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A Comparative Study on Casein and Albumin Contents in Cow and Commercial Milk Samples

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Abstract: *In the present paper, a comparative study on the contents of casein and albumin in cow and commercially available milk samples were analysed. Milk serves as the primary food source in infants (young mammals) because milk is the only source of nutrition for significant periods following birth. Results indicate that, there were minor variations in the casein content in all the three milk samples, on all the days of isolations (cow milk sample [4.64 g%]; Com* milk sample 1 [3.57 g%]; and Com* milk sample 2 [3.43 g%]). However, cow milk sample showed a slight higher casein content (1 g higher than the commercial milk samples). There was no significant variation in albumin content in all the 3 milk samples (cow sample milk [2.15 g%]; Com* milk sample 1 [2.01 g%]; and Com* milk sample 2 [2.10 g%]).*
Keywords: *Albumin, casein, cow milk, commercial milk, isoelectric point*

I. Introduction

Milk can be considered as a complex of biological mixture of chemicals. It essentially contains all the biological molecules (water, vitamins, minerals, proteins carbohydrates and lipids) **[1]** necessary to sustain life. Although most mammals stop drinking milk beyond a certain age after birth, some humans either continue to drink milk or consume milk products in the form of cheese, butter, and cream throughout their entire life **[2].** The amounts of nutrients present in different types of milk differ greatly **(Table 1).**

Table 1. Milk Components (% Composition)

	Cow	Human	Goat
Water	87.8	87.4	87.0
Protein	3.0	1.4	3.3
Lipids	3.9	4.0	4.2
Sugars	4.6	7.0	4.8
Minerals	0.7	0.2	0.7

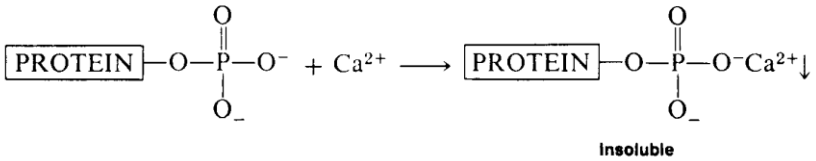
Cow and goat milk are almost comparable in every aspect. Human milk on the other hand contains only half the amount of proteins present in cow or goat milk. However, the sugar content in human milk is almost 1.5 times more than sugars present in cow or goat milk. Iron and vitamin C are the only nutrients absent in milk **[3].**

Milk contains three kinds of proteins, (*caseins*, *lactalbumins*, and *lactoglobulins)*. The proteins in milk can be referred to as "complete proteins" because they contain all the amino acids that are important for development of blood and tissue. They are adequate to sustain life and can support normal growth if they are the only proteins in the diet. The concentrations of these proteins are higher than those present in plants **[3].**

Casein

Casein (a phosphoprotein) is one of the major milk protein found in milk to the extent of about 3%. Milk appears white in colour on account of its casein micelles. Micelles are normally stable; however, on treatment with acids, salts or centrifugal forces these micelles can be disturbed. Casein proteins comprise of α, β and κ casein **[2].**

Calcium caseinate has an isoelectric point at pH 4.6. Since proteins tend to be insoluble at their isoelectric point, this property can be used for isolation from their natural sources. On addition of acid, the negative charges on casein micelles are neutralized, by protonation of the phosphate groups [2] and thus casein precipitates out **[4].**



Ca^{+2}Caseinate + 2HCl → Casein + $CaCl_2$

A natural example of this process is the souring of milk. Microorganisms hydrolyse lactose into glucose and galactose; galactose is then converted to lactic acid by lactobacilli present in milk. When pH of milk is lowered by lactic acid casein precipitates out. In casein isolation, acetic acid is preferred over hydrochloric acid because it is less harsh. Warming of milk to 40^0C causes casein to separate as a single large colloid. Complete separation of casein leaves behind a yellow solution called whey. Industrial applications of casein are given by Edwin Sutermeister **[5].**

Albumins

Albumins (globular proteins) are generally soluble in water and in dilute salt solutions. They can be denatured and coagulated by heat. After casein, albumins are the second most abundant proteins in milk. After removing casein from milk, the whey can be heated to precipitate lactalbumins. The molecular weight of albumin is about 41,000 daltons [2].

Since casein has several commercial applications, the present study is carried out to isolate casein from cow milk and compare the yield of casein in cow milk and those isolated from two other commercial milk samples.

II. Materials And Methods

2.1 Samples

1. Milk (cow and two commercially available milk samples). Cow milk sample was procured directly from the cow owners. Commercially available milk samples were procured from an identified milk booth. Samples were collected for a period of over 10 days.

2.2 Reagents Required

1. 10% acetic acid solution
2. 95% Ethanol
3. Ethanol: ether mix (1:1 ratio)
4. Ether

2.3 Isolation of Casein

Casein and albumin isolation was carried out for10 successive days. Duplicate samples were used for isolations.

Casein and albumin from the milk samples were isolated according to published methods **[6-7].** Milk **(**100 mL) was warmed to 40^oC, (the optimal temperature to denature the milk into curds). Following warming, 10% acetic acid was added in a drop wise manner to adjust the pH to the isoelectric point of casein. At isoelectric point casein precipitated out along with butter fat leaving a liquid component called whey. The milky whey liquid becomes clear when casein separates out completely. Casein was separated from the whey by straining the precipitate through four layers of cheese cloth. The precipitated casein was washed with 20 mL of 95% ethanol with vigorous stirring for 5 min (Casein is insoluble in ethanol and this property is used to remove unwanted fat from the preparation). The suspension was then filtered. After filtration, the precipitate was washed with 20 mL of ethanol : ether mixture. Finally the precipitate was washed with 30 mL of ether. After the final wash the precipitate was transferred on to a watch glass and dried at 40-50^0 C in an oven. After drying, the weight of casein was taken and the yield of casein was recorded as g%. All the milk samples were similarly treated.

2.4 Isolation of albumin

Requirements

1. Whey from the above casein isolated milk samples
2. Calcium carbonate (2.5 g/100 mL of milk)

Immediately after the casein filtration, 2.5 g of powdered calcium carbonate was added to the filtrate (whey) and the solution was mixed thoroughly. The mixture was then brought to almost boiling for about

10 min; with continuous stirring. This precipitates the remaining proteins. The precipitated albumin was filtered on a filter paper. Once the precipitate dried, the weight of albumin was taken and the yield of albumin was recorded as g%.

III. Results And Discussion

A total of 3 different milk samples were employed for determining the content of casein and albumin. Milk samples included cow and two commercially available milk samples. Casein and albumin isolations were carried out in duplicate and results are summarized in **Tables I and II.** As evident from **Table I.A**, the content of casein ranged between 4.47 to 4.77 g % (cow milk sample) 3.33 to 3.75 g % (commercial milk sample 1) and 3.23 to 3.63 g % (commercial milk sample 2) respectively over the 10 day isolation period. These observations suggest that there was a very minor variation in the casein content on all the days of isolations. However, the casein content was higher by about 1 g in case of cow milk sample as compared to the commercial milk samples 1 and 2. Mean ± SD for casein (g%) isolated over the ten day period is shown in **Table I.B**. Casein contest in cow milk sample and commercial milk samples 1 and 2 are shown in Fig I.

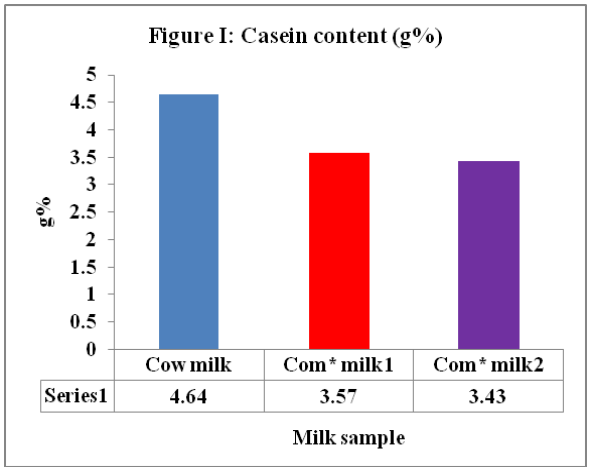
Table I.A: Casein content (g%)

Day	Cow milk		Average	Com* milk 1		Average	Com* milk 2		Average
1	4.64	4.40	4.52	3.50	3.59	3.55	3.41	3.05	3.23
2	4.54	4.92	4.73	3.69	3.79	3.74	3.34	3.18	3.26
3	4.96	4.58	4.77	3.39	3.63	3.51	3.39	3.66	3.53
4	4.54	4.89	4.72	3.63	3.67	3.65	3.46	3.51	3.49
5	4.52	4.97	4.75	3.40	4.10	3.75	3.41	3.35	3.38
6	4.64	4.40	4.52	3.25	3.57	3.41	3.67	3.59	3.63
7	4.18	4.76	4.47	3.48	3.67	3.58	3.38	3.54	3.46
8	4.65	4.61	4.63	3.73	3.68	3.71	3.46	3.35	3.41
9	4.60	4.85	4.73	3.42	3.52	3.47	3.62	3.26	3.44
10	4.50	4.70	4.60	3.28	3.38	3.33	3.45	3.45	3.45
	Average		4.64	Average		3.57	Average		3.43

***Commercially available milk samples 1 and 2**

Table I.B: Casein content (g%) (Mean ± SD)

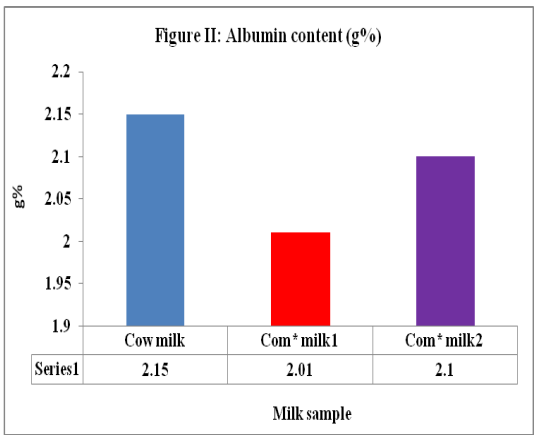
Cow milk	Com* milk 1	Com* milk 2
4.64 ± 0.11	3.57 ± 0.14	3.43 ± 0.12



The content of albumin ranged between 1.39 to 2.57 g%, 1.75 to 2.24 g% and 1.64 to 2.65 g% in case of cow milk sample and commercial milk samples 1 and 2 respectively over a ten day isolation period **(Table II.A).** The albumin content in all the 3 milk samples showed a variation between 0.40 to 0.80 g over the 10 day isolation period. Unlike the casein content between the three milk samples, there was no significant variation in the albumin content in all the 3 milk samples. Mean ± SD for albumin (g%) isolated over the ten day period is shown in **Table II.B**. Albumin contest in cow milk sample and commercial milk samples 1 and 2 are shown in Fig II.

Table II.A: Albumin content (g%)								
Day	Cow milk		Average	Com* milk 1		Average	Com* milk 2		Average
1	2.02	1.95	1.99	1.99	1.88	1.94	1.59	1.69	1.64
2	2.09	2.16	2.13	1.84	1.66	1.75	2.07	2.29	2.18
3	2.00	2.20	2.10	2.19	2.19	2.19	2.0	2.27	2.14
4	2.34	1.95	2.15	2.24	1.98	2.11	2.06	1.93	2.00
5	2.13	2.15	2.14	1.72	1.94	1.83	2.05	1.91	1.98
6	2.30	2.64	2.47	1.9	2.10	2.00	2.34	2.17	2.26
7	1.24	1.54	1.39	1.66	1.87	1.77	2.31	2.12	2.22
8	2.58	2.16	2.37	2.11	2.37	2.24	2.77	2.54	2.66
9	2.48	2.67	2.58	2.03	2.17	2.10	2.12	2.02	2.07
10	2.41	2.36	2.39	2.04	2.23	2.14	1.75	1.9	1.83
	Average		2.15	Average		2.01	Average		2.10

Table-II.B: Albumin content (g%) (Mean ± SD)		
Cow milk	Com* milk 1	Com* milk 2
2.15 ± 0.34	2.01 ± 0.19	2.10 ± 0.23



IV. Conclusions

The present study clearly suggests that the casein content in cow milk was higher by 1 g as compared to the two other commercial milk samples. However, there were no noticeable differences in the albumin content in all the three milk samples. With increasing reports on milk adulteration [8] throughout the world, it is advisable that people switch to cow milk for their daily milk consumption (for all age groups except infants below one year (infants below one year cannot digest cow milk completely [9]).

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