MORPHOLOGICAL STUDY IN AZERI AND KHUZESTANI BUFFALOES OF IRAN

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ABSTRACT

In order to evaluate and compare the properties of type traits in Khuzestani and Azeri river buffaloes, 148 and 336 Khuzestani and Azeri buffaloes were used, respectively. Animals were evaluated for traits such as Height at Withers, Body depth, Body length, Heart girth, Hip width, Pin width and Hip to Pin length. The averages for these traits in Khuzestani breed were 145.2±6.63, 78.27±5.43, 140.5±10.05, 208.87±13.75, 57±4.44, 25.29±3.03 and 44±2.97 cm and in Azeri breed were 138.93±6.39, 76.4±5.61, 136.22±10.05, 184±13.66, 54.96±4.85, 26.43±3.94 and 43.8±3.44 cm, respectively. The effect of breed on height at withers, heart girth and hip width was quite significant ($P<0.001$) and values for these traits in Khuzestani breed was higher than Azeri. The effect of parity number for all studied traits was significant ($P<0.001$), except for the heart girth. Heifers had the lowest values among different age groups and differences in this group increased with increasing age and parity. Also, the effects of province as a factor for climate and culture circumstances on studied traits was quite significant ($P<0.001$), except for the heart girth and hip to Pin length. Buffaloes in Guilan province had lowest and buffaloes in Khuzestan and Kermanshah provinces had the highest values.

Keywords: *Bubalus bubalis*, buffalo, Azeri buffalo, Khuzestani buffalo, type traits, Karaj, Iran

INTRODUCTION

Buffalo population is scattered in 129 countries all over the world while they generally founded in Asia and only very few of them are in other continents (Iamartino *et al*., 2017). About 194 million or 97% of buffaloes are located in Asia. India (57%) and Pakistan (43%) with 149 million buffaloes have the biggest buffalo population and their people's life are strongly depended on water buffalo more than any other domesticated animals (Moaeen-ud-Din, 2014). Buffalo milk and meat plays a vital role in the economy and the health of people in different countries and according to the latest FAO report, 97 million tones of milk (12.9%) and 3.6 million tones of meat (4.5%) which produced all over the world is belonged to buffaloes (FAO, 2013).

In 2500 BC, Indo-Aryan civilization was one of the advanced civilizations. Evidence

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from this civilization has been indicative of the existence of domestic buffaloes and the extent of their distribution from the Silk Road in the East to the Mesopotamia in the West has been identified. Domesticated buffaloes were probably raised in Iran Before Christ (BC), and it has even been mentioned that about 538 BC, the breeding of buffaloes was common in Persia. A bunch of royal cane for 900 to 750 BC is available at the British Museum, which archaeologists believe that it's origin was Lorestan province. The image of three calves and three buffaloes is carved on this stick. According to this document, the experts admitted that buffaloes lived in Iran from the seventh century BC and completely adapted to the conditions of Iran's climate (Manzoor, 1994).

Unfortunately, trends belong to buffalo population in Iran in recent years have shown a significant reduction from ~523 thousand in 2002 (Borghese and Mazzi, 2005) to ~199 thousand in 2012 (Anonymous, 2012). This reduction in Iran, like some other countries in the world is because of high producing dairy cows replacement instead of buffaloes, mechanization of agriculture and the reduction of market demand for buffalo products (Borghese and Mazzi, 2005). Iran's buffalo population consists of three breeds known as Khuzestani, Mazandarani and Azeri. Khuzestani breed is located in Khuzestan, Lorestan, Kermanshah, Ilam, Fars and some other neighboring provinces. Azeri breed is scattered in different cities of East Azerbaijan, West Azerbaijan, Ardebil and Guilan and also is known as Caucasus breed. Mazandarani (or Caspian) breed is located in different cities of the Caspian Sea and it's population is in third place after Azeri and Khuzestani breeds. In some references, this breed is considered as a part of Azeri breed.

Each Azeri, Khuzestani and Mazandarani breed's population are about 145 thousand (73%), 50 thousand (25%) and four thousand (2%) from the total population of Iranian buffaloes (Anonymous, 2012), respectively. Buffalo production in Iran is mainly for its milk (293 thousand tons, which is 2.8% of all milk produced in Iran) and its meat (24.7 thousand tons, which is 2.5% of all meat produced in Iran) is in second concern (Anonymous, 2010).

Buffalo breeding in Iran is based on smallholder farming systems with an average number of five animals in most herds (99%) and also a small number of herds with between 20 to 50 and some of them are up to 300 buffaloes. Smallholder's management is according to environmental opportunities, such as pasture, straw, shrubs and fodder and also is based on environmental conditions in which they hold them. Buffaloes in Khuzestan are kept outdoors throughout the year, while in the north west of Iran, buffaloes are kept indoors in autumn and winter (Broghese and Mazzi, 2005).

Type traits are about the shape and form of some animal body components which are physical and visible and are used in the apparent judgment of the livestock to be placed in the appropriate classification (Trim-Berger *et al*., 1992). These traits are important for selection and decision-making about reproduction in dairy cows (del Schneider *et al*., 2003). These traits are also effective, directly and indirectly, in decision-making for animal removal, longevity and milk production (del Schneider *et al.*, 2003) because of their relation with production traits (Kavandi *et al*., 2011; Misztal *et al*., 1992). A buffalo breeder should be able to evaluate and judge his animals and categorize them according to the type for better nutrition and breeding and to overcome management problems (Trim-Berger *et al*., 1992).

Many environmental factors affect the

body size and body measurements and these effects can mask the true genetic value of these animals. Obtaining more accurate values for these traits can help to formulate selection strategies to improve the yield of milk production under field conditions (Javed *et al.*, 2013).

Norman and Van Vleck (1972) announced that the effect of year on type traits was low and contribution of the year to type changes was reported to be 2 to 3% (Norman and Van-Vleck, 1972). Short *et al.* (1992) reported that the effect of month was significant for some type traits (Short *et al*., 1992). Thompson *et al*. (1981) reported that the effect of age on 11 traits from 14 type traits was significant (Tompson *et al*., 1981). Norman *et al.* (1978) also reported that the effect of age was significant for all type traits in the Jersey breed (Norman *et al*., 1978). Given that the conditions in the herds such as raising systems, management, feeding systems and etc. are different, therefore, herd effect should be considered as a specific environmental factor in our analysis. This effect cannot be separated from other environmental effects (Swalve, 1995). Norman *et al*. (1978) declared that the importance of the herd effect is more than the year effect and they reported that the effect of herd on type traits were 9 to 13% (Norman *et al*., 1978). Also, the herd effect on all type traits announced significant by Thompson *et al*. (1981); (Tompson *et al*., 1981).

It is most likely to have error in evaluation of type traits, because this evaluation is often theoretical. Therefore, the evaluator's effect on evaluating these traits is significant (Short *et al*., 1992). Thompson *et al*. (1981) announced that the effect of the evaluator on all studied type traits was significant (Thompson *et al*., 1981). Vinston *et al.* (1982) reported that the contribution of the evaluator to the variance of different traits was 0.7 to 0.5 (Vinson *et al*., 1982). The final score for type traits at the beginning and the end of the lactation period have been reported higher than mid-lactation. At the end of the lactation period, the lactation has a lower score and the body capacity gets more points (Warwick, 1979). Norman *et al*. (1978) described that the effect of lactation stage on type traits in Jersey breed (excluding body capacity and dairy character) was insignificant (Norman *et al*., 1978). Thompson *et al*. (1981) also stated that type characteristics associated with body weight (strength and dairy character, fore udder attachment, Udder depth) are more likely to be affected by the stage of lactation (Thompson *et al*., 1981). Other factors such as breed, region (Shankar and Mandal, 2010; Moradi-Shahrbabak, 1997; Vander Warf and Schaeffer, 1997), sex (Kayastha *et al*., 2011) and parity (as a measure of age) (Javed *et al*., 2013; Shankar and Mandal, 2010) have been statistically significant effect on type traits, body measurements and body weight. Of course, due to the very high impact of sex effect on physical measurements, information about different sexes is reported separately (Borghese and Mazzi, 2005). The aim of this study is to evaluate and compare some type characteristics in Azeri and Khuzestani buffaloes and also to investigate the effects of genotype (breed), parity and calving age on these traits.

MATERIALS AND METHODS

In this study, 484 buffaloes (148 Khuzestani and 336 Azeri buffaloes) from 161 herds with pedigree and under recording system of Iranian Animal Breeding Center (ABC) were used. Azeri buffalo samples were prepared from East Azerbaijan, West Azerbaijan, Ardebil and Guilan

provinces and Khuzestanies samples were gathered from Khuzestan and Kermanshah provinces. We prefer to determine samples with the lowest relationship and highest variety for our data set. The animals were evaluated for height at withers, body depth, body length, heart girth, hip width, pin width and hip to pin length (Figure 1).

Prior to statistical analysis, descriptive statistics for each trait were determined and the normality test was performed to the data for each trait and for different provinces separately using Xlstat software. Each of the traits in the study for at least one of the normality tests (Shapiro-Wilk, Anderson-Darling, Lilliefors and Jarque-Bera) were non-significant and the data were normal or near normal. The statistical model to analyze the data was

$$y_{ijlk} = \mu + G_i + A_j + Sh_l + e_{ijlk}$$

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where,

$y_{ijlk}y_{ijlk}$ = The value of kth individual under ith breed group, jth age, lth province.

μ = Total mean.

G_i = effect of ith breed (I = 1, 2).

A_j = effect of jth age (j = 3-20).

Sh_l = effect of lth province (l = 1-6).

e_{ij} = Residual effect or the random error.

All effects included in the model are considered as fixed effects. Since a series of factors such as sex, evaluator and evaluation time effects were similar for all animals, therefore they were not included in the model. Statistical analysis was performed using the GLM procedure by SAS 9.1.

RESULTS AND DISCUSSION

Descriptive statistics for height at withers, body depth, body length, heart girth, hip width, pin width and hip to pin length in Khuzestani and Azeri breeds are in Table 1. The average of height at withers for Khuzestani and Azeri breeds was 145.25 and 138.93 cm, respectively. Borghese and Mazzi had previously reported these values at 141 and 133 cm, respectively (Borghese and Mazzi, 2005). The obtained values for height at withers in Azeri and Khuzestani breeds were higher than the average mature Chilika females with 124 cm (Patro *et al*., 2003), Nili-Ravi with 125 cm (Borghese and Mazzi, 2005) and 132 cm (Javed *et al*., 2013), Murrah with 133 cm (Borghese and Mazzi, 2005), Banni with 136.7 cm (Mishra *et al*., 2009) and Anatolian breed whose area was adjacent to the Azeri breed with a height of 134 cm (Borghese and Mazzi, 2005). This value was 144 cm for mature Egyptian buffaloes, which was higher than the average for Azeri breed and close to the Khuzestan breed average (Borghese and Mazzi, 2005). Khuzestani or Iraqi breed is probably the largest breed of buffalo (Borghese and Mazzi, 2005) and the results obtained for height at withers as an indicator of the size of the animal confirms this. The average body depth for mature Khuzestani and Azeri breeds was 78.27 and 76.4 cm, respectively.

The average body length for Khuzestani and Azeri breeds was 160.5 and 136.22, respectively. These values are higher than those for the Chilika breed with 122 cm (Patro *et al*., 2003) and similar to the values found for mature Anatolian breed with 138.56 cm (***) and Nili-Ravi breed in different parities with 139.55 cm (Javed *et al*., 2013).

The average heart girth for Khuzestani and Azeri breeds was 208.87 and 184, respectively. This value for mature Nili-Ravi buffaloes in different

parities was 194.45 cm (Javed *et al*., 2013) and in other studies, this value was 170 cm for the Chilika buffaloes (Patro *et al*., 2003) and 205.5 cm for the Bannie breed (Mishra *et al*., 2009).

The average for hip width in Khuzestani and Azeri breeds was 57 and 54.96 cm, respectively. This value for mature Chilika buffaloes and Banni breed was 48 (Patro *et al*., 2003) and 55.4 (Mishra *et al*., 2009) cm, respectively.

The average for pin width in Khuzestani and Azeri breeds was 25.29 and 26.43 cm, respectively. This value for mature Banni buffaloes was 27.9 cm (Mishra *et al*., 2009).

Also, The average for hip to pin length in Khuzestani and Azeri breeds was 44 and 43.8 cm, respectively. The characteristics of pelvic tract are important for reproduction.

Descriptive statistics of the studied traits in Azeri and Khuzestani breeds indicate that Khuzestani breed is relatively larger than Azeri (Table 1). However, analysis of variance is necessary to ensure that the differences are significant. The results for analysis of variance and least squares means are presented in Table 2 and 3, respectively.

Considering that it is necessary to provide a suitable model for variance analysis, therefore, environmental factors affecting traits should be included in the statistical model as much as possible. In this study, all animals were female, so the sex effect as a factor was not included in the model. Also, due to the evaluation of all animals in a limited time period, and by an evaluator and also the singleton of all studied animals, there was no need to estimate the effects of the evaluator, the time of evaluation, and the type of birth in the model.

The herd effect as an essential factor in statistical analyzes should be placed in the model but due to the large number of herds (161 herds) and the small number of animals used per herd, estimating the effect of this factor on the model was not possible. Instead, the province factor was considered as a factor indicating different climates and different breeding methods. It has been reported that the use of zoning in the country in analytical models as an effective factor for type traits, has been significant (Vander Warf and Schaeffer, 1997). Also, in the analysis model, parity was introduced as a measure of age at the time of sampling. Heifers used in this study were sexually mature and more than 2.5 years old.

According to tables 2 and 3, the effect of genotype on height at withers, heart girth and Hip width was completely significant ($P<0.001$) and on body depth, body length, pin width and hip to pin length was non-significant. Table 3 shows that the least squares means of all studied traits in Khuzestani breed is greater than Azeri, except for pin width, which was the same for both breeds and equal to 26 cm. However, except for height at withers, heart girth and Hip width, these differences were non-significant.

The effect of parity as an indicator for animal age was significant on all traits ($P<0.001$) except heart girth. Significant effect of animal age on type traits was consistent with the results of Norman et al. on Jersey (1978); Javed *et al*. (2013); Thompson *et al*. (1981) and also Shankar and Mandal (2010). The effect of different parity on the estimated buffalo weight, which was calculated from physical measurements, was significant in this study ($P<0.001$) Non-significant effect of parity on heart girth was inconsistent with Javed *et al*. (2013). The age range of buffaloes used in this study was from heifers with 2.5 years old to buffaloes with 16 parity. Due to the large number of age groups and also considering that buffaloes

reach the maturity in their third parity (Shankar and Mandal, 2010), and fewer animals in older age groups, therefore, buffaloes were classified into 6 age groups including Pregnant heifers and buffaloes which are in their first to fifth parities. The results show that the significant differences in the studied traits are mainly related to low age groups such as heifers and first parity buffaloes with older ones. In all studied traits, where the parity effect was significant, heifers were the lowest and the animals with more than two parities had the highest values (Table 3). Low values in lower age groups are probably due to the lack of physical maturity and the presence of the animal in the growth phase. There was no significant differences in the studied traits between higher age groups. This can be due to physical growth stop or animal's skeletal growth Stop due to physical maturity (Shankar and Mandal, 2010).

Because these two studied breeds were not present together in any provinces and we can not estimate this effect alone in the model, therefore, it was placed in the model as an interbreed effect as a factor of different climates and different breeding methods. As shown in table 3, Azeri breed is scattered in West Azerbaijan, East Azerbaijan, Ardebil and Gilan provinces and Khuzestani breed is in Khuzestan and Kermanshah provinces. According to the results of tables 2 and 3, it is seen that the inter-breed effect of province on the studied traits is significant ($P<0.001$) except for heart girth and hip to pin length. The significance of province effect or region is compatible with Moradi Shahrbabak (1997); Shankar and Mandal (2010); Vander Warf and Schaeffer (1997). Least squares Means related to effect of provinces on all traits were investigated. It was observed that the average performance in the provinces where the Khuzestani breed is scattered is lower than the provinces where the Azeri breed is. Within the provinces with Azeri breed, the highest values are for buffaloes in western Azerbaijan and the lowest values for buffaloes in Guilan province. Further studies indicates a decrease in the quantities from

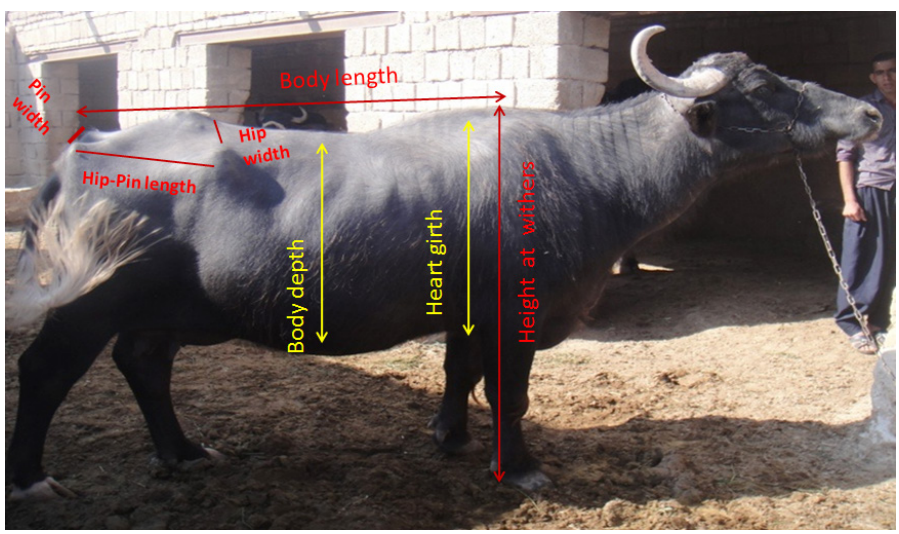

Figure 1. A Khuzestani buffalo.

Table 1. Descriptive statistics for type traits in Azeri and Khuzestani buffaloes.

Breed	Trait	Number of observation	Average (cm)	Standard deviation (cm)	Min (cm)	Max (cm)	Range (cm)
Khuzestani	height at withers	148	145.25	6.63	133	162	29
	body depth	133	78.27	5.43	66	104	38
	body length	110	140.5	8.39	115	159	44
	heart girth	85	208.87	13.75	180	242	62
	Hip width	131	57	4.44	42	68	26
	pin width	131	25.29	3.03	18	34	16
	hip to pin length	129	44	2.97	36.5	50	13.5
Azeri	height at withers	336	138.93	6.39	104	150	46
	body depth	336	76.4	5.61	50	93	43
	body length	335	136.22	10.05	106	170	64
	heart girth	221	184	13.66	140	230	90
	Hip width	336	54.96	4.85	27	68	40
	pin width	336	26.43	3.94	15	42	27
	hip to pin length	335	43.8	3.44	35	54	19

Table 2. Variance analysis for some factors affecting some type traits in Azeri and Khuzestani buffaloes.

Sources of variance	df	height at withers	body depth	body length	heart girth	Hip width	pin width	hip to pin length
		478	460	425	164	457	458	459
Genotype	1	693.32	64.81^{ns}	302.40^{ns}	5576.52***	250.48***	0.53^{ns}	96.11^{ns}
Province	4	613.20***	196.36***	2897.63***	620.40^{ns}	157.34***	397.40***	95.50^{ns}
Parity	5	184.91***	303.89***	735.5***	844.54^{ns}	348.22***	141.14***	168.02**
Residual		35.77	24.63	91.40	455.14	17.35	8.91	54.10

* = P<05, ** = P<01, *** = P<0001, NS = non significant

Table 3. Least-square means and standard errors for some type traits in Azeri and Khuzestani buffaloes.

Sources of variance	Categories	Number of animals	Height at withers	Body depth	Body length	Heart girth	Hip width	Pin width	Hip to pin length
Khuzestani		148	143.63^{b}±1.03	77.30±0.85	138.45±1.73	195.37^{b}±2.88	57.29^{b}±0.72	26.03±0.51	45.41±1.27
Azeri		336	138.73±0.34	75.76±0.29	135.04±0.57	183.89±1.95	54.30±0.24	26.07±0.18	43.56±0.56
Parity	Heifers	40	139.01^{a}±0.96	72.67^{a}±0.81	129.86^{a}±1.60	179.98^{a}±6.33	49.59^{a}±0.69	22.95^{a}±0.49	41.88^{a}±1.21
	the first	62	139.22^{a}±0.94	75.10^{b}±0.80	134.3^{ab}±1.59	186.68^{ab}±4.01	55.32^{b}±0.67	24.98^{b}±0.48	43.34^{ab}±1.17
	Second	78	140.73^{ab}±0.87	75.60^{b}±0.73	136.05^{b}±1.47	188.08^{ab}±3.13	56.47^{b}±0.61	26.41^{c}±0.44	43.93^{ab}±1.07
	Third	83	143.16^{c}±0.85	78.41^{c}±0.71	139.63^{c}±1.42	193.05^{ab}±3.18	57.72^{bc}±0.59	26.34^{cd}±0.43	45.66^{bc}±1.05
	the fourth	73	142.61^{bc}±0.88	78.88^{c}±0.74	140.77^{c}±1.47	196.09^{b}±3.60	57.99^{c}±0.63	26.90^{cd}±0.45	45.55^{bc}±1.11
	the fifth	148	142.35^{bc}±0.73	78.59^{c}±0.62	139.87^{c}±1.24	193.91^{b}±2.51	57.68^{c}±0.52	27.72^{d}±0.37	46.53^{bc}±0.91
Province	Khuzestan	136	144.82^{d}±0.58	77.27^{b}±0.50	137.13^{c}±1.05	195.37^{b}±2.88	56.01^{c}±0.42	24.24^{ab}±0.30	44.67±0.75
	Kermanshah	11	142.44^{c}±2.05	77.32^{ab}±1.71	139.8^{bcd}±3.4	-	58.57^{c}±1.43	27.83^{c}±1.03	46.15±2.53
	West Azerbaijan	82	142.45^{cd}±0.69	78.51^{b}±0.58	144.59^{d}±1.11	180.84^{a}±2.63	55.88^{c}±0.48	29.05^{cd}±0.34	44.70±0.85
	Guilan	102	135.47^{a}±0.61	74.90^{a}±0.51	128.45^{a}±1.01	181.50^{a}±2.65	52.52^{a}±0.42	23.50^{a}±0.30	42.42±0.45
	East Azerbaijan	76	139.74^{bc}±0.70	74.62^{a}±0.58	133.80^{b}±1.15	191.93^{ab}±5.16	55.05^{bc}±0.49	26.69^{c}±0.35	44.48±0.86
	Ardebil	77	137.24^{a}±0.69	75.11^{a}±0.57	133.32^{b}±1.11	181.29^{a}±3.81	53.75^{ab}±0.48	25.06^{b}±0.35	42.63±0.86

Means with different superscripts differ significantly (P<0.05).

the west to the east of the Azeri Distribution Zone, respectively. In other words, the animal's size decreases in this direction. These differences were significant for height at withers, body depth, body length, hip width and pin width ($P<0.001$). Due to the large difference in climate in different provinces and their different breeding styles, the existence of these differences are predictable and the results confirm them.

CONCLUSION

Given the challenges ahead of gathering record in buffaloes, this study is broadly a part of the rare studies that have been carried out on this species. In this research, the characteristics of Azeri and Khuzestani buffaloes were determined and compared. In addition to the characterization of each breed for desired traits, average performance of the studied traits particularly the height at withers and heart girth, which have a very high correlation with animal weight and Chuck, are higher for the Khuzestani breed than the Azeri. Using this information along with production information can be useful in designing corrective strategies.

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