

Anatolian Water Buffaloes Husbandry in Turkey

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ABSTRACT

Anatolian water buffalo is found mostly in the half northwestern of Türkiye including north part of the middle Anatolia. It is more common along the coast of Black sea. It is also found in Eastern Anatolia. From a taxonomical point of view it is classified as 'Mediterranean' type. In the past, buffalo farming has been an important production source for Türkiye (1,117,000 heads assessed in 1971), while currently the population size is of only 110,000 heads. In Turkey most farmers keep 1-2 buffaloes for family consumption and this system is very widespread in villages while farms with around 100 heads are located near to the big cities. In despite of the popular indifference, farming of this species has survived in order to promote productive systems in agreement with sustainable rural development and trend to revalue autochthonous genetic types. There are *in situ* and *ex situ* conservation programme and incentive premiums in order to stop the reducing tendency of population. Nation-wide water buffaloes improvement program has also initiated called community based herd improvement program.

Anatolian water buffalo is reared for triple aptitude: meat, milk and draught. Most meat is especially used for making sausage, which is a very popular typical product in Anatolia, prepared with buffalo meat, beef and mutton spiced especially with garlic. Concerning milk production, research is evidencing that controlled farming and feeding conditions may significantly improve performances. Milk is also employed to make a very popular traditional product, known as 'lüle kaymağı'.

The Anatolian water buffalo has dark brown, dark grey to black coat, with muzzle, hoofs and horns hairs usually black to black grey. Horns are relatively long, resembling the Mediterranean type, and narrow. They have relatively longer body and face smaller girth and longer thicker legs. The ears are wide and hairy inside. The neck is long and not unduly thick. The withers height tends to be the same as height at sacrum. The body is coarse and sometimes angular. White marks sometimes occur on head, on the lower part of legs and at the end of tail. The horns of female are longer and thinner than those of the male.

INTRODUCTION

Generally small structured with easy temperament and having generally long horn. Colour of horn and nail of legs are black and coat colour varied from dark black to light block of Brown. Body coat covered with long hair. Young animals have black hairs till 1-1.5 years and came reddish black colour often weaning. Usually has beard under chin. Average carcass weight estimates 110 kg. It is estimates 100,000 head of buffalo populations exist in Türkiye. Adult body weight of water Buffalo raised in Turkey is approximately 400 kg. Average lactation yield and length of Buffalo of Türkiye are 1 ton and 250 day respectively. Average age at first insemination is 22-24 month. Average open day period is three month. First heat cycles are observed generally after 3 month of calving. There are raised in coastal area of North Anatolia especially Samsun and North part of central Anatolia relatively close to coastal area such as Tokat, Trakya region (Istanbul) has the biggest number of buffalo population of Türkiye. Additionally east part of Türkiye such as Muş, Kars, Sivas has also water buffalo populations. Afyon in western Anatolia and Diyarbakır in South Eastern Anatolia has also buffalo population. Average rate of live weight gaining is 400 gram in young period up to 1 years of age. Buffaloes are raised as the form of family operation 3-5 head of farm size. They are used in forest area also for their pulling power. When the buffaloes used as draft animals are castrated in 12 years of age. They can be used up to 12 years of age as for pulling

Accepted April 10, 2013; Online November 11, 2013.

power. Most important reason for raising buffaloes are their milk meat and especially cream or (fat) characteristics which is favourable for consumer buffalo for meat is favourable for garlic flavoured Sausage. Buffalo cream is favourable as for additives to the famous Turkish deserts. They are also raised as meat production with average size of 50 head of herd in the region close to big cities. Average withers height of adults of male is 140 cm. Average fat content and total solid content of milk in first lactation is 8% and 16 % respectively.

According to FAO (2000) data, there are about 166 million domesticated buffaloes raised in the five world continents. However, there are about 158 million buffaloes left in the world (FAO statistics, 2003). Roughly 97 percent of them or 153 million heads are water buffaloes essentially found in the Asian region.

Also, in Turkey the buffaloes population have declined dramatically over the last decades. The total population according to FAO statistics is 164,000 heads (2003 <http://faostat.fao.org/>). Formerly buffaloes have been used as draft animals for centuries. Also they have been used for source of meat and milk products. Than buffalo number was decreased, because of increasing demand for cattle breeding and increasing technology in agriculture.

In despite of the popular indifference, farming of this species has survived in order to promote productive systems in agreement with sustainable rural development and trend to revalue autochthonous genetic types. In this context, beginning from 1963 some provincial, regional and national research institutes have established programmes aimed to revalue and improve reproductive and productive potentiality of Anatolian water buffalo. In 1989 improvement plans has been established by crossing Anatolian buffalo with “Murrah” buffalo imported from Bulgaria.

Concerning milk production, research is evidencing that controlled farming and feeding conditions may significantly improve performances. Indeed, in comparison with buffaloes reared in village conditions , buffaloes under experimental conditions show more favourable values for mean lactation period (245 d vs 250 d), maximum and minimum milk yield (1.715 vs 1.603 litres and 442 vs 186 litres, respectively) and mean fat milk percentage (8% vs 7 %). Milk is also employed to make a very popular traditional product, known as ‘lüle kaymağı’ whose preparation and chemical composition were described by Uraz (1970).

Buffalo for draught purpose is limited to tree stump hauling in forest area when mechanical equipments may not be used. In Türkiye most farmers keep 1-2 buffaloes for family consumption and this system is very widespread in villages while farms with around 100 heads are located near to the big cities.

Concerning housing system, most farmers own 1-2 buffaloes as source of animal protein for family consumption and this system, very widespread in villages, is based on pasture resource exploitation; on the contrary, big herds (around 100 heads) are located near to the big cities and buffaloes in this case receive concentrate supplemented feed (maize, wheat, barley, cottonseed and sugar beet by-products) when available. Although artificial insemination forms cornerstone of buffalo improvement program yet at present it represent only very rare occasion mostly research purposes.

Artificial insemination is not applied in villages while is widely used in experimental farms, such as Afyon and Bandırma district of Turkey previously and at Department of animal science of Mustafa Kemal University currently by (Sekerden, 2007). The programme is currently in progress at Zootecnics Institute of Bandırma district in the Turkish province of Balıkesir employing artificial insemination and breeding programmes. The larger farms with 40-50 females maintain their own males and the villages usually share a common male.

Natural mating keeping sires within the herd continuously are practiced. . Live weight is about 450-500 and 700-800 kg in the adult female and male respectively. The water buffalo population and the amount of production from water buffalos in Turkey are also decreasing. There is only one water buffalo breed called Anatolian water buffalo in Türkiye. The water buffalo *in-situ* conservation program was conducted in Balıkesir province of western Türkiye. The number of water buffalo population were decreased 1,178,000 (1970) to 847,268 (2010) and increased 97,632 in 2011 again.

The latest attempt regarding Conservation of animal genetic resources was establishing water buffalo breeding organization of Türkiye started in 2008 and central water buffaloes breeder association were established in 2011. Nationwide water buffaloes improvement program were initiated under the name of community based improvement program. So far 14 provinces and 2,873 farm total of 16,082 adult individual water buffaloes were included in the nationwide improvement program.

Recently this kind support put on implementation that water buffalo breeding stock breeder who is member of breeder union and join the nationwide herd improvement program can receive 250 Euro per head as incentive premium. The aim of this project is to create superior breeding stock. Other water buffaloes breeders rather than included in improvement program also receive support as premium but lower (150 Euro) than included improvement program. Due to opening door for subsidizing the support to the farmer; this activity will help very much stopping the tendency for decreasing the number of water buffaloes in Türkiye.

The water buffalos in Turkey are named as Anatolian water buffalo and they are among Mediterranean water buffalos which are subgroup of river buffalos (Soysal et al., 2005). They are mostly bred in Samsun and Sinop in North Anatolia sea shore; in Çorum and Amasya in Middle Anatolia; in Afyon and Balıkesir in Inner West Anatolia; in Sivas and Muş in East Anatolia and in Diyarbakır in Southeast Anatolia (Atasever and Erdem, 2008). In Turkey water buffalos are particularly bred for milk production and they are slaughtered for meat production after they finish their productive ages (Şekerden, 2001). The cream produced from Anatolian water buffalo milk is a popular product which is consumed together with many local desserts (Soysal et al., 2005). In some regions, Anatolian water buffalo milk is also used for cheese production.

Anatolian water buffalo meat is consumed as fresh or in meat products like Turkish style fermented sausage, pastrami and salami. In the recent years there has been a rise in the production for only meat. Anatolian water buffalo meat is more commonly used in Turkish sausage as it decreases the fermentation duration and is believed to give taste. In some regions in Turkey, Anatolian water buffalo breeding is a traditional production model which has great importance in the economy and culture of its breeders. In recent years strong emphasis were placed on the management of farm animal genetic researches in general and also water buffaloes husbandry in Particular. In general effort related conservation and sustainable utilization of the farm animal genetic resources are coordinated and supported financially and technically by the general directorate of agricultural researches and policy of ministry of food agriculture and livestock.

According to the Yılmaz et al. (2011) certain carcass and meat quality characteristics of Anatolian water buffalos were given on following tables.

There is only one water buffalo breed called Anatolian water buffalo in Türkiye. The water buffalo *in-situ* conservation program was conducted in Balıkesir province of western Türkiye. There is also *ex situ* conservation program for Anatolian water buffalo breed in Türkiye at Bandırma Animal research Institute in Türkiye. The latest attempt regarding Conservation of animal genetic resources was establishing water buffalo breeding organization of Türkiye started in 2008. *In situ and ex situ* conservation and incentive premium support programs are carried out to stop the declining the population number.

Due to opening door for subsidizing the support to the farmer; this activity will help very much stopping the tendency for declining the number of water buffalo in Türkiye.

Recently (2009) this kind support put on implementation that water buffalo breeding stock breeder who is member of breeder union can receive 150 Euro per head as incentive premium.

GENETIC CONSTITUTION OF POPULATION

The Anatolian water buffalo are involved in a protection program of gene resources with the declaration of guidelines for subsidizing animal farming by the Ministry of Agriculture and Rural Affairs in Turkey. So it is highly important to characterize the molecular structure of Anatolian buffalo in Turkey. In the last decade, many molecular studies have been conducted using

microsatellites (Gargani et al., 2009; Soysal et al., 2007), mtDNA (TURKHAYGEN I Project, 2012), ISSR markers (Aytekin et al., 2011) and PRNP gene promoter (Oztabak et al., 2009).

In order to reveal the genetic constitution of Anatolian water buffalo several molecular genetic diversity studies has been carried on.

The genetic variation and relationship among six Turkish water buffalo populations typical of different regions was assessed using a set of twenty-six heterologous (bovine) microsatellite markers. Between 7 and 17 different alleles were identified per microsatellite in a total of 254 alleles. The average number of alleles across all loci in all the analyzed populations was found to be 12.57. The expected mean heterozygosity (H_E) per population was between 0.5 and 0.58. The overall polymorphic information (PIC) value was between 0.33 and 0.86. Significant departures from Hardy-Weinberg equilibrium were observed for 44 locus-population combinations. Population differentiation was analyzed by estimation of the F_{ST} index (values ranging from 0.053 to 0.123) among populations. The PCA analysis identified three clusters: the Merzifon and Danamandira populations represented one cluster each, and the Afyon, Coskun, Pazar and Turhal formed a single cluster. The assignment of individuals to their source populations performed using the Bayesian clustering approach implemented in STRUCTURE 2.2 software evidentiate a high differentiation of Merzifon and Danamandira populations as well. The results of this study could be useful for the conservation strategies of the Turkish buffalo (Soysal et al., 2008).

Another molecular genetic study for indigenous water buffalo population to Anatolia were characterised with 11 cattle autosomal microsatellite loci. A set of 4 cattle microsatellite loci was found to be polymorphic in the Anatolian buffalo genome. Genotyping of these polymorphic microsatellite loci revealed alleles ranging from 3 to 9. The observed heterozygosity ranged from 0.550 to 0.775 and the expected heterozygosity ranged from 0.494 to 0.815. The F_{IS} value changed from -0.101 to 0.205. This result shown that, Anatolian water buffalo population samples seemed to be in Hardy-Weinberg expectation (Soysal et al., 2007).

MORPHOMETRIC CHARACTERISTICS OF WATER BUFFALOE POPULATION OF TURKIYE

An investigation done by Soysal et al. (2007); 76 males and 127 females of the Istanbul district and 32 males and 70 females raised in Danamandra village of Silivri district were measured. On each buffalo, withers height, rump height, body length, chest depth and chest width were determined. The results showed a significant difference between males and females starting from 12 months in buffaloes of Danamandra village and from 3 years of age in animals of Istanbul district.

There is only one water buffalo breed called Anatolian water buffalo in Turkiye. The water buffalo *in-situ* conservation program was conducted in Balıkesir province of western Turkiye. The number of water buffaloes population were decreased 1,178,000 (1970) to 847,268 (2010) and increased 97,632 in 2011 again. The latest attempt regarding conservation of animal genetic resources was establishing water buffaloes breeding organization of Turkiye started in 2008 and central water buffaloes breeder association were established in 2011. Nationwide water buffaloes improvement program were initiated under the name of community based improvement program. So far 14 provinces and 2,873 farm total of 16,082 adult individual water buffaloes were included in the nationwide improvement program. Recently this kind support put on implementation that water buffalo breeding stock breeder who is member of breeder union and join the nationwide herd improvement program can receive 250 Euro per head as incentive premium. The aim of this project is to create superior breeding stock. Other water buffalo breeders rather than included in improvement program also receive support as premium but lower (150 Euro) than included improvement program. Due to opening door for subsidizing the support to the farmer; this activity will help very much stopping the tendency for decreasing the number of water buffaloes in Turkiye.

Buffalo improvement program for Anatolian water buffalo were designed as simple selection program in the beginning stage. Farmers were selected according to their willingness to take part of in the improvement program. Animals registered and ear tagged then selected on the

basis of conformation and milk yield related data. The young bulls were also selected on the basis of their conformation and milk yield of their dams.

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Table 1. Means and standard errors (SE) for certain carcass quality characteristics of male and female Anatolian water buffalos.

Characteristics	Male		Female		Sig.
	Mean	SE	Mean	SE	
Hot carcass weight, kg	325.40	2.65	288.20	5.99	***
Carcass length, cm	127.07	1.00	132.16	1.93	*
Chest depth, cm	45.37	0.43	46.26	0.60	NS
Leg length, cm	72.62	1.30	67.87	0.84	**
Leg width, cm	29.96	0.65	28.99	0.61	NS
Conformation score	5.20	0.42	5.50	0.40	NS
Fatness score	7.70	0.47	7.30	0.68	NS
Backfat thickness, cm	19.84	1.69	19.77	2.06	NS
Fat colour parameters					
Lightness (L*)	64.00	1.04	60.03	0.96	*
Redness (a*)	6.14	0.49	7.01	0.89	NS
Yellowness (b*)	7.03	0.63	7.08	0.59	NS
pH _u	5.49	0.01	5.44	0.01	***

NS= Not significant (P>0.05). *=P<0.05; **=P<0.01; ***=P<0.001.

Table 2. Least-squares means for meat quality characteristics of Anatolian water buffaloes due to gender and aging duration.

Characteristics	Gender (G)		Aging Duration (AD)		SEM	Significance		
	Male	Female	7-day	21-day		G	AD	G × AD
	WHC ^a , %	9.81	9.98	10.57		9.23	0.284	NS
Cooking loss, %	27.40	27.93	28.84	26.49	0.336	NS	**	NS
Shear force, kg	3.26	3.18	3.54	2.90	0.095	NS	**	NS
Colour parameters at 1 h								
Lightness (L*) ^{1h}	39.33	36.49	37.35	38.48	0.257	***	*	NS
Redness (a*) ^{1h}	21.78	22.98	21.29	23.47	0.281	*	***	NS
Yellowness (b*) ^{1h}	7.48	7.56	7.30	7.74	0.189	NS	NS	NS
Colour parameters at 24 h								
Lightness (L*) ^{24h}	40.87	38.23	38.82	40.29	0.215	***	**	NS
Redness (a*) ^{24h}	23.99	25.89	25.30	24.58	0.262	***	NS	NS
Yellowness (b*) ^{24h}	7.84	7.91	8.90	6.85	0.198	NS	***	NS

^a WHC=Water holding capacity

NS= Not significant (P>0.05).

* =P<0.05; ** =P<0.01; *** =P<0.001.

Table 3. Means and standard errors (SE) for sensory characteristics of male and female Anatolian water buffalos.

Characteristics	Male		Female		Sig.
	Mean	SE	Mean	SE	
Odour intensity	4.54	0.12	4.53	0.12	NS
Tenderness	4.67	0.12	4.68	0.12	NS
Juiciness	4.29	0.12	4.23	0.12	NS
Flavour intensity	4.87	0.12	4.96	0.12	NS
Flavour quality	4.79	0.12	4.79	0.12	NS
Overall acceptability	4.66	0.12	4.69	0.12	NS

^{NS}, Not significant (P>0.05).

Table 4. Several characteristics about Anatolian water buffalo raised in Türkiye.

	Maximum	Minimum	Sources
Lactation Yield (kg)	1070.5±279.9	709.6±23.0	Şekerden et al (2000b) Uslu, N.T. (1970b)
Lactation Length (day)	269.2±70.0	222.0±44.2	Şekerden et al (2000a) Şekerden et al (2000b)
Fat (%)	8.1±0.205	6.6±0.68	Kök, S., (1996) Şekerden et al (2000a)
Adult Body Weight	518.6±17.2	411.0±9.07	İlarşlan et al (1983) Uslu N.T, (1970a)
Calving Interval	434.3±57.1	365.2±17.5	Şekerden et al (2000a) İlarşlan et al (1983)
Age at first Insemination(day)	679.7±210.9		Şekerden et al (2000a)
Age at first calving (day)	1313.2±234.8	964.1±3.94	Şekerden et al (2000b) İlarşlan et al (1983)
Birth Weight (Male)	34.3±1.20	26.7±0.52	Alaçam et al. (1992) Uslu N.T; (1970b)
Birth Weight (Female)	31.6±0.90	22.1±0.48	Alaçam et al. (1992) Uslu N.T., (1970b)
Service Period	112.45	70.8	İlarşlan et al (1983) Şekerden et al (2000b)
Gestation Length (day)	326.5±5.8 (artificial insemination)	317.0±51.5 (natural insemination)	İzgi and Asker, (1989) İzgi and Asker, (1989)
Daily Live Weight Gaining (gr) (0-3 Month)	(Male)	(Female)	Şekerden et al. (2000c)
Male	0.483		
Female		0.456	
Daily Live Weight Gaining (gr) (3-6 Month)	(Male)	(Female)	Şekerden et al. (2000c)
Male	0.305		
Female		0.294	
Birth Weight (Female)	31.6±0.90	22.1±0.48	Alaçam et al. (1992) Uslu N.T., (1970b)
Service Period	112.45	70.8	İlarşlan et al (1983) Şekerden et al (2000b)

Table 4. Several Characteristics about Anatolian water buffalo raised in Türkiye (Continued).

	Maximum	Minimum	Sources
Gestation Length (day)	326.5±5.8 (artificial insemination)	317.0±51.5 (natural insemination)	İzgi and Asker, (1989) İzgi and Asker, (1989)
Daily Live Weight Gaining (gr) (0-3 Month)	(Male)	(Female)	Şekerden et al. (2000c)
Male	0.483		
Female		0.456	
Daily Live Weight Gaining (gr) (3-6 Month)	(Male)	(Female)	Şekerden et al. (2000c)
Male	0.305		
Female		0.294	
Daily Live Weight Gaining (gr) (6-9 Month)	(Female)	(Male)	Şekerden et al. (2000c)
Male		0.314	
Female	0.357		
Daily Live Weight Gaining (gr) (9-12 Month)	(Male)	(Female)	Şekerden et al. (2000c)
Male	0.504		
Female		0.360	
Fat Content of Milk	8.1	6.1	Kök (1996) Soysal and Kök (1997)
Total Solid Matter of Milk	17.7 (3. Lactation)	15.3 (1. Lactation)	Şekerden et al. (2000b)
Ash % of Milk	0.830	0.743	Şekerden et al. (2000a) Şekerden et al. (2000b)
Water of Milk	82.3		Kök (1996)
Protein % of Milk	4.6	4.2	Şekerden et al. (2000a) Soysal and Kök (1997) Kök, (1996)
Caseine % of Milk	3.4 (3. Lactation)	3.0 (1. Lactation)	Şekerden et al. (2000b)

Table 5. Mean, standard deviation and comparison between males and females*, distinctly for class of age, of somatic traits measured on buffaloes raised in Danamandra village, of Silivri district of Istanbul province of Turkiye.

	<1 Year		1 ≥Years <2		2 ≥Years <4		≥ 4 Years	
	N	$X \pm S_{\bar{x}}$	N	$X \pm S_{\bar{x}}$	N	$X \pm S_{\bar{x}}$	N	$X \pm S_{\bar{x}}$
<i>1. Withers height</i>								
Male	28	87.46±12.01	3	131.33 ^a ±5.02	11	126.54±9.59	1	141.30
Female	22	90.95±10.74	5	105.00 ^b ±13,64	0	-	32	134.15±5.32
<i>2. Rump height</i>								
Male	28	93.28±12,22	3	137.33 ^a ±9,28	11	128.09±7.50	1	147.50
Female	22	95.81±10.88	5	109.20 ^b ±12,79	0	-	32	132.87±7,35
<i>3. Tail base height</i>								
Male	28	86.00±10.90	3	126.00±3,98	11	117.70±6.33	1	136.500
Female	22	89.22±11.44	5	103.8±14,65	0	-	32	122.34±6.28
<i>4. Body lenght</i>								
Male	28	75.82±16.67	3	116.00 ^a ±9.53	11	127.09±11.44	1	142.50
Female	22	74.27±9.62	5	96.40 ^b ±22.74	0	-	32	138.56±8.26
<i>5. Chest width</i>								
Male	28	20.07±4.39	3	29.33±1.14	11	32.63±5.27	1	39.30
Female	22	20.36±4.83	5	22.60±4.72	0	-	32	33.78±4.92

*Different letter means significant difference for P<0.05.

Table 5. Mean, standard deviation and comparison between males and females*, distinctly for class of age, of somatic traits measured on buffaloes raised in Danamandra village, of Silivri district of Istanbul province of Turkiye (continued).

	≤1 Year		1> Years ≤2		2> Years ≤3		3 > Years ≤4		Adult	
	N	$X \pm S_{\bar{x}}$	N	$X \pm S_{\bar{x}}$	N	$X \pm S_{\bar{x}}$	N	$X \pm S_{\bar{x}}$	N	$X \pm S_{\bar{x}}$
<i>1. Withers height</i>										
Male	4	110.75±9.93	18	122.1±8.29	13	129.38 ^a ±4.68	6	132.83±8.03	35	138.23±7.22
Female	6	99.00±11.15	10	122.7±8.09	12	122.92 ^b ±5.07	8	127.13±5.24	91	133.14±6.76
<i>2. Rump height</i>										
Male	4	112.00±10.29	18	122.78±8.40	13	129.85 ^a ±3.55	6	133.00±9.4	35	135.71±7.06
Female	6	103.60±11.69	10	125.5±7.60	12	125.58 ^b ±6.34	8	125.88±4.85	91	132.57±7.20
<i>3. Body length</i>										
Male	4	118.25 ^a ±6.85	18	123.17±8.11	13	137.85 ^a ±8.00	6	145.67 ^a ±10.21	35	145.09±7.88
Female	6	102.2 ^b ±10.47	10	121.9±8.07	12	127.42 ^b ±10.06	8	132.00 ^b ±4.78	91	142.43±8.77
<i>4. Chest depth</i>										
Male	4	29.50 ^b ±3.00	18	59.67±5.19	13	64.96 ^a ±1.56	6	74.67 ^a ±5.24	35	77.2±8.45
Female	6	45.20 ^a ±8.70	10	61.70±7.10	12	64.92 ^b ±3.20	8	67.38 ^b ±2.92	91	71.1±4.85

*Different letter means significant difference for P<0.05 (small letter) or P<0.01 (capital letter).

Table 6. Several body traits of Anatolian water buffalo of Türkiye; (Soysal and Kök, 1997).

	Adult		4 Year		3 Year		2 Year		1 Year	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Withers Height	138.23	133.14	132.83	127.13	129.38	122.92	122.1	122.7	110.75	99
Rump Height	135.71	132.57	133.0	125.88	129.85	125.58	122.78	125.5	112.0	103.6
Shoulder Height	130.77	128.43	127.83	122.63	123.85	121.25	118.56	120.1	108.0	99.4
Tai Head Height	126.23	123.26	123.83	117.38	120.08	116.92	114.67	114.7	105.0	96.8
Height of Tuber coxa	122.31	118.46	118.5	112.5	116.23	109.92	110.5	108.6	101.0	95.4
Body Length	145.09	142.43	145.67	132.0	137.85	127.42	123.17	121.9	118.25	102.2
Chest Depth	77.20	71.10	74.67	67.38	69.46	64.92	59.67	61.7	29.5	45.2
Chest Girth	56.86	41.56	45.33	36.38	39.23	35.25	34.56	35.2	55.0	25.2
Width Between tuber coxa	31.11	27.78	24.17	29.375	25.85	22.33	19.56	27.9	20.25	15.4
Width Between Hipbone	60.94	56.52	52.0	52.63	51.38	48.5	44.5	46.2	41.50	34.8
Head Length	48.03	50.83	51.5	49.50	49.33	45.18	44.43	45.20	34.25	37.5
Width of Head	19.57	20.30	22.5	20.0	20.69	18.75	20.83	18.60	15.25	16.75
Rear shin Bone circumference	21.97	20.71	20.67	20.25	18.38	19.42	18.22	17.60	17.50	15.25
Front Shin Bone Circumference	23.80	22.814	24.58	22.25	19.92	21.08	19.89	19.50	19.25	17.0
Chest Circumferences	222.77	196.59	215.17	179.0	178.31	172.75	153.5	159.13	142.5	132.17

Table 7. Preliminary data on milk constituent of water buffalo population of Istanbul included in herd improvement program.

variable	N	Mean	Standart error	Standart deviation	Coefficient of variation	Minimum	Maximum
Fat	30	7.593	0.487	2.670	35.16	1.410	15.350
Protein	30	3.437	0.155	0.851	24.76	1.760	5.600
Non fat solid matter	30	9.291	0.420	2.300	24.75	4.750	15.150
Dansity	30	1.0187	0.00115	0.00629	0.62	1.0100	1.0300
Lactoze	30	5.203	0.235	1.288	24.75	2.660	8.480
Freezing degree	30	-0,6010	0.0277	0.1517	-25.25	-0.9900	-0.3000

Table 8. Preliminary data on length of lactation (days milked) of water buffalo population of İstanbul included in herd improvement program.

N	Mean	Standart error	Standart deviation	Minimum	Maximum
175	198.81	1.68	22.7	141.00	260.00

Table 9. Preliminary data yield of lactation of water buffalo population of İstanbul included in herd improvement program.

N	Mean	Standart error	Standart deviation	Minimum	Maximum
175	1072.6	26.5	350.2	339.00	2051

Table 10. Distribution female water buffalo body measurement according to the age and provinces (mean and standart error).

Provinces	Age Group	N	CY (cm) X±Se	SAGY (cm) X±Se	SY (cm) X±Se	KSY (cm) X±Se	OTYY (cm) X±Se	VU (cm) X±Se	GD (cm) X±Se	GC (cm) X±Se	OYAG (cm) X±Se	KYAG (cm) X±Se	GG (cm) X±Se	
Sakarya	1	3	90.3 ± 5.3	94.6 ± 1.2	94 ± 4.0	84.3 ± 4.3	82.6 ± 3.1	80 ± 6.0	51.3 ± 5.5	118.6 ± 4.3	12.3 ± 4.3	33.3 ± 8.4	32.6 ± 4.2	
	2	4	109.7 ± 5.0	108.7 ± 4.3	106.7 ± 4.3	106.5 ± 4.1	101.5 ± 3.9	108.7 ± 3.1	61 ± 2.1	146.2 ± 5.8	18.7 ± 2.4	43 ± 2.8	34.7 ± 1.3	
	3	5	121.8 ± 2.0	121.6 ± 2.0	119.2 ± 2.1	111.8 ± 3.6	108.2 ± 2.8	110 ± 6.5	110 ± 6.5	70.8 ± 2.1	177.6 ± 11.3	21 ± 0.7	45.6 ± 1.4	36.4 ± 1.4
	4	5	128 ± 2.2	129.8 ± 3.1	128.4 ± 2.7	118.2 ± 1.7	109.4 ± 5.3	123.4 ± 5.5	123.4 ± 5.5	73 ± 1.6	217.6 ± 13.4	24.3 ± 1.8	53.2 ± 2.8	40 ± 2.0
	5	12	131.3 ± 2.3	130.3 ± 2.0	129.3 ± 2.0	120.0 ± 1.6	112.1 ± 1.2	126.8 ± 2.7	126.8 ± 2.7	79.0 ± 3.2	222 ± 5.6	34.9 ± 1.8	57.5 ± 1.7	40.8 ± 1.1
Çorum	Total	29	121.8 ± 2.7	120.8 ± 2.3	119.4 ± 2.4	112.7 ± 2.3	106.4 ± 2.0	116.0 ± 3.2	71.2 ± 2.2	192.4 ± 7.8	31.2 ± 1.1	50.2 ± 1.9	37.9 ± 0.8	
	1	12	91.9 ± 2.5	92.6 ± 2.4	90.2 ± 2.5	87.9 ± 2.1	85.3 ± 1.9	78.0 ± 4.2	38.8 ± 2.4	99.7 ± 9.0	12.2 ± 1.2	25.4 ± 1.6	20.6 ± 1.2	
	2	5	113.2 ± 4.4	113.8 ± 4.1	111 ± 4.5	109.4 ± 3.9	105.2 ± 4.0	103.6 ± 2.6	47.8 ± 2.0	139.8 ± 3.3	15 ± 1.0	32 ± 3.3	23.4 ± 0.6	
	3	8	126.5 ± 4.3	125.7 ± 3.9	122.7 ± 4.0	118.2 ± 3.6	113.3 ± 3.0	115.6 ± 5.2	54.8 ± 2.3	148.1 ± 9.5	21.1 ± 2.6	42.3 ± 3.7	28.7 ± 1.5	
	4	10	132.1 ± 1.4	131.7 ± 1.8	130.1 ± 1.7	125.6 ± 1.7	119.3 ± 1.4	123.0 ± 1.2	129.0 ± 3.9	61.6 ± 1.9	185.2 ± 8.3	30.3 ± 1.5	56.2 ± 1.5	36.5 ± 1.2
Aydın	5	22	136.6 ± 1.3	134.5 ± 1.0	132.5 ± 1.2	128.0 ± 1.2	123.0 ± 1.2	113.1 ± 3.2	53.7 ± 1.5	154.3 ± 5.9	22.4 ± 9.2	43.9 ± 1.8	30.1 ± 1.0	
	Total	57	123.0 ± 2.5	122.1 ± 2.3	119.9 ± 2.4	116.1 ± 2.2	111.5 ± 1.1	113.1 ± 3.2	43.0 ± 2.3	108.2 ± 10.4	15.3 ± 1.4	27.7 ± 2.7	26.2 ± 1.8	
	1	15	100.9 ± 5.8	99.4 ± 5.7	93.1 ± 5.4	94.2 ± 5.1	89.9 ± 5.1	90.6 ± 5.0	111.5 ± 3.6	53.4 ± 2.2	155.0 ± 8.7	21.1 ± 1.9	40.8 ± 2.8	36.1 ± 1.7
	2	9	127.5 ± 3.0	125.1 ± 2.8	122.7 ± 3.0	116.6 ± 2.9	112.2 ± 3.0	111.5 ± 3.6	53.4 ± 2.2	159.7 ± 4.1	22.8 ± 1.0	43.6 ± 1.4	36.5 ± 1.5	
	3	17	129.9 ± 1.7	126.2 ± 1.9	124.1 ± 1.8	119.4 ± 1.7	112.9 ± 1.9	116.2 ± 2.6	127.9 ± 1.4	59.3 ± 1.2	189.8 ± 2.4	28.4 ± 0.6	51.4 ± 1.2	40.2 ± 0.8
Balıkesir	4	31	138.8 ± 0.9	136.2 ± 0.9	133.9 ± 1.0	128.4 ± 1.1	122.0 ± 1.2	139.2 ± 0.8	64.7 ± 0.6	202.5 ± 1.26	32.7 ± 0.3	58.2 ± 0.4	41.7 ± 0.4	
	5	90	142.0 ± 0.5	136.8 ± 0.5	134.6 ± 0.6	128.6 ± 0.5	122.1 ± 1.1	128.6 ± 1.4	59.9 ± 0.7	184.1 ± 2.6	28.6 ± 0.5	51.6 ± 0.8	39.4 ± 0.4	
	Total	162	135.5 ± 1.1	131.4 ± 1.0	128.8 ± 1.1	123.5 ± 1.0	117.0 ± 1.1	128.6 ± 1.4	79.2 ± 2.7	100.7 ± 2.9	13.5 ± 0.5	24.9 ± 1.0	24.2 ± 1.0	
	1	30	87.4 ± 1.6	88.3 ± 1.5	85.9 ± 1.5	83.7 ± 1.4	79.6 ± 1.4	107.3 ± 5.6	52.5 ± 2.4	145.0 ± 9.7	19.8 ± 2.1	38.7 ± 3.1	30.0 ± 2.0	
	2	11	113.0 ± 4.0	112.1 ± 3.8	109.6 ± 3.6	104.7 ± 2.9	100.2 ± 3.1	112.0 ± 3.2	57.4 ± 1.7	150.5 ± 4.6	21.0 ± 0.8	39.4 ± 1.4	33.0 ± 2.8	
Samsun	3	21	116.7 ± 2.4	115.7 ± 2.3	114.0 ± 2.2	108.5 ± 1.9	103.0 ± 2.0	126.0 ± 2.2	63.4 ± 1.3	182.0 ± 2.0	23.9 ± 0.5	51.1 ± 1.5	39.5 ± 1.2	
	4	20	130.6 ± 0.9	128.1 ± 0.9	125.8 ± 0.8	120.4 ± 0.9	114.9 ± 0.9	140.0 ± 1.3	70.1 ± 0.7	205.5 ± 1.3	30.2 ± 0.4	61.0 ± 0.5	41.2 ± 0.7	
	5	79	139.2 ± 0.5	131.8 ± 0.6	131.4 ± 0.6	124.3 ± 0.5	117.6 ± 0.5	120.6 ± 2.1	60.0 ± 1.0	172.0 ± 3.4	24.0 ± 0.6	48.7 ± 1.2	36.0 ± 0.7	
	Total	161	123.7 ± 1.6	119.8 ± 1.4	118.5 ± 1.4	112.8 ± 1.3	107.1 ± 1.2	120.6 ± 2.1	35.8 ± 1.1	87.9 ± 2.9	11.6 ± 0.3	20.8 ± 0.6	22.7 ± 0.5	
	1	29	79.3 ± 1.6	79.6 ± 1.6	78.1 ± 1.6	76.6 ± 1.6	73.2 ± 1.5	70.0 ± 1.5	49.8 ± 1.0	136.6 ± 2.7	15.1 ± 1.1	31.7 ± 0.9	32.2 ± 0.8	
Tokat	2	16	112.5 ± 2.2	113.7 ± 2.4	111.0 ± 2.4	106.3 ± 2.0	101.6 ± 2.2	94.5 ± 1.9	57.6 ± 1.0	164.4 ± 5.8	21.7 ± 0.7	42.6 ± 1.2	36.4 ± 1.4	
	3	12	129.2 ± 2.2	129.0 ± 1.7	125.5 ± 1.8	118.3 ± 2.0	112.7 ± 1.9	121.0 ± 4.9	61.3 ± 1.6	175.6 ± 4.8	23.3 ± 0.3	45.0 ± 3.0	39.0 ± 3.0	
	4	3	135.0 ± 2.0	134.0 ± 3.7	131.0 ± 2.5	126.0 ± 4.5	120.6 ± 2.9	133.0 ± 3.5	62.3 ± 0.8	191.7 ± 2.1	27.4 ± 0.6	53.7 ± 0.8	41.2 ± 0.7	
	5	42	137.8 ± 1.0	135.0 ± 1.0	132.0 ± 0.9	127.5 ± 7.5	121.7 ± 2.2	107.8 ± 2.8	52.2 ± 1.2	149.9 ± 4.5	20.2 ± 0.7	39.3 ± 1.4	33.9 ± 0.8	
	Total	102	116.1 ± 2.9	114.6 ± 2.4	112.5 ± 2.3	107.6 ± 2.1	102.6 ± 2.0	77.5 ± 1.6	39.9 ± 0.7	103.9 ± 1.8	12.5 ± 0.4	24.7 ± 0.8	22.3 ± 0.7	
Total	1	28	89.7 ± 1.2	91.6 ± 1.3	89.7 ± 1.3	86.7 ± 1.1	83.3 ± 1.2	100.5 ± 7.3	47.0 ± 4.1	133.7 ± 17.7	14.7 ± 1.6	30.7 ± 4.0	26.2 ± 4.4	
	2	4	111.7 ± 9.5	110.7 ± 7.7	108.7 ± 8.5	105.2 ± 7.6	101.5 ± 7.0	105.5 ± 4.5	50.7 ± 3.0	147.0 ± 7.7	16.8 ± 1.2	35.8 ± 2.2	28.7 ± 1.4	
	3	8	116.2 ± 4.4	116.2 ± 4.0	114.2 ± 4.1	110.8 ± 4.0	107.0 ± 3.6	119.5 ± 1.5	54.9 ± 2.0	158.5 ± 13.5	20.0 ± 2.0	39.0 ± 6.0	30.0 ± 0.3	
	4	2	123.5 ± 1.5	124.0 ± 1.5	122.5 ± 0.5	119.0 ± 2.0	114.0 ± 4.0	137.5 ± 2.7	63.6 ± 1.2	198.2 ± 5.8	30.8 ± 0.6	57.7 ± 1.1	39.2 ± 1.0	
	5	20	134.6 ± 0.9	131.6 ± 0.6	129.1 ± 0.7	124.4 ± 0.8	118.4 ± 0.9	112.2 ± 3.5	53.9 ± 1.4	143.6 ± 5.8	19.3 ± 1.0	37.6 ± 1.9	29.1 ± 1.0	

Not: traits; CY = Withers Height, SAGY = Rump Height, SY = Scouler (back) height, KSY = Height At Tuber İchii, VU = Body Length, GD = Chest Depth, GC = Chest Girth, OYAG = Width Between Tuber İchii, KYAG = Width Between Tuber İchii, GG = Chest Width and age group; 1 = 0 – 6 month; 2 = 6 month – 1 year; 3 = 1 year – 2 year; 4 = 2 year – 3 year; 5 = greater than 4 year

Table 10. Distribution male water buffalo body measurement according to the age and provinces (mean and standart error) (Continued).

Provinces	Age Group	N	CY (cm) X±Se	SAGY (cm) X±Se	SY (cm) X±Se	KSY (cm) X±Se	OTYY (cm) X±Se	VU (cm) X±Se	GD (cm) X±Se	GC (cm) X±Se	OYAG (cm) X±Se	KYAG (cm) X±Se	GG (cm) X±Se
Sakarya	3	3	125 ± 5.0	124 ± 5.5	119 ± 3.3	122 ± 3.6	111 ± 1.0	113.66 ± 2.6	72 ± 2.5	179 ± 10.4	19.66 ± 1.3	45.8 ± 6.5	36.5 ± 2.0
	1	13	94.3 ± 2.0	94.6 ± 2.1	92.4 ± 2.0	90 ± 2.2	87.5 ± 1.9	84.4 ± 2.9	42.1 ± 1.3	109.6 ± 3.1	10.9 ± 0.4	24.7 ± 1.0	20.7 ± 0.8
	2	4	107 ± 5.4	106.7 ± 5.7	105 ± 5.3	103.5 ± 5.3	100.2 ± 5.08	99 ± 4.3	46 ± 2.1	128.5 ± 4.6	11.7 ± 1.0	28.7 ± 2.8	23.2 ± 2.2
Çorum	3	6	122.5 ± 4.5	123 ± 3.9	119.3 ± 4.8	115.8 ± 4.4	110.6 ± 4.2	109.3 ± 4.3	52.5 ± 0.4	152.8 ± 5.4	14.5 ± 1.1	36.5 ± 2.4	30.6 ± 2.1
	4	2	130.7 ± 2.5	129 ± 3.9	126.3 ± 2.5	120 ± 2.0	113.5 ± 0.5	121 ± 2.0	55.5 ± 0.5	159.5 ± 0.5	20.5 ± 1.5	40.5 ± 1.5	32.5 ± 0.5
	Total	25	105.7 ± 3.1	106 ± 3.1	103.6 ± 3.0	100 ± 2.99	97.2 ± 2.69	95.6 ± 3.22	46.3 ± 1.2	144.6 ± 4.1	12.6 ± 0.6	29.4 ± 1.46	24.4 ± 1.1
Afyon	1	15	94.4 ± 4.6	94.5 ± 4.7	92.5 ± 4.5	90.8 ± 3.9	86.5 ± 3.5	84.4 ± 5.3	41.6 ± 2.3	106.8 ± 7.0	14.1 ± 0.7	26.2 ± 1.9	26.6 ± 1.4
	2	4	127.0 ± 3.4	128.0 ± 3.5	125.5 ± 3.1	120.0 ± 3.7	115.0 ± 3.6	120.7 ± 1.2	51.0 ± 0.9	152.0 ± 4.8	18.0 ± 2.4	35.5 ± 2.5	34.2 ± 0.8
	3	18	133.5 ± 2.1	131.5 ± 2.4	128.7 ± 2.3	125.2 ± 2.2	120.2 ± 2.3	123.2 ± 2.75	55.3 ± 1.0	168.0 ± 4.6	21.7 ± 1.0	40.8 ± 1.2	37.4 ± 1.2
	4	4	143.0 ± 3.2	140.0 ± 2.9	137.5 ± 3.0	133.5 ± 2.7	129.0 ± 3.8	133.5 ± 3.9	65.7 ± 3.9	192.0 ± 6.5	25.7 ± 1.7	48.0 ± 2.9	42.2 ± 1.8
Total	41	120.5 ± 3.4	119.9 ± 3.3	116 ± 3.3	113.8 ± 3.1	108.9 ± 2.8	109.7 ± 3.2	51.4 ± 1.5	148.7 ± 5.7	19.4 ± 0.8	36.2 ± 1.5	34.3 ± 1.1	
Balıkesir	1	28	85.7 ± 1.5	86.8 ± 1.5	84.0 ± 1.5	82.5 ± 1.7	79.0 ± 1.4	78.1 ± 2.2	37.5 ± 1.1	100.7 ± 3.3	12.9 ± 0.4	24.0 ± 0.9	25.4 ± 1.0
	2	4	102.5 ± 5.7	102.5 ± 6.6	99.2 ± 1.0	98.7 ± 6.1	95 ± 6.1	93.5 ± 7.7	43.7 ± 4.6	141.0 ± 7.7	15.0 ± 0.9	34.3 ± 2.3	28.7 ± 1.6
	3	11	114.8 ± 1.4	113.9 ± 1.0	111 ± 1.3	108.8 ± 1.2	103.3 ± 1.1	106.1 ± 3.0	51.7 ± 1.8	145.5 ± 5.5	16.7 ± 1.0	37.7 ± 2.0	30.0 ± 1.8
Samsun	4	4	136.0 ± 5.8	130.5 ± 5.7	126.7 ± 4.1	120.7 ± 4.3	115.2 ± 4.5	128.7 ± 6.4	64.5 ± 3.6	180.0 ± 8.8	25.1 ± 3.7	52.7 ± 5.3	37.0 ± 1.9
	Genel	47	98.2 ± 2.7	98.2 ± 2.4	95.2 ± 2.4	93.2 ± 2.3	89.1 ± 2.1	90.3 ± 2.9	43.6 ± 1.5	120.7 ± 4.7	14.8 ± 0.6	30.0 ± 1.55	27.7 ± 0.9
	1	13	83.6 ± 1.9	85.6 ± 1.7	83.1 ± 1.8	81.1 ± 1.7	77.3 ± 1.7	71.5 ± 1.6	32.5 ± 1.6	99.3 ± 3.7	12.0 ± 0.6	20.2 ± 0.6	22.3 ± 0.6
Tokat	2	12	113.7 ± 3.2	113.6 ± 3.1	111.3 ± 3.2	108.0 ± 2.6	103.4 ± 2.5	103.5 ± 2.5	50.4 ± 1.1	135.1 ± 3.5	13.2 ± 0.5	32.0 ± 1.2	30.4 ± 1.2
	3	13	127.0 ± 2.8	124.0 ± 3.2	121.9 ± 3.0	117 ± 2.6	110.6 ± 2.3	115.5 ± 3.4	53.6 ± 1.0	154.2 ± 4.4	18.5 ± 1.4	40.1 ± 1.6	35.7 ± 0.8
	Genel	38	108 ± 3.3	107.6 ± 3.1	105.3 ± 3.1	101.8 ± 2.8	96.9 ± 2.6	96.7 ± 3.4	45.3 ± 1.7	129.4 ± 4.3	14.6 ± 0.7	30. ± 1.5	29.5 ± 1.0
	1	31	91.1 ± 1.4	93.8 ± 1.3	91.5 ± 1.4	89.5 ± 1.2	85.6 ± 1.3	80.9 ± 1.7	41.1 ± 0.6	105.6 ± 2.6	12.4 ± 0.3	24.9 ± 0.7	23.0 ± 0.7
Total	3	17	124.5 ± 2.7	122.7 ± 2.8	122.4 ± 2.7	117.5 ± 2.2	113.2 ± 2.2	111.5 ± 3.1	52.4 ± 1.3	162.5 ± 6.2	16.1 ± 0.6	37.4 ± 1.4	30.6 ± 1.2
	4	18	133.7 ± 1.1	132.4 ± 1.0	131.0 ± 1.0	124.8 ± 0.7	120.5 ± 0.7	122 ± 1.2	57.3 ± 0.5	182.8 ± 4.6	18.8 ± 0.5	42.9 ± 0.5	34.7 ± 0.9
	Total	66	111.8 ± 2.5	111.8 ± 2.3	110.3 ± 2.4	106.3 ± 2.1	102.2 ± 2.1	100.0 ± 2.5	48.4 ± 1.0	141.3 ± 4.8	15.2 ± 0.4	33.0 ± 1.1	28.2 ± 0.8

Not: traits; CY = Withers Height, SAGY = Rump Height, SY = Scouler (back) height, KSY = Height Of Coxae, OTYY = Height At Tuber Ichii, VU = Body Length, GD = Chest Depth, GÇ = Chest Girth, OYAG = Width Between Tuber Ichii, KYAG = Width Between Tuber Ichii, GG = Chest Width and age group; 1 = 0 – 6 month; 2 = 6 month – 1 year; 3 = 1 year – 2 year; 4 = 2 year – 3 year; 5 = greater than 4 year

Table 11. Preliminary data concerning lactation length (days milked) and yield of the population of water buffalo herd improvement program of Turkiye.

Provinces	N	Lactation length (days milked)	N	Lactation yield
İstanbul	175	198.81 ± 1.68	175	1072,6 ± 26.5
Düzce	39	150.41 ± 12.28	39	435.12 ± 44.13
Balıkesir	12	144.50 ± 13.12	12	695.87 ± 128.86
Afyon	274	243.87 ± 2.29	274	1063.38 ± 26.40
Bitlis	184	286.5	184	841.75
Tokat	486	147.9 ± 1.63	486	708.5 ± 15
Samsun	543	219.1 ± 1.65	543	624.8 ± 10.80
Diyarbakır	684	-	684	751.166 ± 19.53

Table 12. Number of water buffalo and name of provinces included in nationwide water buffalo improvement project in Turkiye.

Provinces	Number of farmer	Heifer	Bull	Total
AFYON	135	1145	26	1171
BALIKESİR	125	995	20	1016
BİTLİS	297	1652	77	1729
DİYARBAKIR	514	1927	87	2014
DÜZCE	105	1105	22	1127
İSTANBUL	45	1002	38	1040
SAMSUN	88	1974	37	2011
TOKAT	149	1020	50	1070
ÇORUM	163	911	36	947
GİRESUN	521	1095	31	1126
KAYSERİ	104	956	24	980
KÜTAHYA	383	911	7	918
SİVAS	243	879	35	914
MUŞ	-	-	-	-
TOPLAM	2873	15572	490	16062

Table 13. Preliminary data obtained regarding weight at several ages of water buffalo population of the community based water buffalo improvement program in Turkiye.

Provinces	N	Birth weight (kg)	N	Weight at 6 month (kg)	N	Yearling weight (kg)
İSTANBUL	637	34.011 ± 0.270	371	107.87 ± 1.29	-	-
DÜZCE	393	32.785 ± 1.133	6	75.200 ± 8.70	-	-
BALIKESİR	399	33.536 ± 0.336	-	-	-	-
AFYON	756	29.160 ± 0.215	377	89.202 ± 0.501	-	-
BİTLİS	1097	29.350 ± 0.150	791	85.100 ± 0.650	-	-
TOKAT	639	27.7 ± 0.182	-	-	-	-
SAMSUN	504	28.96 ± 0.309	362	100.54 ± 0.893	-	-
DİYARBAKIR	957	28.37 ± 0.22	684	83.27 ± 1.12	-	-

Table 14. Characteristics of bovine microsatellite markers tested on Anatolian water buffalo population.

Population	n	H _o	H _E	n _A	F _{IS}	Microsatellite number	Reference
Pazar	32	0.55	0.62	5.76	0.10	26	Garganiet <i>al.</i> , 2009
Danamandira	18	0.53	0.62	5.14	0.13		
Merzifon	34	0.58	0.81	9.20	0.29		
Turhal	20	0.58	0.64	5.42	0.08		
Coskun	34	0.55	0.65	6.38	0.16		
Afyon	19	0.50	0.70	7.00	0.18		
Silivri	40	0.67	0.69	6.75	-0.101 / 0.205	4	Soysalet <i>al.</i> , 2007
Ege -Güney Marmara (Afyon, Balıkesir, Bursa)	56	0.49	0.53	-	0.08	20	TURKHAYGENI Project, 2012
Karadeniz (Sinop, Samsun, Tokat)		0.48	0.55	-	0.13		
Trakya (Saray, Silivri)		0.48	0.54	-	0.12		
Afyon, Konya, Sivas	30	0.19	-	-	-	11	Aytekinet <i>al.</i> , 2011