FULL CHARACTERIZATION OF BOVINE COLOSTRUM, RAW MATERIAL FOR DIETARY SUPPLEMENTS. HIS BENEFICIAL EFFECT ON THE HUMAN IMMUNE SYSTEM

— research paper —

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Abstract: Colostrum is the first substance that is produced by the mammary gland (pre-milk), following the birth of the newborn. Having a special composition compared with any other food, this product may represent an irreplaceable support the immune system. The most important components of these foods are the immune factors, growth factors and protective proteins that helps the newborn to survive. For characterization of this product, we collected samples of colostrums from Holstein different cattle breeds, first milked after calving. Samples were taken from cattle farms in the area of Transylvania and analyzed in the laboratory of SC Bioef SRL, Alba. Samples were analyzed physic-chemical (parameters: fat, protein, milk solids, etc) and enzymatic immediately after sampling and were frozen for the determination of immunoglobulin and lactoferrin. This bovine colostrum has been transformed to powder using a freeze-drying system. The products is freeze at – 35 Celsius degrees and after that dry at 40 Celsius degrees under low pressure (vacuum) to keep intake the content of immunoglobulin and lactoferrin.
The bovine colostrums is an important source of lactoferin and immunoglobulin that can help the human immune system to fight with the all the potential infection. The amount of lactoferrin and and immunoglobulin IgG is 388.41 mg/l respectively 98.46 mg/ml. Temperature above 60 degrees Celsius degraded the IgG and LF in bovine colostrum.

Keywords: immunoglobulin (IgG), lactoferrin, bovine colostrum, freeze-drying system

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INTRODUCTION

The colostrums contains immunes factors that provides the immunity necessary to ward off potentially fatal infections until the newborn's immunity system is activated and growth factors who helps to complete the development of the digestive system (the gut), which is not fully developed at the time of birth, as presented by (Stott, 1981) and (Boyd, 1972).

It is a big difference in composition between bovine colostrums and human colostrums. (Keech, 2009) showed that the human placenta allows passing immunoglobulin G, from mother to sun, which is responsible for the activation and establishing the immune system of the newborn. After birth, the human colostrums has o small quantity of immunoglobulin G (IgG) but a big concentration of immunoglobulin A (IgA), which is responsible to defend the body from the local infection, starting with the mouth.

The bovine placenta, however, does not allow the passage of the IgG from mother to fetus and the calf is born completely unprotected from infection. In order to activate the immune system, the bovine colostrums contain over 85% IgG of total immunoglobulin. This is the reason to use bovine colostrums from the first milking after calving to create a dietary supplement than can help the immunity system of human body.

The first objective of this study is to establish the quality of the bovine colostrums from Holstein cows, to determining the physical-chemical compositions (dry matter, protein, fat, density, lactose, ash, chlorides, phosphorus, calcium, magnesium, potassium, sodium, immunoglobulin G, lactoferrin), to freeze dry this samples to obtain colostrums powder.

Because the samples of colostrums must be freeze to storage and after that thawed and centrifugation to extract the fat, these steps involve heating to a temperature as close as possible from 60 to 70 Celsius degrees to a good separation of fat.

A second objective is to determine the effect of the temperature and "stress factors" (freeze–thawed, heating, and centrifugation) on the immunoglobulin and lactoferrin concentration.

Data will be analysed statistically according to the animal's breed, age, location, health and number of calving until the time of sampling.

MATERIALS AND METHODS

Bovine colostrums – raw material

Colostrum was collected from 60 cows from farm Bioterra (Alba department) until March and July, totaling about 60 liters of colostrums**.** Samples have been collected from first milked after calving, each cow was milked out as completely as possible by machine, and about 800 - 1500 ml was taken for analysis. All samples were stored at - 20°C (freeze). After the analysis, the samples are freeze-dried and the products are analyses for the same parameters described above. For testing the effect of freeze, thawed, fat separation, heating to better separation, 5 samples from the same colostrum ware analyzed (IgG and lactoferrin) after heating at 40, 60 and 70 Celsius degrees

Methods

Dry matter and ash content of all samples were determined according to the AOAC methods. Samples were analyzed for protein by the Kjeldahl method (Kjeldahl system form Velp, Italy) according to the European standard. The fat analysis was made using the Gerber methods (centrifuge Funke Gerber) and the lactose was determined using the Luft Schoorl method.

The cations (Ca, Mg, Na, K) was determined using an atomic absorption spectrophotometer (GBC, Sens AA, Australia) and the cations was determined by titration (using the Volhard method for chloride) and by UV VIS spectrophotometer (Varian, Cary 50) for phosphorus.

The immunoglobulin and lactoferrin concentration was determined using the enzymatic method Elisa with active micro plates (Bio-X diagnostic for IgG and Taradon, Belgium for lactoferrin and a multiskan reader Thermo Scientific).

RESULTS AND DISCUSSIONS

Dry matter, ash, total protein, fat, somatic cells, lactose, pH, conductivity, and density, cations (Ca, Mg, Na, and K) anions (chloride, phosphorus) in liquid colostrum

Colostrum has a high content of dry matter comparable to normal milk, has a very variable content of fat and is very rich in protein. (Parrish et al., 1950) reported that, based on equal weights of dry matter, milk had a similar energy value to colostrum. Therefore, when colostrums is diluted with water

to the totals solids content of milks, 50 kg colostrum would be equivalent on an energy basis to approximately 100 kg of milk, as presented by Parrich D.B. and Wise G.H.

The dry matter in colostrum consists essentially of protein, carbohydrate (mainly lactose) fat, minerals and vitamins. The nutrients are needed for the survival of the newborn it is weaned. The amount of dry matter in colostrums would have an effect on the movement of water in the digestive tract of the suckling calf.

The lactose concentration in the colostrums is lower than normal milk and this can be an advantage because the lactose can induce the diarrhea (Kruse, 1970).

The results we obtained by analyze the colostrums samples (media value for each parameter) is shown in the Table 1.

Table 1: The average values calculated for each breed of cows

Parameter	UM[1]	Result	Max[3]	Min[4]
Dry matter	%	23.56	29.15	21.60
Density	g/cm^3	1.076	1.088	1.060
Fat	%	3.51	5.78	4.60
Total protein	%	9.47	11.66	6.59
Lactose	%	3.50	3.37	3.94
pH		6.490	6.110	6.380
Conductivity	mS/cm	5.40	5.24	5.20
NCS[2]	µg/dl	2.55	2.39	2.94

1- NCS – somatic cells; 2 - Measuring unit; 3- Maximum value, 4 - Minimum value

Our date for ash is very similar but variable for all the cows. The composition of colostrums ash is mainly formed by calcium, magnesium, potassium and sodium but also iron and phosphorus, chloride and other minerals. In our laboratory we tested and determined the concentration in Ca, Mg, K, Na, chloride and phosphorus. Other minerals as lead, manganese and cobalt are not detected.

Some studies showed that Ca, Mg, Na, Chloride and P were high at parturition and during the early hours of lactation but rapidly declined towards a fairly constant level as the milk became normal. Calcium and phosphorus are needed for development of bones and teeth. In addition to its function as a major constituent of the bones, phosphorus is involved in

energy metabolism and many other metabolic functions. Chloride is the major anion that determines the tonicity of milk.
The results that we obtained for this parameter are described in Table 2. Differences of concentrations for cations and anions between breeds of cows are not very large, they are determined to a great extent on the type and composition of the daily nutrition of cows.
There were significant variations observed concentrations of anion and cation with the animal age and his health. They found higher concentrations in anion and cation nutrition for cows which are supplemented with combined feed containing mainly these minerals. For example, there are differences of calcium content among in colostrums from cows feeded with various foods (273.47 mg/100 g) and cows ho are not received combined feed (168.48 mg/100 g).

Table 2: The average values for cations and anions of colostrums bovine samples

Parameter	UM[1]	Result	Max[3]	Min[4]
Calcium	mg/100 g	258.71	273.47	203.46
Magnesium	mg/100 g	37.74	39.11	35.54
Sodium	mg/100 g	125.49	63.58	59.02
Potassium	mg/100 g	151.08	151.93	243.2
Chloride	mg/l	236.89	211.47	252.44
Phosphorus	mg/100 g	127.75	56.77	60.32
Ash	%	1.48	1.33	1.10

Concentration of immunoglobulin and lactoferrin in bovine milk

Regarding the content of immunoglobulin and lactoferrin in colostrum, the results showed a significant decrease in the concentration depending on the sampling period, on the number of hours after parturition and a increasing of concentration depending with the animal age and number of parturition, as presented by (Saucedo – Quintero and Avendano-Reyes, 2004).
So how many hours the time of parturition with increases in both colostrum composition change, so after 24 hours, respectively after the third milking, colostrum has a composition approximately similar to normal milk. There are many studies in literature that have shown that the concentration of IgG in colostrum decreases by up to 47% of initial value, after 24 hours of calving, as presented by (Brandon et al., 1971)

The concentration obtain for immunoglobulin IgG and lacoferrin are shown in Table nr 3 for median, maximum and minimum values.

Table 3:. The concentration of IgG and lactoferrin in bovine milk

Parameter	UM[1]	Result	Max[3]	Min[4]
Immunoglobulin IgG	mg/ml	98.46	108.12	73.25
Lactoferrin	mg/l	388.43	405.46	255.38

We discovered large variations comparing the concentration in IgG / animal age. We observe that proportionally with increasing the number of calving increase the concentration of immunoglobulin IgG and lactoferrin (LF) in colostrums, as observed in Table 4.

Table 4: Variation of IgG and LF concentration with number of calving

Number of calving	Immunoglobulin IgG	Lactoferrin
	(mg/ml)	(mg/100 ml)
1	67.8	28.62
2	71.4	32.15
3	76.7	36.25
4	99.01	45.25

The concentration in lactoferrin in the colostrum is an important parameter since it can be exploited later in the food supplements industry. Lactoferrin is sensitive to heat and partially destroyed by pasteurization. The process of freeze drying of colostrum could be an advantage in keeping intact the content of lactoferrin. The concentration of lactoferrin in milk is approximately 120 – 150 mg/l but in colostrums we found an average of about 388.43 mg/l.

Effect of temperature and stress condition on the IgG and LF amount

For testing the influence of the temperature and stress condition, 5 samples from the same batch of colostrums were submitted to freezing, defrosting, and centrifugation ad heating condition at different temperature: 40, 60 and 70 Celsius degrees. The result obtained for IgG and LF are shown in Table 4.

Table 4: Variation of IgG and LF whit temperature and stress condition

	Immunoglobulin IgG			Lactoferin LF		
	40°C	40°C	60°C	40°C	60°C	70°C
	mg/ml	mg/ml	mg/ml	mg/l	mg/l	mg/l
Sample 1	106.78	106.78	96.78	257.50	258.00	90.00
Sample 2	104.83	104.83	95.26	261.50	260.00	165.50
Sample 3	106.45	106.45	94.75	255.00	271.50	152.00
Sample 4	105.82	105.82	95.12	254.00	268.00	129.00
Sample 5	107.11	107.11	96.32	252.00	271.50	126.50

CONCLUSIONS

The bovine colostrum is an important source of lactoferin and immunoglobulin that can help the human immune system to fight with the all the potential infection. The amount of lactoferrin (388.41 mg/l) and immunoglobulin IgG (98.46 mg/ml) are high compared to regular milk or with any other foodstuff.

High temperature (above 60 degrees Celsius) is a factor of degradation of immunoglobulin and lactoferrin, an aspect taken into consideration in the next stages of processing.

However, the freeze-drying process can maintain intake the original composition of the colostrum.

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