

Original Research Article

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Studies on Physical and Microbial Parameters of Bovine Colostrum Powder

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This study investigates the physical and microbial parameters of bovine colostrum powder. Colostrum is the first mammary secretion for 24 - 48 hours after parturition and is a complex fluid rich in immune factors and growth factors. Studies have indicated that the immune boosting properties of bovine colostrum are beneficial for human beings with no reports of allergic or anaphylactic reactions. Colostrum powder was prepared by spray drying the whole colostrum. Physical and Microbial parameters were analyzed in colostrum powder. The total viable count found to be increased as the advancement of storage and coliforms were not detected. While comparing the water activity on initial and final day no changes were observed. With regard to physical parameters viz. texture analysis, insolubility index and bulk density no difference was found between cow and buffalo colostrum powder. Storage study of colostrum powder was carried out up to 6 months period

Introduction

In the recent days, the development of a new product which is rich in protein, vitamins and mineral content and also have therapeutic values are at a high demand among the consumers. The global consumers are more concerned about the nutrition of food what they intake than the taste of the food. Nowadays, high calorie foods are mostly avoided even by the younger generations. The importance of new product development and the role of food engineers and the nutritionists towards the development of nutritious food is

at a rapid growth. The demand of the consumer towards healthy food has made the professionals to move towards the new product development. As of now the only available immunoglobulin rich product is colostrum which is used in prevention and treatment of disease.

Colostrum is the secretion of the mammary gland immediately after parturition and contains a high concentration of Immunoglobulin (Tom R. Philips, 1998). Colostrum is the most persuasive natural immune booster known to science apart from a source of nutrients (contains more protein,

immunoglobulins (Igs), non-protein nitrogen (NPN), fat, ash, vitamins and minerals than does normal milk) (Xanthou *et al.*, 1995; Xu, 1996; Quigley and Drewry, 1998). Available evidence suggests a beneficial effect of supplementation of bovine colostrum in improving body composition, athletic performance, diarrhoea in person with immune deficiency syndromes, NSAID (Nonsteroidal induced gastrointestinal disturbances and aspects of the acute phase response that occur secondary to surgery (Kelly, 2003).

Concerning on the surplus amount of colostrum which is rich in immunoglobulin, a rare substance found in naturally occurring material, the excess amount of colostrum could be utilized for the production of colostrum powder rich in immunoglobulin G.

Spray drying is fast and energy efficient compared to other drying methods (like, freeze drying and microwave evaporation). In this method, under controlled conditions, evaporation maintains low droplet temperature, 20–30 °C lower than outlet air temperature in concurrent system (Carid, 2003), which can avoid heat damage to the bioactive components (Chelack *et al.*, 1993).

Hence this study is envisaged to investigate the physical and microbial properties of spray dried cow and buffalo colostrum.

Materials and Methods

Buffalo and cow colostrum were collected from the Community Cattle Care Centre of CFDT, Koduvveli, Government Instructional Livestock Farm Complex (ILFC), Madhavaram, Post-Graduate Research Institute in Animal Sciences (PGRIAS), Kattupakkam of Tamilnadu Veterinary and Animal Sciences University (TANUVAS) and Private farms. Colostrum samples were collected for 2 consecutive days immediately

after parturition from both cow and buffalo. After collection, the colostrum samples were stored at -20°C for further analysis.

Processing of colostrum

Colostrum powder

Glass Spray Drier (Milk-Tech Engineers) was used to make spray dried cow and buffalo colostrum powder. Based on preliminary studies, colostrum powder (CP) was prepared by adopting 160/80°C- inlet/outlet air temperature and stored at room temperature.

Insolubility index

The insolubility index was determined as prescribed in IDF (1988) by adding 10g of colostrum powder to 100ml of water at 24°C±0.2°C with high speed mixing for 90 seconds after adding defoaming agent (octyl alcohol or diglycol laurate). The reconstituted milk was left to stand for 15min and after stirring, it was filled in 50ml centrifuge tubes. It was centrifuged and supernatant was removed. It was diluted with water to 50ml and recentrifuged at 900rpm for 5min. The amount of sediment in tubes was taken in ml and expressed as insolubility index.

Bulk density

Bulk density of spray dried colostrum was measured as per the method given in GEA Niro Analytical Methods for Dry Milk Products, GEA Process Engineering A/S, Denmark by using Thermonic bulk density apparatus (Campbell electronics, Mumbai).

For measuring the bulk density of spray dried colostrum, a 50 mL glass measuring cylinder without top was weighed. It was filled up to 50 mL mark with powder using a spoon. The weight of the powder was recorded and loose bulk density was calculated using below

mentioned formula and expressed as g mL⁻¹.

Bulk Density (g mL⁻¹) = Weight of the powder / volume

Subsequently after closing the cylinder with rubber stopper, it was tapped 100 times. The volume of the powder in the cylinder was recorded and packed bulk density (g mL⁻¹) was calculated using same formula above.

Water activity

The Novasina lab touch water activity meter was used to determine the water activity of the Colostrum powder samples. Sample cup was filled up to half of its volume with sample and placed into water activity meter after well setting and calibration. Readings were displayed automatically after 5 minutes on the screen and expressed as a_w .

Texture analyser

The hardness of the powder were analysed by TA.XT Plus texture analyser (Microstable systems). Physical product characteristic such as hardness, adhesiveness of the food is measured.

Texture analyser settings and parameters:
Sequence Title: TPA 1 T.A. Variable No: 1:
Compression Pre-Test Speed: 1.00 mm/sec
Test Speed: 5.00 mm/sec Post-Test Speed: 5.00 mm/sec T.A. Variable No: 5: 0.0 g
Distance: 10.000 mm Strain: 75.0 % Trigger Type: Auto (Force) Trigger Force: 5.0 g
Probe: PCC; PCC Batch: TPA TEST Points per second: 200 Test Run by: MVC

Microbial analysis

Total viable count (TVC) and coliform counts of samples were determined by the method described by American Public Health Association (APHA, 1984). 10g of the

colostrum powder was added with appropriate diluent and it is blended and homogenised for 2-5min. 1ml of this primary dilution is added into sterile petriplates in duplicate. Serial dilution was performed at 10⁻², 10⁻³, 10⁻⁴ for TVC. Add 1ml from each dilution in respective petri plates. Pour the sterile molten plate count agar. Allow the plate to solidify. Invert the plates and incubate at 37°C for 48 hours

10g of the colostrum powder was added with appropriate diluent and it is blended and homogenised for 2-5min. 1ml of this primary dilution is added into sterile petriplates in duplicate. Serial dilution was performed (10⁻²). Pour the sterile molten violet red bile agar. Allow the plate to solidify. Invert the plates and incubate at 35°C for 18-24 hours. The Media used were from Hi-Media, Mumbai.

Statistical analysis

The results from all of the tests were calculated as mean \pm SE obtained from average of six trials. Analyses were performed using IBM SPSS® 20.0 for Windows® software as per the standard procedure of Snedecor and Cochran, 1989.

Results and Discussion

Insolubility index were observed as 0.10 \pm 0.013 and 0.10 \pm 0.014 ml and 0.15 \pm 0.013 and 0.10 \pm 0.014 ml for 1st and 2nd day milking of cow and buffalo colostrum powder respectively. According to Indian Standard Institution the maximum insolubility index of spray dried skim milk powder should be 2.0 ml. Hence, the result obtained in present study was within the limit.

Bulk density was 0.425 \pm 0.001 and 0.421 \pm 0.001 g/m3 for 1st and 2nd day cow colostrum powder, whereas, 0.454 \pm 0.002 and

0.450±0.001 g/m3 for buffalo colostrum powder. The results obtained were closely related to the findings of Upadhyay (1989). As per the study of Upadhyay (1989), the bulk density of normal spray dried powder varies between 0.5-0.8 g/ml. The result of Bulk density and Insolubility index is shown in table 1.

The water activity for cow colostrum powder on initial day storage was 0.556±0.001 and 0.557±0.001 while, the level for final day of storage were 0.550±0.009 and 0.550±0.001 respectively. For buffalo colostrum powder on initial day storage were 0.550±0.003 and

0.551±0.001 while, the level for final day storage were 0.549±0.000 and 0.551±0.001 respectively (Table 2). Statistical analysis revealed that there is no significant difference in initial and final day for buffalo colostrum powder but in cow colostrum powder it showed significant difference. It was demonstrated that an increase in equilibrium moisture content was very small in the range of water activity 0.1 to 0.9. Higher levels of water activity than 0.9 resulted in a marked increase of equilibrium moisture content and susceptibility to spoilage by microorganisms (Stencl, 1999).

Table.1

Physical properties	Cow colostrum powder				Buffalo colostrum powder		
	Days		F Value	Days		F value	
	1	2		1	2		
Insolubility index	0.10±0.013 ^a	0.10±0.014 ^a	0.78 ^{NS}	0.15±0.013 ^b	0.10±0.014 ^a	0.025*	
Bulk density	0.425±0.001 ^b	0.421±0.001 ^a	0.093*	0.454±0.002 ^a	0.450±0.001 ^a	0.082*	

@ Average of six trials; NS-Non-Significant ($P>0.05$); * - Significant ($P<0.05$), Mean Values bearing different superscripts in a row differ significantly

Table.2

Parameters	Cow colostrum powder				Buffalo colostrum powder			
	Days	1	2	F value	1	2	F value	
Initial day (A_w)	0.556±0.001 ^{aB}	0.557±0.001 ^{bB}	0.754 ^{NS}	0.550±0.003 ^{aA}	0.551±0.001 ^{aA}	0.429 ^{NS}		
Final day (A_w)	0.550±0.009 ^{aA}	0.550±0.001 ^{aA}	1.00 ^{NS}	0.549±0.000 ^{aA}	0.551±0.00 ^{bA}	0.357 ^{NS}		
F value	0.014*	0.011*		0.625 ^{NS}	1.00 ^{NS}			

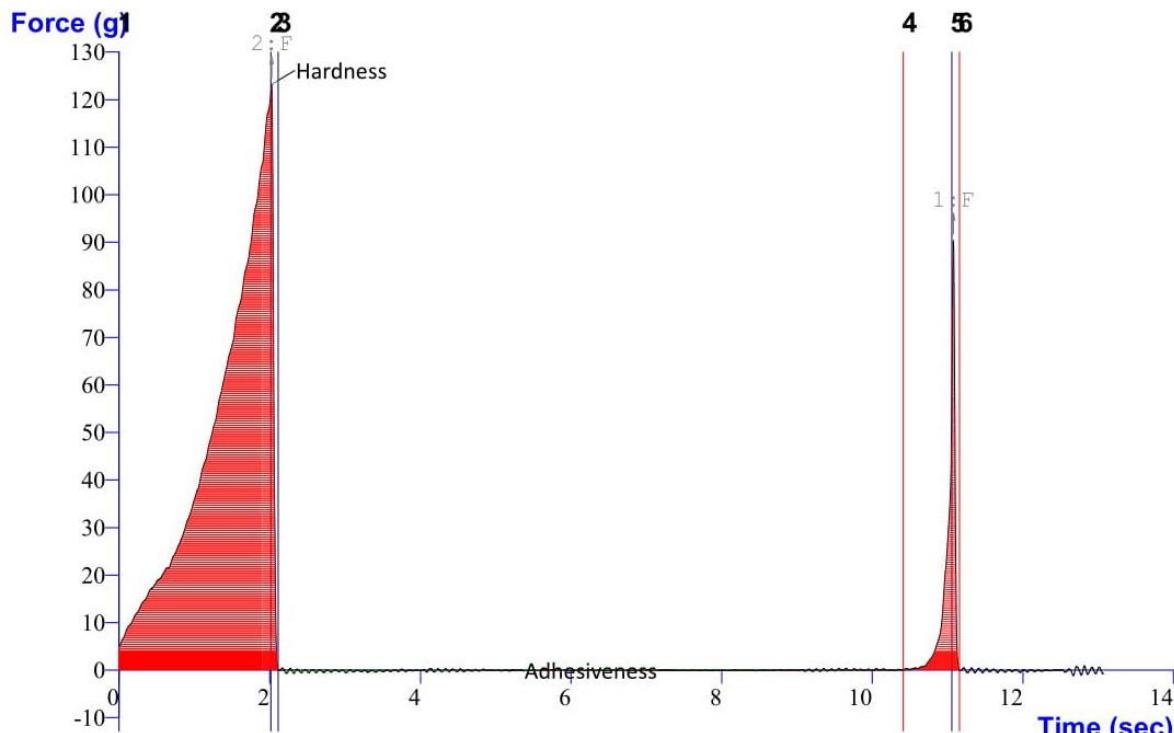
@ Average of six trials; NS-Non-Significant ($P>0.05$); * - Significant ($P<0.05$); Mean Values bearing different lower case superscripts in a row differ significantly, Mean Values bearing different upper case superscripts in a column differ significantly.

Table.3

Microbial analysis (\log_{10} cfu/ml)	Days	Cow colostrum powder				Buffalo colostrum powder			
		Storage period(in months)			F value	Storage period(in months)			F value
		1	3	6		1	3	6	
Total viable count	1	1.5±0.05	1.57±0.09	1.65±0.15	0.12 ^{NS}	1.48±0.04	1.55±0.08	1.63±0.11	1.00 ^{NS}
	2	1.52±0.06	1.58±0.03	1.67±0.10	1.05 ^{NS}	1.55±0.10	1.59±0.05	1.66±0.04	0.19 ^{NS}
Coliform count	1	Nil			-	Nil			-
	2								

@ Average of six trials; NS-Non-Significant ($P>0.05$)

Fig.1



There was no spoilage in the spray dried colostrum powder during the storage period as the water activity of above said powder was 0.5 which was within the range of 0.1-0.9. The TVC for cow colostrum powder during different storage periods viz. 1, 3 and 6 months were 1.5 ± 0.05 , 1.57 ± 0.09 , 1.65 ± 0.15 and 1.52 ± 0.06 , 1.58 ± 0.03 , 1.67 ± 0.10 \log_{10} cfu/ml for first and second days respectively, whereas, for the buffalo colostrum powder 1.48 ± 0.04 , 1.55 ± 0.08 , 1.63 ± 0.11 and 1.55 ± 0.10 , 1.59 ± 0.05 , 1.66 ± 0.04 \log_{10} cfu/ml for first and second day respectively. The TVC count for cow and buffalo colostrum showed increasing trend during storage period. It is due to storage of colostrum powder at room temperature. But statistical analysis revealed no significant difference during different storage period with regard to TVC of spray dried colostrum powder. Coliform were not detected in spray dried colostrum powder. This is due to high processing temperature maintained in spray

drier process. There are no specific standards for spray dried whole colostrum powder. The final quality of the colostrum powder depends on the initial quality of the colostrum collected from the farms and the influence of the processing parameters (heat induced changes, fractionation of components etc.). Specific standards on the microbial quality of the colostrum powders are not available at present. The standards are to be established for these products. Specifications of some of the colostrum manufacturing companies' product available in market were 10,000 org/g for standard plate count and absent in 0.1 g for coliforms. The result for TVC and coliform are shown in table 3

In conclusion, colostrum powder was prepared by spray drying the whole colostrum with inlet and outlet temperature of 160°C and 80°C respectively. The yield of cow and buffalo colostrum powder was 12 and 15 per cent respectively. Hence, the surplus

colostrum was utilized by spray drying method and found to have no changes in physical and microbial parameters during storage at room temperature.

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