	7.84	Bp	10.79	e	15.24	Bp	10.79	e	15.24	SD	5	DEL	10.7	SD	6.92
DD	7.33	DEL	3.92	SD	6.33	WCM	7.00	d	7.07	d	7.68	GL	9.56	DD	14.32	GL	9.56	DD	14.32	DIL	4.9	DEM	10.52	e	6.74
SD	5.36	SD	3.64	GL	5.35	DEM	5.51	De	7.03	Be	6.27	e	9.55	Bp	13.76	e	9.55	Bp	13.76	DIM	4.7	d	10.32	Dd	6.38
e	4.37	Be	3.63	DIL	5.23	SD	5.12	DIL	7.01	DIL	5.51	DD	9.37	Dp	13.32	DD	9.37	Dp	13.32	Bp	3.9	e	10.25	GL	6.36
DEM	4.35	Dd	3.61	DEL	5.21	DD	5.08	DEL	6.91	De	5.48	Be	9.07	WCL	13.09	Be	9.07	WCL	13.09	GL	3.8	De	10.03	Be	5.64
Be	4.23	e	3.43	e	5.20	Be	4.87	DIM	6.82	DIM	5.34	Dp	8.56	Be	12.98	Dp	8.56	Be	12.98	WCM	3.6	Bp	10	Bp	5.61
d	3.64	DIM	3.42	d	5.19	Bp	4.85	Bp	6.63	DEL	5.15	WCM	8.42	DEL	12.75	WCM	8.42	DEL	12.72	WCL	3.6	WCL	9.87	Dp	5.21
WCL	3.22	DIL	2.85	Bp	5.10	GL	4.63	WCM	6.48	WCL	5	DEL	8.32	WCM	12.69	DEL	8.32	WCM	12.69	Bd	3	WCM	9.55	Bd	4.13
DEL	3.08	DEM	2.66	Bd	4.90	Dd	4.14	WCL	6.17	WCM	4.97	De	8.21	DEM	12.32	De	8.21	DEM	12.32			DIL	9.4		
WCM	2.99	GL	2.61	WCL	4.80	d	4.10	Be	6.04	DEM	4.96	DEM	8.14	Bd	11.96	DEM	8.14	Bd	11.96			Bd	9.31		
GL	2.56	WCL	2.59	DIM	4.51	Bd	3.98	DD	6.02	Bp	4.92	WCL	8.04	DIM	11.75	WCL	8.04	DIM	11.75			DIM	9.06		
DIM	2.47	Bp	2.56	DEM	4.15	DEL	3.97	Bd	6	Bd	4.73	Bd	7.79	DIL	11.74	Bd	7.97	DIL	11.74			Be	8.93		
Bp	2.20	d	2.42	WCM	3.85	DIM	3.85	e	5.66	Dd	4.59	Dd	7.73	GL	11.58	Dd	7.73	GL	11.58			GL	8.84		
DIL	2.06	Bd	2.03	DD	2.91	e	3.16	GL	5.34	GL	3.97	DIL	7.36	De	11.24	DIL	7.36	De	11.24			Dd	8.69		
												DIM	7.18	Dd	9.97	DIM	7.18	Dd	9.97			Dp	8.4		

Tablo 9. *Comparison of knowledge of the study with literature metatarsus CV%, a: Bacinoglu 2006, b: Pazvant ve ark. 2014, c: Onar ve ark. 2008*

Morkaraman				Tuj				Kvırcık[a]				Lallemand 2002				Guintard ve Lallemand 2003				Davis 1996		Yenikapı[b]		Anzaf Kalesi[c]	
Female		Male		Female		Male		Female		Male		Female		Male		Female		Male		Female					
Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV	Order	%CV
Be	14.81	De	6.50	WCM	11.69	DEM	9.30	DEM	8.88	e	8.58	d	13.73	d	18.54	d	13.73	d	18.54	SD	5.1	DD	8.49	DD	9.36
De	10.13	e	4.66	Dd	8.08	WCM	5.86	d	7.84	d	7.69	SD	12.66	SD	17.68	SD	12.66	SD	17.68	DIL	4.9	d	8.33	SD	8.32
d	7.48	DEL	3.81	GL	6.12	DIM	4.98	DIM	7.73	DD	7.47	e	11.49	DEM	16.83	e	11.49	DEM	16.83	DIM	4.4	De	8.2	e	8.29
Dd	7.33	DIL	3.73	d	6.11	De	4.81	De	7.67	SD	7.39	GL	10.41	e	16.64	GL	10.41	e	16.64	GL	4.1	SD	8.05	Dp	8.04
SD	6.76	WCL	3.72	De	5.98	DEL	4.47	SD	7.52	De	6.67	DEM	10.2	DEL	16.3	DEL	10.2	DEL	16.3	Bd	3.2	GL	7.89	De	7.86
DEM	6.08	Dd	3.57	SD	5.27	DIL	4.35	WCL	7.25	Be	5.86	DEL	10.2	DD	16.14	DEM	10.2	DD	16.14			e	7.86	GL	7.71
DEL	6.01	Be	3.26	Bp	5.10	e	4.00	Dd	7.09	DEL	5.82	DD	10.18	Bp	15.3	DD	10.18	Bp	15.3			DEM	7.47	Be	7.26
e	5.92	DD	2.95	DIL	5.10	GL	3.99	DEL	6.97	DIL	5.6	Dp	10.04	Dp	15.16	Dp	10.04	Dp	15.16			DEL	7.38	Bp	5.95
DD	5.46	d	2.91	DIM	5.02	Dd	3.90	DIL	6.88	Dd	5.36	WCM	9.99	DIL	14.82	WCM	9.9	DIL	14.82			Dd	7.1	Dd	5.81
WCL	4.91	Bp	2.88	DD	4.95	Bd	3.86	WCM	6.63	DEM	5.33	WCL	9.96	GL	14.55	WCL	9.96	GL	14.55			Dp	6.98	Bd	5.45
Bd	4.16	Bd	2.62	WCL	4.94	Be	3.73	Bp	6.5	DIM	5.32	Bp	9.95	WCL	14.47	Bp	9.95	WCL	14.47			Bp	6.78		
WCM	3.83	WCM	2.20	Bd	4.88	WCL	3.64	DD	6.38	WCL	5.19	Be	9.52	DIM	14.45	Be	9.52	DIM	14.45			Be	6.64		
Bp	3.39	GL	2.06	Be	4.80	d	3.07	Be	6.23	Bp	5.03	Dd	9.44	De	14.39	Dd	9.44	De	14.39			DIL	6.57		
GL	3.38	DEM	1.69	DEL	4.58	SD	2.57	e	6.11	Bd	5.01	De	9.17	Be	14.23	De	9.17	Be	14.23			DIM	6.57		
DIM	3.28	DIM	1.47	e	4.23	DD	2.49	Bd	6.06	WCM	4.85	Bd	8.95	WCM	14.23	Bd	8.95	WCM	14.23			WCM	6.33		
DIL	2.28	SD	1.27	DEM	4.13	Bp	2.31	GL	5.55	GL	4.11	DIL	8.5	Bd	13.71	DIL	8.5	Bd	13.71			WCL	6.05		
												DIM	8.25	Dd	12.91	DIM	8.25	Dd	12.91			Bd	5.91		

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