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SOME STUDIES ON MILK PRODUCTION AND ITS COMPOSITION IN MAGHREBI SHE-CAMEL UNDER FARMING AND TRADITIONAL PASTORAL SYSTEMS IN EGYPT

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ABSTRACT

This study aimed to determine the effect of management systems (farming and traditional pastoral system) and parity order on milk yield and composition from lactating Maghrebian she-camel in addition to its effects on somatic cell count and bacterial infection of subclinical mastitis. Total of forty lactating she-camels (*camelus dromedarius*) (aging 5–12 years, weighing 370-590 kg, between the first and eighth parities) were divided into two system groups (farming and pastoral, 20 in each). Each of farming or pastoral group was divided into four sub groups according to their parity, including 1-2,3-4,5-6 and 7-8 parities ,5 animals in each. Over all mean of IgG, IgM and IgA concentrations did not differ significantly (P<0.05) under both management systems. Concentration of IgG and IgA increased (P<0.05), while IgM insignificantly increased by advancing parity. Effect of interaction between management system and parity of immunoglobulin concentrations was not significant. Daily or total milk yield was higher (P<0.001) under farming more than pastoral system by about 20.70 and 11.75%, respectively. Fat, protein, lactose, total solids, and solid non fat contents attained significantly higher values in milk of farming than in pastoral system. However, ash content showed an opposite (P<0.001) trend. Daily and total milk yield and its composition significantly increased by advancing parity .The interaction between management system and parity was not significant on milk yield and milk compositions. For somatic cells count the ratio was highly significant (P<0.05) in the traditional pastoral system than that recorded in farming system for collected milk samples from subclinically mastitic she-camels. Under pastoral system milk showed significantly higher contents of Na and K and significantly lower P and Mg than farm system. Milk Ca and chlorine contents were not affected by management system. By advancing animal parity, Ca and P contents increased (P<0.05), up to 7-8 parities, while Na and K increased (P<0.05), 5-6 and 3-4 parities respectively. Yet, Mg and chlorine contents were not affected significantly by parity. The interaction between management system and parity was highly significant (P<0.001) only on K and P, reflecting different trend of change in K and P contents in camels under farm and pastoral system by advancing parity. The levels of mineral contents subsequently increased with advanced ages in both systems. Our bacteriological study results revealed that *S.aureu*s (2% and 6%), *CNS* (5% and 2%), *E.coli* (8% and 2%), *S.agalactia* (1% and 2%) and *other Strept*. (10% and 3%) were the main single bacterial isolates from all studied milk samples in both groups: traditional pastoral system and farming system respectively .Total bacterial isolates in single bacterial infections were significantly different in both systems of management (26% and 15%) respectively. Also investigations illustrated that CNS *+E.coli, S.aureus + E.coli, S.aureus + other Strept., S.aureus + E.coli + other Strept. and S.aureus+ CNS+ other Strept.* were the main groups of mixed bacterial isolates in percentages of (7% and 2%), (6% and 4%), (7% and 5%), (6% and 3%) and (6% and 5%) respectively, with significant different in total mixed bacterial isolates (32% and 19%) in both traditional pastoral system and farm system respectively. There was a direct relationship between the frequency of sub-clinical mastitis and the calving number. The study could be recommended to increase awareness of the nomads about the importance of the effect of feeding system and parity in addition to bacterial isolates on yield and nutritive value of camel milk produce for human consumption or suckling their newborns.

***Key words*:** Maghrebi she-camel, management system, age category, milk yield and composition camel sub-clinical mastitis.

INTRODUCTION

Dromedary camels are considered the strategic stockpile of food security, play an important role as a milk source and meat in many countries (El-Bahrawy *et al*., 2015). Increasing human population challenge food security and evoke the need to explore new resources of food, such as camel products (Faye and Konuspayeva, 2012). Milk composition and quality are important characteristics that determine the nutritive value and consumer acceptability. Mal *et al*. (2006) mentioned to camel milk has an important role in human nutrition in many regions and also widely exploited for medication and human health such as anti-cancer (Magjeed, 2005), anti-diabetic (Agrawal *et al.,* 2011) and hypo-allergic properties (Shabo *et al.,* 2005). Camel sustains its productivity in difficult

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conditions and comparatively less affected by the adverse factors like lack of feed and water. Factor such as type of food is expected to affect the quality and composition of camel milk (Mustafa *et al.,* 2015). The information on the milk off take of camels varies according to the management of camels in their natural environment or under improved condition Yagil (1982). However, geographical origin and seasonal variations were found to be the most effective factors in camel milk composition (Konuspayeva *et al.,* 2009). Camel milk was found to contain all the essential nutrients found in bovine milk, (Narmuratova *et al.,* 2006). Milk yield in the dromedary camels has range widely (3.5–20 kg) (Jianlin, 2005), suggested that milk yield and composition in camels is influenced by environmental conditions, time of milking and number of milking (Aljumaah *et al.,* 2011). Camel management systems are different from region to another, very rare references on various quantitative traits of milk under different productive systems are available (Eha *et al.,* 2016). Kamoun and Jemmali (2012) reported that the milk yield of camel varies greatly depending on the region. Musaad *et al.* (2013) concluded that camel milk composition showed a wide variability in its constituents depending on the physiological, genetic and environmental factors. Milk yield of the Maghrebi she-camels under traditional extensive conditions averages 2.0 l/d though, under more favorable conditions, it ranges between 6 and 12 l/d (Ayadi *et al.,* 2009), which suggest that the milk yield potential of this breed is greater than that recoded under the traditional extensive conditions. Variations observed in camel milk composition could be attributed to several factors such as feeding conditions (Khaskheli *et al.,* 2005) and production systems (Bakheit *et al.,* 2008 and Aljumaah *et al.,* 2012). Mastitis is a major problem in traditionally managed camels and deserves further attention owning to its potential impact on milk production affecting food security. Camels affected by mastitis are reported to have considerably shorter lactation periods (Barbour *et al*., 1985). The disease is not usually treated in traditionally managed camels and will often take a natural course to chronicity resulting in permanent loss of milk production (Abdulrahman *et al*., 1991 and Obeid *et al.,* 1996). An increase in the number of somatic cells, particularly granulocytes, in camel milk is a good indication of inflammation. As in the cow, the intensity of the cellular reaction correlates with the degree of irritation of the

mammary gland. However, a cellular fragment in the size range of somatic cells found in camel milk makes both enumeration and differentiation of somatic cells difficult (Abdulrahman *et al*., 1992). The bacteria isolated from camel milk are known mastitis-causing organisms in the cow, sheep and goat. *Staphylococcus, Streptococcus, E.coli* and *Bacillus* species were the major isolates, mastitis prevalence was significantly ($p < 0.05$) affected by tick infestations, udder lesions, and increased age and parity of the animals (Abera *et al.,* 2010). The objective of this study are evaluate the effect of different management system and parity order on milk yield, milk composition and bacteriological examination of Maghrebi camel under Egyptian conditions.

MATERIALS AND METHODS

Study area: The study was carried out in the Marsa Matrouh Governorate (Northwest Egypt, 500 km from Cairo), to detect the effect of management system and age category on milk production, bacteriological examination and chemical composition. The experimental period lasted approximately one year.

Animals and experimental design

Total of forty dairy Maghrebi she-camels (*Camelus dromedarius*), (aging 5–12 years, weighing 370-590 kg, and between the first and eighth parities) without history of diseases, were divided into two groups (G1 and G2). Twenty camels were chosen from a dairy farming system (Center of Studies and Development of Camel Production), belonging to the Animal Production Research Institute, Marsa Matrouh Governorate and twenty camels from a traditional pastoral herd in the desert areas inhabited by pastoral tribes (Bedouins) followed the same area (Marsa Matrouh Governorate). Each of farming or pastoral group was divided into four sub groups according to their parity, including 1-2, 3-4, 5-6 and 7-8parities, 5 animals in each. Camels in the first group (G1, n = 20) were managed under farming system, all animals were kept in the experimental farm during the day, housed in semi-open barns all times and offered ration consisted of 4.5 kg DM of a forage mixture (Berseem hay and rice straw) and 3.5 kg DM of a commercial feed concentrate mixture composed of 25% wheat bran, 25% yellow corn, 9% uncorticated cotton seed meal, 20% barely, 15% rice brain,3% molasses, 2% premix and 1% common salt (Table 1). Feeds were offered to animals twice daily. Free access to clean water was provided at all times by a water tanks. Camels in the second group (G2, n = 20) were managed under traditional pastoral system; animals were brought to graze and browse the available plants and agricultural residues. The dominant vegetations of the natural pasture are Leucaena (30% CF and 20% CP), A triplex (20% CF and 15% CP), Mesquite (25% CF and 23.5% CP), Kochiaindica (14% CF and 23% CP) and Alph alpha (20% CF and 17% CP). Climatic conditions, including ambient temperature (Max. and Min.) and relative humidity as well as calculated temperature-humidity index all over the year were 25.6 and 16.7^{o}C, 64.6 and 58.1%), respectively. However, photoperiod fluctuate between 11 h of light and 13 h of dark during this period.

Table 1: Chemical composition of different feed stuffs used in farm camel feeding.

Item	CFM	BH	RS
DM (%)	89.44	88.91	88.46
Chemical analysis (%):			
OM	92.43	82.92	82.24
CF	8.85	24.91	35.69
CP	12.24	13.85	2.53
EE	4.64	1.14	1.52
NFE	66.70	43.02	40.50
Ash	7.57	17.08	19.76

CFM: Concentrate feed mixture. BH: Berseem hay. RS: Rice straw

Colostrum analysis

Colostrum samples were collected 3 times within one hour of parturition (first milking), 24 and 48 hours from each dam postpartum for immunoglobulin studies. Determination of immunoglobulins, including IgA, IgM and IgG in colostrum was applied by Camel Radial Immune-Diffusion (RID) kit according to the procedure outlined by the manufacturer (The Binding Site Ltd, Birmingham, UK). The principle of the technique was derived from the work of Mancini *et al*. (1965) and Fahey and McKelvey (1965).

Milking and milk samples:

All camels were milked twice a day, handily in case of traditional pastoral system and by semi-automated milking machine unit in case of farming system. Milk yield was measured after the calves were allowed to suckle colostrums from their dams for the first seven days. After each milking, milk was weighed on limited day for each week and then monthly milk yield was calculated for lactation period.

Determination of milk compositions:

As reported by Farah (1993), milk samples (30ml) were collected from each lactating camels at milking time in clean glass bottles. Monthly sample of each camel were mixture from morning and evening milking was taken for the determination of composition and physical characteristics of milk all over the lactation period. Whole milk samples were stored frozen at−20°C without adding preservatives then the samples were heated to 40°C in a water bath and held at this temperature for 15 min for detection of milk parameters (protein, fat, lactose, total solids, solid not fat and ash) by using Lactoscan – Ultrasonic milk analyzer – Bulgaria.

Mineral contents of milk camels:

Levels of Ca, K, Na, and Cl in the milk samples were determined with an atomic absorption spectrophotometer (Hitachi U-2000, Tokyo, Japan) according to standard methods (AOAC, 1980). Phosphorus content was determined spectrophotometrically using the procedure of Watanabe and Olsen (1965).

Somatic cell count (SCC):

Milk samples were transported on ice-box directly to the Animal Reproduction Research Institute (ARRI) laboratory and kept at 4^{o}C until analysis of SCC. Somatic cell count was measured automatically using a Nucleo-counter, SCC – 100 (Chemotactec Denmark). Somatic cell count values were sorted into 4 categories<250 x10^{3}cells/mL (grade A); 250 to 500 x10^{3} (grade B); 500 to <750 x10^{3} (grade C) and >750 x10^{3}cells/mL (grade D) (Johnson and Young, 2003 and Park *et al*., 2007).

Milk samples for bacteriological examination:

Prior to milking, udder and teats were washed thoroughly and dried with a separate towel. Teat ends were cleaned with 70% alcohol before sampling. The first three streams of milk from each teat were discarded. About 20 ml of milk, was taken aseptically from all quarters affected by sub-clinical mastitis pre-tested by field test, California Mastitis Test (CMT), only to be sure that the collected milk samples from udder quarters suffered from any degree of sub-clinical mastitis, into a separate sterile tubes for bacteriological analysis. All samples were kept on ice box (4ºC) and transported to the bacteriological Laboratory in ARRI as soon as possible for investigations.

Isolation and Identification of Bacteria:

Each milk sample was streaked onto Mannitol salt agar, Edward agar, MacConky agar, Neutrient agar and 5% sheep blood agar plates (Hi Media) and incubated at 37^{o}C for 24 h. Colonies were initially assessed by their morphology and hemolysis patterns, followed by Gram staining and motility tests. The isolates were identified according the procedures of Quinn *et al*. (2002). Biochemical tests, specifically, catalase, coagulase, oxidase, carbohydrate fermentation tests (glucose, mannitol, ribose, sorbitol,

and trehalose), biochemical reaction on MacConkey agar, indole production, methyl red tests, urease production and citrate utilization tests, triple sugar iron agar reactions (TSI) were performed as required. In cases where no growth was detected, plates were re-incubated at 37°C for an additional 24 h.

Statistical analysis

Statistical analysis was carried out using the General Linear Model Program (GLM) of SAS (2000). Data were analyzed using the following model:

$$Y_{ijK} = \mu + T_i + D_K + e_{ijK}$$

Where μ = overall mean,

T_i = fixed effect of management,

RESULTS

Table 2: Effect of management system and parity on immunoglobulin concentration in colostrum in Maghrebi she camels.

Variable	IgG (g/dl)	IgM (g/dl)	IgA (g/dl)
Effect of management system:			
Farm system (F)	33.69±2.31	4.93±0.20	2.92±0.24
Pastoral system (P)	32.0±2.09	4.98±0.21	3.11±0.20
Significance	NS	NS	NS
Effect of parity:			
1-2 parities	20.54±0.79d	4.49±0.32	2.49±0.27b
3-4 parities	28.99±0.89c	5.43±0.24	2.73±0.25b
5-6 parities	36.96±1.56b	4.88±0.15	3.60±0.30a
7-8 parities	44.89±0.91a	5.02±0.34	3.23±0.33ab
Significance	***	NS	*
Interaction between breeding system and parity			
F x 1-2 parities	20.28±1.21	4.36±0.48	2.14±0.28
F x 3-4 parities	29.36±1.24	5.20±0.35	2.48±0.26
F x 5-6 parities	39.64±1.78	5.02± 0.25	4.10±0.50
F x 7-8 parities	45.48±1.34	5.14 ±0.50	2.94±0.41
P x 1-2 parities	20.80±1.14	4.62±0.50	2.84±0.44
P x 3-4 parities	28.62±1.40	5.66±0.32	2.98±0.41
P x 5-6 parities	34.28±2.06	4.74±0.19	3.10±0.16
P x 7-8 parities	44.30±1.34	4.90±0.53	3.52±0.53
Significance	NS	NS	NS

NS = Insignificant, * $P < 0.05$ and *** $P < 0.001$.

Means denoted within the same column for each factor with different superscripts are significantly different at $P < 0.05$.

Table 3: Milk yield and chemical composition of Maghrebi she-camels as affected by management system, camel parity and their interaction.

Variable	Milk yield (kg)		Milk composition (%)					
	Daily	Total	Fat	Protein	Lactose	Ash	Total solids	Solid not-fat
Effect of management system:								
Farm system (F)	7.29± 0.39a	496.0± 26.18a	2.52± 0.11a	3.08± 0.15a	5.77± 0.17a	0.80± 0.04b	12.17± 0.38a	9.64± 0.32a
Pastoral system (P)	5.78± 0.26b	437.4± 33.04b	1.87± 0.05b	2.64± 0.11b	5.30± 0.24b	1.004± 0.03a	10.81± 0.35b	8.94± 0.34b
Significance	***	**	***	***	*	***	***	**
Effect of parity:								
1-2 parities	4.86c± 0.26c	282.7± 27.76c	1.94± 0.15c	2.28± 0.07d	4.34± 0.23b	0.75± 0.06b	9.32± 0.21c	7.37± 0.25c
3-4 parities	6.22b± 0.37b	478.6± 26.60b	2.04± 0.07bc	2.59± 0.11c	5.60± 0.25a	0.88± 0.06a	11.12± 0.34b	9.08± 0.29b
5-6 parities	6.90b± 0.51b	508.3± 19.68b	2.33± 0.16ab	3.00± 0.14b	6.09± 0.17a	0.97± 0.03a	12.41± 0.35a	10.07± 0.27a
7-8 parities	8.15a± 0.28a	597.3± 12.32a	2.46± 0.18a	3.55± 0.17a	6.08± 0.14a	0.99± 0.04a	13.09± 0.36a	10.63± 0.22a
Significance	***	***	**	***	***	***	***	***
Interaction between management system and parity:								
F x 1-2 parities	4.94± 0.51	351.2± 31.77	2.18± 0.23	2.26± 0.14	4.66± 0.27	0.66± 0.12	9.76± 0.17	7.58± 0.33
F x 3-4 parities	7.14± 0.39	505.0± 44.11	2.24± 0.04	2.88± 0.09	5.95± 0.14	0.76± 0.07	11.83± 0.14	9.59± 0.18
F x 5-6 parities	8.26± 0.44	515.0± 33.90	2.72± 0.19	3.20± 0.11	6.35± 0.22	0.89± 0.01	13.17± 0.33	10.45± 0.24
F x 7-8 parities	8.82a± 0.25	613.0± 11.79	2.95± 0.19	3.97± 0.18	6.11± 0.08	0.89± 0.03	13.91± 0.34	10.96± 0.21
P x 1-2 parities	4.78± 0.22	214.2± 10.61	1.71± 0.16	2.31± 0.07	4.02± 0.36	0.84± 0.04	8.88± 0.30	7.17± 0.41
P x 3-4 parities	5.30± 0.25	452.2± 29.85	1.84± 0.04	2.31± 0.09	5.25± 0.46	1.01± 0.08	10.42± 0.51	8.58± 0.49
P x 5-6 parities	5.54± 0.28	501.6± 23.92	1.94± 0.11	2.80±0.26	5.85±0.25	1.07±0.03	11.66±0.40	9.71± 0.47
P x 7-8 parities	7.48± 0.28	581.6± 20.52	1.98± 0.07	3.15± 0.16	6.05± 0.30	1.11± 0.04	12.28± 0.40	10.30± 0.36
Significance	**	NS	NS	NS	NS	NS	NS	NS

NS = Insignificant and *** P < 0.001.

Means denoted within the same column for each factor with different superscripts are significantly different at P < 0.05.

Table 4: Mineral content in milk of Maghrebi she-camels affected by management system, camel parity and their interaction.

Variable	Mineral content (mg/dl)					
	Calcium	**Sodium**	**Potassium**	**Inorganic phosphors**	**Magnesium**	**Chlorine**
Effect of management system:						
Farm system (F)	188.27±4.34	75.38±2.97b	87.83±1.49b	117.74±3.07b	11.80±0.34a	100.24±0.54
Pastoral system (P)	190.77±3.61	81.98±3.31a	92.22±3.06a	102.47±1.79a	7.38±0.17b	101.38±0.42
Significance	NS	**	*	***	***	NS
Effect of parity						
1-2 parities	167.55±4.68c	65.30±2.10b	75.43±2.05b	104.07±2.21c	9.53±0.96	99.80±0.49
3-4 parities	190.25±4.44b	68.45±2.70b	94.36±2.35a	103.62±2.26c	9.51±0.66	101.07±0.65
5-6 parities	197.61±3.17ab	88.39±2.12a	93.26±2.35a	111.20±4.72b	9.64±0.95	100.28±0.81
7-8 parities	202.66±1.81a	92.58±2.91a	97.05±1.80a	121.55±4.84a	9.66±0.71	102.09±0.66
Significance	***	***	***	***	NS	NS
Interaction between management system and parity:						
F x 1-2 parities	158.48±3.32d	62.22±2.68	79.55±1.37e	106.53±2.47bc	12.02±0.97	99.94±0.93
F x 3-4 parities	196.88±5.79ab	66.23±3.98	90.51±2.32cd	106.97±1.82bc	11.36±0.48	100.52±1.23
F x 5-6 parities	198.66±3.71a	86.40±2.82	88.97±3.06d	124.34±3.16a	12.23±0.85	99.56±1.41
F x 7-8 parities	199.06±1.75a	86.65±3.13	92.29±1.13bcd	133.14±5.39a	11.58±0.44	100.94±0.95
P x 1-2 parities	176.64±6.82c	68.38±2.82	71.32±2.93f	101.61±3.59bc	7.04±0.32	99.66±0.48
P x 3-4 parities	183.62±5.76bc	70.67±3.82	98.21±3.49ab	100.27±3.77bc	7.67±0.18	101.62±0.50
P x 5-6 parities	196.56±5.57ab	90.39±3.22	97.56±2.54abc	98.07±2.02c	7.05±0.08	101.0±0.87
P x 7-8 parities	206.26±2.30a	98.50±3.30	101.80±1.42a	109.95±3.09b	7.76±0.54	103.24±0.67
Significance	*	NS	**	**	NS	NS

NS = Insignificant, * P < 0.05, ** P < 0.01 and *** P < 0.001.
Means denoted within the same column for each factor with different superscripts are significantly different at P < 0.05.

Table 5: Somatic cell count from poled milk samples of Maghrebianshe-camels with different rearing systems and ages.

Traditional pastoral system (20 lactating she-camel)					**Farm system (20 lactating she-camel)**				
Age category (N:100 milk samples)					**Age category (N:100 milk samples)**				
G_A 1-2 parities (25 milk samples)	G_B 3-4 parities (25 milk samples)	G_C 5-6 parities (25 milk samples)	G_D 7-8 parities (25 milk samples)	**Total (100 Milk samples)**	G_A 1-2 parities (25 milk samples)	G_B 3-4 parities (25 milk samples)	G_C 5-6 parities (25 milk samples)	G_D 7-8 parities (25 milk samples)	**Total (100 Milk samples)**
259800	**332200**	**392800**	**458600**	**385850**	**166000**	**196000**	**295000**	**356400**	**253350**

Table 6: Bacterial isolates of single infection from poled milk samples of Maghrebianshe-camel with different rearing systems and ages.

Bacterial isolates	Traditional pastoral system (20 lactating she-camel)										Farm system (20 lactating she-camel)									
	Age category (N:100 milk samples)										Age category (N:100 milk samples)									
	G_A 1-2 parities (25 milk samples)		G_B 3-4 parities (25 milk samples)		G_C 5-6 parities (25 milk samples)		G_D 7-8 parities (25 milk samples)		Total (100 Milk samples)		G_A 1-2 parities (25 milk samples)		G_B 3-4 parities (25 milk samples)		G_C 5-6 parities (25 milk samples)		G_D 7-8 parities (25 milk samples)		Total (100 Milk samples)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
S.aureus	0	0	0	0	1	4	1	4	**2**	**2**	1	4	1	4	2	8	2	8	**6**	**6**
CNS	1	4	1	4	1	4	2	8	**5**	**5**	0	0	0	0	1	4	1	4	**2**	**2**
E.coli	1	4	1	4	2	8	4	16	**8**	**8**	0	0	1	4	0	0	1	4	**2**	**2**
S.agalactiae	0	0	0	0	0	0	1	4	**1**	**1**	1	4	0	0	0	0	1	4	**2**	**2**
Other Strept..	2	8	2	8	3	12	3	12	**10**	**10**	0	0	0	0	1	4	2	8	**3**	**3**
Total	**4**	**16**	**4**	**16**	**7**	**28**	**11**	**44**	**26**	**26**	**2**	**8**	**2**	**8**	**4**	**16**	**7**	**28**	**15**	**15**

S.aureus = Staphylococcus aureus, E.coli = Escherichia coli, CNS = Coagulase Negative Staphylococcus, S.agalactiae = Streptococcus agalactia

Table 7: Bacterial isolates of mixed infection from poled milk samples of Maghrebianshe-camels with different rearing systems and ages.

Bacterial isolates	Traditional pastoral system (20 lactating she-camel)										Farming system (20 lactating she-camel)									
	Age category (N:100 milk samples)										Age category (N:100 milk samples)									
	G_A 1-2 parities (25 milk samples)		G_B 3-4 parities (25 milk samples)		G_C 5-6 parities (25 milk samples)		G_D 7-8 parities (25 milk samples)		Total (100 Milk samples)		G_A 1-2 parities (25 milk samples)		G_B 3-4 parities (25 milk samples)		G_C 5-6 parities (25 milk samples)		G_D 7-8 parities (25 milk samples)		Total (100 Milk samples)	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
CNS +*E.coli*	1	4	1	4	2	8	3	12	**7**	**7**	0	0	0	0	1	4	1	4	**2**	**2**
S.aureus + *E.coli*	1	4	1	4	2	8	2	8	**6**	**6**	0	0	1	4	2	8	1	4	**4**	**4**
S .aureus + *other Strept.*	1	4	2	8	2	8	2	8	**7**	**7**	1	4	1	4	1	4	2	8	**5**	**5**
S.aureus + *E.coli* + *otherStrept.*	2	8	2	8	1	4	1	4	**6**	**6**	0	0	0	0	1	4	2	8	**3**	**3**
S.aureus+ *CNS*+ *otherStrept.*	1	4	1	4	2	8	2	8	**6**	**6**	1	4	1	4	1	4	2	8	**5**	**5**
Total	**6**	**24**	**7**	**28**	**9**	**36**	**10**	**40**	**32**	**32**	**2**	**8**	**3**	**12**	**6**	**24**	**8**	**32**	**19**	**19**

DISCUSSION

Immunoglobulin concentration in camel colostrum

(Table 2) showed that overall mean of IgG, IgM, and IgA concentrations in colostrum of camels did not differ significantly ($P < 0.05$) under both management systems. However, concentration of IgG and IgA significantly ($P < 0.05$) increased, while IgM insignificantly increased by advancing animal parity. Meanwhile, the effect of interaction between management system and parity on immunoglobulin concentrations was not significant. Concentration of IgG in camel milk is 1.64 mg/ml as compared to 0.70, 0.67, 0.55, 0.63 and 0.86 mg/ml for goat, cow, sheep, buffalo and human milk, respectively (El-Agamy and Nawar, 2000). In spite of the higher mean IgG concentration in the Dromedary camels, found that mean IgG concentration in raw camel milk was 0.718 ± 0.330 mg/m, but IgG concentration differed for region Konuspayeva *et al.* (2007). They also found seasonal change in IgG content, being higher in winter than in summer. Concentration of IgG decreased regularly ($P < 0.001$) throughout the year, with the highest value in January and the lowest in July. It is highly required to investigate colostrum under farming and traditional systems to evaluate the impact of this variable on neonatal viability rate. In this respect, Bernabucci *et al*. (2013) mentioned that multiple factors influence the production and the composition of colostrum, including the species, breed, health status of the mammal, feeding practices, and time collected post-parturition. However, El-Hatmi *et al.* (2006) found that concentration of IgG at first milking in Tunisian camels dropped abruptly in the subsequent milkings. Fahmy and Maha (2010) found that the concentration of IgG1 decreased by 94% within the whole period of lactation in dromedary camel (Camelus dromedarius) reared in Marsa Matroh governorate during the first season of lactation. Also, in bovin, Król *et al.* (2012) demonstrated that feeding system has the major impact on the milk yield and its chemical composition. Milk of cows grazing the pasture were characterized by a higher content of IgG. Osman (2014) reviewed that individual animals showed a wide range of colostrum composition which suggests a prominent role of animal individuality. The chemical characteristics of colostrum were greatly affected by colostral days and slightly by lactation number.

Milk yield and composition

Data in (Table 3) showed that daily or total milk yield significantly ($P < 0.001$) higher for she-camels under farming systems more than those under traditional pastoral system by about 20.70 and 11.75%, respectively. Also, camel milk composition showed significant differences between both management systems. Fat, protein, lactose, total solids and solids not-fat contents attained significantly higher values in milk of farming system as compared with the traditional pastoral system. However, ash content showed significantly ($P < 0.001$) an opposite trend. As affected by animal parity, results in (Table 3) cleared that significant increase in daily and total milk yield and its composition by advancing parity. The interaction between management system and parity was not significant on milk yields and milk composition. Also, increasing milk yield by advancing camel parity, regardless management system, was related to developmental changes in udder and teat measurements by age progress. These results indicated significant effects of camel management system on yield and composition of milk. Remarkable variation in feeding system was achieved in camel farms or during grazing. In this study, camels were under good feeding system in the farm, while camels under pastoral system were under poor feeding of fry and wet shrubs and desert shrubs and insufficient in drinking water (thirst). The most important factor in camel milk for peoples living in dry zone is its water content (Wilson, 1998). In similarity with the present results, Bakheit *et al*. (2015) found that average daily milk yield was 6.85±1.32 and 3.14±0.66 liter for semi-intensive and traditional system, respectively with highly significant ($P < 0.001$) differences. The increase in average daily milk yield amounted to 53% under semi-intensive system compared to those under traditional system. The present values of milk composition are nearly agreement with the results of Abdalla *et al.* (2015) who indicated that milk of Maghrebi she-camels under normal condition contained 3.01, 3.06, 0.69, 4.33, and 11.06%for protein, fat, ash, lactose and total solids contents, respectively. Also, Obied and Hakem (2014) found a wide range of variation in the chemical composition of milk among different management systems especially under uncontrolled environmental condition as is mostly the case locally and the significant effect between the mean values of the two milk groups at ($P < 0.05$) were found to be in water, lactose, ash and total solids . In this respect, Shuiep *et al.* (2014) revealed that, camel milk under semi intensive system showed significantly ($P < 0.05$) higher total protein, solids not-fat and lactose contents. Whereas, fat was significantly ($P < 0.05$) higher in milk samples collected from traditional nomadic system. Several authors reported that camel milk composition was influenced by regional differences including feeding conditions (Al-Haj and Al-Kanhal 2010; Babiker and El Zubeir 2014) or management system, season, stage of lactation and calving number (Riyadh *et al*., 2012), and geographical locations or feeding conditions (Konuspayeva *et al*., 2009 and Bekele *et al*., 2011). On the other hand, Dowelmadina *et al.* (2014) found that the highest percentages of fat, protein, lactose, total solids and solids not fat were recorded for the camel in the traditional nomadic system, followed by the semi intensive system. Finally, Mustafa *et al.* (2014) showed that mean values of solid non-fat;

crude fat; crude protein and lactose were (9.13 and 8.42%); (5.39 and 1.71%); (4.94 and 4.57%) and (3.64 and 3.24%) in milk of camels kept under traditional pastoral and farming system, respectively.

Mineral content in milk

Lower inorganic P and Mg than those reared under farm system. However, milk Ca and chlorine contents were not affected by management system. These trends may be due to the differences of the feeding and water intake. By advancing animal parity, Ca and P contents significantly ($P < 0.05$) increased up to 7-8 parities, while Na and K significantly ($P < 0.05$) increased up to 6-7 and 7-8 parities, respectively. Yet, Mg and chlorine contents were not affected significantly by parity. The interaction between management and parity was highly significant ($P < 0.001$) only on K and P, reflecting different trend of change in K and P contents in camels under farm and pastoral system by advancing camel parity (Table 4). It was demonstrated that the major mineral contents (Ca, P, Na, and K) of dromedary camel milk showed a large variation among different studies due to breed, feeding, stage of lactation, drought conditions, or analytical procedures (Mehaia *et al.,* 1995 and Gorban and Izzeldin, 1997). In agreement with this study, Obied and Hakem (2014) found that the desert camel bulk milk had significantly higher amount of Ca, Na and K than in farm camel milk. Shawket and Ibrahem (2012) found increased ($P < 0.05$) content of macro-elements (Na, K and Ca %) in milk of camels fed ad lib. on fresh Atriplexhalimus due to higher Na, K and Ca contents in Atriplex than in berseemhay. On the other hand, Elnour and Bakheit (2012) and Musaad *et al*. (2013) indicated that mineral contents in camel milk were affected by parity. Contents of P, Na and K markedly increased with increasing parity number. Content of P in milk of camels at one and three parities were 1.13 and 1.4%, respectively, increased to 1.8% at advanced perities. Content of Na (0.65- 0.95%) and K (3.37-4.1%) increased, while Ca content (5.2-1.55%) markedly decreased (5.2 and 1.55%) by increasing camel parity. Results in (Table 4) revealed that camels reared under traditional pastoral system showed significantly higher contents of Na and K.

Somatic cell count (SCC)

The leukocytes in milk (SCC) release specific substances that attract more leukocytes to the area to fight the infection. Numbers of somatic cells remain in large concentrations after bacteria are eliminated until healing of the gland occurs. Clots formed by the aggregation of leukocytes and blood clotting factors may block small ducts and prevent complete milk removal. Damage to epithelial cells and blockage of small ducts can result in the formation of scar tissue in some cases, with a permanent loss of function of that portion of the gland. In other cases, inflammation may subside, tissue repair may occur, and function may return in that lactation or the subsequent one. On the other hand bacteria possess a wide array of defense mechanisms in an effort to avoid destruction. Staphylococci produce a toxin that can impede migration of poly-morph nuclear cells towards chemo-attractants. Also, as an infection persists and milk ducts remain clogged, secretory cells revert to non-producing state and alveoli begin to shrink (Harmon, 1994). Substances released by PMN completely destroy the alveolar structure which is replaced by connective and scar tissue. Pockets of infection become walled off and they become difficult to reach with antibiotics. For somatic cells count the ratio was highly significant ($P<0.05$) in traditional pastoral system than that recorded in farming system, also the numbers were increased with age (parities) and this may be attributed to bad hyagin and management applied in rearing and milking method incase of open grazing system which leads to more bacterial infections causing mastitis and so increase in somatic cell count, also the age play the same action due to old and repeat infections of mammary tissues and mammary glands in first years of reproduction, increased season after season of milking (Park *et al*., 2007).

Bacteriological study

Subclinical mastitis is a form of mastitis, affect all lactating farm animals, causing changes in milk yield and milk composition. Factors help in subclinical mastitis: type of bacteria, physiological status, age of lactating animal, level of milk production, inherited featured, milking and environment. Diagnosis of subclinical mastitis by SCC plus microbiological isolation and identification (Macdonald Campus of McGill University, 2012). Tests to detect changes in milk can be routinely used for screening purposes in milking herds. An increase in the SCC to more than 5x105 cells/ml is considered to be an indication of udder infection in she-camel (Eberlein, 2007). The present study gave incidence of subclinical mastitis in milk of she-camels (*Camelus dromedarius*). Results revealed that *S.aureu*s, *CNS*, *E.coli*, *S.agalactia* and *other Strept.* were the main single bacterial isolates from all studied milk samples .Same isolates nearly were recorded by Suheir *et al*. (2005) and Sherifa and Eman (2012), detected same bacteria as a single mastitis infection of their studied she-camles. From the results of (Table) 6*S. aureus* isolates represented by (2% and 6%), *CNS* (5% and 2%), *E.coli* (8% and 2%), *S.agalactia* (1% and 2%) and other Strept.. (10% and 3%) in both groups traditional pastoral system and farming system, respectively. The differences between two systems of management were clear in contagious bacterial infections (*S.aureus* and *Strept. agalactia*) were higher in farming system than in traditional pastoral system. Meanwhile environmental bacteria (*CNS*, *E.coli* and other Strept.) were high in percentage in traditional pastoral system than in farm system. These results are attributed to different management systems, in case of traditional pastoral system the ways of feeding, manual milking

and lack of bedding cleaning give a chance for environmental bacterial infection. In the contrary hand farm system by organized housing, feeding, semi-automated milking and continuous bedding changes lead to more contagious bacterial infections. *Staphylococcus aureus* has been identified as the main cause of sub-clinical camel mastitis, in farm system, while *E.coli* was the main cause in pastoral system, this confirm the results obtained by Abdulrahman *et al*. (1995) and Amel (2003). Total bacterial isolates in single bacterial infections showed a significant differences between both systems of management (26% and 15%) respectively in traditional pastoral system and farming system (Table 6). Same prevalence rates were obtained from studies performed in many she-camels rearing countries, such as in Palestine (Guljye *et al.*, 2002), also cases of subclinical mastitis in she-camels have recently been reported in Saudi Arabia, Egypt, and Somalia (Barbour *et al*., 1985; Mostafa *et al.*, 1987; Abdulrahman *et al.*, 1991). The predisposing factors for she-camel mastitis may be due to weather, expose of udder to trauma, due to ticks or desert plant and anti-suckling devices which used by camel's owner to allow the young calves older than one year are herded together with their harms. All these factors are predispose the udders to bacterial infections. Also this study confirmed the results obtained by Guljye *et al*. (2002), as they showed that *CNS, Staph. aureus* and *Strept. agalactiae* were the main causes of single mastitis infection. In addition, Atofari *et al*. (2005) and Azmi *et al*. (2008), found that the most prevalent groups were Strept. group, CNS and *Staph. aureus*. Table (7), showed the mixed bacterial infection causing sub-clinical mastitis in eight subgroubs belong to two main groups of 200 tested she-camel milk samples. It was illustrated that CNS *+E.coli, S.aureus + E.coli, S.aureus + other Strept.. , S.aureus + E.coli + other Strept. and S.aureus+ CNS+* other Strept.., were the main groups of bacterial isolates in percentages of (7 and 2%), (6 and 4%), (7 and 5%), (6 and 3%) and (6 and 5%) respectively, with total mixed bacterial isolates (32% and 19%) in both traditional pastoral system and farming system, respectively. There is a significant differences between total bacterial isolates in mixed bacterial mastitis infection in both management systems. Mixed bacterial isolates of sub-clinical mastitis were not detected and discussed carefully in milk of she-camels as in cattle and buffaloes cows or even in sheep and goat sub-clinical mastitis. This due to most authors sum the microorganism as a total number either isolated in a single or mixed infection and not illustrated in two categories as our study explained. High defense mechanism of she-camel immune system of Maghrebian species fights most bacterial infection, as showed nearly in low percentage of single and mixed bacterial infections caused subclinical mastitis. Also it is very clear from our results that defense mechanism of mammary gland and udder tissues reduced by age of lactating she-camel. This may explain the reasons of increase the rate of infection for both single and mixed isolates by parity of lactating animals. That is why group four was more infected than third group and group three was more infected than second group and so on. These results were agree with same results obtained by Suhair *et al*. (2005) whom explained that there was a direct relationship between the frequency of mastitis and the calving number. During the first, second and third calving the incidence revalence of mastitis was 25% while at the fourth and fifth calving the incidence increased to 43.8%. However, mastatic cases decreased to 16.7% for more than seven calving. Same idea and same results were discussed by Abera *et al*. (2010).

CONCLUSION

Based on the foregoing results, both parity order and management system play an important role in productive performance of Maghrebi lactating camels, in terms of remarkable increase in milk yield and production of goodquality milk of Maghrebi she-camel under farm system as compared to pastoral system and by advancing parity order, without obvious effect was found on level of immunoglobulins in milk. Moreover, there were a clear differences between both types of management in case of single and mixed bacterial causes of subclinical mastitis. Also between each type of infection with parity and different types of management. Somatic cell count showed remarkable differences between traditional and farming methods of rearing and it was the mirror of infection degree.

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بعض الدراسات على انتاج اللبن وتركيبه فى النوق المغربى تحت النظم المزرعية والمناطق الرعوية فى مصر

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هدفت الدراسة إلى التعرف على تأثير نظم التربية (النظام المزرعى والنظام الرعوي التقليدي) وعدد مرات التناسل (الولادات) على كمية الحليب وتكوينه من النوق المغربية بالإضافة إلى تأثيره على عد الخلايا الجسيمية والعدوى البكتيرية لالتهاب الضرع الغير ظاهرى. وقد تم تقسيم مجموع أربعين من النوق الحلابة (العمر ٥-١٢ سنة، وزنها ٣٧٠-٥٩٠ كجم، بين موسم الحليب الأول والثامن) إلى مجموعتين نظام (المزرعى والرعوى، لكل منهما ٢٠ ناقة). وقد قسمت كل مجموعة مزرعية أو رعوية إلى أربع مجموعات فرعية وفقا لعدد مواسم الحليب، مرتبة كالتالى : ١-٣،٢-٥،٤-٦ و ٧-٨ موسم تناسل، فى كل مجموعة ٥ حيوانات. متوسط تركيزات الجلوبيولين المناعى أنواع أى جي جى ، أى جى ام و أى جى ايه لا تختلف اختلافا كبيرا ($P < 0.05$) تحت نظامين التربية المختلفين . زاد تركيز ال أى جى جى وال أى جى ايه زيادة معنوية ($P < 0.05$)، في حين زيادة ال أى جى ام كانت غير معنوية بشكل كبير من خلال تقدم الناقة فى العمر. ولم يكن تأثير التفاعل بين نظام التربية وتكافؤ تركيزات الجلوبيولين المناعي كبيرا.كان إنتاج الحليب اليومي أو الكلي أعلى بكثير ($P < 0.001$) تحت نظام المزرعة أكثر من النظام الرعوي بنحو(٢٠.٧٠ و ١١.٧٥%) على التوالي . كانت نسب الدهون، البروتين، اللاكتوز، المواد الصلبة الكلية، والمحتويات الصلبة غير الدهنية حققت قيم أعلى بكثير في الحليب من نظام المزارع عن ما هو عليه في النظام الرعوي. ومع ذلك، أظهر محتوى الرماد عكس ($P < 0.001$) الاتجاه بالنسبة لباقى مكونات الحليب. كما أن معدل إنتاج الحليب اليومي والكلى ومكوناته زاد بشكل كبير من خلال تعزيز عدد مرات التناسل والولادات. ولم يكن التفاعل بين نظام التربية وعمر الناقة (عدد مرات التناسل) معنويا على إنتاج ومكونات الحليب. أما بالنسبة للخلايا الجسيمية فكانت النسبة معنوية جدا ($P < 0.05$) في النظام الرعوي التقليدي عن تلك المسجلة في النظام المزرعى لعينات الحليب المجمعة من نوق مصابة بالتهاب ضرع غير ظاهرى. في ظل نظام الرعى الحر أظهر الحليب محتوى أعلى بكثير من أملاح الصوديوم والبوتاسيوم وأقل بكثير من أملاح الفوسفور الماغنيسيوم من نظام المزرعة. لم تتأثر نسبة الكالسيوم ومحتويات الكلور بنظام الرعاية والتربية. كانت زيادة محتويات الكالسيوم والبوتاسيوم معنوية ($P < 0.05$)، مع تقدم مواسم الحليب حتى ٧-٨ موسم، في حين أن كلا من الصوديوم والبوتاسيوم كانت زيادتهما معنوية ($P < 0.05$) فى مواسم الحليب ٥-٦ و ٣-٤ على التوالي، ولم تتأثر نسب الماغنيسيوم والكولورين كثيرا بعدد مرات التناسل والولادة. كان التفاعل بين نظام التربية والعمر معنويا للغاية ($P<0.001$) فقط على البوتاسيوم والفوسفور، مما يعكس الاتجاه المختلف للتغير في المحتوبين البوتاسيوم والفوسفور في الجمال تحت نظام المزرعة والرعي من خلال تعزيز التناسل. أظهرت نتائج الدراسة البكتيريولوجية أن المكور العنقودى الذهبى (٢ و ٦%)، المكور العنقودى سالب التجلط (٥ و ٢%)، الميكروب القولونى (٨ و ٢%)، المكور السبحى نوع الاجالاكتيا (١ و ٢%) والمكور السبحى من الانواع الاخرى غير الاجالاكتيا (١٠ و ٣%) هى من أهم المعزولات البكتيرية المنفردة والمسببة لالتهاب الضرع الغير ظاهرى فى النوق الحلاب والمدروسة في المجموعتين: النظام الرعوي التقليدي والنظام المزرعى على التوالي. أوضح المجموع الكلى للمعزولات البكتيرية في العدوى البكتيرية المنفردة اختلاف واضح بين كلا النظامين فى التربية والرعاية (٢٦ و ١٥ %) على التوالي. كما أظهرت التحقيقات أن نسب العزل للميكروبات المختلطة وهى : المكور العنقودى سالب التجلط مع الميكروب القولونى ، المكور العنقودى الذهبى مع الميكروب القولونى ، المكور العنقودى الذهبى مع المكور السبحى من الانواع الاخرى غير الاجالاكتيا ، المكور العنقودى الذهبى مع الميكروب القولونى والمكور السبحى من الانواع الاخرى غير الاجالاكتيا بالاضافة الى المكور العنقودى الذهبى مع المكور العنقودى سالب التجلط والمكور السبحى من الانواع الاخرى غير الاجالاكتيا (٧ و ٢%) و (٦ و ٤%) و (٧ و ٥%) و (٦ و ٣%) و (٦ و ٥%) على التوالي. ممثلة لأهم المجاميع البكتيرية المشتركة والمسببة لألتهاب الضرع الغير ظاهرى فى النوق الحلابة. كان هناك اختلاف واضح في المجموع الكلى للمعزولات البكتيرية المختلطة (٣٢ و ١٩%) في كل من النظام الرعوي التقليدي ونظام المزرعة على التوالي. أظهرت نتائج العزل المنفردة والمختلطة عن وجود علاقة مباشرة بين معدل التهاب الضرع الغير ظاهرى وعدد الولادات (التناسل ومواسم الحليب). نوصى بضرورة زيادة الوعي لدى البدو حول أهمية تأثير نظام التغذية وطرق التربية بالإضافة إلى أهمية الفحص البكتيرى على المحصول والقيمة الغذائية لإنتاج حليب الإبل للاستهلاك البشري أو إرضاع المواليد الجدد.