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Milk composition Comparison between donkey, goat and cow breeds

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Abstract – This study is interested in donkey's milk composition of Tunisian donkey breed. Milk composition of donkey population was compared with goat and cow breeds. Manual milking was carried out only once a day after separation of asses from their colt. Bovine milk was obtained from 73 animals (Holstein breed) reared in 5 private farms situated in kef, cows were mechanically milked. Goat milk was collected from 73 local Tunisian goat breed reared in 4 private farms situated in Kef. After milking, samples of a donkey, bovine, and goat milk were immediately cooled and transported, to the laboratory, under refrigerated conditions. Result showed that milk content varied significantly with breeds. Dray matter were 9.8 ± 0.56; 11.9 ± 0.5 and 12.1 ±1.1 respectively for donkey, cow and goat. Protein, lactose, fat and ash content for donkey were 1.49 ± 0.3; 6.07 ± 0.43; 1.3 ± 0.4 and 0.51 ± 0.05 respectively. Cattle milk content was higher than donkey and goat breeds. These parameters were 3.07 ± 0.2; 5.02±0.12; 3.6±0.4 and 0.74 ±0,02 for Protein, lactose, fat and ash. Gaot analysed milk showed 3.01 ± 0.3; 4.5 ± 0.4; 5.04 ±1.7 and 0.85± 0.009 for Protein, lactose, fat and ash. This species can play key economic potential for Tunisian farmers in the future.

Keywords: milk, characteristics, donkey, goat, cow.

1. Introduction

The donkey is native to northeastern Africa, it is domesticated in Egypt around 4000-5000 BC and in the Middle East around 100 BC (Beja-Pereira et al. 2004; Clutton-Brock 1999; Epstein 1984). For a long time, the donkey occupies a social, economic, cultural and medicinal importance , from where in Africa, it is used for the transport of the people and the goods search for water point, agricultural work (Doutressoulle 1947; ROAMBA 1990; Tapsoba 2012)and also for treatment of several diseases like (whooping-cough, hemorrhoid))(Bernus 2013), it is for this reason in kabylie they respect donkeys and refuse to mistreat them . Donkeys milk was used as a breast milk substitute because for their similar nutritional composition especially low casein content(Vincenzetti et al. 2005), and high content of lysozyme 1 mg/l(Vincenzetti et al. 2005). It is more and more used to nourish allergic kids to cow milk (Carroccio et al. 2000; Lauzier 2011). Recently, some researchers show the effects of donkey's milk on atherosclerosis prevention (Tafaro et al. 2007),they also prove that it has an antibacterial, antiviral(Brumini et al. 2013; Vincenzetti et al. 2005), and antitumor effect(Mao et al. 2009). Finally, donkey milk is highly used for cosmetic reasons.

In Tunisia, the donkey was used in farms for agricultural work. Donkey's milk has not been valorized yet. National statistics (ONAGRI 2018) show a headcount of 123000 unequally distributed in Tunisian territory; in fact, mountainous, borders and center regions hold the majority of a donkey.

Few studies concerning this theme have been carried out such as (Sana 2005) which is interested in the phenotypic characterization of donkey breeds in Tunisia, (Charfi et al. 2018) has studied the microbiological quality of Arabian donkey milk. So, it seems important to focus on this species that seems to be an economic potential for Tunisian farmers in the future. For this reasons, this study is interested in donkey's milk composition of Tunisian donkey breed.

2. Materials and Methods:

2.1. Milk samples

Donkey milk was collected from 73 local Tunisian donkeys aged between 8 and 10 years reared in 3 Tunisian regions (Kef, Zaghouan,Kasserine). Manual milking was carried out only once a day after separation of asses from their colt. Bovine milk was obtained from 73 animals (Holstein breed) reared in 5 private farms situated in kef, cows were mechanically milked. Goat milk was collected from 73 local Tunisian goat breed reared in 4 private farms situated in Kef. After milking, samples of a donkey, bovine,and goat milk were immediately cooled and transported to the laboratory under refrigerated conditions.

2.2. Chemical composition

The pH was measured by a pH meter (Model , HI98107 pHep) Dry matter, Protein, Fat, Ash,Lactose, Density and freezing point were analyzed using an automatic milk analyzer device " Lactoscan " calibrated to donkey, cow and goat milk.

2.3. Statistical analysis:

After data collection and processing, different statistical tools were used, all data was processed by using Microsoft excel 2007 software.Results were analyzed using one-way ANOVA to verify therepeatability of every parameter result. These analyses werecarried out usingXlstat(Addinsoft 2013). To compare between each mean value parameter of donkeymilk, bovine milk and goat milk data were subjected to Student's t-test.The statistical significance of the relationship was analyzedat the 95% confidence level and evaluated by the Pvalue.

3. Results And Discussion

3.1. Milk composition

Result showed that milk content varied significantly with breeds. Dray matter were 9.8 ± 0.56; 11.9 ± 0.5 and 12.1 ±1.1 respectively for donkey, cow and goat. Protein, lactose, fat and ash content for donkey were 1.49 ± 0.3; 6.07 ± 0.43; 1.3 ± 0.4 and 0.51 ± 0.05 respectively. Cattle milk content was higher than donkey and goat breeds. These parameters were 3.07 ± 0.2; 5.02±0.12; 3.6±0.4 and 0.74 ±0,02 for Protein, lactose, fat and ash. Gaot analysed milk showed 3.01 ± 0.3; 4.5 ± 0.4; 5.04 ±1.7 and 0.85± 0.009 for Protein, lactose, fat and ash.

The observed average of donkey milk dry matter content (Tab1) (9.8%) was higher than data reported by (Ivanković et al. 2009; Salimei et al. 2004) respectively (8.8 %, 8.48%) and lower than data for dry matter content (10.8%) reported by (Oftedal and Jenness 1988), this level of donkey milk dry matter is significantly ($p<0.0001$) lower than cow and goat milk (fig 1) .

The observed average of milk fat content (Tab1) (1.3 ± 0.4 %) was found to behigher than values reported by (Guo et al. 2006)and (Ivanković et al. 2009) respectively (1.15%, 0.22%).It remained lower than data reported by (Oftedal and Jenness 1988) (1.82%) and higher than the value reported by (Ivanković et al. 2009) respectively (0.22%),compared to goat and bovine milk (Fig 1) Fat content donkey milk shows a lower fat content($p<0.0001$) for this reasons, it was recommendedin diet therapy to prevent cardiovascular, autoimmune and inflammatory diseases(Martemucci and D'Alessandro 2012).

The observed average milk protein contentof Tunisian donkeys breed (Tab1) (1.49%) was similar to the data protein content 1.5% proved by (Ivanković et al. 2009) for the littoral Dinaric asses and it was lower than values reported by (Salimei et al. 2004) and (Giosuè et al. 2008) respectively (1.72%,1.89%).According to most authors, the composition of protein content varies considerably among species and is influenced by breed, stage of lactation, feeding, climate, parity, season and udder health status (Gubić et al. 2015). The protein content of donkey milk was significantly ($p<0.0001$) lower than cow and goat milk (Fig1).

The average lactose contentof Tunisian donkeys breed (Tab1) (6.07 ± 0.41%) was lower than content found by (Guo et al. 2006; Ivanković et al. 2009; Salimei et al. 2004) ,Donkey milk lactose is significantly higher than cow and goat milk (Fig 1) ($p<.0001$) (Fig1). In fact,the high lactose level is responsible for the good palatability of milk and facilitates the intestinal absorption of calcium that is essential for Infant's bone mineralization. Lactose gives good taste to donkey milk (Monti et al. 2007) and is also a precious source of galactose, essential for the development of the nervous system.

Compared withgoat and bovine milk, donkey milk presents high lactose content, therefore it's as inadequate for people suffering from lactose intolerance (Heyman 2006).
Basedon protein and lactose content similar to human milk (Salimei et al. 2004),donkey milk could be better substitute for the breastmilk compared to bovine and goat milk.

Table 1. Physicochemical characteristics of Tunisian donkey milk compared to bovine and goat milk

	Donkey milk	Bovine milk	Goat milk
Dry matter (%)	9.8 ± 0.56	11.9 ± 0.5	12.1 ±1.1
Protein (%)	1.49 ± 0.3	3.07 ± 0.2	3.01 ± 0.3
Lactose (%)	6.07 ± 0.43	5.02 ± 0.12	4.5 ± 0.4
Fat (%)	1.3 ± 0.4	3.6 ± 0.4	5.04 ± 1.7
Ash (%)	0.51 ± 0.05	0.74 ± 0,02	0.85 ± 0.009

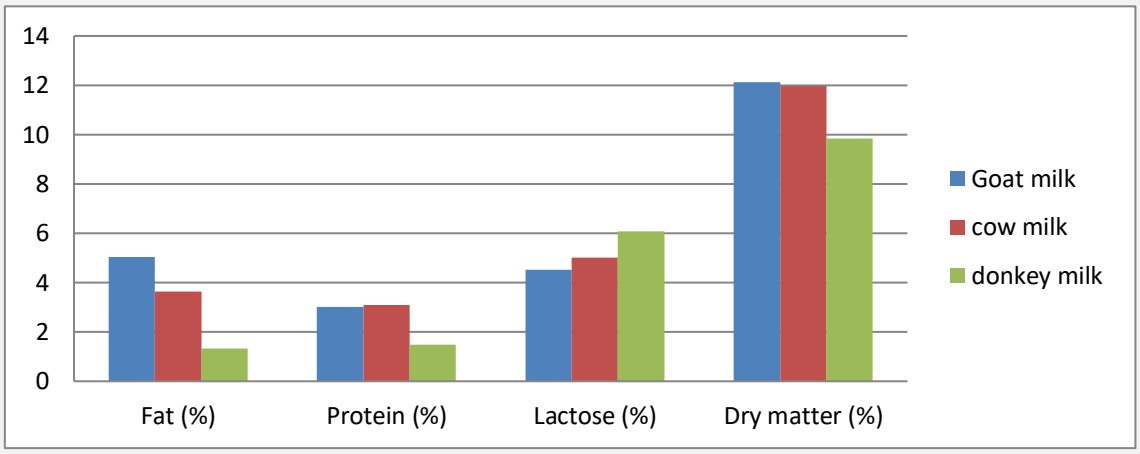

Fig 1. Variation of the chemical composition of donkey, goat and cow milk

Donkey milk had a freezing point value of -0.510, which was significantly ($P \leq 0.0001$) higher than that of bovine milk -0.520 (°C) and goat milk -0.555 (°C) (Fig 2). This result can be explained by the dry matter content of asses milk, which was lower compared to cow and goat milk .In fact ,milk freezes at a temperature slightly lower than water, because of the presence of soluble constituents such as lactose and soluble salts; the freezing point of milk depends on the molar concentration of its soluble, low molecular weight compounds (Acharya et al. 2006; Charfi et al. 2018).

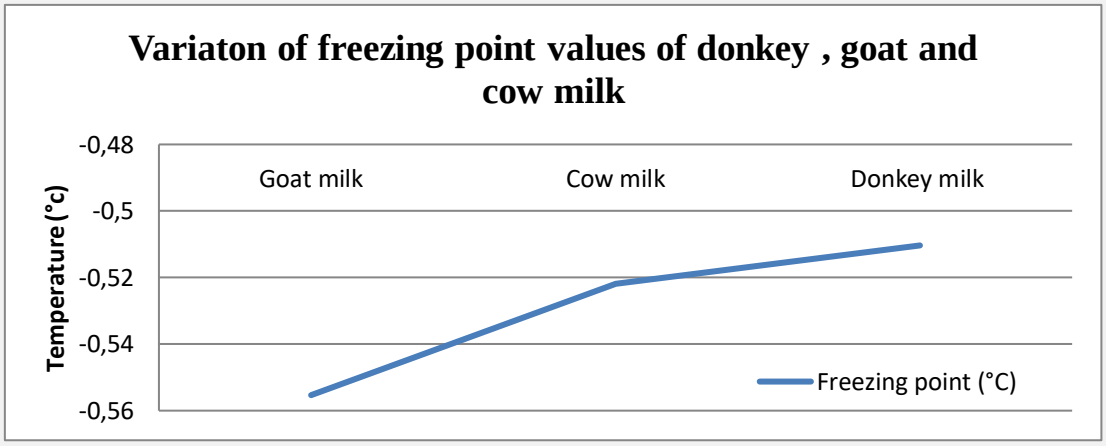

Fig 2. Variation of freezing point values of donkey, goat and cow milk

The pH measurements performed on a donkey, goat,and bovine milkshowed that donkey milk had higher neutral pH (7.09) compared to bovine milk (6.65) and goat milk (6.5) (Fig 3).This difference was explained by the lower levels of caseins, phosphate, citrates and initial lactic acids present in donkey milk (Charfi et al. 2018).

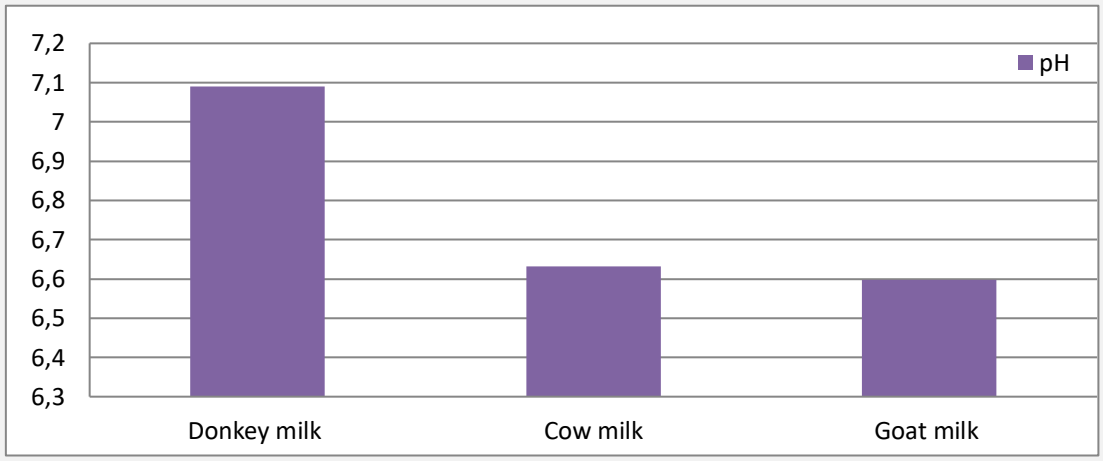

Fig 3. Variation of pH values of donkey, cow and goat milk

4. Conclusion

Result showed that milk content varied significantly with breeds. Dray matter were 9.8 ± 0.56; 11.9 ± 0.5 and 12.1 ±1.1 respectively for donkey, cow and goat. Protein, lactose, fat and ash content for donkey were 1.49 ± 0.3; 6.07 ± 0.43; 1.3 ± 0.4 and 0.51 ± 0.05 respectively. Cattle milk content was higher than donkey and goat breeds. These parameters were 3.07 ± 0.2; 5.02±0.12; 3.6±0.4 and 0.74 ±0,02 for Protein, lactose, fat and ash. Gaot analysed milk showed 3.01 ± 0.3; 4.5 ± 0.4; 5.04 ±1.7 and 0.85± 0.009 for Protein, lactose, fat and ash.

Donkeys can play a vital role in the Tunisian economy. Nowadays, for its multidisciplinary use such as cosmetics, medicinal and health issues donkey milk become more and more sought-afterwhich makesthe research of their production possibilities reasonable.Further research of milkproduction and functionality and production technology will help in a more completeutilization of Tunisian donkey.

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