

## **ANATOLIAN WATER BUFFALO HUSBANDRY IN TURKEY**

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### **Abstract**

Anatolian Water Buffalo is found mostly in the half northwestern of Turkey including north part of the middle Anatolia. It is more common along the coast of the 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 Turkey (1 117 000 heads assessed in 1971), while currently the population size is of only 117,591 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 spite 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 programmes and incentive premiums in order to stop the reducing tendency of population.

Nationwide water buffalo improvement program has also initiated so-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 sausages. 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' and yogurt production.

**Key words:** *Anatolian Water Buffalo husbandry herd improvement program*

### **Introduction**

Anatolian Water Buffaloes breed morphological characteristics is registered by the National committee for breed registration (Anonymus, 2004). According to this source Anatolian Water Buffalo is generally small structured with easy temperament and having generally long horn. Color of horn and nail of legs are black and coat colour varies from dark black to light black or brown. Body coat is covered with long hairs. Young animals have black hairs till 1-1.5 years and it becomes reddish black colour after weaning (Anonymus, 2004). According to the Turkish Statistic Institute data ([www.turkstat.gov.tr](http://www.turkstat.gov.tr)) 100,000 water buffalo slaughtered in 1991 (buffalo population of 360150 head) producing 8803 metric ton buffalo meat. Average carcass weight estimates 110 kg. It is estimated that 250,000 heads of buffalo population exist in Turkey. Adult body weight of water buffalo raised in Turkey is approximately 400 kg. Average lactation yield and length of buffaloes of Turkey are 1 ton and 250 day respectively. Average age at first insemination is 22-24 month. Average open day period is three months. First heat cycle is observed generally after 3 month of calving. They are raised in a coastal

area of North Anatolia, especially Samsun and north part of central Anatolia relatively close to coastal area such as Tokat, Trakya region (Istanbul) that has the biggest number of buffalo population of Turkey. In addition the eastern part of Turkey 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 gain 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. The buffaloes used as draft animals are castrated in 12 years of age. They can be used up to 12 years of age as a pulling power. Most important reason for raising Buffaloes are their milk and 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 (2008) data, there are about 185.29 million domesticated buffaloes raised in the 42 countries of which 179.75 million(97%) are in Asia among five world continents. However, there are about 158 million buffaloes left in the world. During the last 10 years the world Buffalo production increased by 1.49 % annually.

Also, in Turkey the buffalo population has declined dramatically over the last decades. The total population according to the Turkish Statistic Institute was 117,591 heads in 2013 ([www.turkstat.gov.tr](http://www.turkstat.gov.tr)). Former 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 spite 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 have 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 ‘lülekaymağı.

Buffalo for draught purpose is limited to tree stump hauling in forest area when mechanical equipments may not be used. 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.

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 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 for research purposes.

Artificial insemination is not applied in villages while it is widely used in experimental farms, such as Afyon and Bandırma district of Turkey and at the Department of Animal Science of Mustafa Kemal University (Sekerden,O., 2008). The programme is currently in progress at Zootechnics 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 sires within the herd is a common practice. 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 buffalo in Turkey are also decreasing. There is only one water buffalo breed called Anatolian water buffalo in Turkey. The water buffalo *in-situ* conservation program was conducted in Balıkesir province of western Turkey. The number of water buffalo population decreased from 117,8000 (1970) to 847,268 (2010) and increased by 117,591 in 2013 again. The latest attempt regarding Conservation of animal genetic resources establishing Water buffalo breeding organization of Turkey which started in 2008 and central water buffalo breeder association established in 2011. Nationwide water buffalo improvement program was initiated under the name of community based improvement program. So far 14 provinces and 2873 farms with total of 16082 adult water buffalo individuals were included in the nationwide improvement program. Recently this kind of support put on implementation that water buffalo breeding stock breeder who is a member of breeder union and joins 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 be 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 buffalos in Turkey .

**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 <sub>u</sub>	5.49	0.01	5.44	0.01	***

NS= not significant (P>0.05)

\*P<0.05; \*\*P<0.01; \*\*\*P<0.001

The water buffalos in Turkey are named as Anatolian Water Buffalos 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 (Soysal, 2009). In Turkey water buffalos are particularly bred for milk production and they are slaughtered for meat production after they finish their productive age. 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 meat only. 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 was placed on the management of farm animal genetic researches in general and also on the water buffalo husbandry in particular. In general, the efforts related to conservation and sustainable utilisation of the farm animal genetic resources are coordinated and supported financially and technically by the General Directorate of Agricultural Research and policy of the Ministry of Food, Agriculture and Livestock.

According to the A. Yılmaz et al. (2011) certain carcass and meat quality characteristics of Anatolian Water Buffalos were given in the following tables

**Table 2.** Least-square means for meat quality characteristics of Anatolian Water Buffalos 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 <sup>a</sup> , %	9.81	9.98	10.57	9.23	0.284	NS	*	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*) <sup>1h</sup>	39.33	36.49	37.35	38.48	0.257	***	*	NS
Redness (a*) <sup>1h</sup>	21.78	22.98	21.29	23.47	0.281	*	***	NS
Yellowness (b*) <sup>1h</sup>	7.48	7.56	7.30	7.74	0.189	NS	NS	NS
Colour parameters at 24 h								
Lightness (L*) <sup>24h</sup>	40.87	38.23	38.82	40.29	0.215	***	**	NS
Redness (a*) <sup>24h</sup>	23.99	25.89	25.30	24.58	0.262	***	NS	NS
Yellowness (b*) <sup>24h</sup>	7.84	7.91	8.90	6.85	0.198	NS	***	NS

<sup>a</sup> 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	
<b>Odour intensity</b>	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)

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

Due to opening door for subsidizing the support to the farmer this activity will help very much stopping the tendency for declaring the number of water buffalo in Turkey. Recently (2009) this kind of support put on implementation that water buffalo breeding stock breeder who is a member of breeder union can receive 150 Euro per head as incentive premium.

**Table 4.** Several characteristics of Anatolian Water Buffalo raised in Turkey

Parameters	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	İlarslan et al (1983) Uslu N.T., (1970a)
Calving Interval	434.3±57.1	365.2±17.5	Şekerden et al (2000a) İlarslan 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) İlarslan et al (1983)
Birth Weight (Male)	34.3±1.20	26.7±0.52	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	İlarslan 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 Gain (gr) (0-3 Month)	(Male) 0.483	(Female) 0.456	Şekerden et al. (2000c)
Daily Live Weight Gain (gr) (3-6 Month)	(Male) 0.305	(Female) 0.294	Şekerden et al. (2000c)
Daily Live Weight Gain (gr) (6-9 Month)	(Female)	(Male)	Şekerden et al. (2000c)
Male		0.314	
Female	0.357		
Daily Live Weight Gain (gr) (9-12 Month)	(Male) 0.504	(Female) 0.360	Şekerden et al. (2000c)
Fat Content of Milk	8.1	6.1	Kök, S. (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, S. (1996)
Protein % of Milk	4.6	4.2	Şekerden et al. (2000a) (Soysal and Kök, 1997) Kök S. (1996)
Casein % of Milk	3.4 (3. Lactation)	3.0 (1. Lactation)	Şekerden et al.(2000b)

### **Genetic constitution of population**

In order to reveal the genetic constitution of Anatolian water buffalo several molecular genetic diversity studies have been carried out. The genetic variation and relationship among six Turkish water buffalo populations typical of different regions were 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 evidenced 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 was 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 shows that Anatolian water buffalo population samples seemed to be in Hardy-Weinberg expectation (Soysal et al., 2007).

**Table 5.** Mean, standard deviation and comparison between males and females (<sup>1</sup>), distinctly for class of age, of somatic traits measured on buffaloes raised in Danamandra village, of Silivri district of İstanbul Province of Turkey

	<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 <sup>a</sup> ±5.02	11	126.54±9.59	1	141.30		
Female	22	90.95±10.74	5	105.00 <sup>b</sup> ±13.64	0	-	32	134.15±5.32		
<i>2. Rump height</i>										
Male	28	93.28±12.22	3	137.33 <sup>a</sup> ±9.28	11	128.09±7.50	1	147.50		
Female	22	95.81±10.88	5	109.20 <sup>b</sup> ±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 length</i>										
Male	28	75.82±16.67	3	116.00 <sup>a</sup> ±9.53	11	127.09±11.44	1	142.50		
Female	22	74.27±9.62	5	96.40 <sup>b</sup> ±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		
<sup>(1)</sup> Different letter means significant difference for P<0.05										
	≤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 <sup>A</sup> ±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 <sup>B</sup> ±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 <sup>a</sup> ±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 <sup>b</sup> ±6.34	8	125.88±4.85	91	132.57±7.20
<i>3. Body length</i>										
Male	4	118.25 <sup>a</sup> ±6.85	18	123.17±8.11	13	137.85 <sup>A</sup> ±8.00	6	145.67 <sup>a</sup> ±10.21	35	145.09±7.88
Female	6	102.2 <sup>b</sup> ±10.47	10	121.9±8.07	12	127.42 <sup>B</sup> ±10.06	8	132.00 <sup>b</sup> ±4.78	91	142.43±8.77
<i>4. Chest depth</i>										
Male	4	29.50 <sup>B</sup> ±3.00	18	59.67±5.19	13	64.96 <sup>A</sup> ±1.56	6	74.67 <sup>A</sup> ±5.24	35	77.2±8.45
Female	6	45.20 <sup>A</sup> ±8.70	10	61.70±7.10	12	64.92 <sup>B</sup> ±3.20	8	67.38 <sup>B</sup> ±2.92	91	71.1±4.85

<sup>(1)</sup> Different letter means significant difference for P<0.05 (small letter) or P<0.01 (capital letter)

### Morphometric characteristics of Water Buffalo population of Turkey

An investigation done by Soysal et al. (2007) in which 76 males and 127 females of the İstanbul 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 İstanbul district.

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