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RAW CAMEL MILK PRODUCTION IN ALGERIAN'S SOUTH EASTERN ARID AREAS: CONSTRAINT RELATED TO COLLECTION, STORAGE AND TRANSPORT: IMPACT ON PRODUCT QUALITY

MERIBAI A[1], AMZALI N[2] & BENSOLTANE A[3]

[1,2]Laboratory of Characterization and Valorization of Natural Products, Faculty of Nature and Life Sciences, University Elbachir Elibrahimi, Bordj Bou Arreridj, Algeria

[2]Laboratory of Food and Industrial Microbiology– Faculty of Biological Sciences University of Oran1, Algeria

ABSTRACT

Background: Camel the most adapted species to arid's areas. Camel's milk, has nutritional, therapeutic properties, rich in salts, enzymes, inhibiting microbial activity, hence it's long shelf life and low ability coagulation. In Algeria, camel population is about 315000 heads, distributed over 17 provinces, with 75% in eight desert provinces and 25% in nine steppe provinces. Camel breeding, practiced in extensive, dependent on climatic conditions, low milk productivity, because of the lack of collection system, intended more to camel's meat production. Although this milk, highly required in urban areas and Northern provinces for therapeutic use. However, the collection and transport for long-distance alters it's physico-chemical quality. Aim: Study aimed to explore stability of physicochemical parameters pH, conductivity, viscosity, Titratable acidity, density, total azote, protein, whey and dry matter, during milking collection, transport and storage. Results gives values between : pH(6,38- 6,58); conductivity (5,73- 7,24µs/cm); viscosity (3- 3,75mpa/s); Titratable acidity (23,58- 27,06ºD); density (0,93- 1,03); total azote (3,68- 5,62g/l); protein (25- 34g/l); whey (71,78- 81,6%) and dry matter (24,5- 35,63%).showed the heterogeneity and instability of explored physicochemical's tests. Freezing seems the ideal method for the collection, storage, preservation and transportation of raw camel milk which is accessible only in arid areas.

KEYWORDS: Camel Milk, Stability, Physicochemical, Analysis

INTRODUCTION

Camel's population estimated around 19 million in the World (FAO 2008), of which 15 million are found in Africa and 04 million in Asia (Farah et *al.;* 2007). Two different species belonging to the genus *Camelus*. One humped dromedary camels (*Camelus dromedarius*) that mainly live in the desert areas, and two-humped bactrian camels (*Camelus bactrianus*) which living in the cooler areas (Al hadj and Al Kanhal, 2010). More than 60% of the dromedary population is concentrated in the four Northeastern african countries: Somalia, Sudan, Kenya and Ethiopia. (Farah et *al.*, 2007). Camels are big water and food saving (De Almeida, 2011). Under extreme arid conditions, they have ability to produce milk for a long time more than any other species, (Farah et *al*., 2007). Each camel (both species) produces between 1000 and 2000 liter for 08 to 18 months lactation period (FAO, 2006).According to Faye et *al*., (2014) the camel population in North Africa has decreased from 07% in 1961 to 03.5 in 2011. According to F.A.O. data, camel population in Algeria is about 315000 heads, 237000 head in Tunisia, and 163000 heads Morocco, only 570000 heads in Libya (FAO-STAT, 2013. http: // www. faostat. Org). During the period 1961- 2011, camel's population, recorded significant growthin Algeria, has

increased 02.14 and recorded a multiplication by 01.37 in Tunisia. While this population decreases of 0.32 in Libya and 0.62 in Egypt(Faye et *al*., 2014). However the total number of the camels estimated by the Algerian Ministry of Agriculture, in 2010, to more than 300000 heads. Little data is available on the Algerian camel population. Nomenclature of these populations was more related to the names of tribes who breed them (*Chaambi, Targui, Reguibi, Sidicheikh*) than a distinction based on phenotypic or/andgenotypic characteristics (Chehma et *al.,* 2008).In Algeria,disertcovers more than 85% of the total area (Chehma 2003; Chehma et *al.,* 2008). Dromedary is the only species able to valorize this arid ecosystem (Chehma et *al*., 2008). Camel population, in Algeria, is spread over seventeen provinces, with 75% of the livestock in eight disertic provinces : Ouargla, Ghardaia, El-Oued,Tamanrasset, Illizi, Adrar, Tindouf and Bechar and 25% of livestock in nine steppe provinces: Biskra, Tebessa, Khenchela, Batna, Djelfa, El-Bayad, Naama, Laghouat and M'sila (Benaissa 1989).Camel breeding is nomadic (classic), led to the extensive, dependent on weather conditions, intended to meat production and low milk production, because of collection system lack, low productivity and beneficial opportunities. Milk is intended primarily for the young camel's diet and autoconsumption (Chehma 2003).Camel's milk has relatively similar physico-chemical composition to cow's milk, has a white color, opaque; (Farah et *al*., 2007; Al Haj and Al Kanhal, 2010); because of the structure and composition of fat content, relatively poor in β-carotene (Sawaya et *al*.,1984), less viscous than cow's milk (Kherouatou et *al*., 2003; Sboui et *al*., 2009). It has a sweet (Farahet *al*., 2007), with a slightly salty taste (Al Haj and Al Kanhal, 2010). However, changes in taste seem mainly caused by the nature of feed (halophytes plants) andwater availability (Farah et *al*., 2007; Al Haj and Al Kanhal, 2010). This milk is distinguished by it's high content of vitamin C : 37.4 mg/l (Farah et *al*., 1992; Haddadin et *al*., 2008), niacin (B3) (Haddadin et *al*., 2008). Camel's milk composition differs from one areas to another in worldwide, (Konuspayeva et *al*., 2009): it has04.5 to 03.5% protein;05,50 to 03,07% Fat; 0,7 to 0,95% ash; 03,4 to 05,6% lactose and 12,1 to 15% total solids respectively(Shuiepet *al*., 2008). These wide variations inmilk constituents were attributed to some factors such as: age, number of calving, management, stage of lactation, the sampling technique used and feed quality (Shuiep et *al*., 2008).However, according to Ereifej et *al*., (2011) changes in the biochemical composition of camel's milk, are based on the population (race), animal age, nutrition, lactation stage, ecological, climatic areas and breeding typology. In addition, season strongly affects milk composition through heat stress, feed available quality and water availability by affecting the total solids of milk and this directly affects other milk components (Shuiep et *al*., 2008). Unlike cow's milk, camel's milk can be stored for a longer time at room temperature(around 30°C). According to Yagil et *al*., (1984), at temperature of4°C, it's kept for more than three months, without recording any changes. According to Sboui et *al*., 2009 camel's milk can be preserved for 30hours at room temperature; it would be preserved for more than seven days at coldat (-4)ºC, unlike cow's milk (preserved only for five days).It seems that the presence of a strong enzymo-protective system (Benkerroum et *al*., 2004; El Agamy 2009) due to relatively high enzymes levels as :lactoferrin (El Agamy 2000) lactophorine (Konuspayeva et *al.,* 2007), lysozyme, lactoperoxidase and immunoglobulin (El Agamy et *al.,* 1996; El Hatmi et *al.,* 2007) and bacteriocins produced by indigenous lactic flora (Benkerroum et *al.,* 2004), extends the duration of it's shelf within hours. In arid and isolated southern Algerian provinces, where camel breeding practiced, raw camel's milk collection, storage and transport, even in good conditions of hygiene and respect for the cold chain, for long distances to urban areas and Northern provinces, where this beverage is highly required for therapeutic use, this negatively impact the physico-chemical quality of milk. Study aimed to explore stability of physicochemical parameters pH, conductivity, viscosity, Titratable acidity, density, total azote, protein, whey and dry matter, during milking collection, transport and storage for thirty-one samples raw camel milk samples.

MATERIALS AND METHODS

2.A. Sampling Strategy

Thirty-one samples of raw camel milk were collected from different localities in three Southeastern provinces of Algeria: El Oued(Eo 10 samples), Biskra(Bs 11 samples) and Msila(Ms 10 samples) Table 1.

2.B. Milking, Collection and Transport of Samples

Milking was conducted according to good hygiene practices on good health animals, camel's milk collected in previously autoclaved bottles. Transport to the laboratory in cold conditions

2.C. Physico-Chemical Tests

Determination of pH by a pH meter ino-Lab 730Germany (Chamba and Prost 1989). Acidity titratble in Dornic degré(ºD) (Amiot and La pointe-Vignola, 2002). Conductivity in microsciemens/centimeter at 20ºC, by Conductimeter InoLab Cond- Germany.

Viscosity in millipascale/second by viscometer: ViscotesterVT- 30. Density with thermolactodensitomèter Lauda®, model TD1C at 20ºC, total nitrogen and protein by Kjeldahl method, conducted in three stages: mineralization (ore-K-424 Buchi Digestion Unit Switzerland), distillation and titration (A.O.A.C 1997), whey rate by centrifugation on Sigma Centrifuge 2/6E, Germany a volume of milk at 3500rpm for 60 min the supernatant indicates the rate of whey. Dry matter (%) was measured, after desiccation by evaporation of 5g milk deposited in a dried capsule at 103°C during 4H.

2.D. Statistical Treatment of Results by ANOVA Program:

Results of physicochemical tests were analysed with ANOVA program: illustredon Figure 1 Table 2 and 3

RESULTS AND DISCUSSION

pH: The average pH values were :6,63 (Biskara); 6,56 (El Oued); 6,58 (Msila), are similar to thosereported by various authors: are between 06,5 and 06,7 (Mehaia and Cheryan, 1983;Mehaia et *al*, 1995; Khaskheli et *al*., 2005). 06,6 (Hassan et *al*. 1987; Shamsia 2009). From 06,5 to 06,82 (Cavalcante et *al*., 2005); 06,4 (AbuTaraboush et *al*., 1998), 06 (ElHadiSulieman et *al*., 2006). From 06,48 to 06,65 (Mahboub et *al*., 2012), 06 (Benyagoub et *al*., 2013). According to Yagil et *al*., (1984) the camel's milk pH is similar to the sheep's milkpH. However, it is lower than that of cow's milk (Sawaya et *al*., 1984). Changes in pH and titratable acidity values for the same sample are probably due to differences in milking hygiene levels and initial level of milk flora (Mehaia et *al*., 1995) table 1 and table 2. The average values of titratable acidity, for all the samples were: 27,06ºD (Biskara); 26,11ºD (El Oued); 23,58ºD (Msila). These values are high compared to those reported by: Hassan et *al*., (1987) 15ºD, Kamoun(1994) 15,6±1.4 D; Abu Lehia, (1994)15°D;Shuiep et *al*., 2008 (15ºD);Shamsia 2009 (16,3ºD).In addition, Camel milkis characterized by a buffering effect higher, relatively to other species milk:cow, Sheep and goat,these helps to explain the lack of direct relationship between the values of pH and titratable acidity (AbuTaraboush, 1996). Dornic degree (°D) is the expression of the acidity developed by transformation of lactose to lactic acid, a Dornic degree (ºD) corresponds to 0.1 grams of lactic acid in one liter of milk (Chamba and Prost 1989).Density:The average values of density were: 1.03(Biskara); 1,025(El Oued) and 0.94(Msila), are similar to those reported by: Farah (1996): 1,029.

N/S*Number of samples; Cd*: Conductivity; (µs/cm): microsiemens/cm; Vs*: Viscosity; T.A*: titratable acidity;

ºD Dornic Degree; D*: Density; T.N*: Total Nitrogen; Whe%*: Whey; Prt : proteins; D.M % Dry Matter; M: Average; m: means; SD Standard deviation.

According to Hassan et *al*., (1987) density was of 0,99 to 1,034. While, for Gnan and Sherida, (1986); Cavalcante et *al*., (2005) it ranges from:01, 025 to 01,032 respectively. In addition, milk density depends directly on the content of camel milk solids, strongly related to the frequency and composition of the diet.

Table 1: Results of Physico-Chemical Tests

Provinces	Tests Physico- Chimiques									
Areas	**N/S***	**pH**	**Cd* (µs/cm)**	**Vs* mPa/s**	**TA/°D**	**D***	**Total N. ***	**Prt* (g/l)**	**Whe* (%)**	**DM*%**
Biskra (Bs)	Bs1	06.63	05.74	03.4	28.97	1.025	4.424	28.26	82	18
	Bs 2	06.68	04.94	03.8	30.96	1.031	5.6	35.78	92	28
	Bs 3	06.60	05.03	03.5	30.96	1.03	6.384	40.73	94	26
	Bs 4	06.73	05.54	05	23.97	1.032	5.04	32.20	76	24
	Bs 5	06.89*	05.89	02	17.98*	1.03	5.208	33.27	83.6	26.4
	Bs 6	06.59	05.65	02.8	23.97	1.03	4.62	29.52	80	20
	Bs 7	06.52	06.06	02.6	30.95	1.031	5.04	32.20	86	24
	Bs 8	06.45	06.62	2,11	30.96	1.035	9.24	49.04	74	26
	Bs 9	06.64	05.50	02.9	25.92	1.03	5.096	32.563	80	20
	Bs 10	06.80	05.44	03.3	23.94	1.03	5.95	38.020	60	38
	Bs 11	06.74	06.67	02.8	23.94	1.03	5.183	33.100	90	18
M(Av)*		6,638	5,734	3,00	27,06	1,03	5,62	33,56	81,6	24,5
m(SD)**		0,1053	0,5571	0,546	3,336	0,00235	1,32	3,73	9,574	5,727
El Oued (Eo)	Eo 1	06.49	09.29	4.8	23.94	1.02	4.76	30.416	76	24
	Eo 2	06.70	06.59	02.9	25.92	1.03	6.58	42.046	72	28
	Eo 3	06.56	06.91	03	23.97	1.025	5.348	34.173	68	32
	Eo 4	06.59	06.47	05	30.96	1.03	7.028	44.08	68	32
	Eo 5	06.54	07.01	04	22.97	1.03	4.648	29.70	69	31
	Eo 6	06.36	08.07	04	27.97	1.021	4.928	31.48	80	20
	Eo 7	06.71	07.23	04.1	29.97	1.025	5.824	37.215	60	40
	Eo 8	06.60	06.52	03.5	30.06	1.03	5.432	34.71	81	19
	Eo 9	06.56	07.14	03.5	24.17	1.025	4.9	31.31	80	20
	Eo 10	06.17	09.45	04	25.95	1.02	3.92	25.048	74	26
M.Av*		6,5677	7,2477	3,755	26,11	1,025	5,326	34	72,8	27
m SD**		0,1056	0,90805	0,5939	2,66	0,0045	0,9884	5,796	6,731	6,729
Msila (Ms)	Ms 1	06.71	05.88	03	23.94	1.03	4.52	29.34	56	44
	Ms 2	06.52	06.45	03	23.95	1.03	4.25	27.195	64	36
	Ms 3	06.38	06.00	04.5	27.9	1.03	4.95	31.668	79	21
	Ms 4	06.66	05.93	03.3	19.98	1.025	4.31	27.553	81	19
	Ms 5	06.78	07.00	03	23.94	1.025	4.36	27.911	78	22
	Ms 6	06.51	06.50	03.1	21.97	1.025	3.80	24.33	84	16
	Ms 7	06.53	06.66	02.9	21.97	1.03	4.22	27.016	81	19
	Ms 8	06.53	07.70	03.7	24.3	1.03	2.00	17.88	60.26	59.74
	Ms 9	06.53	08.00	03.5	24.3	1.02	2.14	18.68	64.26	59.74
	Ms 10	06.53	06.43	02.7	24.3	1.03	2.799	17.89	70.26	59.74
M.Av*		6,5889	6,515	3,27	23,583	0,9344	3,681	24,953	71,78	35,632
m SD**		0,1006	0,61824	0,5229	2,186	0,00353	1,0889	5,0513	10,062	18,71

Table 2: Average Values and Standard Deviations

Région	Constants	Maximum Value	Minimum Value	Average* (M)	SD* (m)
	Biskra11 Echantillons				
Biskra Bs	pH	06.89	06.45	6,638	0,1053
	Cd*(µs/cm)	06.67	04.94	5,734	0,5571
	Vs* mPa/s	05	02	3,00	0,546
	Ac/°D	30.96	17.98*	27,06	3,336
	D*	1.035	1.025	1,03	0,00235
	Ntotal*	9.24	4.424	5,62	1,32
	Prt*(g/l)	49.04	28.26	33,56	3,73
	Whey* (%)	94	60	81,6	9,574
	Dry matter *(%)	38	18	24,5	5,727
	El Oued 10 Echantillons				
El Oued Eo	pH	06.71	06.17	6,5677	0,1056
	Cd*(µs/cm)	09.45	06.47	7,2477	0,90805
	Vs* mPa/s	05	02.9	3,755	0,5939
	Ac/°D	30.96	22.97	26,11	2,66
	D*	1.025	1.02	1,025	0,0045
	Ntotal*	7.028	3.92	5,326	0,9884
	Prt*(g/l)	44.08	29.70	34	5,796
	Whey* (%)	81	60	72,8	6,731
	Dry matter *(%)	40	19	27	6,729
	Msila 10 Echantillons				
Msila Ms	pH	06.78	06.38	6,5889	0,1006
	Cd*(µs/cm)	08.00	05.88	6,515	0,61824
	Vs* mPa/s	04.5	02.7	3,27	0,5229
	Ac/°D	27.9	19.98	23,583	2,186
	D*	1.03	1.02	0,9344	0,00353
	N.total*	4.95	2.00	3,681	1,0889
	Prt*(g/l)	31.668	17.88	24,953	5,0513
	Whey* (%)	84	56	71,78	10,062
	Dry matter *(%)	59.74	16	35,632	18,71

M*: Average, m* (SD):Standard Deviation

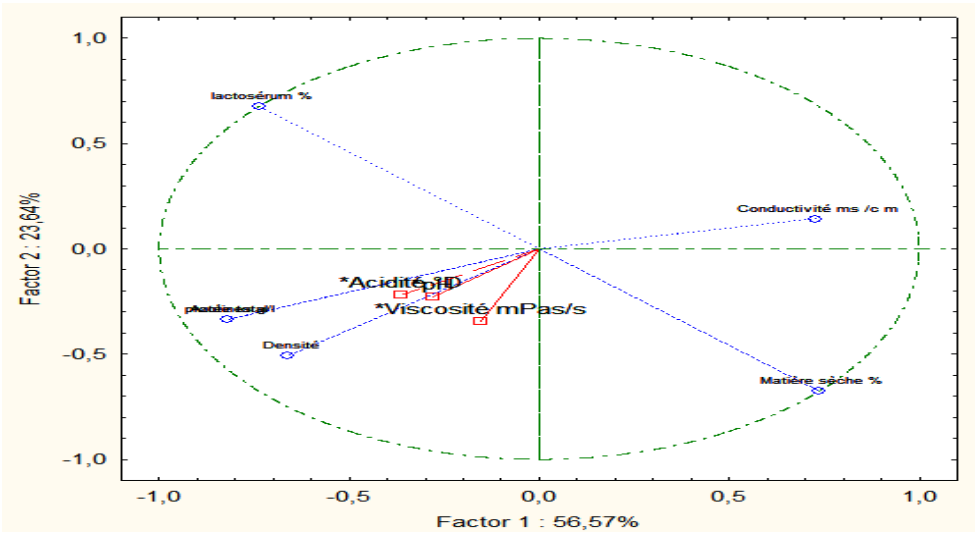

Figure 1: Correlation between Physico-Chemicals Tests of Camel Milk

Conductivity: is related to camel milk content ions, essentially: chlorides, phosphates, citrates, carbonates, bicarbonates of potassium, sodium, calcium and magnesium (Mabrook and Petty, 2003), present at high rate in our

samples, relatively to cow's milk (El Amin and Wilcox, 1992; Bengoumi et *al*., 1994); this seems due to a probable effect of the rich halophytes diet composition. Viscosity: The average values of viscosity were between : 03.75 (El Oued); 3.27 (Msila) and 03 (Biskara) mPa/s, are higher than the average values reported by Hassan et *al*., (1987): 02,20;. Kherouatou et *al*., (2003). 01,73. Al Haj and Al Kanhal, (2010) 1,72 mPa/s respectively. Total nitrogen and proteins: For all samples, total nitrogen values varied, from one sample to the other, with the means of: 05,62g/l (Samples Biskra) 5,32g/l (El Oued samples) and 3,69g/l for samples of Msila, they corresponding to the average protein: 33.5; 34 and 24.95 g/l respectively. These protein's values, are close to those reported by Kamoun (1994); 34.3g/l;Shamsia (2009) (34.6 g/l), similar to values recorded by Konuspayeva et *al*., (2009), (31 g/l). Al Haj and Al kanhal, 2010 (31.05 g/l); Shuiep et *al*., (2008) 29,4 g/l. According to Shuiep et *al*., (2008), seasonal changes and geographical origin, were the most effective factors influencing formation and chemical composition of camel milk. However, Al Haj and Al Kanhal, (2010), reported that the average values of protein on the composition of camel milk, recorded during the last three years ago were: 31.05+05 g/l.Vertical axis I (Factor1) showed 56.57% of the variation, Axis 2 (horizontal) explained 23.64% of the variation Figure 1. Results of physicochemical tests suggests wide variability (heterogeneity) between samples of camel milk.

CONCLUSIONS

Raw camel milk collected in southeastern of Algeria, has heterogeneous chemical composition, with physicochemical profile very unstable. All samples were very viscous with higher titratable acidity, despite following good hygiene practices, the cold chain during the sampling and transport. Exploration of indigenous lactic flora and bacterial indicators of contamination groups is desirable for further study

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