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Comparison of Fatty Acid Contents of Cow and Goat Colostrum

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Abstract: Colostrum has great importance in the development and viability of the offspring. The importance of colostrum comes from its nutrients. Goat milk has rapidly increase especially in the last 10 or 20 years with the importance given to public nutrition and the benefits of goat milk. Although there is 1.6 percent protein in breast milk, this rate is 4.3 in goat milk. Easy digestion of goat milk protein has a practical and special place in the nutrition of infants and diets of sick and old people. The colostrum composition are highly variable due to a number of factors, including individuality, breed, parity, pre-partum nutrition, length of the dry period of cows and time post-partum. The aim of this study was to compare the fatty acids contents of cow colostrum and goat which is most frequently used in human nutrition. Animal material healthy and similar characteristics of the 15 head Holstein cow and 15 head Saanen goat breed were used. These cows and goats were selected among the first to give birth. Colostrum samples were taken at birth at 8 and 16 hours after parturition. The pH, protein, fat, moisture, ash and fatty acid analyzes of colostrum samples were carried out in the laboratory of Çukurova University Fisheries Faculty. At the end of this study the level of Caproic acid, Caprylik acid and Caprik acid levels were lowe in cattle. On contrar yerucic acid, Docosahexaenoic acid, Stearic acid, Methylpentadecanoate, palmitic acid and Palmitoleic acid levels of cattle were higher than goats. Thus it can be said that the contents of colostrum of animal types were significant ($p<0,01$).

Key words: comparisons, goat, cow, colostrum, fatty acids

I. Introduction

Colostrum is the first milk secretion of mammary gland containing more lactalbumin and lactoprotein, and also being rich in antibodies that confer passive immunity to the newborn. Colostrum are rich in protein, immunoglobulin, lactoferrin and growth factors. Colostrum is a valuable food source for all mammals especially humans. Cow's milk is widely consumed in the world, but goat's milk has become prominent in recent years with some different characteristics. Goat milk has been proposed as an alternative to human breast milk. Goat's milk is an easily digestible, tasty and nutrient-rich alternative in the intestine. Goat milk has rapidly increase

especially in the last 10 or 20 years with the importance given to public nutrition and the benefits of goat milk. It is suggested that newborn babies can get some nutrients they need from cow's milk in goat's milk in cases where they cannot get breast milk and during childhood development. Although there is 1.6 percent protein in breast milk, this rate is 4.3 in goat milk. Easy digestion of goat milk protein has a practical and special place in the nutrition of infants and diets of sick and old people. The colostrum composition are highly variable due to a number of factors, including individuality, breed, parity, pre-partum nutrition, length of the dry period of cows and time post-partum . In general, colostrum contains less lactose and more fat, protein, peptides, non-protein nitrogen, ash, vitamins and minerals, hormones, growth factors, cytokines and nucleotides than mature milk; except in the case of lactose, the levels of these compounds decrease rapidly during the first 3 days of lactation (Uruakpa et al. 2002). Changes in the composition and physical properties of milk throughout lactation have been studied extensively (Cerbulis and Farrell, 1976; Donnelly and Horne, 1986; Quigley et al, 1994; Rodriguez et al., 2001; Sacerdote et al, 2013); however, little is known about the comparative stdy with goat and cow colostrum. Generally, but not always, the fat content of colostrum is higher than that of milk (Marnila and Korohnen 2002; Madsen et al. 2004). There is a very wide range of average fat content of colostrum (Kehoe et al. 2007; Morrill et al. (2012). Abd El-fattah et al. (2012) reported a decrease in the fat content of colostrum from Holstein cows from 8.04% at parturition to 3.9% after 5 days. The aim of this study was to compare the faty acids contents of cow colostrum and goat which is most frequently used in human nutrition.

II. Material and Methods

This study was carried out in Çukurova University Agricultural Faculty Research Farm and a Private Farm in Eastern Mediterranean Region of Turkey. As animal material healthy and similar characteristics of the 15 head Holstein cow and 15 head Saanen goat breed were used. All animals were in first gestation and single birth. Colostrum samples were taken at birth at 8 and 16 hours after parturition. After cleaning and disinfection of the udder, colostrum samples were taken to a 15 ml sterile tube and the information on the cow was recorded on the tube and frozen at -20 °C before being stored in the freezer until -80 °C until the analysis period. During the analysis period, the sample was dissolved at +4 °C and the necessary measurements were made. The pH, protein, fat, moisture, ash and fatty acid analyzes of colostrum samples from the Holstein and Jersey breed cows were carried out in the laboratory of Çukurova University Fisheries Faculty.

Lipid Analysis

Lipid analysis was performed according to the method applied by Bligh and Dyer (1959). 15 g of the homogenized sample is then mixed with 120 mL of methanol / chloroform (1/2) on the homogenizer. Subsequently, the samples filtered from the filtration paper (Scleicher & Schuell, 5951/2 185 mm) by adding 20 mL of 0.4% $CaCl_2$ solution onto these samples are drained into the tared flask jars for 1 hour at 105 °C.These balloons are closed to keep their mouths in a dark place. The next day the upper layer of methanol-water is removed by a separating funnel. Chloroform from the chloroform-lipid fraction remaining in the balloons is blown in the water bath at +60 °C using a rotary evaporator.Then the balloons are kept in the oven for 1 hour at 90 °C and the entire chloroform is allowed to fly. It is cooled to room temperature in a desiccator and weighed on a precision sensitive scale of 0,1 mg.

Determination of Fatty Acids

Fatty acid methyl esters from exudated lipid were made according to the method of Ichihara et al. (1996).4mL of 2M KOH and 2mL of n-heptane are added onto the exhaled 25 mg oil sample. It is then stirred for 2 minutes at room temperature in a vortex and centrifuged at 4000 rpm for 10 minutes and the heptane layer is taken for analysis in gas chromatography (GC).

Gas Chromatography Conditions

Fatty acid analysis was analyzed using a GC Clarous 500 device (Perkin-Elmer, USA), a flame ionization detector, and a SGE column (30 m x 0.32 mm ID x 0.25 lm BP20 0.25 UM, USA).The injector and detector

temperatures are first adjusted to 220 °C and then to 280 °C respectively. The oven temperature is maintained at 140 °C for 5 minutes.It is then increased by 4 °C every minute to 200 °C, and from 200 ° C to 220 °C by increasing 1 °C every minute. The sample size is 1ml and the carrier gas is controlled at 16 ps. Split 1: 100 ratio was used. Fatty acids are defined by comparing the FAME mixture, which consists of a standard of 37 components, depending on their arrival times.

pH Analysis

pH changes in colostrum were measured using a digital pH meter (WTW 315i pH Meter; Weilheim, Germany). 5 ml colostrum was taken and mixed in 50 ml of distilled water (1/10) for 5 minutes. The pH of the colostrum was measured by immersing the pH meter in this solution.

Total Crude Protein Analysis

Total crude protein was made according to Kjeldahl method (AOAC 1984). 2 Kjeldahl tablets (Merck, TP826558) and 20 ml H_2SO_4 are added to the 1 g homogenized sample in Kjeldahl tubes and the samples are burned for 2-3 hours until the green color. After reaching room temperature, 75 mL of water is added to the tube. 25 ml of 40% boric acid (H_3BO_3) solution is added to the erlenile, kjeldahl tubes are placed in the kjeldahl device with 40% NaOH distillation for 6 minutes. The solution in the Erlen from the Kjeldahl is titrated with 0.1 M HCl until the color is transparent.

Crude Ash Analysis

Crude ash analysis was performed according to AOAC (920.153., 2002) method.Porcelain crucibles used in the analysis is first dried in an oven at 103 ° C for 2 h,after cooling in the desiccator, the tares are taken at 0.1 mg sensitive precision scale. 3.3-5 g is taken from the homogenized sample and weighed by placing in the crucibles and these samples are burnt for 4 hours at +550 ºC until the color is light gray and then cooled to room temperature in the desiccator and weighed in the sensitive balance.

Moisture Analysis

Moisture analysis was based on AOAC (950.46., 2002) method. The casseroles are dried for 1 hour at 105 ° C in the oven and cooled for 30 minutes at the desiccator and the tares are taken at 0.1 mg sensitive precision scale. The tare weight of the crucible is taken and approximately 4-5g of homogenized sample is placed and dried at 105 ° C (24 hours).The sample is placed in the desiccator to cool to room temperature The results are weighed by weighing in a 0.1mg sensitive scale.

Statistical analyses

Data were analyzed using the SPSS 2016 program. The model included breed and time (1st, 8th and 14th hour of lactation) and the interaction between the two factors. Data were analyzed by analysis of variance(ANOVA), and Duncan's test was applied in order to determine statistical differences between group means. Significance was determined at $P<0.05$.

III. Results and discussion

In this study, chemical composition of colostrum of goat and cow having their first birth is given in Table 1. In the table, it is seen that protein ratios in the colostrum of goats and cows are similar. It was found higher fat ratios in goat colostrum that the differences were significant ($p<0.00$). In addition, when the differences in chemical composition between species are examined, it is seen that the difference between lipid ($p<0.05$). As seen in Table 1, difference between moisture and pH ($p<0,01$) were significant while protein, lipid and ash were not ($p>0,05$).

Table 1. Chemical composition of cow and goat colostrum

Content	Cow $\bar{X}\pm S\bar{x}$	Goat $\bar{X}\pm S\bar{x}$	**Significance level**
Protein (%)	7,04±3,19	7,86±0,65	,831
Lipid (%)	4,35±0,43	10,34±4,02	,021
Moisture (%)	82,88±1,85	70,85±0,73	,000
Ash(%)	0,51±0,74	1,00±0,38	,381
pH	6,16±0,09	6,32±0,03	,015

$\bar{X}\pm S\bar{x}$:Mean ± standard deviation,$p<0.05$

Kehoe et al. (2007) found in their study that the protein content of colostrum 14.9%, fat ratio 6.7% and ash ratio 0.05%. Tsioulpas et al. (2007) found the protein, fat and ash ratios as 16.2%, 3.6% and 1.25%. Patoo et al. (2014) found the maximum mean fat, protein, total solids and ash content As 6.79 ± 0.16, 13.28 ± 0.13, 23.02 ± 0.27, 1.10 ± 0.06 and they have found a decrease in rates as the postpartum days progress. Paszczyk et al (2016) reported that average contents of fat in the colostrum and milk of all cows amounted to 5.5% and 3.7%. McIntyre et al. (1952) reported that the pH of colostrum at parturition ranged from 6.0 to 6.61, with an average value of 6.32. Sebela and Klicnik (1977) reported that the low pH of colostrum is caused by the increased concentration of protein, dihydrogen phosphate, citrate and carbon dioxide.

The detailed fatty acids profiles of goat and cow colostrum were given Table 2. In goat and cow colostrum, 26 fatty acids were detected. The differences Myristic acid, Palmitic acid, Margaric acid, Vaccenic acid, Eicosanoic acid and Eicosadienoic acid were not significant. The highest 3 fatty acids in goat colostrum were Palmitic acid, Oleic acid and Myristic acid while Palmitic acid, Oleic acid and stearic acid in cow colostrum.

Table 2. The detailed fatty acids profiles of goat and cow colostrum

Faty acids	**Formula**	**Goat**	**Cow**	**Significance**
Caproic acid	C6:0	1,01±0,3	0,66± 0,09	0,001
Caprylic acid	C8:0	1,44±0,5	0,46±0,10	0,001
Capric acid	C10:0	5,94±0,6	0,86±0,13	0,000
Laurik acid	C12:0		1,76±0,26	
Myristic acid	C14:0	9,79±2,2	9,73±1,32	0,595
Myristoleic acid	C14:1	0,22±0	0,33±0,04	0,008
Pentadecanoic acid	C15:0	0,66±0,1		
Methylpentadecanoate	C15:1	0,21±0	0,36±0,06	0,017
Palmitic acid	C16:0	28,52±3,6	31,62±0,66	0,275
Palmitoleic acid	C16:1	1,15±0,1	1,44±0,10	0,012
Margaric acid	C17:0	1,11±0,1	1,02±0,06	0,194
Heptadecenoic acid	C17:1	0,68±0,1	0,41±0,06	0,003
Stearic acid	C18:0	8,39±2,3	12,46±0,33	0,002
Oleic acid	C18:1n9	28,09±2,5	25,33±1,07	0,016
Vaccenic acid	C18:1n7	0,90±0,1	0,94±0,03	0,329
Linoleic acid	C18:2n6	2,46±0,1	2,8±0,37	0,012
Alfa Linolenic acid	C18.3n3	0,42±0	0,22±0,02	0,000
Gama Linolenic acid	C18:3n6	0,17±0	0,1±0,01	0,000

Arachidic acid	C20:0	0,58±0,1	0,25±0,08	0,000
Eicosanoic acid	C20:1n9	0,09±0	0,1±0,03	0,855
Eicosadienoic acid	C20:2n6	0,06±0	0,07±0,01	0,346
Erucic acid	C22:1n9	0,46±0,1	0,79±0,14	0,013
Behenic acid	C22:0	0,03±0		
Eicosapentaenoic acid (EPA)	C20:5n3		0,08±0,02	
Docosahexaenoic acid	C22:6n3	0,07±0	0,22± 0,07	0,018
Homo- γ –Linolenic acid	C20:3n6	0,09±0		
Nervonic acid	C24:1n9	0,09±0,1		
Lignoceric acid	C24:0	0,29±0,1		

Laakso et al. (1996) reported that the during the first week of parturition, the proportions of short-chain fatty acids (C_4–C_{10}) typically increased as well as those of stearic and oleic acids, whereas the relative amounts of C_{12}–C_{16} acids decreased, especially those of myristic and palmitic acids of cow colostrum. Palmquist et al. (1993) reported that the proportions of short-chain fatty acids, with the exception of C4, are low in cow colostrum. Paszczyk et al. (2005) reported that colostrum contains a lower content of *trans* fatty acids and *cis*-9 *trans*-11 C18:2 (CLA) than milk. Bitman and Wood (1990) reported that all five major subclasses of phospholipids are present at significantly lower concentrations in colostrum. Also cholesterol content of colostrum reported that significantly higher than milk (Precht 2001). ∑ SFA, ∑MUFA and ∑PUFA ratios of fatty acids detected in goat and cow colostrum is given Table 3.

Table3. Goat and cow colostrum ∑ SFA, ∑MUFA and ∑PUFA ratios

Faty acids	**Goat**	**Cow**
C6:0	1,01±0,3	0,66± 0,09
C8:0	1,44±0,5	0,46±0,10
C10:0	5,94±0,6	0,86±0,13
C12:0		1,76±0,26
C14:0	9,79±2,2	9,73±1,32
C15:0	0,66±0,1	
C16:0	28,52±3,6	31,62±0,66
C17:0	1,11±0,1	1,02±0,06
C18:0	8,39±2,3	12,46±0,33
C20:0	0,58±0,1	0,25±0,08
C22:0	0,03±0	
C24:0	0,29±0,1	
∑ SFA	**57,76**	**58,82**
C14:1	0,22±0	0,33±0,04
C15:1	0,21±0	0,36±0,06
C16:1	1,15±0,1	1,44±0,10
C17:1	0,68±0,1	0,41±0,06
C18:1n7c	0,90±0,1	0,94±0,03
C18:1n9c	28,09±2,5	25,33±1,07
C20:1n9	0,09±0	0,1±0,03
C22:1n9	0,46±0,1	0,79±0,14
C24:1n9	0,09±0,1	
∑ MUFA	**31,89**	**29,7**
C18:2n6	2,46±0,1	2,8±0,37

C18:3n6	0,17±0	0,1±0,01
C18:3n3	0,42±0	0,22±0,02
C20:2n6	0,06±0	0,07±0,01
C20:5n3		0,08±0,02
C20:3n6	0,09±0	
C22:6 n3	0,07±0	0,22± 0,07
∑ PUFA	**3,27**	**3,49**
MUFA/SFA	0,55	0,5
PUFA/SFA	0,06	0,06
PUFA/MUFA	0,1	0,12
∑n6	2,78	2,97
∑n3	0,49	0,52
n6/n3	5,67	5,71

Table 3 shows that the total saturated fatty acid (∑ SFA) ratios of the animals are 57.76% and 58.82%, respectively, in goats and cows. ∑ SFA rates were higher in cows. Monounsaturated fatty acids (∑ MUFA) rates were calculated as 31.89% in goat and 29.7% in cows, and ∑ MUFA rates were higher in goats. Polyunsaturated fatty acids (∑ PUFA) were calculated as 3.37% in goats and 3.49% in cows. ∑ PUFA rates were higher in cows. The fatty acid composition of colostrum may be affected by several factors. In colostrum, as in normal milk, the fatty acid composition depends on the lipid profile of the feed. Some of the long chain n3-unsaturated fatty acids (n3-PUFA) from fish oil in the feed pass to the colostrum (Cattaneo et al. 2006). Since fatty acids are essential for newborn calves, fats taken from feed and fat tissue of the animal help to maintain a certain level of long chain PUFA in the colostrum (Leiber et al., 2011).

IV. Conclusions

It has been concluded that, significant differences in colostrum fatty acids composition among goat and cow species were pointed out. Thus to understand of goat milk importance in infants and sick and old human beings diets the fatty acid profile should be indicated. The knowledge of differences in composition and functional properties farm animal colostrum will increase knowledge on the beneficial effects on animal production and human nutrition as well as their potential in disease prevention and/or treatment.

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