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Relationship of the udder and teats morphological traits with the milk yield and somatic cells count of unimproved Awassi ewes reared in the middle of Iraq

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Abstract
Data were made available on 240 unimproved Awassi breed ewes reared in private farm in AL-Diwanya province (middle of Iraq) in the year 2016 to determine the effect of some udder traits milk yield traits. Results showed that udder shape affected significantly (P≤ 0.05) on total and daily milk yield (TMY and DMY), yield before and after 60 days from lactation period (YB60D and YA60D). The highest milk yield related with the too flat udder shape was 60.4kg, 501g, 29.66kg and 30.73kg respectively**.** TMY and YA60 days from lactation were affected significantly (P≤ 0.05) by udder length, the highest values were found in udders more than 25 cm namely, 60.23 and 32.03 kg respectively. The circumference before and after milking was affected significantly on milk traits. The results also showed a significant effect of udder quality on milk traits. Average teats length was affected significantly on TM, DMY, YB60D and YA60D.The higher values with the teats more than 2.5cm of length were 61kg, 480gm, 31.5kg and 29.5kg respectively. Teat width more than 10 mm affected significantly on DMY and YA60D. Significant effects were shown of the average teats diameter and angle of teat on milk traits. Result also showed significant correlations among udder and teats morphological traits with some of milk traits.

Keywords: Awassi, milk traits, udder traits

1. Introduction

Awassi is one of the dual-purpose, fat-tailed sheep breeds which can be accepted as a sheep-milk resource in south-west Asia. It also exists in Europe, Australia, New Zealand, and China. The breed is well adapted to harsh conditions and capable of producing and reproducing under these circumstances [1, 2]. Awassi is contributing about 58.2% from Iraqi sheep and the productive performance is faced with many difficulties under the classical breeding systems [3, 4]. Despite the low production of milk and the short lactation period, ewe milk is a major importance in countries where climatic conditions and tradition are not conducive to raising dairy cattle.

Milk production, especially in uncommon season is one of the important goals for sheep breeders to cumulate profit. The importance of the mammary traits on milk yield and milking routine has been studied in the dairy ewe since the development of machine milking, and its evaluation during lactation can be significant for obtaining a positive genetic response in the milk ability of dairy ewes [5]. Last decades, the interest in this field increased and considerable efforts were done to determine the effect of udder morphological traits on milk yield and components. Many studies refers that the sheep milk production is influenced by many physiological and environmental factors such as dam weight and age, lactation stage and birth type [6]. Morphological udder traits are very important for dairy animals and very interesting to the breeder because of their influence on applicability to mechanical milking, udder health and milk yield [7]. Macuhova *et al.* [8] reported that the udder traits might be affected by several factors such as genotype, parity, lactation stage and breeding system.

McKusick *et al.* [9, 5] and Rovai *et al.* [5] referred to important relationship among morphological udder traits and milk production or its components. Izadifard and Zamiri [10] referred to the necessity of determining the udder traits to predict of milk production in Iranian ewes in both hand or mechanical milking systems. Abu *et al.* [11] reported that udder and teats characteristics are important determinants of milk yield and milking ability in dairy animals.

The major aim of this study is to provide a valuable information on the udder morphological traits and determine the effect this traits on milk production in order to use this information as guidelines or indicators for the management strategies for ewes under the farming conditions for selecting and improving the performance of domestic animals.

2. Materials and methods

2.2. Experimental animals and management

Data were made available on 240 unimproved Awassi breed ewes reared on private farm in AL-Diwanya province (middle of Iraq) through the year 2016. Experimental ewes were in 2nd and 3rd parity. Flock is housed under semi-open sheds and can be fed on the concentrated ration consuming about (500 – 600) gm / head / day, for the period of mating season to the last six weeks of pregnancy. Green roughages such as Alfalfa and clover can be added throughout the season. Sires and dams will be recorded in breed records and the health status of the flock must be under regular observations. All ewes were hand milking and all lambs were separated. Milk yield was measured twice daily and lactation period was recorded individually for all ewes.

2.3. Measures and statistical analysis

Morphological udder traits and teats traits were measured by using the method described by Marie-Etancelin et.al. [12]. SAS [13] computer program and general linear model procedure were used to analyze data according to the following linear models:

Udder traits: $Yijklmno = \mu + Ui + Lj + Wk + DL + Cm + Rn + Qo + eijklmno$

Where

Ui: Effect of shape.
Lj: Effect of length.
Wk: Effect of width.
DL: Effect of depth.
Cm: Effect of circumference before milking.
Rn: Effect of circumference after milking.
Qo: Effect of quality.

Teats traits: $Yijklmn = \mu + Ai + Wj + Pk + DL + Rm + Gn + eijklmn$

Where

Ai: Effect of average length.
Wj: Effect of width at the base.
Pk: Effect of width at the medium point.
DL: Effect of Distance between teats.
Rm: Effect of Average diameter.
Gn: Effect of teat angle.

Phenotypic correlations analyses among udder morphological traits, teat traits and milk yield were performed by using CORR. procedure from SAS [13].

3. Results

Results presented in table (1) showed a significance of the udder morphological traits on some of milk traits. Udder shape affected significantly (P≤ 0.05) on total and daily milk yield, yield before 60 days and yield after 60 days from lactation period. The highest values related to the too flat udder shape namely, 60.4 kg, 501g, 29.66 kg and 30.77kg respectively while udder shape not affected significantly neither on somatic cell count nor on lactation period. Udder length affected significantly (P≤ 0.05) on milk yield. Total and daily milk yield and the yield after 60 days from lactation period were affected significantly (P≤ 0.05) by udder length, the highest values were found in udders with more than 25 cm (60.23 kg, 491g and 32.03 kg respectively). Udder width did not affected significantly on milk yield and somatic cell count while the depth of udder affected significantly (P≤ 0.05) on total and daily milk yield, somatic cell count and the yield after 60 days from lactation period, the highest values were found in udders with more than 7 cm of depth (52.5 kg, 427g, 0.182 $\chi\ 10^6$ cel/ml and 26 kg respectively). Total and daily milk yield, yield before and after 60 days from lactation increased significantly(P≤0.05) in ewes which had more than 45cm of udder circumference before milking (57.81 kg, 690 gm, 30.5 kg and 27.31kg respectively). Udder circumference after milking (more than 35cm) affected significantly (P≤ 0.05) on total and daily milk yield, somatic cell count and milk yield before 60 from lactation period, the values were 59.2 kg,497gm,197 $\chi\ 10^6$ cel/ml and 33.2kg respectively).

According to the present results, there were considerable and significant effect (P≤ 0.05) of udder quality on milk yield and somatic cell count. The highest total and daily milk yield, yield before and after 60 days from lactation period and lactation period length were found in ewes which characterized of mediocre udder and the values namely, 58.5kg, 475 gm, 31.25 kg, 27.25 kg and 123 days respectively. Somatic cell count increased significantly in ewes milk characterized of meaty udder it's about 0.199 $\chi\ 10^6$ cel/ml compared with 0.170 SCC $\chi\ 10^6$ cel/ml in mediocre udder.

Results presented in table (2) shows significance effects of teats morphological traits on milk yield and somatic cell count. Average teats length (more than 2.5 cm) effected significantly (P≤ 0.05) on total and daily milk yield and milk yield before and after 60 days of lactation namely, 61 kg, 480 gm, 31.5 kg and 29.5 kg respectively) compared with less than 2.5 average teats length (50.75 kg, 404 gm, 24.5 kg and 26.25 kg respectively).Teat width at the base did not affected significantly on milk traits. As the width of teat at the medium point increase (more than 10mm), a significant (P ≤ 0.05) increase of total and daily milk yield and milk yield before and after 60 days of lactation period (60.5 kg, 496 gm, 31kg, 29.5 kg respectively). Also the distance between teats (more than 10cm) were significant effect on milk production traits (60.5 kg, 500gm, 32 kg and 28.5 kg respectively). It is worth remarking the average of teats diameter (more than 2cm) effected significantly (P≤ 0.05) on the milk production traits while the angle of teats did not effected significantly on milk traits. Phenotypic correlations among udder traits, teats measures and milk traits are presented in table 3 indicated that the values varied from - 0.23(between udder width and udder depth) to 0.88 (between total milk yield and daily milk yield).Total milk yield correlated significantly (P≤ 0.01) with udder size, udder quality, udder width, udder circumference before milking and udder depth (0.61, 0.48, 0.44, 0.43, and 0.40 respectively). Total milk yield also correlated significantly (P≤ 0.05) with both udder circumference after milking and udder shape (0.31 and 0.30). Positive and significant (P≤ 0.01) correlation among daily milk yield and udder size, udder circumference before milking, udder quality, udder depth and udder width (0.65, 0.50, 0.44, 0.42, and 0.40 respectively) and also correlated significantly (P≤ 0.05) with both udder shape and udder circumference after milking (0.28 and 0.27 respectively).Lactation period correlated significantly (P≤ 0.05) with total and daily milk yield, milk yield before and after 60 days of lactation and udder depth (0.30, 0.29, 0.33, 0.29, and 0.33 respectively).

Results showed a high significant and positive correlation of milk yield before 60 days of lactation with the most of the udder traits such as udder size (0.57), udder quality (0.44), udder depth (0.41), circumference before milking (0.40) and udder width (0.39). In regard to the correlation coefficients among milk yield after 60 days of lactation and udder measures were highly significant with udder size (0.55), circumference before milking (0.40), udder depth (0.39), and udder quality (0.38) while a significant correlation (P≤ 0.05) between yield after 60 days of lactation and udder width (0.31). Significant (P<0.01) and positive correlations (0.30 to 0.72) were found between udder size and teat measurements (length, distance between teats and teat depth). Due to the teats traits, the highest positive and significant correlation was between teat diameter and teat length (0.88) Negative correlation was found between udder width and udder depth (-0.23). Udder circumference correlated negatively with teat diameter and udder quality, the values were -0.20 and - 0.19 respectively.

Table 1: Effect of udder morphological traits on milk production traits

Udder traits	Milk traits					
	TMY (Kg)	DMY (gm)	$SCC\ \chi\ 10^{6} cel/ml$	YB60D (Kg)	YA60D (Kg)	LP (day)
Shape						
Too flat	60.4 ± 2.40 a	501 ±1 5.33 a	0.179 ± 0.011 a	29.66 ± 1.51 a	30.73 ± 1.79 a	121± 8.83 a
Broken	54.0 ± 2.08 b	452 ± 19.29 b	0.176 ± 0.015 a	26.96 ±0.89 b	27.03 ± 0.51 b	119 ± 6.34 a
Pendulous	50.9 ± 1.68 b	427 ±1 4.45 b	0.180 ± 0.015 a	26.26 ± 0.59 b	24.70 ± 0.75 c	119 ± 6.89 a
Asymmetric	54.9 ± 3.05 ab	458 ±1 6.2 b	0.169 ± 0.013 a	27.43 ± 0.60 b	27.46 ± 0.53 b	120 ± 7.52 a
Length (cm)						
Less than 25	52.60 ± 3.10 b	493 ± 7.85 a	0.177 ± 0.012 a	26.40 ± 3.73 a	24.30 ± 2.88 b	120 ± 10.33 a
More than 25	60.23 ± 3.08 a	491 ± 6.69 a	0.183 ± 0.017 a	30.06 ± 5.90 a	32.03 ± 3.79 a	122 ± 11.03 a
Width(cm)						
Less than 20	48.5 ± 3.47 a	410 ± 12.25 b	0.140 ± 0.014 a	22.7± 0.98 a	29.5 ± 2.95 a	117 ± 4.35 a
More than 20	53.0 ± 4.45 a	449 ± 16.70 a	0.147 ± 0.015 a	23.5 ± 1.86 a	25.4 ± 2.49 a	121 ± 4.91 a
Depth (cm)						
Less than 7	46.0 ± 2.13 b	377± 8.27 b	0.168 ± 0.006 b	26.0 ± 3.20 a	20.00 ± 2.55 b	122 ± 5.55 a
More than 7	52.5 ± 2.10 a	427± 15.75 a	0.182 ± 0.005 a	26.5 ± 2.19 a	26.00 ± 2.17 a	124 ± 7.67 a
Circumference before milking(cm)						
Less than 45	43.9 ± 3.17 b	362 ± 17.56 b	0.166 ± 0.010 a	22.90 ± 3.11 b	21.00 ± 1.99 b	121 ± 6.73 a
More than 45	57.81 ± 5.75 a	690 ± 27.99 a	0.171 ± 0.017 a	30.50 ± 3.08 a	27.31 ± 2.65 a	123± 9.50 a
Circumference after milking (cm)						
Less than 35	50.25 ± 2.19 b	425 ± 11.83 b	0.188 ± 0.003 b	26.25 ± 2.10 b	24.00 ± 2.17 a	118 ± 6.17 a
More than 35	59.20 ± 3.08 a	497 ± 14.52 a	0.197 ± 0.005 a	33.20 ± 3.40 a	26.00 ± 2.66 a	119± 4.28 a
Quality						
Soft	45.88 ± 1.29 b	388 ± 10.10 b	0.172± 0.003 b	24.00 ± 1.21 b	21.88 ± 1.95 b	118 ± 1.27 b
Mediocre	58.50 ± 3.14 a	475 ± 17.41 a	0.170± 0.007 b	31.25 ± 3.25 a	27.25 ± 2.14 a	123 ± 2.19 a
Meaty	40.00 ± 2.02 c	336 ± 8.30 c	0.199 ± 0.008 a	22.00 ± 2.89 b	18.00 ± 1.27 c	119 ± 1.02 ab

Values within each subclass with different superscripts differ significantly (p ≤ 0.05).

Table 2: Effect of teats morphological traits on milk production traits

Teat traits	**Milk traits**					
	TMY (Kg)	**DMY (gm)**	$SCC\ \chi\ 10^{6} cel/ml$	**YB60D (Kg)**	**YA60D (Kg)**	**LP (day)**
Average Length (cm)						
Less than 2.5	50.75 ± 3.14 b	404 ± 5.54 b	0.174 ± 0.011 a	24.50 ± 1.53 b	26.25 ± 1.09 b	125± 6.44 a
More than 2.5	61.00 ± 3.25 a	480 ± 6.50 a	0.177 ± 0.006 a	31.50 ± 2.60 a	29.50 ± 1.11 a	127 ± 7.32 a
Width at the base (mm)						
Less than13	49.50 ± 4.63 a	402 ± 4.78 a	0.167 ± 0.003 a	26.50 ±2.77 a	23.00 ±3.27 a	123 ± 3.21 a
More than 13	50.75 ± 3.87 a	403 ± 7.10 a	0.165 ± 0.004 a	29.50 ± 3.90 a	21.25 ± 2.18 a	126 ± 5.09 a
Width at the medium point (mm)						
Less than 10	55.12 ± 3.17 a	459 ± 8.71 b	0.171 ± 0.005 a	28.00 ± 0.92 b	27.12 ± 1.01 b	120 ± 5.90 a
More than 10	60.50 ± 3.11 a	496 ± 12.88 a	0.173 ± 0.002 a	31.00 ± 1.37 a	29.50 ± 1.20 a	122± 7.77 a
Distance between teats (cm)						
Less than 10	55.10 ± 1.34 b	444 ± 10.33 b	0.187 ± 0.003 a	27.10 ± 1.22 b	24.00 ± 2.10 b	124 ± 5.11 a
More than 10	60.50 ± 2.19 a	500 ± 17.53 a	0.185 ± 0.003 a	32.00 ± 2.17 a	28.50 ± 2.19 a	121 ± 4.20 a
Average diameter (cm)						
Less than 2	43.22 ± 3.77 b	351 ± 10.15 a	0.170 ± 0.005 a	22.22 ± 2.19 b	21.00 ± 2.15 b	127 ± 6.31 a
More than 2	57.40 ± 3.90 a	448 ± 18.66 b	0.167 ± 0.005 a	29.25 ± 3.81 a	28.15 ± 3.10 a	128 ± 6.69 a
angle (°)						
Less than 45	59.00 ± 4.41 a	464 ± 16.40 a	0.179 ± 0.006 a	28.75 ± 4.30 a	30.25 ± 4.75 a	127± 3.81 a
More than 45	57.16± 5.02 a	443 ± 11.30 a	0.180 ± 0.006 a	27.16 ± 3.60 a	30.00 ± 3.40 a	129 ± 4.34 a

Values within each subclass with different superscripts differ significantly (P ≤ 0.05).

Table 3: Phenotypic correlation of udder and teats morphological traits with milk production traits.

Traits	UW	UD	CBM	CAM	USI	UQ	TL	DBT	TD	TLO	CMT	TMY	DMY	SCC	YB60D	YA60D	LP
USH	0.21	0.68**	0.12	0.15	0.03	0.00	0.00	0.00	0.00	0.17	0.22	0.30*	0.28	0.09	0.16	0.12	0.09
UW		- 0.23	0.44**	0.37*	0.18	0.00	0.00	0.23	0.00	0.06	0.10	0.44**	0.40**	0.10	0.39*	0.31*	0.12
UD			0.20	0.19	0.20	0.00	- 0.05	0.00	0.00	0.17	0.21	0.40**	0.42**	0.13	0.41**	0.39*	0.33*
CBM				0.75**	0.73**	0.22	0.34*	0.21	0.33*	0.10	0.11	0.43**	0.50**	0.10	0.40**	0.40**	0.15
CAM					0.68**	0.18	0.29*	0.17	0.19	0.20	0.23	0.31*	0.27	0.11	0.19	0.22	0.14
USI						0.00	0.72**	0.66**	0.30*	0.00	0.71**	0.61**	0.65**	0.09	0.57**	0.55**	0.20
UQ							0.00	0.00	0.00	0.00	- 0.19	0.48**	0.49**	0.14	0.44**	0.38*	0.17
TL								0.09	0.88**	0.00	0.10	0.14	0.20	0.00	0.13	0.17	0.08
DBT									0.03	0.58**	0.44**	0.18	0.19	0.00	0.15	0.15	0.00
TD										0.00	- 0.20	0.15	0.22	0.00	0.10	0.15	0.04
TLO											0.14	0.22	0.17	0.05	0.18	0.21	0.11
CMT												0.19	0.34**	0.10	0.14	0.11	0.22
TMY													0.88**	0.15	0.37*	0.39*	0.30*
DMY														0.14	0.18	0.18	0.29*
SCC															0.11	0.13	0.11
YB60D																0.44**	0.29*
YA60D																	0.33*
LP																	

USH: Udder shape
UW: Udder width
UD: Udder depth
CBM: Udder circumference before milking
CAM: Udder circumference after milking
USI: Udder size
UQ: Udder quality
TL: Teat length
DBT: distance between teats
TD: Teat diameter
TLO: Teat location
CMT: Complete milking time
TMY: Total milk yield
DMY: Daily milk yield
SCC: Somatic cell count
YB60D: Milk yield before 60 day
YA60D: Milk yield after 60 day
LP: Lactation period
** $P \leq 0.01$
* $P \leq 0.05$

4. Discussion

The evaluation of udder morphological traits and their effects on milk yield was different from the various authors. Many studies referred to a considerable relation of udder shape with the milk production. According with Marie-Etancelin *et al*. [12] the udder shape is related to milk yield and milk flow rate in Spanish and French dairy sheep breeds. In this sense, Birol and Zulkadir [14] found that milk flow less satisfactory from baggy udders than from those adequate shape. Sandor *et al*. [15] indicated that the udder size had a strong and significant effect on milk production. Matineze *et al*. [16] referred that the udder variation was compatible with the reduction of milk potential. Possible effects of udder measures (depth, width, circumference) were determined by numerous past studies [17, 18, 19]. As a new technique, Rafat and Janmohammadi [20] proved that picture analysis technique provides a great amount of measurements and has the advantage of a greater feasibility compared to direct measure of the udder.

Numerous studies revealed that location and size of teats affected significantly on milk yield and milk ability in ewes [18]. Others authors highlighted the strong relationship of teats measures with milk production and reported that the milking morphological aptitude could be hindered by a small teats and horizontal teats are also more susceptible to distortion during machine milking [21, 22]. Significant phenotypic correlations among udder measures and milk yield were appointed by many researchers who accorded that most of correlations are positive and significant [10, 9, 23].

5. Conclusion

In general, the results of this study confirm a strong relationship of udder and teats measures with milk yield in Awassi ewes therefore, we can benefit from these results as a good evident roles in dairy sheep improving. Briefly, we can select animals for udder measures which positively correlated with milk traits as a method for indirect and early selection.

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