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Buffalo Cow Productive, Reproductive and Udder Traits and Stayability under Sub-tropical Environmental Conditions of Egypt

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Abstract

The overall mean values estimated weights were 32.4 kg for body at birth 124.3 kg at weaning, 379.1 kg at first calving and 0.61 kg as pre-weaning daily gain. The average milk yield per lactation was 1171.2 kg. The lactation period was 269.8 days. The dry period was 194.5 days and calving interval was 464.3 days. Effects of year of calving were significant ($P<0.01$ or 0.05) on birth weight, weaning weight, pre-weaning daily gain. Effects of season of calving were significant ($P<0.01$ or 0.05) on birth weight, weaning weight and pre-weaning daily gain. Birth weight of heifers was affected significantly ($P<0.01$) by dam's weight at calving, while pre-weaning daily gain was affected significantly ($P<0.01$) by birth weight and weaning period. Effects of milking system (manual and mechanical) were significant ($P<0.05$) on lactation period and milk yield. The comparison between the data of the present study (1993 – 1995) and that obtained from a previous one (1983 – 1987) on the same farm, showed decline in all the studied traits. Stayability of Egyptian buffalo cow averages (survival rates) to 60, 72 and 84 months of age were 87, 60 and 44.0%, i.e. 13, 40 and 56% of the original buffalo cows left the farm prior to 60, 72 and 84 months of age, respectively. Averages of productive indexes estimated at the different ages were the highest at 60 and 72 months of age.

Regarding the udder traits, season of calving effects were highly significant ($P<0.01$) on teat length, teat diameter and distance between front teats. Parity effects on all udder traits were not significant. Lactation month affected significantly ($P<0.01$ or 0.05) all udder traits. Milking system (manual or mechanical) effects were significant ($P<0.01$ or 0.05) on milk yield and right and left front teat lengths. Partial regression coefficients of udder measurements on daily milk yield were significant ($P<0.01$ or 0.05). The phenotypic correlations between left and right teats, length and diameter of the four

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teats and distances between the teats, were mostly high and positive. Residual correlations were lower than phenotypic correlations between traits studied. Repeatability values of the traits related to teat length and distances between teats were moderate to high.

1 Introduction

In Egypt, buffalo is the most important domestic animal, since it serves as the main source of economic meat and milk. However, its full utilization in this respect is limited, probably to either poor managerial conditions under which the animals live or to the lack of improvement of the breeding stocks or to both of them.

From another point of view, the relationships between udder traits and milk yield (WHITE and VINSIN, 1974), optimal udder for mechanical milking (MIKUS, 1978), factors affecting udder traits (NORMAN *et al.*, 1983), genetic parameters of udder traits (CHARON, 1990) and genetic improvement of mechanical milking aptitude (FUENTE *et al.*, 1996), are known in dairy cows and ewes. However, such studies on buffaloes are scarce.

The objectives of the present investigation were to study productive and reproductive performance, stayability and udder traits of the Egyptian buffalo cows, under Egyptian sub-tropical conditions. Some environmental factors affecting, in addition to changes in the studied traits throughout about 10 years of the life of the herd, were also studied.

2 Materials and Methods

The data were collected from the records of a Governmental farm located in the Eastern North of Nile Delta (30°N 32°E). The study included 1336 complete records of buffalo cows from birth to the end of the 4th parity, during the years 1993 – 1995, and the udder traits of 250 milking buffalo cows until ≥ 8th parity.

All animals were kept under a regular system of feeding. Feeds were offered to the animals according to their requirements (live body weight, reproductive status and milk yield) in the form of concentrates mixture and green fodder. All animals were offered concentrates mixture and green fodders as Egyptian clover (*Trifolium alexandrinum*) during winter and spring months and as green plants of maize or sorghum during summer and autumn months in addition to hay of Egyptian clover during summer and rice or wheat straw during winter. Each kilogram of concentrates mixture fed contained 510 g wheat bran, 200 g cottonseed cake, 100 g yellow maize, 100 g soybean cake, 50 g rice bran, 30 g calcium carbonate and 10 g sodium chloride. Concentrates were offered twice daily before morning and evening milkings. Fresh clean water and minerals mixture were always available, all the year round. All calves were left to suckle naturally or artificially on complete cows milk twice daily.

All cows were kept in loose housing (open sheds), while each of the bulls was housed separately in a safety pen and stalled with adequate provisions of sunlight and exercise. During pre-weaning, calves were housed in closed barns.

All animals were weighed early in the morning before feeding, from birth until first calving. Lactating buffaloes were hand or machine milked twice a day at 7.00 and 19.00 h. The buffalo cows, which did not respond to machine milking, were moved to hand-milked group. Machine milking was carried out in 4x8 Herringbone milking-parlour. Milk yield was recorded daily to the nearest 0.1 kilogram for each individual animal. The amount of milk produced in a lactation period was estimated as the sum of the actual milk yield produced by each individual cow from calving till drying off.
Udder traits (front teats length, front teats diameter, rear teats length, rear teats diameter and teat distances) were measured immediately before the morning milking during lactation months.

Climatological data including maximum and minimum air temperatures (°C) and relative humidity (%) at Khattara Farm. The temperature humidity index (THI) was estimated according to the method of LPHSI (1990) and modified by Marai et al. (Under Publication) using the following formula THI= db°C – [(0.31- 0.31 RH) (db°C-14.4)], where db°C= dry bulb temperature in Celsius and RH = RH % / 100. The obtained values of THI were classified as follows: < 22.2= absence of heat stress, 22.2 to < 23.3 = moderate heat stress and 23.3 to < 25.6 = severe heat stress and > 25.6 = very severe heat stress.

The analysis of data was carried out by least squares methods (quantitative traits) using the SAS Program (1997). The following models were used:

2.1 Calf performance

Model 1. *Birth weight*

$$Y_{ijk} = m + Y_i + S_j + YS_{ij} + b_1x_1 + e_{ijk},$$

where Y_{ijk} = birth weight (kg), m = overall mean, Y_i = effect due to the i[th] year of birth (i = 1, 2 and 3), S_j = effect due to the jth season (j = 1, ..4; 1 = winter, 2 = spring, 3 = summer and 4 = autumn), Y_{ij} = the interaction between i[th] year and j[th] season, b_1x_1 = partial regression coefficient of Y_{ijk} on dam weight at calving (x_1) and e_{ijk} = residual.

Model 2. *Weaning weight and pre-weaning average daily gain*

$$Y_{ijkl} = m + Y_i + S_j + M_k + b_1x_1 \text{ X } b_2x_2 + e_{ijkl}$$

where Y_{ijkl} = weaning weight (kg) or pre-weaning average daily gain (kg), μ, Y_i , S_j and e_{ijk1}, were as defined in Model 1, M_k = effect due to the kth suckling system (k= 1 and 2; 1= natural suckling and 2= artificial suckling) and b_1x_1 and b_2x_2= partial regression coefficients of Y_{ijkl} on suckling period (x_1) and birth weight (x_2).

Model 3. *Udder traits*

The data were analyzed by least squares methods using the general linear model procedures (SAS, 1997). Repeatabilities were estimated using VARCOMP procedure.

The statistical analysis was based on the general linear model:

$$Y_{ijklm} = \mu + S_i + P_j + M_k + H_l + b_1x_1 + e_{ijkm},$$

where Y_{ijklm} = the observation for each trait, μ = overall mean, Si = effect of the i[th] season (i = 1, ...4; 1 = winter, 2 = spring, 3 = summer and 4 = autumn), Pj = effect of the j[th] parity (j= 1,...8), M_k = effect of k[th] lactation month (k= 1,...9), H_l = effect of the milking system (l = 1 and 2; 1= hand milking and 2 = machine milking), b_1x_1 = partial regression coefficient of Y_{ijklm} on daily milk yield and e_{ijklm} = residual effects.

Significance of the deferences between means was detected according to Duncan (1955).

3 Results and Discussion

3.1 Body weight traits:

Least square means and analysis of variance of weights at birth, weaning and first calving and daily gain of buffalo heifers as affected by year of calving, season of calving, dam's weight at calving, weaning period and birth weight are shown in Table 1.

The estimated birth weight was nearly similar to those estimated by Zeidan (1990), in Egypt, and Tomar (1984), in India. However, Alim (1991) obtained higher value (37.3) in Egyptian buffaloes. Year of calving effects on the traits studied were highly significant ($P<0.01$). Such results were similar to those obtained by Osman (1989) and Peeva and Vankov (1994) reflecting the remarkable variation in management practices applied in the different years. Season of calving effects on most of the same traits were highly significant ($P<0.01$), except on weight at first calving ($P>0.05$). Born calves in summer tended to be lower in weight than in those born during the other seasons. This may be due to exposure of the animals to very severe heat stress (THI = 33.5, 32.6 and 32.7 during 1993, 1994 and 1995, respectively) during summer. Such results were similar to those obtained by El-Menshawy (1994) and Peeva and Vankov (1994). Birth weight of calves was affected significantly ($P<0.01$) by dam's weight at calving, while pre-weaning daily gain weight values were affected significantly ($P<0.01$) by weaning period and birth weight. The correlation coefficients were positively significant ($P<0.01$) between weaning weight and weight at first calving and negatively significant ($P<0.01$) between weaning weight and dam's age at calving (0.394) in buffalo heifer (-0.158). The high weaning weight helps in increasing the weight and accordingly shortening the age at first calving, which are of economic importance.

Table 1: Least squares means ± SE of birth weaning, dam's weight at calving, weaning period and birth weight, under Egyptian sub-tropical conditions weight, weaning weight, pre-weaning daily gain and weight at first calving, as affected by year and season of calving.

Items	Heifer numbers	Birth weight (kg)	Weaning weight (kg)	Pre-weaning daily gain weight (kg)	No.	Weight at first calving(kg)
Overall means	1336	32.44	124.33	0.6	270	379.1
Year of calving:		**	**	**		**
- First	347	28.7 ±0.4a	133.4 ±1.0a	0.4 ±0.009a	80	414.9 ±10.6a
- Second	527	34.3 ±0.3b	124.4 ±0.5b	0.6 ±0.005b	94	376.7 ±6.6a
- Third	462	33.2 ±0.3c	115.2 ±0.5c	0.8 ±0.006c	96	349.5 ±9.0c
Season of calving:		**	**	**		NS
- Winter	440	32.5 ±0.2a	124.6 ±0.7a	0.6 ±0.1a	83	375.4 ± 8.6
- Spring	150	32.7 ±0.5a	127.2 ±1.0b	0.7 ±0.1b	35	385.1 ±15.8
- Summer	162	30.9 ±0.45b	122.2 ±0.9c	0.6 ±0.1c	37	384.0 ±12.2
- Autumn	584	32.00 ±0.22c	126.0 ±0.4ab	0.6 ±0.04a	115	376.9 ±6.1
Regression:		**	-	-	-	
Dam's weight at calving (b1)		0.04 ±0.02	-	-	-	
Weaning period (b2)		-	NS	**		NS
		-	0.1 ±0.1	-0.1 ±0.1		0.8 ±0.4
Birth weight (b3)			NS	**		-
			-0.07 ±0.1	-0.06 ±05		-

Means bearing different letters within each classification differ significantly ($P<0.01$ or $P<0.05$)

b1, b2 and b3 = Partial regression coefficients of the studied traits on dam's weight at calving, weaning period and birth weight, respectively

** = $P<0.01$ and NS = Not significant

3.2 Reproductive traits

Table 2 shows that the season of calving effects on lactation period, dry period and milk yield, were significant ($P<0.01$ or 0.05). The results regarding lactation period were similar to those reported by Mourad *et al.* (1990). In the present study, spring recorded the longest lactation period (291.0 days), while the summer recorded the shortest one (251.2 days). The results regarding the dry period were similar to those reported by Mourad *et al.* (1990). Summer recorded the longest (236 days) dry period, while spring recorded the shortest one (157.7 days). Parity effects were significant

(P<0.05) on lactation period and milk yield. Milking system (manual and mechanical) effects on lactation period and milk yield were significant (P<0.05). The manual milking was accompanied with higher (P<0.05) lactation period, calving interval and milk yield than in the mechanical system.

Correlation coefficients were significantly (P<0.01) positive between adjusted milk yield (305 days) and lactation period (0.136) and significantly (P<0.05) negative with each of weaning weight (0.067), weight at first calving (P<0.01) and calf birth weight (P<0.01).

Comparison between the periods 1983 – 1987 (EL-MENSHAWY, 1994) and 1993 – 1995 (Mohamed, 2000) in buffaloes farm showed that the estimated traits were deterioted (Table 3). Such decline may be due to the decrease in the level of managerial care during the last period of the study. The unstable and changeable policies that govern the life during the present days in the developing countries such as extension in privatization of the Governmental Companies may be one of such reasons, in this respect. The relax and interruption in conducting the managerial systems that accompany the change in such policies, normally affect adversely on the productive efficiency of such projects. These results confirm those of Marai *et al.* (Unpublished) that poor management is the most important problem of which buffaloes suffer, under the present conditions.

3.3 Stayability and productivity

Percentages and distribution of stayability for Egyptian buffalo cows under Khattara farm conditions, i.e. the probability of the cows to remain in the herd to a specific age, are showed that averages of survival rates to 60, 72 and 84 months of age for Egyptian buffalo cows under present study conditions were 87, 60 and 44 %, i.e. 13, 40 and 56 % of the original buffalo cows left the herd prior to 60, 72 and 84 months of age, respectively. Farghaly (1992) found survival rate value to 60, 72, 84 and 96 months of age, were 24.0, 17,1 and 17, 7 and 12.0 % in Friesian cows, respectively. Such results show that the survival rates of buffalo cows are 3-4 times, as much as, those of Friesian cows until 72 months of age and about 2 –3 times at 84 months of age, under Egyptian conditions.

Averages of productive indexes (PI) estimated at the different ages of Egyptian buffalo cows under desert conditions are as [(Average of the birth weight x Number of calves born during the study) + Total milk yield (kg) produced during the same period] / Average dam's weight at first calving x Average length of the period (Days) between age at first calving and the end of the study (120 months)] x 100. The highest PI values were obtained (4.16 and 3.36) at 60 and 72 months of age, respectively. Similarly, the milk yield (1170 and 1161 kg), respectively) and number of calves (125 and 86, respectively at the same ages were of the highest values obtained in the study.. Therefore, it could be concluded that the conventional selection practices carried out according to PI would lead to the increase of productive performance (directly) and reproductive performance (indirectly) of the animals.

Table 2: Least squares means ± SE of lactation period (LP), dry period (DP), calving interval (CI) and milk yield (MY), as affected by season of calving, parity and milking system of Egyptian buffalo cows.

Classification	No. of obs.	LP (Days)	DP (Days)	CI (Days)	MY (kg)
Overall means	527	269.8 ±6.5	194.5 ±23.2	464.3 ±24.3	1171.2 ±25.1
Season		**	*	NS	*
Winter	103	267.7 ±6.6 b	203.6 ±25.4 ab	470.9 ±32.0	1159.5 ±32.0 a
Spring	95	291.0 ±6.7 a	157.7 ±26.2 b	448.7 ±32.9	1146.7 ±30.2 a
Summer	124	251.2 ±6.8 c	236.1 ±27.8 a	487.9 ±34.6	1185.3 ±30.5 b
Autumn	205	269.2 ±4.90bc	180.5 ±19.1 ab	449.7 ±24.0	1180.1 ±23.0 b
Parity:		*	NS	NS	*
1	146	283.8 ±5.6 a	197.6 ±21.7	481.4 ±27.21	1118.2 ±25.0 b
2	147	278.2 ±5 a	187.5 ±12.0	465.7 ±17.5	1183.4 ±24.9 a
3	146	263.8 ±6.1 b	199.0 ±23.6	462.8 ±29.7	1201.1 ±27.2 a
4	88	264.5 ±5.1 b	197.9 ±35.2	440.4 ±40.3	1202.3 ±28.2 a
Milking system:		*	NS	*	*
Manual	187	278.0 ±5.0 a	199.9 ±19.5	477.9 ±24.5a	1183.5 ±23.2 a
Mechanical	340	257.8 ±3.2 b	188.9 ±17.1	446.7 ±20.3b	1164.6 ±22.0 b

Means bearing different letters within each classification differ significantly ($P<0.01$ or $P<0.05$)

** = $P<0.01$, * = $P<0.05$ and NS = Not significant

No. of animals= 147, No. of obs.= No. of observations

Table 3: Buffalo cow traits estimated during the years 1983, 1987 (EL-Menshawy, 1994) and 1993 – 1995 (Mohamed, 2000) in Khattara Farm, Sharkia Governorate, Egypt

Traits	EL-Menshawy (1994) (1)			Mohamed (2000) (2)			Change (%)
	No. of obs.	Means ±SE	CV %	No. of obs.	Means ±SE	CV %	
Birth weight (kg)	175	42.0 ±0.5	15.0	1336	32.4 ±0.26	29.3	-22.9
Weaning weight (kg)	175	134.8 ±0.4	4.2	1336	124.3 ±0.64	18.8	-7.8
Birth-weaning (kg)	175	0.667 ±0.01	18.9	1336	0.61 ±0.004	24.6	-8.5
Lactation period (Days)	1344	244.1 ±1.2	18.6	147	269.8 ± 6.5	29.2	+10.5
Dry period (Days)	1170	148.7 ±2.0	45.1	147	194.5 ±23.2	144.6	+30.8
Calving interval (Days)	1170	402.6 ±2.6	15.9	147	464.3 ±24.3	63.5	+15.3
Total milk yield (kg)	1344	1590 ±11.0	26.5	147	1171 ±25.1	25.98	-26.4

Change % = [(2 – 1)] / 1] x 100, where (1) = EL-Menshawy (1994) and (2) = Mohamed (2000).
obs = observations

Most CV% values estimated were low which meant that improvement of such traits through selection according to their phenotypic values only is impossible. However, the CV % values estimated by EL-Menshawy (1994) were lower than those of Mohamed (2000). This may be due to that there are more environmental factors than those studied in the latter case, are involved.

3.4 Udder traits

The overall means, coefficients of variation and least squares means of udder traits (teat length and diameter and distances between teats) as affected by season, parity, lactation month, milking system (hand and machine milking) and daily milk yield of Egyptian buffaloes are shown in Tables 4 – 6.

In general, CV% values were low ranging between 15.96 and 26.70 for teat length, teats diameter and distances between teats, which indicate that improvement of such traits according to their phenotypic values only, is impossible.

Season of calving showed significant ($P<0.01$) effects on teat length, teat diameter and distances between front teats. The highest values of teat length and diameter were noticed in winter, probably due to the increase in the perpendicular position of the teat due to the increase in milk pressure when udder is in repletion. Rahman *et al.* (1989)

also found that all udder measurements were the highest during winter and the lowest during summer, in Indian buffaloes. The results regarding the distances between the front teats were similar to those reported by Prajati *et al.* (1992).

Parity affected insignificantly all traits studied.
The effects of lactation month on most udder traits were significant ($P<0.01$ or 0.05). Teat size (length and diameter) tended to decrease after the fourth month of lactation. Such difference was significant between the first four months and the later months of lactation. The decrease in the later months of lactation period may be due to the lower milk yield during the later months of the lactation period as shown in cattle (Seykora and McDaniel, 1986 and Bhagat et al., 1992) and the ewe (Fermandez et al., 1995).
Effects of milking system on right and left front teat lengths were highly significant. Teat length was the highest with machine milking. This may be due to regular pressure on the teats during machine milking.

Partial linear regression coefficients of teat diameters and distances between teats on daily milk yield were mostly positively significant ($P<0.01$ or 0.05). In other words, each increase in milk yield was accompanied with an increase in teat diameter and distances between teats. Fuente *et al.* (1996) obtained similar results in dairy ewe. The results regarding the distances between teats were in agreement with those obtained by Patel and Tomer (1990).
The estimated phenotypic correlations between udder traits can be classified to three groups: between lengths of teats, diameters of teats and distances between teats. The phenotypic correlations between lengths, diameters and distances of the four teats were mostly high and positive, similar to that found by Fernandez *et al.* (1995).
The residual correlations were lower than the phenotypic correlations. Such differences might be due to inclusion of the influences of environmental and managerial factors such as season, lactation month, milking system and level of milk yield, in the latter values.
The teat length and distances between teat traits showed high repeatability estimates (between 0.7 and 0.9), which made them potential candidates for genetic improvement and suggest that a single record per lactation would be sufficient to selection. The teat diameter traits showed low repeatability estimates (between 0.1 and 0.3) probably due to their dependence on milk yield. The repeatability for distances between teats were moderate and ranged between 0.3 and 0.4.
In conclusion, studying the factors that affect production and reproduction of the buffalo cow, which is the most important domestic animal in the sub-tropics, helps in putting the most feasible programs for its improvement.

Table 4: Least squares means ± SE of teats length (cm) as effected by season of calving, parity, month of lactation, milking system and daily milk yield of Egyptian buffalo cows, under Egyptian sub-tropical conditions

Items	No. of animals	Front teats length		Rear teats length	
		Right	Left	Right	Left
Overall means	250	6.9 ± 0.11	6.91 ± 0.1	7.4 ± 0.1	7.3 ± 0.1
CV%		15.96	17.28	16.79	16.62
Effects of season:		**	**	**	**
Summer	133	7.1 ±0.15 a	7.20 ±0.2a	7.7 ±0.1 a	7.5 ±0.1 a
Winter	117	6.7 ±0.16 b	6.61 ±0.2 b	7.2 ±0.2 b	7.2 ±0.2 b
Parity:		NS	NS	NS	NS
1	31	6.1 ±0.2	6.1 ±0.2	6.7 ±0.3	6.7 ±0.2
2	44	6.5 ±0.2	6.6 ±0.2	6.9 ±0.2	6.7 ±0.2
3	38	6.5 ±0.2	6.6 ±0.2	7.0 ±0.2	7.0 ±0.2
4	28	6.4 ±0.2	6.5 ±0.2	7.1 ±0.3	7.1 ±0.3
5	29	6.3 ±0.2	6.4 ±0.2	7.2 ±0.3	7.3 ±0.2
6	32	6.4 ±0.2	6.4 ±0.2	7.2 ±0.2	7.2 ±0.2
≥ 7	48	6.6 ±0.2	6.7 ±0.2	7.2 ±0.2	6.8 ±0.2
Month of lactation:	**	**	**	**	
1	27	7.4 ±0.2 a	7.6 ±0.2 a	8.0 ±0.2 a	8.4 ±0.2 a
2	46	8.1 ±0.2 a	8.7 ±0.2 a	8.2 ±0.2 a	7.9 ±0.2 ab
3	58	8.1 ±0.2 a	8.0 ±0.2 a	8.4 ±0.2 a	8.2 ±0.2 ab
4	15	8.1 ±0.5 a	8.0 ±0.6 a	7.9 ±0.4 a	7.7 ±0.4 b
5	20	5.4 ±0.3 b	5.4 ±0.2 b	6.2 ±0.3 b	5.9 ±0.3 c
6	46	5.5 ±0.2 b	5.4 ±0.2 b	6.5 ±0.2 b	6.4 ±0.2 c
7	19	5.2 ±0.1 b	5.4 ±0.1 b	6.0 ±0.3 b	6.0 ±0.3 c
≥8	19	5.4 ±0.4 b	5.5 ±0.4 b	6.7 ±0.4 b	6.6 ±0.4 c
Milking system:		**	**	NS	NS
Manual	138	6.6 ±0.1 a	6.5 ±0.1 a	7.5 ±0.1	7.4 ±0.1
Mechanical	112	7.4 ±0.2 b	7.4 ±0.2 b	7.4 ±0.2	7.2 ±0.2
Regression (b1) on daily milk yield		NS 0.1 ±0.04	NS -0.1 ±0.04	NS -0.03 ±0.04	NS -0.01 ±0.04

Means bearing different letters within each item, differ significantly ($P<0.05$)
** = $P<0.01$, * = $P<0.05$ and NS = Not significant
CV % = Coefficient of variation
b1 = Partial regression coefficients of the studied traits on daily milk yield

Table 5: Least squares means ± S.E of teats diameter (cm) as effected by season of calving, parity, month of lactation, milking system and daily milk yield of Egyptian buffalo cows, under Egyptian sub-tropical conditions

Items	No. of animals	Front teats Right	Front teats Left	Rear teats Right	Rear teats Left
Overall means	250	2.6 ±0.10	2.6 ±0.11	2.6 ±0.10	2.5 ±0.10
C.V. %		17.19	18.18	17.40	16.82
Effects of season:		**	**	**	NS
Summer	133	2.6 ±0.14 a	2.6 ±0.15 a	2.6 ±0.14 a	2.6 ±0.13
Winter	117	2.5 ±0.15 b	2.5 ±0.16 b	2.5 ±0.13 b	2.5 ±0.13
Parity:		NS	NS	NS	NS
1	31	3.3 ± 0.26	3.4 ± 0.28	2.4 ± 0.26	2.4 ±0.25
2	44	2.6 ± 0.22	2.6 ± 0.24	2.5 ± 0.23	2.5 ±0.22
3	38	2.7 ± 0.25	2.7 ± 0.27	2.7 ± 0.25	2.7 ±0.24
4	28	2.5 ± 0.28	2.5 ± 0.30	2.5 ± 0.28	2.4 ±0.27
5	29	2.4 ± 0.28	3.4 ± 0.30	2.4 ± 0.28	2.5 ±0.27
6	32	2.6 ± 0.26	2.6 + 0.28	2.6 ± 0.26	2.6 ±0.25
≥ 7	48	2.7 ± 0.22	2.7 ± 0.24	2.6 ± 0.23	2.6 ±0.27
Month of lactation:		**	**	**	**
1	27	2.6 ±0.18 bc	2.6 ±0.26 bc	2.6 ±0.28 ab	2.6 ±0.31 ab
2	46	2.6 ±0.24 ab	2.9 ±0.24 ab	2.6 ±0.19 ab	2.7 ±0.18 ab
3	58	2.9 ±0.18 a	2.9 ±0.18 a	2.8 ±0.19 a	2.8 ± 0.18 a
4	15	2.7 ±0. 41 ab	2.7 ±0.43 abc	2.6 ±0.33 abc	2.4 ±0.31 bc
5	20	2.2 ±0.23 d	2.2 ±0.28 d	2.3 ±0.32 bc	2.3 ±0.28 c
6	46	2.3 ±0.24 dc	2.3 ±0.26 ed	2.5 ±0.23 abc	2.2 ±0.23 bc
7	19	2.6 ±0.34 d	2.2 ± 0.30 d	2.2 ±0.36 c	2.2 ±0.39 c
8	≥19	2.3 ±0.29 d	2.3 ± 0.30 d	2.3 ±0.4 bc	2.3 ±0.3 c
Milking system:		NS	NS	*	NS
Manual	138	2.5 ±0.12	2.6 ±0.14	2.6 ±0.13 a	2.6 ±0.13
Mechanical	112	2.6 ±0.17	2.6 ±0.17	2.5 ±0.14 b	2.5 ±0.14
Regression (b1) on daily milk yield		*	*	**	**
		0.3 ±0.01	0.4 ±0.01	0.06 ±0.01	0.06 ±0.01

Means bearing different letters within each classification, differ significantly (P< 0.05)
** = P<0.01, * = P<0.05 and NS = Not significant
C.V. % = Coefficient of variation
b1 = Partial regression coefficients of the studied traits on daily milk yield

Table 6: Least squares means ± S.E of distances between teats (cm) as effected by season of calving, parity, month of lactation, milking system in Egyptian buffalo cows, under Egyptian sub-tropical conditions

Items	No. of animals	Front teats	Rear teats	Right teats	Left teats
Overall means	250	6.8 ±0.1	5.8 ±0.1	4.5 ±0.1	4.5 ±0.1
C.V. %		23.31	26.70	18.23	10.78
Effects of season:		**	NS	NS	NS
Summer	133	6.3a ±0.1	5.3 ±0.2	4.5 ±0.1	4.5 ±0.1
Winter	117	7.2b±0.2	6.2 ±0.1	4.4 ±0.1	4.5 ±0.1
Parity:		NS	NS	NS	NS
1	31	6.5 ±0.3	5.4± 0.3	4.5 ± 0.2	4.5 ±0.2
2	44	7.4 ±0.3	5.5± 0.3	4.5 ± 0.1	4.5 ±0.1
3	38	7.4 ±0.3	5.3± 0.3	4.1 ± 0.2	4.2 ±0.2
4	28	7.5 ±0.3	5.3± 0.3	4.4± 0.2	4.4 ±0.2
5	29	6.9 ±0.3	5.4± 0.3	4.4 ± 0.2	4.5 ±0.2
6	32	7.4 ±0.3	5.3± 0.3	4.6 ± 0.1	4.4 ±0.1
≥ 7	48	7.1± 0.3	5.2 ±0.3	4.5 ± 0.2	4.5 ±0.2
Month of lactation:		**	**	**	*
1	27	6.5 ±0.3 abcd	5.6 ±0.3 bc	4.5 ±0.2 a	4.5 ±0. 2 a
2	46	6.1 ±0.2 d	6.1 ±0.2 ab	4.5 ±0.1 a	4.5 ±0.1 ab
3	58	6.4 ±0.2 dc	6.6 ±0.2 a	4.8 ±0.1 a	4.8 ±0.1 a
4	15	6.6 ±0.5 bcd	5.7 ±0.4 bc	4.8 ±0.2 a	4.8 ±0.2 a
5	20	7.1 ±0.4abc	5.0 ±0.3 c	4.4 ±0.2 a	4.4 ±0.2 ab
6	46	7.6 ±0.3abc	5.3 ±0.3 bc	4.3 ±0.1 a	4.3 ±0.1 ab
7	19	7.6 ±0.5 b	5.2 ±0.4 bc	3.8 ±0.1 b	3.9 ±0.2 b
≥ 8	19	7.5 ±0.5 ab	4.7 ±0.4 bc	4.4 ±0.2 a	4.4 ±0.2 ab
Milking system:		NS	NS	NS	NS
Manual	138	6.6 ±0.1	5.8 ±0.2	4.4 ±0.1	4.5 ±0.1
Mechanical	112	7.0 ±0.2	5.7 ±0.1	4.5 ±0.1	4.5 ±0.1
Regression (b1)		*	**	*	**
on daily milk yield		0.1 ±0.1	0.17 ±0.1	0.1 ±0.02	0.1 ±0.03

Means bearing different letters within each classification differ significantly (P<0.05)

** =P<0.01, * = P<0.05 and NS = Not significant

C.V. % = Coefficient of variation

b1 = The regression coefficients of the studied traits on daily milk yield

4 References

ALIM, K.A., 1991. Environmental and genetic effects on body weights of calves in Egyptain buffalo. World Review of Animal Production, 26: 83 - 87.

BHAGAT, S.S., SASTRY, N.S.R AND PATIL, S.S., 1992. Quarter difference in milk yield and composition, milking behaviour and udder health in Murrah buffaloes. Buffalo Bulletin, 11(4): 86 - 92.

CHARON, K.M., 1990. Genetic parameter of the morphological traits of sheep udder. World Review of Animal Production, 25: 73 – 85.

DUNCAN, D.R., 1955. Multiple range and multiple F test. Biomertrics, 11: 1 – 42.

EL-MENSHAWY, S.M.S., 1994. Studies on productive and reproductive efficiency of Egyptian buffaloes. Ph.D. Thesis, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

FARGHALY, H.M., 1992. Studies on performance of some exotic breeds under Egyptian conditions. Ph.D. Thesis, Faculty of Agriculture, Zagazig University, Zagazig, Egypt.

FERNANDEZ, P., ALVAREZ, F. SAM PRIMITIVO, F. AND DE LA FUENTE, L.F., 1995. Factors affecting variation of udder traits of dairy ewes. Journal of Dairy Science, 78: 842 –849.

FUENTE, DE LA L.F., FERNANDEZ, G. AND SAM PRIMITIVO, F., 1996. A linear evaluation system for udder traits of dairy ewes. Livestok Production Science, 45: 171.

LABUSSIERE, J., 1988. Review of physiological and anatomical factors influencing the milking ability of ewes and the organization of milking. Livestock Production Science, 18: 253-264.

LPHSI, 1990. Livestock and Poultry Heat Stress Indices, Agriculture Enginering Technology Guide, Clemson University, Clemson, Sc. 29634, USA.

MARAI, I.F.M., DAADER, A. H., SOLMAN, A.M. AND EL-MENSHAWY, S.M.S. (Under Publication). Performance of female buffalo, under desert new relaimed land conditions, in Egypt. Indian Journal of Animal Science (In Press).

MOHAMED, I.A.S., 2000. The performance of Egyptian buffaloes under desert new reclaimed lands. MSc. Thesis, Faculty of Agriculture, Zagazig University, Zagazig, Egypt. Indian Journal of Animal Sciences.

MOURAD, K.A. AFIFI, E.A AND BEDEIR, L.H., 1990. Non-genetic factors influencing milk production traits in Egyptian buffaloes. Egyptian Journal of Animal Production, 27(1): 1- 18.

NORMAN, H.D., CASSELL, B.G. AND DAWDY, M.L., 1983. Genetic and environmental effects influencing Guernsey type classification scores. Journal of Dairy Science, 66: 127.

OSMAN, H.Z.H., 1989. Productive and reproductive performance of primiparous buffaloes. M.Sc. Thesis, Faculty of Agriculture, Ain-Shams University, Cairo, Egypt.

PATEL, A.K AND TOMER, O.S., 1990. Prediction of production performance based on pre-partum udder measurements in cross-bred heifers. Indian Journal of Animal Production and Management, 6(1): 13- 18.

PEEVA, T.S. AND VANKOV, K., 1994. The effect of some genetic and non-genetic factors on the body weight of buffalo calves. Proceedings of the 4th World Buffalo Congress, Sao Poula, Brasil, 3: 381 - 383.

PRAJATI, K.B., RADADIA, N.S., TAJANE, K.R. AND PATEL, J.P., 1992. Importance of udder biometrics in selecting Mehsana buffaloes for milk. World Review of Animal Production, 27(4): 5 - 31.

RAHMAN, S.M, GILL, R.S. AND PARMAR, O.S., 1989. Relationship of udder measurements and their collapsibility with milk yield in Murrah buffaloes. Indian Journal of Dairy Science, 42(2): 316 - 320.

SAS, 1997. Statistical Analysis System. SAS User's Guide: Statistics. Institute Inc Cary, NC, USA.

SEYKORA, A.J. AND MCDANIEL, B.T., 1986. Genetic statistics and relationship of teat and udder traits, Somatic cell counts and milk production. Journal of Dairy Science, 69: 2395 - 2403.

TOMAR, M.S., 1984. Variation due to age of dam in the productivity of female progeny. Indian Veterinary Journal, 61(1): 49 - 53.

WHITE, J.M. AND VINSIN, W.E., 1974. Relationships among udder characteristics, milk yield and non yield traits. Journal of Dairy Science, 58: 58 -72.

ZEIDAN, S.M., 1990. Study of productive performance of Egyptian buffaloes. M.Sc. Thesis, Faculty of Agriculture, Moshtohor, Banha Branch, Zagazig University, Egypt.