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Research Article

Composition and Nitrogen Distribution of Ouled-Djellal and Rumbi Algerian Ewe's Milk

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Abstract: The chemical composition and nitrogen distribution of milk from two ewe's breed (Ouled-Djellal and Rumbi) (n = 20 each) reared in Algerian area steppe, were studied. The ewes were balanced for age and weight. All were in middle period of lactation. Individual milk samples were taken from each ewe third time from lactating period during spring season. Rumbi ewe's milk gave the highest values ($p \leq 0.01$) for lactose (4.89±0.61%), solid non-fat (11.19±0.87%) and density (1037.57±3.78) than Ouled-Djellal ewes (4.38±0.45%, 10.24±0.77% 1033.82±2.59, respectively) and lowest values ($p \leq 0.01$) for freezing point (-0.57±0.05°C vs -0.53±0.02°C). No significant difference was observed between the two breeds on fat, protein, total solids. The mean percentages were 6.26±1.38%, 5.54±0.76 and 16.51±1.44%, respectively for Ouled-Djellal ewes, while those of Rumbi's were 5.66±3.52%, 5.91±1.10% and 16.85±3.32%, respectively. No statistical differences related to the breed were found in the milk for all nitrogen fractions. Rumbi ewe's milk contains about 1.01% nitrogen however Ouled-Djellal's hold about 0.96%. Total nitrogen content is distributed between non-protein nitrogen (0.09% in all breeds) and protein nitrogen (0.93 vs 0.87% for Rumbi and Ouled -Djellal ewes respectively). The protein nitrogen includes casein nitrogen (0.76 vs 0.71) and whey protein nitrogen (0.20 vs 0.19%) from Rumbi and Ouled-Djellal ewes, respectively. Algerian sheep breeds were not actually selected for their milk production; selection program should be implemented to improve milk production and increase fat and protein contents. Thus further studies should carry out on milk ability and milk yield of these breeds.

Keywords: Algeria, milk composition, nitrogen distribution, Ouled-Djellal ewe, Rumbi ewe

INTRODUCTION

The population of sheep in Algeria is estimated at over 21 million heads (ONS, 2009). Sheep are mainly composed of local breeds (Benyoucef *et al*., 2000) with low production but well adapted to the different natural regions (Benyoucef *et al*., 1995) and unevenly distributed among primary (Ouled-Djellal, Rumbi and Hamra) and secondary breeds which are less abundant (Chellig, 1992). Ouled-Djellal (OD) is the most common breed and represents approximately 63% of the total number, then comes Hamra with a percentage of 21%; however the Rumbi (RB) represents 12% of the total population (Boucif *et al*., 2007).

Algerian breeds are usually studied for their reproductive performance (Dekhili, 2004; Dekhili and Aggoun, 2005) never for their milk composition. Average milk production per day, all races confounded, is estimated at 400 g for 4 to 5 months (Khelifi, 1999). This production is valued at 70-80 kg in 6 months of lactation for OD ewes; it is 55-65 kg in 5-6 months for Rumbi's (Chellig, 1992). This milk is generally used for breast lambs in the first place, then it is consumed by the farmers as well as or transformed traditionally often on "smen" (traditional butter), on "l'ben" (fermented milk) or in "djeben" (fresh cheese).

The composition of milk determines firstly its processing ability (Pearse and Mackinlay, 1989; Pellegrini *et al*., 1994; Bencini, 2002) and secondly the quality of products that result (Pirisi *et al*., 2001).This composition is not constant and many factors are reported that affect the quality of ewe's milk (Bencini and Pulina, 1997; Bencini, 2001). Some of these factors are related to management system (Bocquier and Caja, 1999; Oravcova *et al*., 2007; Rassu *et al*., 2007), others are depending on sheep: stage of lactation (Pavic *et al*., 2002; Kuchtik *et al*., 2008; Hejtmankova *et al*., 2012) and genetic factors (Javor *et al*., 2000). The effects of breed on milk composition have been studied by several researchers (Boylan *et al*., 1988, Haenlein, 2001; Mierlita *et al*., 2011; Pelmus *et al*., 2012).

Research on chemical composition of ewe's breeds was well documented overall the world such as Suffolk (Torres-Hernandez and Hohenboken, 1979), Dorest

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(Wohlt *et al*., 1981), Manchega (Molina, 1987), Rambouillet (Ochoa-Cordero *et al*., 2002), Awassi (Sahan *et al*., 2005), Sicilo-sarde and Comisane (Rouissi *et al*., 2006), Rahmani and Chios (Abd Allah *et al*., 2011) but there is no information, in our knowledge on the chemicals of ewe's milk produced in Algeria, except this one reported by Yabrir *et al*. (2012), neither for sheep breeds. Thus, this investigation constitute the first and preliminary study carried out concerning the milk composition and nitrogen distribution of Algerian ewe breeds (Rumbi and Ouled-Djellal) reared in central steppe area.

MATERIALS AND METHODS

Animals and sampling: This study was carried out using two flocks, one of Rumbi breed, the other of Ouled-Djellal's located in Algerian area steppe. Ewe's were in natural pasture all the year and feed with hay, pasture ensilage and barley when necessary. Twenty ewes were chosen for each breed. The ewes were balanced for age (medium age was 4.8 and 5.6, respectively for Rumbi and Ouled-Djellal), weight (52 kg for Rumbi and 42.5 kg for Ouled-Djellal) and all were in middle period of lactation.

Individual milk samples were taken from each ewe third time from lactating period during spring season. Milk samples were collected at the afternoon hand milking. During each milking about 120 mL of milk was sampled without any preservative and divided in two aliquots. The first was analyzed within 24 h with refrigeration overnight in terms of basic composition of milk. The second aliquot was frozen at -20°C until analysis for nitrogen fractions.

LABORATORY ANALYSIS

Basic composition: Fat, lactose, solids-non-fat were determined by infrared analysis using a milkoscan apparatus (FT 120, Foss Electric, Hilleroed, Denmark). Total solids content was determined according to the method of AOAC (1998) by drying at 103±2°C. The pH values were measured using a pH-meter (Hanna H211, Hanna Instrument, Portugal) previously calibrated. Density was performed by using Quevenne lactometer, according the method described by AOAC (1998) and Milk freezing point by using a cryoscope (model 403, advanced Instruments, Norwood, NA).

Nitrogen distribution: Nitrogen was analyzed by Kjeldahl method according to AOAC (1998). Digestion was carried out using a Buchi K-435 Digestion Unit (Flawil 1, Switzerland) and distillation in Gerhardt Vapodest 10 Distillation Unit (Königswinter, GB). Total Nitrogen (TN) was determined on whole milk, the Non-Protein Nitrogen (NPN) was determined on the supernatants produced by action of trichloroacetic 15% and the Non-Casein Nitrogen (NCN) on the serum obtained by acidifying the milk at 4.6-4.7pH with acetic acid 10% (Shahani and Sommer, 1951). The other nitrogen fractions were calculated as follows: Protein Nitrogen (NP) = TN-NPN, Casein Nitrogen (CN) = TN-NCN, Whey Protein Nitrogen (WPN) = NCN-NPN and Casein index as (CN/TN)*100. A nitrogen conversion factor of 6.38 was used for calculation of protein contents of milk samples and various fractions (Cerbulis and Farell, 1975).

Table 1: Comparison of physico-chemical characteristics of ewe's milk between Ouled-Djellal and Rumbi breeds

	Breed (mean±SD)		
Parameter	Rumbi	Ouled djellal	P*
Protein (%)	5.91±1.10000	5.54±0.7600	ns
Fat (%)	5.66±3.52000	6.26±1.38000	ns
Lactose (%)	4.89±0.61000	4.38±0.45000	**
Total solids (%)	16.85±3.3200	16.51±1.4400	ns
Solids-non-fat (%)	11.19±0.8700	10.24±0.7700	**
Freezing point (°C)	-0.57±0.0500	-0.53±0.0200	**
Density	1037.57±3.78	1033.82±2.59	**
pH	6.78±0.27000	6.76±0.17000	ns

P*: Analysis of variance (ns: not significant, *: p<0.05 **: p<0.01)

Statistical analysis: Statistical analysis was carried out using Statistica program. The significant differences between means were calculated by one-way Analysis of Variance (ANOVA) using Turkey range test. Breed was the factor studied and probability level was either 95 or 99%.

RESULTS AND DISCUSSION

Basic composition: All compositional parameters of milk samples, except fat and freezing point were higher in milk from Rumbi than from Ouled-Djellal breeds (Table 1). Results show that lactose, solid non-fat, freezing point and density were significantly influenced by breed type. The effect of breed on chemical composition of ewe's milk was well established by many workers (Bencini and Pulina, 1997; Mierlita *et al*., 2011; Pelmus *et al*., 2012). No significant difference was observed between the two breeds on protein, fat, total solids and pH.

Regarding the physicochemical characteristics of milk, pH was similar between the two breeds. This report is in disagreement with Martini and Caroli (2003) who reported that the pH of milk was significantly influenced by the breed of sheep. The pH value in this study was slightly higher than that reported by Hilali (2001) for Awassi sheep and by Bianchi *et al*. (2004) for Sardinian healthy ewe but is in agreement with Rouissi *et al*. (2006) for Comissane sheep. Bianchi *et al*. (2004) observed that pH value of sheep milk increases with somatic cell counts. Concerning the density and freezing point, Rumbi milk has higher density and lower freezing point than Ouled-Djellal milk ($p \leq 0.01$). Simos *et al*. (1996) and Rouissi *et al*. (2006) reported similar density in Epirius Mountain and Comisane ewes respectively than that in our study for Rumbi ewe, while Hilali (2001) and Rouissi *et al*. (2006) found the same value of density in Awassi and

Table 2: Nitrogen distribution (%) in milks of Rumbi and Ouled-Djellal ewe's

	Breed (mean±SD)				
Parameter	Rumbi	Ouled djellal	P*	Avenage	Cowmilk**
TN***	1.01±0.18	0.96±0.15	ns	0.99±0.17	0.580
NPN	0.09±0.03	0.09±0.04	ns	0.09±0.04	0.028
PN	0.93±0.17	0.87±0.12	ns	0.90±0.15	0.550
CN	0.76±0.16	0.71±0.12	ns	0.74±0.14	0.450
WPN	0.20±0.06	0.19±0.05	ns	0.19±0.06	0.100

*: Analysis of variance (ns: not significant); **: Cerbulis and Farrell (1975); ***: TN: Total Nitrogen, NPN: Non-Protein Nitrogen, PN: Protein Nitrogen, CN: Casein Nitrogen, WPN: Whey Protein Nitrogen

Sicilo-sarde sheep respectively than that for Ouled-Djellal ewes. Our finding for the freezing point of Rumbi ewe is in agreement with values reported by Gonzalo *et al*. (2005) for several breeds in Spain and for Ouled-Djellal is almost similar than that found by Martini *et al*. (2008) for Massese sheep in Italy.

Protein and fat were mainly studied because basic and incentive payments for milk (Pirisi *et al*., 2007) or considered as useful material milk for cheese technology (Scintu and Piredda, 2007). As shown in Table 1, there is no significant difference between the two breeds considering the fat and protein contents. Milk fat ranges from 5.66% for Rumbi to 6.26% for Ouled-Djellal ewes which is in agreement with Torres-Hernandez and Hohenboken (1979), Maria and Gabina (1993) and Ochoa-cordero *et al*. (2002), respectively for Suffolk, Latxa and Rambouillet breeds. But lower than that reported by Bencini and Purvis (1990), Simos *et al*. (1996) and Rouissi *et al*. (2006) for Merino, Epirus Mountain and Comisane and Sicilo-Sarde ewes. Also, Nudda *et al*. (2002) reported higher fat content for Sarda, Awassi and Merino sheep in Australia. However, the fat contents were higher than the values reported by Molina (1987) and Casoli *et al*. (1989) for Churra and Massese breeds. The mean percentage protein content balanced between 5.91 for Rumbi and 5.54% for Ouled-Djellal breeds and was higher than the values reported by Molina (1987), Casoli *et al*. (1989) and Bencini and Purvis (1990) for Churra, Massese and Merino ewes breed, respectively but lower than that established by Boylan *et al*. (1988), Simos *et al*. (1996) and Rouissi *et al*. (2006) for Dorest, Epirus Mountain and Sicilo-Sarde and Comisane ewes.On the other hand Riek and Gerker (2006) showed that an increase in protein concentration should result in an increase in pH, because proteins are more anionic than cationic.

Rumbi ewe's milk gave the highest values ($p \leq 0.01$) for lactose. In this study, the mean milk lactose content (%) was 4.89 for Rumbi breed. This level was almost the same with those found by Boylan *et al*. (1988) but was higher than reported by Rouissi *et al*. (2006) and Karoui *et al*. (2011). However milk from Ouled-Djellal gave 4.38% lactose which was also higher than finding by Rouissi *et al*. (2006) and Karoui *et al*. (2011), but lower than reported by many researchers (Molina, 1987; Casoli *et al*., 1989; Bencini and Purvis, 1990) all for several sheep breeds.

The total solids value, ranging from 16.51% (Ouled-Djellal) to 16.85% (Rumbi) did not vary significantly between the two breeds. Similar value was observed in Rambouillet breed milk (Ochoa-Cordero *et al*., 2002). However, this result was higher than that found in Churra and Massese milks obtained by Molina (1987) and Casoli *et al*. (1989), respectively, but lower than that reported by many workers (Wohlt *et al.*, 1981; Bencini and Purvis, 1990; Rouissi *et al*., 2006) in other breeds. The solid non-fat content of ewe milk of Rumbi breed was significantly ($p \leq 0.01$) higher than that of Ouled-Djellal (11.19 v.s 10.24%). The SNF recorded in this study for the Rumbi ewe was supported by Rouissi *et al*. (2006) and Martini *et al*. (2008) but lower than that reported by Kremer *et al*. (1996) and Simos *et al*. (1996) with different sheep breeds. The SNF from Ouled-Djellal milk seems to be the lowest value as regarding the aforementioned study.

Nitrogen distribution: Changes in the nitrogen distribution of ewe's milk protein fractions between Rumbi and Ouled-Djellal breeds are shown in Table 2. No statistical differences related to the breed were found in the milk for all nitrogen fractions. When compared to cow milk, all nitrogen fractions of cow's milk were lower than that reported in this study (Table 2).

Rumbi ewe's milk contains about 1.01% N however Ouled-Djellal's hold about 0.96% N, the average value was 0.99%. this finding coincides with the results obtained by Rouissi *et al*. (2006) and Kondyli *et al*. (2012) in Tunisian and Greeck breeds respectively but very lower than that data reported by Rassu *et al*. (2007), Bornaz *et al*. (2009) and Potocnik *et al*. (2011) for other breeds.

The present study shows that the NT content is distributed between non-protein nitrogen (NPN, 0.09% in all breeds) and Protein Nitrogen (PN, 0.93 vs 0.87% for Rumbi and Ouled-Djellal ewes respectively, with average equal to 0.90%). The NPN contents found in this study were one time higher than those reported by Pirisi *et al*. (2001) and Rouissi *et al*. (2006) for Sarda and Sicila-Sarde ewes breeds, another time lower than that reported for the same breeds by Bornaz *et al*. (2009) and Bovera *et al*. (2003). These values of NPN account for 8.67 and 9.15% of the TN in milk of Rumbi and Ouled-Djellal respectively and which are higher tha

Table 3: Nitrogen distribution (%N of TN) in milks of Rumbi and Ouled-Djellal ewe's

	Breed (Mean±SD)				
Parameter	Rumbi	Ouled djellal	P*	Avenage	Cowmilk**
NPN/TN***	8.67±2.84	9.15±3.53	ns	8.91±3.170	4.90
PN/TN	91.33±2.84	90.85±3.53	ns	91.09±3.17	95.1
CN/TN	74.66±5.63	74.42±4.27	ns	74.54±5.10	77.9
WPN/TN	19.14±3.39	19.60±3.8	ns	19.37±3.56	22.1

*: Analysis of variance (ns: not significant); **: Cerbulis and Farrell (1975); ***: TN: total nitrogen, NPN: Non-Protein Nitrogen, PN: Protein Nitrogen, CN: Casein Nitrogen, WPN: Whey Protein Nitrogen

Table 4: Nitrogen compounds (%)

	Breed (Mean±SD)				
Parameter	Rumbi	Ouled djellal	P*	Average	Cowmilk**
TN*6.38	6.47±1.17	6.12±0.96	ns	6.30±1.07	3.72±0.63
Proteins	5.91±1.10	5.54±0.76	ns	5.73±0.95	3.54±0.60
Caseins	4.84±0.99	4.55±0.74	ns	4.70±0.87	2.89±0.51
Whey Proteins	1.26±0.40	1.20±0.32	ns	1.23±0.14	0.63±0.13***

*: Analysis of variance (ns: not significant); **: Cerbulis and Farrell (1975); ***: True whey proteins

Table 5: Average nitrogen distribution and nitrogen compounds of ewe's milk from other breeds

Breed	TN	NPN	PN	CN	WPN	TN*6.38	Proteins	Caseins	Whey proteins	Reference
Sarda	-	0.23	-	77.6*	-	5.66	-	4.4	1.03	Bianchi *et al*. (2004)
Sarda	4.5	0.31	-	-	-	-	4.18	3.38	0.80	Rassu *et al*. (2007)
ND	-	0.044	95	82.3**	-	5.63	5.35	4.41	0.946	Pellegrini *et al*. (1994)
Sicili-sarde	1.06	0.043	-	-	-	6.55	-	5.16	-	Rouissi *et al*. (2006)
Comisane	1.03	0.042	-	-	-	6.40	-	4.97	-	Rouissi*et al*. (2006)
Sarda	-	0.04	-	76.7**	-	-	5.28	4.26	1.02	Pirisi *et al*. (2001)
Sarda	-	0.05	-	73.2**	-	-	5.66	4.36	1.30	Pirsi *et al*. (2001)
ND	5.55	0.39	-	4.3	1.1	-	-	7.75	2	Potocnik *et al*. (2011)
ND	-	0.8	-	76 - 83*	17 - 22***	-	6.2 - 4.6	4.2	-	Park *et al*. (2007)
Sarda	-	0.15	-	-	-	4.99	-	3.93	0.89	Bovera *et al*. (2003)
Sarda	-	0.16	-	-	-	5.02	-	3.98	0.90	Bovera *et al*. (2003)
Sicila-sarde	5.77	0.29	-	84*	-	-	5.48	4.85	-	Bornaz *et al*. (2009)
Sicila-sarde	5.91	0.24	-	83.7*	-	-	5.67	4.95	-	Bornaz *et al*. (2009)
Boutsiko	1.02	-	-	-	-	-	6.46	5.00	-	Kondyli *et al*. (2012)
Karamaniko	0.97	-	-	-	-	-	6.17	4.74	-	Kondyli *et al*. (2012)
ND		0.269	-	-	-	5.78	5.52	4.55	0.97	Assenat (1985)

ND: Not Defined; *: CN/TN; **: CN/Proteins; ***: WPN/TN

that of cow milk (Table 3). According to DePeters and Ferguson (1992), the NPN content of milk is less variable among breeds but the NPN as a percentage of TN is quit variable. On the other hand, NPN compounds does not have nutritional value (except free amono acids, B vitamins and nucleotids) (Mehaia *et al*., 1995) or commercial value that would justify taking it into consideration in a payment scheme (Grappin, 1992).

The main value of protein nitrogen was higher than cow milk (Table 2). It varies from 0.87% (milk of Ouled-Djellal) to 0.93% (Rumbi's milk). The protein nitrogen includes casein nitrogen (CN, 0.76 vs 0.71 between Rumbi and Ouled-Djellal breeds) and whey protein nitrogen (WPN, 0.20 vs 0.19% from Rumbi and Ouled-Djellal ewes, respectively). Generally, the casein nitrogen is expressed as caseins contents. Thus, the mean value of caseins in ewe milk (4.70%) was higher than cow milk (2.89%) (Table 4); moreover, compared to varied values of other sheep breeds (Table 5), it is found that the value of caseins of milk from the Algerian breeds is either similar or higher than those reported elsewhere. Park *et al*. (2007) reported that casein content of milk has a significant influence on rheological properties of the rennet gel. It is negatively correlated with the quantity of serum retained during the cheese making (Storry *et al*., 1983). The average casein number (CN/TN*100) for Rumbi and Ouled-Djellal ewe milks were 74.66 and 74.42, respectively which did not differ and were lower than that reported for cow milk (Table 3). This value is also lower than that reported in literature (Table 5) from various breeds of sheep. When compared to published data, attention will be taken that some authors use the ratio of casein in true protein (Pirisi *et al*., 2001) instead of casein in total protein (Bianchi *et al*., 2004; Park *et al*., 2007; Bornaz *et al*., 2009).The casein number may vary among species and according to animal and lactation stage (Raynal-Ljutovac *et al*., 2008). On the other hand, it characterizes the suitability of milk for cheese production (Mehaia *et al*., 1995).

Many of the whey proteins have interesting physic-chemical (functional), nutritional and physiological properties (Fox, 2001). Milk samples from Algerian

ewe's breed contained on average 1.23% whey proteins which did not differ between the two breeds (1.26 and 1.20, respectively from Rumbi and Ouled-Djellal milk) and where higher than that reported by Cerbulis and Farell (1975) for cow milks. Our finding was higher than that of Sarda ewe's milk (Bovera *et al*., 2003; Bianchi *et al*., 2004; Rassu *et al*., 2007) and lower than that of Sarda ewe's milk when feed on pasture ryegrass (Pirisi *et al*., 2001). Park *et al*. (2007) reported that sheep milk whey proteins account for 17-22% of total protein which is in agreement with the result of this study.

CONCLUSION

This study showed that the breed had a significant effect on lactose, solid non-fat, freezing point and density. However, no significant difference was observed between the two breeds on protein, fat, total solids and pH. The milk from Rumbi ewe seems to be richer than Ouled-Djellal's. Further Studies should carry out on milk ability and milk yield of these breeds. Algerian sheep breeds were not actually selected for their milk production; their importance for the dairy sheep industry cannot be assessed at the present time. Selection program should be implemented to improve milk production and increase fat and protein contents.

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