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Milk Composition of Najdi, Australian (Border Leicester X Merino) Ewes and Their Crossbred

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ABSTRACT. Gross composition and nitrogen distribution of ewe milk obtained from three breeds (Najdi, Australian and Najdi X Australian) in the Central region of Saudi Arabia were studied. The average results of pH, acidity, fat, protein, lactose, ash, and total solids for Najdi were 6.63 ± 0.01, 0.17 ± 0.01%, 5.31 ± 0.55%, 4.71 ± 0.28%, 4.48 ± 0.15%, 0.86 ± 0.02 and 15.36 ± 0.93%; for Australian were 6.64 ± 0.02, 0.16 ± 0.01%, 6.51 ± 0.63%, 5.60 ± 0.32, 4.65 ± 0.26, 0.87 ± 0.02% and 17.63 ± 1.05%, and for the Najdi X Australian were 6.63 ± 0.02, 0.17 ± 0.01%, 5.74 ± 0.63%, 5.14 ± 0.32%, 4.61 ± 0.20%, 0.86 ± 0.02% and 16.35 ± 0.85%, respectively. Moreover, the milk of Australian ewe contained the highest amount of protein fractions whereas the Najdi ewe's milk had the lowest values. However, Najdi ewes had the highest average daily milk yield (1.60 ± 0.21 Kg), wheres Australian ewes produced the lowest amount (0.91 ± 0.17 Kg).

Results also indicated that crossing caused heterosis effect of cross ewes which produced better milk constituents compared to the Najdi ewes and better milk yield compare to the Australian ewes. In fact, ewe's milk was evidently appreciably richer than cow's milk in nearly all the constituents determined, with the notable exception of lactose.

The total population of sheep in the world is about 1190 million of which 6.1 million are in Saudi Arabia and 170 million are in Australia (FAO/WHO/OIE 1992). It is well known that sheep milk represents one of the most valuable food resources in various parts of the world. In Saudi Arabia, sheep milk plays a very important role in the survival of the pastoral population of the country and constitutes a major source of food.

The Najdi sheep constitutes the major sheep breed in the Central region of Saudi Arabia and is well adapted to harsh environmental conditions. It can withstand extreme heat and cold and can thrive on poor ranges, but its milk production is rather poor (Sawaya *et al.* 1984). On the other hand, the Australian ewes (Border Leicester X Merino) are excellent milkers and are widely available throughout Australia as a prime lamb mother. Recently, Australian (Border Leicester X Merino) ewes were imported into Saudi Arabia from Australia, by some co-operation, and used for crossing with local Najdi sires with the intention of upgrading the native breeds to produce an adapted sheep of higher economic value.

The composition of milk, whether from cow and other mammals is dependent on factors such as breed, stage of lactation, feeding, climate, management, milking systems and individuality of the animals. Reviews on the subject were published by Ramos and Juarez (1981) and Anifantakis (1986). Although the composition of sheep milk was reported from various parts of the world (Ashton 1964, El-Gazzar and Farag 1977, Wohlt *et al.* 1981, Ramos and Juarez 1981 and Anifantakis 1986), there has been only two reports on the chemical composition of Najdi sheep milk (Sawaya *et al.* 1984 and Abdel-Rahman and Mehaia 1996) and none on the chemical composition of sheep milk produced from Najdi X Australian crossbred and Australian breeds under Saudi Arabian condition. Moreover, nitrogen distribution of cow's milk has been the subject of extensive research work (Jenness and Patton 1959 and Gordon and Kalan 1978). In contrast, data on the nitrogen distribution research data of ewe's milk are limited (Grappin 1986, and El-Deeb and Hassan 1989).

The present investigation was undertaken to study the gross composition and nitrogen distribution of ewe milk of three sheep breeds (Najdi, Australian and their Crossbred) of Saudi Arabia.

Materials and Methods

Milk Samples

Milk samples were taken from 23 ewes per breed of the Najdi, Australian and Najdi X Australian breeds maintained at the University Farm. All the ewes were in good health, in their second season of lactation and in mid-lactation (2nd to 3rd month of lactation). The ewes were hand-milked at 8 a.m. on the day of sampling. Lambs were separated from their mothers in the evening of the day prior to the day of sampling. The individual samples collected were immediately measured, refrigerated and transferred to the laboratory. The feeding regime was approximately the same for all ewes in the farm: alfalfa, wheat straw, wheat bran, grass and barley. Milk samples were taken at four different times (at days 60, 65, 70 and 75 postpartum) and were analyzed in duplicate. A composite sample of cow milk from a bulk tank from the University of Holstein-Friesian herd cows was also analyzed included for comparative purposes.

Chemical Analysis

Samples of milk were analyzed for total solids, fat, ash and titratable acidity according to procedures outlined in AOAC (1980). pH was measured with an Orion pH meter (Orion Research Inc., Cambridge, MA, USA). Lactose content was determined by difference. Energy content was calculated according to Perrin (1958a).

Determination of Protein Fractions

Nitrogen was determined by the standard micro-Kjeldahl method of the AOAC (1980). A nitrogen conversion factor of 6.38 was used for calculation of the milk protein and its various fractions. Milk samples were fractionated for total nitrogen (TN). non-protein nitrogen (NPN), casein nitrogen (CN), non-casein nitrogen (NCN) and whey protein nitrogen (WPN) by the method of Rowland (1938). The NPN was determined on the supernatant as outlined by Cerbulis and Farrell (1975).

Data were statistically analyzed by analysis of variance using SAS computer programs (SAS 1985). Standard error of the mean was derived from the error mean square term of the ANOVA. If the F test for the ewe breeds was significant ($P < .05$), a protected least significant difference test was used to compare the means of the ewe breeds.

Results and Discussion

Gross Composition

Means and ranges of gross composition of individual milk samples from ewe (Najdi, Australian and Najdi X Australian) breeds, with corresponding values for Holstein-Friesian cow milk, are given in Table 1. Data obtained showed wide range of variations, particularly in fat, protein and total solids contents of milk individual ewes within each breed. However, individuality is considered to be a significant genetically factor that affects the milk composition (Jenness and Patton 1959). The Australian ewe's milk had the highest average content of fat, protein and total solids, whereas the Najdi's ewe milk had the lowest values. Results of Najdi's ewe milk were comparable with those of other workers (Sawaya *et al.* 1984, and Abdel-Rahman and Mehaia 1996). The corresponding values for Najdi X Australian breed were in between. Breed difference in fat, protein and total solids contents were significant at $P < .05$. However, the average values of acidity, pH, lactose and ash were similar in the milk of the three breeds. Moreover, the mean energy contents of Najdi, Australian and Najdi X Australian ewe milks were 937, 1105 and 1006 Kcal/

Table 1. Gross composition and yield and standard deviations (S.D.) of milk of Najdi, Australian and Najdi-Australian crossbred ewes and Holstein-Friesian cow of Saudi Arabia[1]

Constitute	Ewe			
	Najdi	Australian	Najdi X Australian	Cow
	Mean + S.D. (range)			
pH	6.63 ± 0.01^{a} (6.61 - 6.66)	6.64 ± 0.02^{a} (6.61 - 6.67)	6.63 ± 0.02^{a} (6.61 - 6.66)	6.64 ± 0.01^{a}
Acidity, %	0.17 ± 0.01^{a} (0.14 - 0.17)	0.16 ± 0.01^{a} (0.13 - 0.16)	0.17 ± 0.01^{a} (0.14 - 0.18)	0.16 ± 0.01^{a}
Fat, %	5.31 ± 0.55^{c} (4.31 - 6.35)	6.51 ± 0.62^{a} (5.60 - 8.25)	5.74 ± 0.63^{b} (4.71 -7.51)	3.41 ± 0.15^{d}
Protein, %	4.71 ± 0.28^{c} (4.19 - 5.67)	5.60 ± 0.32^{a} (4.81 - 6.81)	5.14 ± 0.32^{b} (4.50 - 6.15)	3.29 ± 0.10^{d}
Lactose, %	4.48 ± 0.15^{b} (4.30 - 4.81)	4.65 ± 0.26^{ab} (4.35 - 4.95)	4.61 ± 0.20^{b} (4.31 - 4.82)	4.90 ± 0.10^{a}
Ash, %	0.86 ± 0.02^{a} (0.76 - 0.92)	0.87 ± 0.02^{a} (0.77 - 0.94)	0.86 ± 0.02^{a} (0.77 - 0.932)	0.73 ± 0.02^{b}
TS[2], %	15.36 ± 0.95^{c} (13.56 - 16.71)	17.63 ± 1.05^{a} (15.53 - 19.68)	16.35 ± 0.85^{b} (14.29 - 18.41)	12.33 ± 0.21^{d}
Energy, Kcal/liter	937 ± 16^{c}	1105 ± 20^{a}	1006 ± 24^{b}	686 ± 10^{d}
Milk yield, Kg/day	1.60 ± 0.21^{a} (1.37 - 1.82)	0.91 ± 0.17^{c} (0.70 - 1.09)	1.23 ± 0.12^{b} (1.10 - 1.36)	—

[1]92 Samples were analyzed in duplicate for each breed of ewes.
[2]TS = Total solids.
[abcd]Means in rows with unlike superscripts differ ($P < .05$).

liter, respectively. Changes in total solids and/or fat content of milk will affect its energy contents. These results indicated that crossing caused heterosis effect of crossbred (Najdi X Australian) which produced better milk constituents compared to Najdi ewe's milk.

In comparison to ewe's milk, cow's milk contained less fat, protein, total solids and energy (Table 1), confirming observations cited in the literature (Ashton 1964, Storry *et al.* 1983 and Anifantakis 1986). It is worth mentioning here that although in the ewe's and cow's milk the same constituents are involved there are significant differences ($P < .05$) in the proportion they exist in the dry matter (Table 2). These of course bring along differences in the nutritive value of the two kinds of milk. In the case of cheesemaking, it is expected from the same amount of dry matter to give a considerably higher yield from ewe milk, a fact of particular significance because this milk is used almost exclusively for cheese production in various parts of the world (Nunez *et al.* 1989).

Table 2. Mean values of fat, protein, lactose and ash of Najdi, Australian and Najdi-Australian Crossbred ewes and Holstein-Friesian cow milks as % of total solids

	Ewe			
Constitute	**Najdi**	**Australian**	**Najdi X Australian**	**Cow**
		(%)		
Fat	34.6[a]	36.9[a]	35.1[a]	27.7[a]
Protein	30.7[a]	31.8[a]	31.4[a]	26.7[a]
Lactose	29.1[b]	26.4[b]	8.2[b]	39.7[b]
Ash	5.6[ab]	4.9[b]	5.3[b]	5.9[a]

[abcd]Means in rows with unlike superscripts differ ($P < .05$).

In Table 3, the chemical composition of the different ewes' milks obtained here are compared with those obtained from different ewe breeds, by other workers in various parts of the world (see references in Table 3). These data emphasize the great variability in the fat and protein contents, and consequently in the percentage of total solids. In fact, the fat content of milk varies more than that any of the other constituents. This is due to breed differences, the milking systems, the stage of lactation, the nutrition plan and, in ruminants, by the quantity and physical condition

Table 3. Average chemical composition of ewe milk from different breeds in various parts of the world (%)

Country	Breed	Fat	Protein	Lactose	Ash	Total Solids	Reference
Australia	Merino	8.00	4.60	4.70	0.90	18.90	Pierce (1934)
Bulgaria	Stara Zagora	6.74	5.52	–	–	17.80	Velev *et al.* (1984)
	Various	7.14	6.40	4.39	0.96	18.89	Shalichev and Tanev (1967)
Czechoslovakia	Various	7.77	5.47	4.74	0.93	19.20	Mikus (1966)
Egypt	Barki	5.90	5.42	6.66	–	18.13	El-Gazzar and Farag (1977)
	Ossimi	5.80	5.67	6.41	–	18.10	El-Gazzar and Farag (1977)
	Rahmani	5.80	5.34	6.76	–	17.92	El-Gazzar and Farag (1977)
	Rahmani	5.80	5.42	–	0.92	16.80	Abou Dawood *et al.* (1980)
France	Various	7.51	6.00	–	–	19.31	Mahieu *et al.* (1977)
Great Britain	Clun Forest	6.20	5.30	4.70	0.87	16.90	Ashton (1964)
	Friesland and Suffolk	6.12	5.50	4.60	–	–	Storry *et al.* (1983)
	Suffolk X Clun Forest	7.80	4.90	4.40	0.95	18.40	Williams *et al.* (1976)
Greece	Boutsiko	7.68	6.04	4.80	0.93	19.30	Voutsinas *et al.* (1988)
	Friesian X Local breeds	6.04	5.71	5.09	0.87	17.59	Anifantakis (1986)
	Karagouniki	8.70	6.60	4.58	0.93	20.31	Anifantakis (1986)
	Vlachiki	9.05	6.52	4.69	0.95	20.61	Anifantakis (1986)
	Chios	7.85	5.47	4.80	0.92	19.08	Anifantakis (1986)
Hungary	Bulk	7.27	6.21	4.80	0.89	–	Balatoni (1964)
Iraqi	Awassi	6.90	6.20	5.80	0.93	19.90	Nejim (1963)
	Karadi	6.40	5.75	4.30	0.94	18.60	Abo-Elnaga *et al.* (1985)
Italy	Various	8.04	6.80	–	–	20.73	Nalossini (1963)
Japan	Various	5.79	5.62	4.22	0.85	–	Kataoka and Nakae (1971)
New Zealand	New Zealand breed	10.0	6.80	4.10	0.91	21.90	Perrin (1958b)
Norway	Various	6.93	5.32	4.93	–	18.37	Oterholm and Rognstad (1982)

Table 3. *(Continud)*

Country	Breed	Fat	Protein	Lactose	Ash	Total Solids	Reference
Saudi Arabia	Nuaimi	6.50	5.20	4.27	0.85	17.10	Sawaya *et al.* (1984)
	Najdi	5.10	4.90	4.30	0.86	16.20	Sawaya *et al.* (1984)
	Najdi	5.15	4.78	5.29	0.89	16.11	Abdel-Rahman and Mehaia (1996)
	Najdi	5.31	4.71	4.48	0.86	15.36	This work
	Australian	6.51	5.60	4.65	0.87	17.63	This work
	Najdi X Australian	5.74	5.14	4.61	0.86	16.35	This work
Spain	Manchega	7.51	5.62	--	0.91	17.93	Juarez *et al.* (1984)
USA	Dorset	12.60	5.20	4.80	0.79	23.40	Wohlt *et al.* (1981)
USSR-Armenia	Aragat	5.70	5.49	4.68	0.96	16.39	Dilanian (1969)
	Balbass	5.84	5.29	4.69	0.96	16.89	Dilanian (1969)
	Merino-Balbass Cross breeds	6.01	5.26	4.53	0.97	16.84	Dilanian (1969)
	Merino-Nazech Cross breeds	6.61	5.39	4.13	0.94	17.20	Dilanian (1969)
Yugoslavia	Pramenka	7.22	5.81	4.74	0.97	18.75	Miocinovic *et al.* (1981)
	Zlatusha	8.09	5.89	4.61	0.99	–	Miocinovic *et al.* (1981)

of the dietary roughage (Ashton 1964, Wohlt *et al.* 1981 and Anifantakis 1986). It is evident from Table 3 that the fat content of milk of Saudi ewe breeds was relatively low compared to other ewe breeds such as those from Australia (Pierce 1934), Bulgaria (Shalichev *et al.* 1967), Czechoslovakia (Mikus 1956), France (Mahieu *et al.* 1977), Great Britain (Ashton 1964 and Williams *et al.* 1976), Greece (Anifantakis 1986), Italy (Nalossini 1963), New Zealand (Perrin 1958b), Spain (Juarez *et al.* 1984), USA (Wohlt *et al.* 1981) and Yugoslavia (Miocinovic *et al.* 1981). Similarly the protein content of Saudi ewe milk was also lower than that of Bulgaria, France, Greece, Hungary and New Zealand ewe breeds. In Saudi Arabia, however, fat, protein and total solids contents of Nuaimi ewe's milk (6.50, 5.20 and 17.10%) were higher than those of Najdi (5.10, 4.90 and 16.20%) and Najdi X Australian (5.74, 5.14 and 16.35%) ewe milks (Sawaya *et al.* 1984 and Abdel-Rahman and Mehaia 1996), whereas the protein and lactose contents were lower than those of Australian ewe's milk.

With few exceptions, the percentages of lactose and ash obtained by various workers (Table 3) are in close agreement with our results. However, El-Gazzar and Farag (1977) obtained a considerably high figure for lactose. This might be due to the analytical procedure used. Since the composition of milk is a function of several factors such as breed, environment, season, stage of lactation, milk system, *etc.* and varies between fairly wide limits (Anifantakis 1986), the composition of the milk usually varies and depends on the combined influence of these factors which vary from one country to another (Sawaya *et al.* 1984).

Table 1 also shows the mean daily milk yield for each ewe breed when the milk samples were taken. Variations of yields are considerable within each breed but between breeds differences in milk daily yield were significant at P < .05. Najdi ewes had the highest average daily milk yild (1.60 ± 0.21 Kg), while Australian ewes produced the lowest amount (0.91 ± 0.17 Kg). Najdi ewes daily milk yield is in agreement with the values recently reported by Abdel-Rahman and Mehaia (1996), 1.55-1.72 Kg.

Nitrogen Distribution in Milk

The data presented in Table 4 show the nitrogen distribution in milks of Najdi, Australian and Crossbred ewes and Holstein-Friesian cow. Whereas Table 5 summarizes the average distribution of the various nitrogen fractions as % of total nitrogen (TN). Distinctive breed differences exist in the nitrogen content of ewe milks (Table 4). Milk from Najdi ewes had the lowest content of TN, PN, CN, NCN and WPN, whereas the milk from the Australian breed had the highest. Breed differences in TN, PN and CN contents were significant at P < .05. Moreover, within each breed a considerable variation exists in the nitrogen content of milk. Similar observations were reported in milk of cow breeds (Cerbulis and Farrell 1975).

The NPN content of ewe milk is less variable among breds, but the range within a given breed is considerable (Table 4). The NPN fraction accounts for only 6.5, 5.8 and 6.1% of the total nitrogen in milk of Najdi, Australian and Najdi X Australian bred, respectively (Table 5). These results were relatively lower than that reported for Egyptian Rahmani ewes (8.1%) as reported by El-Deeb and Hassan (1989), and were slightly higher than that reported for Lacaunce ewes (4.6%) in France (Grappin 1986). However, the average value of NPN content for cow milk was considerably lower compared to that of ewe milk breeds (Table 4), and accounts for only 5.2% of the TN (Table 5). These value are in agreement with other workers (Cerbulis and Farrell 1975, Grappin 1986 and Saidi and Warthesen 1993).

With respect to the casein nitrogen content of ewe milk breeds (Table 4), the Australian breed had the highest content and the Najdi's the lowest; whereas the

Table 4. Nitrogen distribution and standard deviations in milks of Najdi, Australian and Najdi X Australian crossbred ewes and Holstein-Friesian cow of Saudi Arabia (mgN/100 ml)[1]

Component[2]	Ewe: Najdi	Ewe: Australian	Ewe: Najdi X Australian	Cow
	Mean + S.D. (range)			
TN	738 ± 43[c] (657 - 889)	878 ± 49[a] (754 - 1067)	806 ± 47[b] (705 - 964)	516 ± 7.0[d]
NPN	48 ± 3.2[a] (40 - 56)	51 ± 3.5[a] (42 - 59)	49 ± 3.1[a] (42 - 56)	27 ± 1.3[b]
PN	690 ± 25[c] (617 - 825)	827 ± 41[a] (720 - 1000)	757 ± 45[b] (658 - 910)	489 ± 5.40[d]
CN	580 ± 21[c] (520 - 680)	703 ± 35[a] (602 - 841)	637 ± 31[b] (561 - 770)	403.5 ± 4.5[d]
NCN	158 ± 16[a] (142 - 195)	175 ± 18[a] (151 - 210)	169 ± 12[a] (165 - 195)	112.5 ± 4.1[b]
WPN	110 ± 9[a] (96 - 126)	124 ± 13[a] (108 - 145)	120 ± 14[a] (105 - 140)	85.5 ± 3.5[b]

[1]92 Samples were analyzed in duplicate for each breed of ewes.
[2]TN = Total nitrogen, NPN = non-protein nitrogen, PN = protein nitrogen, CN = casein nitrogen, NCN = Non-casein nitrogen, WPN = whey protein nitrogen.
[abcd]Means in rows with unlike superscripts differ ($P < .05$).

value of Najdi X Australian breed was in between. Breed differences in casein content were significant at $P < .05$. Casein is the principle protein component of milk, as well as the principle protein component of cheese; hence, the yield of cheese depends mainly on the amount of casein in milk. The percentage of total nitrogen of milk as casein, also called the casein number, characterizes the suitability of milk for cheese production. The average casein numbers for Najdi, Australian and Najdi X Australian ewe milks were 78.6, 80.1 and 79.0, respectively (Table 5). These values are in agreement with those of other workers (Grappin 1986). Whereas the values are lower than that reported by El-Deeb and Hassan (1989) for Rahmani ewe's milk (83.2) in Egypt, and are higher than that of Manchege ewe's milk (75.5) in Spain (Juarez *et al.* 1984). Casein number of cow milk (78.2) was relatively lower than that of ewe milk (Table 5). Cerbulis and Farrell (1975) reported that the average casein number for cow milk was 77.9 and varies between 64.3 to 83.7. For the cheese industry, however, ewe milk would be best suited for manufacturing of certain types of cheeses for which cow milk might not be the best suitable.

Table 5. Average distribution of the various nitrogen fractions in milks of Najdi, Australian and Najdi X Australian Crossbred ewes and Holstein-Friesian cow of Saudi Arabia (N% of TN)

Component[1]	Ewe			
	Najdi	Australian	Najdi X Australian	Cow
NPN	6.5[a]	5.8[b]	6.1[ab]	5.2[c]
PN	93.5[b]	94.2[a]	93.9[ab]	94.8[a]
CN	78.6[ab]	80.1[a]	79.0[ab]	78.2[b]
NCN	21.4[a]	19.9[b]	21.0[a]	21.8[a]
WPN	14.9[b]	14.1[b]	14.9[b]	16.6[a]

[1]NPN = Non-protein nitrogen, PN = protein nitrogen, CN = casein nitrogen = casein number, NCN = Non-casein nitrogen, WPN = whey protein nitrogen.
[abcd]Means in rows with unlike superscripts differ ($P < .05$).

The whey protein nitrogen (WPN) content in milk of the three ewe breeds were relatively similar, and were considerably higher than that of cow milk (Table 4). However, the WPN accounts for only 14.9, 14.1 and 14.9% of the TN in milk of Najdi, Australian and Najdi X Australian ewes, respectively. These results were considerably higher than that reported for Egyptian Rahmani ewes, 8.7% (El-Deeb and Hassan 1989), but were relatively lower than that reported for French Laraunce ewes, 16.7% (Juarez *et al.* 1984). On the other hand, the average WPN percentage of total nitrogen in cow milk (16.6%) was higher than that in ewe milk (14.7%). Cerbulis and Farrell (1975) reported that the average WPN in cow milk was 17.2% of the total milk nitrogen and Grappin (1986) reported that the average value was 17%. Breed differences in average non-casein nitrogen (NCN) content, which equal to the NPN plus WPN contents, were not significant.

Conclusions

From the foregoing results it could be concluded that Australian ewe's milk contained the highest amount of fat, protein fractions, total solids and energy, the Najdi's contained the lowest amount, whereas, the values of the Cross-bred ewes were in between. However, Najdi ewes had the highest average daily milk yield, while Australian ewes produced the lowest amount and the value of the Cross-bred ewes was in between. This implies that crossing caused heterosis effect of Cross-bred ewes which produced better milk constituents compared to that of the Najdi breed and better milk yield compare to that of the Australian ewes. However, more research is needed to explore factors that influence milk composition and yield of the three ewe breeds, under Saudi Arabian conditions.

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References

Abdel-Rahman, K.M. and **Mehaia, M.A.** (1996) Influence of feeding different crude fiber levels on milk yield and milk composition of Najdi ewes. *Small Ruminant Res.*, **19:** 137-141.

Abo-Elnaga, I.G., El-Dahan, A.S. and **Ridah, S.H.** (1985) The composition of Karadi ewe's and goat's milk. *Nahrung,* **29:** 197-200.

Abou Dawood, A.E., Ghita, I.I. and **Taha, S.M.** (1980) Major and minor components and trace elements of Egyptian ewes' and goats' milk. *Egyptian J. of Dairy Science,* **8:** 109-115.

Anifantakis, E.M. (1986) Comparison of physico-chemical properties of ewes' and cows' milk. *Bulletin of International Dairy Federation,* **202:** 42-53.

AOAC (1980) *Official Methods of Analysis,* 12 **Ed.** Association of Official Chemists, Washington, D.C., USA.

Ashton, W.M. (1964) A study of the composition of Clun Forest ewes' milk. *J. Agric. Sci.,* **63:** 85-90.

Balatoni, M. (1964) *Studies of the composition and properties of ewes' milk. Maryar Agrartudomanyi Egyetem Mezogazdasagtuamanyi Kara,* Godollo, Hungary, Doct. Thesis (from *Dairy Science Abstract,* **26:** 3039.)

Cerbulis, J. and **Farrell, H.M.** (1975) Composition of milks of dairy cattle. I. Protein, lactose, and fat contents and distribution of protein fraction. *J. Dairy Sci.,* **58:** 817-827.

Dilanian, A.H. (1969) Properties of cow's, ewe's and buffaloes milk in the Socialist Sovietic Republic of Armenia. *Bulltein of the International Dairy Federation Part VI.*

El-Deeb, S.A. and **Hassan, H.N.** (1989) Effect of cold storage on physico-chemical properties of goats' and ewes' milk. *Asian J. Dairy Res.,* **8:** 29-34.

El-Gazzar, H. and **Farag, A.H.** (1977) A comparative study on the physico-chemical properties of the sheep milk of local breeds. *Agric. Res. Review (Cairo),* **55:** 175-180.

FAO/WHO/OIE (1992) Animal Health Yearbook. *FAO Animal Production and Health Series* No. 32, Food and Agriculture Organization, Rome, Italy.

Gordon, W.G. and **Kalan, E.K.** (1978) Protein of milk. *In: Fundamentals of Dairy chemistry* (Eds.) **Weeb, B.W., Johnson, A.H.** and **Alford, J.A.** AVI Publish. Comp. Inc., Westport, CN. USA., 87-124 pp.

Grappin, R. (1986) Variations of the major nitrogen fractions of goat and ewe milk. *Bulltein of the International Dairy Federation,* **202:** 79-81.

Jenness, R. and **Patton, S.** (1959) The composition of milk. *In: Principles of Dairy Chemistry,* 1st **Ed.** Wiley Eastern Private Ltd., New Delhi, India, 1-29 pp.

Juarez, M., Ramos, M., Golcoechea, A. and **Jimenez-Perez, S.** (1984) Main components, nitrogen fractions and mineral elements of Manchega ewe's milk. *Chemie Mikrobiologie Technologie der Lebensmittel,* **8:** 143-146.

Kataoka, K. and **Nakae, T.** (1971) *Japanese J. Dairy Sci.,* **20:** A222-A232.

Mahieu, H., Le Jaouen, J.C., Luquet, F.M. and **Mouillet, L.** (1977) Etude comparative de la composition et de la contamination der laits des especes laitieres bovin. *Le Lait,* **565-566,** 287.

Mikus, M. (1966) *Ved. pr. vysk. vst. ovciar.* **3:** 139 from **Anifantakis, E.M.** (1986). *Bulletin of the International Dairy Federation,* **202:** 42-53.

Miocinovic, D., Ostojic, M. and **Vasic, J.** (1981) Changes in composition of ewes' milk during lactation. *Mljekarstvo,* **31:** 23-27 (from *Dairy Science Abstract,* **44:** 4296).

Nalossini, F. (1963) *Annali Sper. Agr.,* **17:** 681 from **Anifantakis, E.M.** (1986), *Bulletin of the International Dairy Federation,* **202:** 42-53.

Nejim, H.T. (1963) *J. Dairy Res.,* **30:** 81.

Nunez, M., Medina, M. and **Gaya, P.** (1989) Ewes' milk cheese: technology, microbiology and chemistry. *J. Dairy Res.,* **56:** 303-321.

Oterholm, A. and **Rognstad, H.** (1982) Norsk Forsoksproduksjon ar saueost. *Meieriposten,* **71:**87 from **Anifantakis, E.M.** (1986) *Bulletin of the International Dairy Federation,* **202:** 42-53.

Pierce, A.W. (1934) The yield and composition of the milk of the Merino ewe. *Australian J. Exper. Biol. Medical Sci.,* **12:** 7-12.

Perrin, D.R. (1958a) The calorific value of milk of different species. *J. Dairy Res.,* **25:** 215-221.

Perrin, D.R. (1958b) Chemical composition of the colostrum and milk of the ewe. *J. Dairy Res.,* **25:** 70-76.

Ramos, M. and **Juarez, M.** (1981) The composition of ewe's and goat's milk. *Bulletin of the International Dairy Federation,* **140:** 5-19.

Rowland, S.J. (1938) The determination of nitrogen distribution in milk. *J. Dairy Res.* **9:** 42-46.

Saidi, B. and **Warthesen, J.J.** (1993) Heat and fermentation effect on total nonprotein nitrogen and urea in milk. *J. Food Sci.,* **58:** 548-551.

SAS (1985) *SAS User's Guide Statistics.* Version 5 Edition, SAS Institute Inc., Cary, NC, USA.

Sawaya, W.N., Safi, W.J., Al-Shalhat, A.F. and **Al-Mohammad, H.M.** (1984) Studies on the chemical composition and nutritive value of sheep milk. *Milchwissenschaft,* **39:** 90-93.

Shalichev, Y. and **Tanev, G.** (1967) *Animal Sci.,* **4:** 81-86.

Storry, J.E., Grandision, A.S., Millard, D., Owen, A.J. and **Ford, G.D.** (1983) Chemical composition and coagulating properties of renneted milks from different breeds and species of ruminant. *J. Dairy Res.,* **50:** 215-229.

Velev, S., Peichevski, I., Stankov, I.K., Dimitrov, T. and **Petrova, N.** (1984) Composition of milk of Stara Zagora ewes. *Zhivotnov dni Nauki,* **21:** 42-46 (from *Dairy Science Abstract,* **46:** 7159).

Voutsinas, L.P., Delegiannis, C., Katsiari, M.C. and **Pappas, C.** (1988) Chemical composition of Boutsiko ewe milk during lactation. *Milchwissenschaft,* **43:** 766-771.

Williams, A.P., Bishop, D.R., Cockburn, J.E. and **Scott, K.J.** (1976) *J. Dairy Res.,* **43:** 325-329.

Wohlt, J.E., Kleyn, D.H., Vandernoot, G.W., Selfridge, D.J. and **Novotnet, C.A.** (1981) Effect of stage of lactation, age of ewe, sibling status, and sex of lamb on gross and minor constituents of Dorset ewe milk. *J. Dairy Sci.,* **64:** 2175-2184.

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مكونات حليب الأغنام النجدية والأسترالية والهجين منهما

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تم دراسة التركيب الكيماوي والتوزيع النيتروجيني لحليب كل من الأغنام النجدية والأسترالية والهجين منهما وذلك في المنطقة الوسطى من المملكة العربية السعودية وكان متوسط نتائج رقم الحموضة (pH) ونسبة الحموضة والدهن والبروتين واللاكتوز والرماد والجوامد الصلبة الكلية في حليب الأغنام النجدية كما يلي : ٦٣, ٦ ± ٠١, ٠ ، ١٧, ٠ ± ٠١, ٠ ٪ ، ٣١, ٥ ± ٥٥, ٠ ٪ ٧١, ٤ ± ٢٨, ٠ ٪ ، ٤٨, ٤ ± ١٥, ٠ ٪ ، ٨٦, ٠ ± ٠٢, ٠ ٪ ، ٣٦, ١٥ ± ٩٣, ٠ ٪ على التوالي وفي حليب الأغنام الأسترالية كما يلي : ٦٤, ٦ ± ٠٢, ٠ ٪ ، ١٦, ٠ ± ٠١, ٠ ٪ ، ٥١, ٦ ± ٦٣, ٠ ٪ ، ٦٠, ٥ ± ٣٢, ٠ ، ٦٥, ٤ ± ٢٦, ٠ ، ٨٧, ٠ ± ٠٢, ٠ ٪ و ٦٣, ١٧ ± ٠٥, ١ ٪ على التوالي وفي حليب الأغنام الهجين كما يلي : ٦٣, ٦ ± ٠٢, ٠ ، ١٧, ٠ ± ٠١, ٠ ٪ ، ٧٤, ٥ ± ٦٣ ٪، ١٤, ٥ ± ٣٢, ٠ ٪ ، ٦١, ٤ ± ٢٠, ٠ ٪ ، ٨٦, ٠ ± ٠٢, ٠ ٪ و ٣٥, ١٦ ± ٨٥, ٠ ٪ على التوالي .

وأحتوى حليب الأغنام الأسترالية على أعلى كميات من أجزاء البروتينات بينما حليب الأغنام النجدية احتوى على أقل كميات من اجزاء البروتينات . لكن الأغنام النجدية اعطت أعلى متوسط كمية حليب في اليوم (٦٠, ١ ± ٢١, ٠ كجم) بينما

الأغنام الأسترالية أعطت أقل كمية (٩١ ,٠ ±١٧ ,٠ كجم) .

ومن ناحية أخرى أوضحت النتائج ان عملية التهجين حسنت من مكونات الحليب الناتج من الأغنام الهجين بالمقارنة بحليب الأغنام النجدية المنخفض في مكوناته ، وحسنت من كمية الحليب بالمقارنة بالأغنام الأسترالية منخفضة الإنتاج .

إن حليب الأغنام أغنى من حليب الأبقار في جميع مكوناته تقريباً عدا اللاكتوز كان تقريباً متساوي .