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IMPACT OF REFRIGERATION ON THE SHELF LIFE, BIOCHEMICAL AND HYGIENIC QUALITY OF RAW DROMEDARY CAMEL MILK OBTAINED IN EXTENSIVE AND SEMI-INTENSIVE BREEDING SYSTEMS FROM SOUTHEASTERN ALGERIA

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ABSTRACT

This study aims to assess the impact of refrigeration and storage duration on physicochemical and microbiological properties of dromedary camel milk in extensive and semi-intensive breeding system. Camel milk samples were obtained from the Sahrawi healthy dromedaries (*Camelus dromedarius*) during autumn. The physicochemical parameters measured included pH, density, titratable acidity, total dry matter, ash, fat, lactose and protein contents. The microbiological quality was evaluated by counting total aerobic mesophilic flora (FAMT) and the presence of coliforms. Initial samples were analysed and stored at 4°C for up to 29 days to monitor the changes.

The pH of milk from the extensive system was higher (6.6 ± 0.2) than the semi-intensive system (6.2 ± 0.2). Dornic acidity was lower in extensive milk (18.5 ± 0.5°D) than in semi-intensive milk (20.5 ± 0.7°D). Furthermore, the density was greater in extensive milk (1.0262 ± 0.0001) relative to semi-intensive milk (1.0192 ± 0.0001) and the ash content was lower in extensive milk (8.85 ± 0.57 g/L) than in semi-intensive milk (10.18 ± 0.2 g/L). Over the storage period, total protein levels decreased from 36 g/L to 30 g/L in extensive milk and 25g/L to 21g/L in semi-intensive milk. Fat content declined from 23g/L to 20g/L (extensive) and from 30g/L to 26g/L (semi-intensive). Lactose levels decreased from 47g/L to 37g/L (extensive) and from 37g/L to 33g/L (semi-intensive). Microbiological assessments indicated an increase in FAMT during storage, with milk from both systems peaking at day 22 before a slight decline. No coliforms were detected in any samples. However, both systems showed decreased pH, ash, protein, fat and lactose contents over the time. Effective breeding and collection practices management is essential to ensure camel milk's optimal quality and safety.

Key words: Breeding systems, camel milk, microbiological quality, physicochemical properties, Sahrawi dromedaries, storage duration

Camel milk is an essential source of nutrition in terms of high-quality proteins, protective and bioactive proteins, polyunsaturated fatty acids, vitamins and minerals (Konuspayeva *et al,* 2008; Konuspayeva *et al,* 2007). Its consumption has also expanded in recent years, enjoying a global reputation as a nutritious and health-beneficial product, especially for those facing various degenerative disorders (Jrad *et al,* 2022). However, there is a significant gap between demand and supply, with most camel milk sources concentrated in Sahelian and African countries (Ismail *et al,* 2022). This raises questions about preserving camel milk properties once outside its natural environment (Ibrahim, 2023).

Cold storage extends the shelf life of most manufactured foods and the same rule applies to camel milk. Sub-zero shelf life and subsequent production of shelf-stable dried camel milk at reasonably low costs assure strong growth for the milk industry (Lund *et al,* 2020; Mohamed and El Zubeir, 2020). Various environmental factors such as temperature, light, oxygen etc. reduce the shelf life of fresh camel milk. Camel milk contains bacteria that produce chemical and enzymatic changes in milk, reducing the shelf life of camel milk (Konuspayeva and Faye, 2021; Oselu *et al,* 2022).

The effect of cold storage on the shelf life of camel milk, with reports on compositional changes,

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properties and quality has been studied (Al-Rumaihi *et al,* 2021; Wang *et al,* 2023).

This study was aimed to evaluate the changes in the physicochemical characteristics of camel milk during refrigeration and storage in extensive and semi-intensive breeding systems focusing on pH, acidity, density, ash content, fat content, protein content and lactose content.

Materials and Methods

Sampling

In this study, raw camel milk samples were collected from bulk tanks during the autumn period of 2024. The milk samples were collected hygienically from several healthy females of Sahrawi breeds of southuest of Algeria in the early stage of lactation in extensive and semi-intensive breeding systems. The udders of the camels were washed and rinsed before milking. Milk was collected in sterile stainless steel containers which were transported in coolers containing ice packs to maintain the freshness of the milk throughout the journey to the laboratory, where the necessary analyses for the study were carried out.

In the laboratory, in the presence of the Bunsen burner, each sample was divided into 5 sterile glass graduated bottles with a capacity of 800ml per bottle. On the first day, one bottle was dedicated to the physicochemical and microbiological analyses, while the remaining four bottles were placed in a refrigerator at 4°C to monitor and study the impact of shelf life on the biochemical and microbiological quality. This study was extended over a period of 29 days.

Physico-chemical parameters

Physico-chemical and biochemical analyses included measurement of pH, density, titratable acidity, total dry extract, ash, fat, lactose and protein contents. The pH was determined potentiometrically using a pH meter (Adwa Instruments. Hungary). These parameters were investigated at different storage intervals (01, 08, 15, 22 and 29 days). Acidity was measured in dornic degrees. Density was assessed using densimeters. After evaporating the water in a boiling bath, the total dry matter was determined by oven drying at 103 ± 2°C. Ash was determined by incinerating the milk at a temperature of 530°C ± 20°C (NF: Norme Française V04-208 1989). Fat was quantified using the GERBER method (Jean, 1974), lactose content was determined spectrophotometrically (AFNOR, 1993) and nitrogen was determined using the Kjeldahl method (ISO 8968-1 2014).

Microbiological quality

Microbiological analyses included the enumeration of total aerobic mesophilic flora (FAMT) and coliforms to assess the microbiological quality of the samples.

Statistical analysis

Statistical analysis was performed using one-way ANOVA with 03 replicates in order to assess the data of effects of rearing systems, storage time and their interaction on various biochemical properties of raw camel milk using software SPSS 20.0. Results the presented as mean ± standard deviation. Differences from an ANOVA of 5% were considered significant.

Results and Discussion

Effect of storage duration and breeding systems on biochemical parameters of raw camel milk

Milk from both breeding systems on day one exhibited significant variations ($p<0.01$ (Table 1)). The findings agreed with those of Arroum *et al* (2015) and Medjour (2014). However, these results contradicted the findings of Cherifa *et al* (2018), who observed that breeding systems did not cause significant changes in milk parameters. The results in Table 2 highlighted the significant impact of storage time on all parameters in both systems ($p<0.01$), except pH in both systems and Dornic acidity in the extensive system ($p>0.01$). These results were consistent with those of Omer and Eltinay (2009), who confirmed that after 21 days at 4°C, storage of raw milk samples resulted in significant changes in overall quality while showing insignificant changes in fat and protein levels. Additionally, the interaction between shelf life and breeding systems had significant impact on the density, ash content and lactose levels.

The pH of camel milk varied significantly depending on the breeding system ($p < 0.001$). Indeed, milk from camels fed extensively had a higher pH (6.6 ± 0.2) than milk from camels fed in a semi-intensive system (6.2 ± 0.2) from the first day. These results corroborated with those of Gorban and Izzeldin (2001), who showed that the availability of food and water can influence pH. The pH values are important as they indicate the freshness and stability of milk (Siboukeur, 2007). The results for milk samples from both systems, stored at +4°C for 1, 8, 15, 22 and 29 days, showed that the pH of milk from the semi-intensive system was 6.2 on the day of collection and remained stable at 6.2 after 8 and 15 days of storage, with a slight decrease in pH to 6.1 and 6.0 after 22 and 29 days, respectively. In contrast, the pH values for milk from the extensive system were 6.6, 6.5, 6.5, 6.3

and 6.2 for days 1, 8, 15, 22 and 29, respectively. Omer and Eltinay (2009) noted a slight decrease in camel milk pH after 21 and 42 days. In our study, the pH of camel milk did not reach its final acidification point. The progressive acidification was due to microbial activity fermenting lactose into lactic acid, thereby reducing the pH, as Fguiri *et al* (2017) reported. The stability of pH in our study can be explained by the higher vitamin C content, which has an antibacterial role (Konuspayeva *et al,* 2011).

Dornic acidity of camel milk was influenced by the breeding system ($p < 0.001$) and increases significantly with storage time ($p < 0.01$). Milk from extensively raised camels showed lower acidity (18.5 ± 0.5) than semi-intensively raised camels (20.5 ± 0.7). The first-day results were similar to those reported by Arroum *et al* (2015) and Siboukeur (2007) for camel milk from intensive systems. Our result for semi-intensive milk (20.5°D) aligns with the findings of Medjour (2014), who reported similar values.

Dornic acidity increased significantly during storage. These results are consistent with those reported by Omer and Eltinay (2009), who observed significant changes in acidity over a 21-day storage period. This increase was more pronounced in semi-intensive milk, where acidity rose from 20.5 to 21.5 and then to 22.5°D on the 1st, 15th and 29th days, respectively, compared to an increase from 18.5 to 19.0, then to 19.1 and 19.16°D on the 1st, 15th, 22nd and 29th days, respectively, in extensive milk. The acidity values in our study for both systems

Table 1. Effect of shelf life and breeding systems in biochemical characteristics of raw camel milk.

Parameters	Breeding systems	Shelf life (Days)				
		01	08	15	22	29
pH	Semi-intensive	6,2±0,2^{a}	6,2±0,1^{a}	6,2±0,1^{a}	6,1±0,1^{a}	6,00±0,1^{a}
	Extensive	6,6±0,2^{a}	6,5±0,2^{a}	6,5±0,1^{a}	6,3±0,2^{a}	6,2±0,1^{a}
Dornic Acidity (°D)	Semi-intensive	20,5±0,7^{a}	20,5±0,5^{a}	21,5±1^{b}	22,5±0,5^{c}	22,5±0,5^{c}
	Extensive	18,5±0,5^{a}	18,5±0,7^{a}	19±1^{a}	19,1±0,76^{a}	19,16±0,7^{a}
Density	Semi-intensive	1,0192±0,0001^{a}	1,0192±0,0002^{a}	1,020±0,0001^{b}	1,0202±0,0002^{b}	1,0204±0,0002^{b}
	Extensive	1,0262±0,0001^{a}	1,0262±0,0002^{a}	1,0262±0,0002^{a}	1,0272±0,0002^{b}	1,0274±0,0002^{b}
Ashes (g/l)	Semi-intensive	10,18±0,2^{a}	8,93±0,64^{b}	7,38±1,06^{c}	5,41±0,16^{d}	3,75±0,56^{e}
	Extensive	8,85 ±0,57^{a}	7,11±0,35^{b}	6,35±0,39^{c}	5,36±0,2^{d}	4,65±0,26^{e}
Total dry extract (g/l)	Semi-intensive	84,32±0,23^{a}	83,56±0,6^{a}	83,48±0,18^{a}	81,44±0,34^{b}	80,36±0,97^{c}
	Extensive	97,17±0,17^{a}	96,91±0,03^{a}	96,76±0,09^{a}	96,06±0,97^{a}	94,71±0,86^{b}
Total proteins (g/l)	Semi-intensive	25,0±0,1b	25,0±0,1^{b}	24,0±0,1^{b}	24,0±0,1^{b}	21,0±0,1^{a}
	Extensive	36,0±0,1c	35,0±0,1^{c}	32,0±0,1^{b}	32,0±0,1^{b}	30,0±0,1^{a}
Lactose (g/l)	Semi-intensive	37,0±0,1^{a}	37,0±0,1^{a}	36,0±0,1^{a}	36,0±0,1^{a}	33,0±0,1^{b}
	Extensive	47,0±0,1^{a}	47,0±0,1^{a}	46,0±0,1^{a}	41,0±0,1^{b}	37,0±0,1^{c}
Fat (g/l)	Semi-intensive	30±0,53^{a}	28,5±0,5^{ab}	27±0,54^{bc}	27±0,53^{bc}	26±0,52^{c}
	Extensive	23±1^{a}	22±1^{ab}	21±1^{bc}	21±1^{bc}	20±1^{c}

a, b , c, d, e : averages on the same line with different letters are significantly different ($p<0.05$)

Table 2. Statistical analysis of the effect of shelf life and breeding systems on biochemical characteristics of raw camel milk.

Effect	Breeding systems	Shelf life		Breeding systems x shelf life
		Semi-intensive	Extensive	
pH	***	NS	NS	NS
Dornic Acidity	***	**	NS	NS
Density	***	***	***	**
Total dry extract	***	***	**	NS
Ashes (g/l)	**	***	***	**
Total proteins (g/l)	***	**	***	NS
Fat (g/l)	***	**	*	NS
Lactose (g/l)	***	**	***	***

NS: No Significant, *: p≤0.05, **: p≤0.01, ***: p≤0.001

were more stable than those of Omer and Eltinay (2009), after 21 days of storing camel milk at 4°C. Therefore, it is possible to store camel milk for long if the cold chain is maintained, as high temperatures stimulate lactic fermentation by milk bacteria. This is demonstrated by the work of Lankri *et al* (2024) at ambient temperature and that of Omer and Eltinay (2009) at 7°C and 30°C. Additionally, hygiene conditions during milking are essential to maintain the quality of camel milk during storage and control the initial microbial load present in raw camel milk.

The density of milk samples were significantly influenced by the breeding system ($p<0.001$). In the semi-intensive system, the average density was 1.0192±0.0001, while in the extensive system, it was 1.0262±0.0001. These values were very close to those reported Lankri *et al* (2024). Density directly depends on the dry matter content, strongly related to the watering frequency (Siboukeur 2007; Benyagoub and Ayat, 2015). The density of camel milk slightly increased during storage ($p<0.001$). In the semi-intensive system, the density increased from 1.0192 to 1.020, 1.0202 and 1.0204 for the 1st, 15th, 22nd and 29th day, respectively, while in the extensive system, it increased from 1.0262 to 1.0272 and 1.0274 for the 1st, 22nd and 29th day, respectively. Density was inversely proportional to fat content; therefore, this increase was attributed to decreased fat content (Vignola, 2002; Kadri *et al,* 2020). A significant interaction existed between the breeding system and storage duration ($p<0.01$).

The ash content in camel milk was significantly influenced by the breeding system ($p<0.01$). Milk from camels raised extensively contained less ash (8.85±0.57g/L) than milk from camels raised semi-intensively (10.18±0.2g/L). Our findings align with the studies of Cherifa *et al* (2018). The mineral composition of camel milk mainly depends on factors such as water deprivation, lactation stage and the amount of milk produced (Siboukeur and Siboukeur, 2012) as well as diet (Faye *et al,* 2023)

The mineral content in the milk decreased significantly ($p<0.001$) during storage. This decrease was more noticeable in semi-intensive milk, falling from 10.18g/L on the first day to 9.85g/L on the 21st day, while in extensive milk, it dropped from 8.85g/L on the first day to 8.72g/L on the 21st day. This finding contrasts with the observations of Omer and Eltinay (2009), who reported an increase in ash content from 9.4g/L on the collection day to 10g/L on the 22nd day at 4°C. The dissociation of caseins from the micelle during cold storage affects the mineral balance in the milk (de la Fuente, 1998).

The breeding systems; semi-intensive and extensive, showed significant differences in the total dry extract levels of the milk. Milk from camels raised in an extensive system had a higher total dry extract content (97.17±0.17g/L) than milk from camels raised in a semi-intensive system (84.32±0.23g/L). Our results are lower than the values reported by Cherifa *et al* (2018). Several studies indicated that the variation in total dry extract content can be attributed to various factors, including the quality and quantity of water available to the animals (Khaskheli *et al,* 2005). The duration of storage also impacts the total dry extract. A significant decrease in total dry extract was observed in both breeding systems over time; It decreased to 80.36g/L for the semi-intensive system and to 94.71g/L for the extensive system. Additionally, the interaction between breeding systems and storage duration significantly affects the total dry extract.

Total proteins were significantly impacted by the rearing systems ($p < 0,001$). The average total protein content in the milk of camels raised in a semi-intensive system is around 25.0±0.1g/L, which was lower than that of camels raised in an extensive system, at 36.0±0.1g/L. The observed differences were highly significant ($p < 0,001$). These results were consistent with those obtained by Medjour (2014) and higher than that reported by Chethouna *et al* (2022). Additionally, results for camels raised in a semi-intensive system (25.0±0.1g/L) were reported by Lankri *et al* (2024). However, these results were lower compared to those obtained by Cherifa *et al* (2018) and Medjour (2014). The protein content in camel milk varied according to lactation stages (Musaad *et al,* 2013) and was influenced by genetic factors. Many studies have shown that a grass-based diet leads to lower protein content in milk. Additionally, breeds and seasonal conditions also significantly affect the protein content of camel milk. The concentration of total proteins decreased significantly ($p < 0.01$) during storage. The average protein levels for semi-intensive milk were 25, 24 and 21g/L on the 1st, 15th and 29th days, respectively. In contrast, protein levels decreased for extensive milk from 36 to 35, 32 and 30g/L on the 1st, 8th, 15th and 29th days. Multiple studies have indicated that storage duration affects the average protein content. Omer and Eltinay (2009) found that storing camel milk at 4°C results in only minor changes over 21 days. Kaskous (2019) also highlighted the significant impact ($p < 0.001$) of storage duration on protein levels, showing that milk protein content was lower after storage at +4°C for 24 and 48 hours ($p < 0.05$).

The analysed camel milk shows fat content levels of 36.0±0.1g/L for the extensive system and

25.0±0.1g/L for the semi-intensive system. Statistical analysis revealed a highly significant difference ($p<0.001$). The average fat content of the milk from camels raised in the semi-intensive system appears to be lower than in the extensive system. The fat content levels in our study were close to the values reported by Boudjenah (2012) and Cherifa *et al* (2018).

The fat content decreased significantly ($p<0.05$) during storage. In semi-intensive milk, from 30g/L to 28.5g/L, then to 27g/L and finally to 26g/L on days 1, 8, 15 and 29, respectively. In extensive milk, it decreased from 23g/L to 22g/L, then to 21g/L and finally to 20g/L on the same days. This result was consistent with the work of Kaskous (2019), which indicates that storage at 4°C significantly affects the fat content of camel milk. However, our results contrast with those found by Omer and Eltinay (2009), which show that storing camel milk at 4°C did not significantly change fat content over 21 days.

The lactose content differed between the samples from the two farming systems. The recorded differences were highly significant ($P<0.001$). A lower rate was observed in milk from camels raised in semi-intensive systems (37g/L) than milk from camels raised in extensive systems (47g/L). The lactose content of camel milk reported in this study was close to those reported by Kihal *et al* (1999) and Kaskous (2019). The breed can influence the lactose content, the stage of lactation and the hydration status (Medjour, 2014).

The lactose content decreased significantly ($p<0.01$) during storage, particularly in milk from the extensive system. It dropped from 47g/L to 46g/L, 41g/L and 37g/L on days 1, 15, 22 and 29, respectively. In contrast, the decrease in semi-intensive milk was less pronounced, falling from 37g/L to 36g/L, then to 33g/L on days 1, 15 and 29. These results were consistent with those of Kaskous (2019) and Omer and Eltinay (2009), who demonstrated that lactose content was most affected by storage at varying temperatures. Our findings also indicated that the interaction between storage duration and the breeding system significantly negatively affected lactose levels ($p<0.001$). The reduction in lactose during storage may be attributed to microbial activity specially psychrotrophic bacteria (Omer and Eltinay, 2009; Ballou *et al,* 1995).

Effects of storage duration and breeding systems on the microbiological characteristics of raw camel milk

The analysis of total coliform counts revealed their absence in all samples from both breeding systems, resulting in 0 CFU/ml, both in the raw state and after 29 days of storage (Table 3). These results confirmed that the samples comply with the established microbiological standards (10^6 CFU/ml as per Guiraud (1998) and indicate a negligible initial bacterial load. This supports Larpent and Larpent (1990) observations, which highlighted that total coliforms do not necessarily indicate direct faecal contamination, as some coliforms may originate from moisture residues on dairy equipment. However, their detection can also indicate hygienic shortcomings related to the milk's quality or the equipment's cleanliness. Our results suggested that adherence to good hygiene practices during milking prevented the presence of these bacteria. Our results were lower than those reported by Chethouna (2011) for raw camel milk (3.25×10^5 CFU/ml). Coliforms indicate milk's sanitary quality (Guiraud and Rosec, 2004). Additionally, these results highlighted the beneficial effect of maintaining cold storage conditions, which is an effective method for slowing or even stopping the proliferation of microorganisms and allowing for prolonged milk preservation (Murielle, 2009; Rosset *et al,* 2002).

The total aerobic mesophilic flora (FMAT) of camel milk was significantly influenced by the breeding system ($p<0.001$). This flora was a good indicator of the overall quality and stability of the products, as well as the hygienic quality of the facilities (Guiraud, 1998). The initial counts of milk samples from camels raised in a semi-intensive system are 2.98 Log CFU/ml, indicating a higher microbial load than the milk samples from camels raised in an extensive system, which were 2.52 Log CFU/ml. These results were lower than those found by Chethouna (2011) (9.5 x 10 CFU/ml). According to many authors, such as Farah (1986) and Faye (1997), camel milk has high antibacterial properties, allowing it to be well-preserved when refrigerated without immediate fermentation. This observation was consistent with the microbial load found in our samples. Male *et al* (2003) indicated that when milk was collected under suitable hygienic conditions, its total flora did not exceed 10^3 to 10^4 CFU/ml. This acceptable microbial load in camel milk can be attributed to several factors, including good hygienic conditions during milking and the storage temperature during transport. These results allowed us to conclude that the action of cold inhibits the growth of the total flora.

The total aerobic mesophilic flora (FMAT) of camel milk was also significantly influenced by the storage duration ($p<0.001$). In both semi-intensive and extensive systems, FMAT levels progressively increased until they peak at 22 days (5.33 Log

CFU/ml and 4.26 Log CFU/ml, respectively), then decreased slightly at 29 days (3.31 Log CFU/ml and 3.55 Log CFU/ml, respectively). This indicated a lower initial microbial load in the milk from both systems, good hygienic conditions during milking and adherence to proper storage conditions.

In the semi-intensive system, significant negative correlations between total mesophilic aerobic flora and parameters such as fat, total dry extract and lactose indicated that an increase in microbial flora was associated with a decrease in these components (Table 4). This observation aligns with previous research, such as that by Leyral and Vierling (2007), which showed that high levels of microorganisms can metabolise certain nutrients, such as lactose into lactic acid. Studies by Bony *et al* (2005) have also observed that high microbial cell counts were associated with reduced proportions of casein in total proteins. Vanbergue *et al* (2020) found that fat was also subject to hydrolysis by lipolysis, a process influenced by various factors, including the animal, breeding conditions, milking equipment and psychrotrophic bacteria. A moderate negative correlation with pH (-0.321) suggested a lower pH was associated with increased microbial growth. Conversely, this recent increase was positively associated with Dornic acidity. Other studies, such as Pougheon (2001), have reported that the presence of bacteria, including mesophilic acidifying flora adapted to lactose metabolism, led to increased Dornic acidity.

In the extensive system, significant negative correlations between total mesophilic aerobic flora and parameters such as total dry extract, ash and total proteins reinforce the idea that an increase in microbial flora could reduce the concentration of these components. Additionally, the strong positive correlation between total mesophilic aerobic flora and density suggests that higher density is associated with microbial development.

Conclusion

This study has demonstrated that camel milk's physicochemical properties and microbiological quality vary based on the breeding system (extensive or semi-intensive) and the storage duration at 4°C. The results reveal significant differences between the two systems regarding the milk's pH, dornic acidity, density, ash content, total solids, total proteins, lactose and fat content.

The results highlighted the significant impact of the rearing system on camel milk quality. Camel milk from the extensive system had higher pH and density values than that from the semi-intensive system. Although both systems showed a decrease in total solids, protein and fat over time, the semi-intensive system undergoes more marked changes. In addition, lactose content decreased more rapidly in the extensive system, suggesting that feeding conditions play a crucial role in these differences. These results highlight the importance of maintaining appropriate storage conditions to preserve microbiological quality.

Finally, future research may focus on improving storage and preservation conditions to extend milk shelf life while maintaining its nutritional and sensory properties.

Table 3. Effect of shelf life and breeding systems in microbiological characteristics of raw camel milk (count CFU/ml).

	Breeding systems	Shelf life (Days)					
		01	08	15	22	29	
Total Coliforms Log (cfu/ml)	Semi-Intensive system	0	0	0	0	0	NS
	Extensive system	0	0	0	0	0	
FAMT Log (cfu/ml)	Semi-Intensive system	$2,98^{a}$	$3,41^{b}$	$3,50^{c}$	$5,33^{d}$	$3,31^{e}$	P<0.001
	Extensive system	$2,52^{a}$	$2,85^{b}$	$3,05^{c}$	$4,26^{d}$	$3,55^{e}$	

FAMT: Flores mesophilic aerobic total, cfu : Colony forming units
a, b , c, d, e : averages on the same line with different letters are significantly different (p<0.05), NS: No Significant

Table 4. Correlation matrix of physico-chemical characteristics, shelf life and development of total mesophilic aerobic flora in camel milk based on breeding system.

		MG	A	TDS	DE	Ac	pH	Pr	LA	FAMT
Semi-Intensive system	FAMT	-0.335^{NS}	-0.430^{NS}	-0.422^{NS}	0.438^{NS}	0.549*	-0.321^{NS}	0.025^{NS}	0.025^{NS}	1,00
Extensive system	FAMT	-0.543^{*}	-0.803^{**}	-0.552^{*}	0.800^{**}	0.224^{NS}	-0.406^{NS}	$-0,661^{**}$	-0.723^{**}	1,00

**Correlation is significant at the 0.01 level , *Correlation is significant at the 0.05 level, , NS: No Significant
MG : FAT, A : Ashes , TDS : Total dry extract, DE : Density, Ac: Dornic Acidity, Pr : Total proteins, LA : lactose : FMAT : Flores mesophilic aerobic total

Competing interests

The authors have declared that no competing interests exist.

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