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Comparative Study of Casein and Lactose Content of Soya Bean Milk With Buffalo Milk

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Abstract: *Milk is an emulsion or colloid of butterfat globules within a water based fluid. In general milk contains about 87 % water, lactose, fat, protein, and minerals. Casein protein is most commonly found in mammalian milk. Carbohydrate present in milk is lactose. It is a disaccharide composed of galactose and glucose. Apart from an animal source, milk can be obtained from a plant source. The most popular varieties of plant milk are soya milk, almond milk, coconut milk, etc. Soya milk is prepared from dried soya beans. Casein content in soya milk is about 1.35%, which is almost 5 times less than casein content of buffalo milk. Lactose content in buffalo milk is almost three times more than that of soya milk. Because of negligible lactose percentage, soya milk is consumed by lactose intolerant. The nutritional value of soya milk is lower than that of buffalo milk. So, soya milk cannot be used as a substitute for buffalo milk for infants.*

Keywords: *Milk, casein, lactose, soya bean milk.*

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Introduction :

Milk is a white liquid produced by mammary glands of mammals. It is the primary source of nutrition for infant mammals (including humans) before they are able to digest other types of food. Early lactation of milk contains colostrum which carries mother's antibodies to its young one and can reduce the risk of many diseases. Milk is composed of protein, carbohydrates, fats, vitamins and minerals. (Composition and structure of milk. Dairy Chemistry and Physics, University of Guelph, 21 July 2009 Pg. 36–52.)

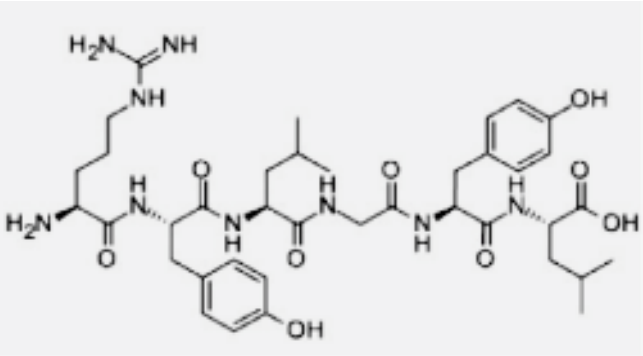


Fig. 1. Structure of casein protein

Casein is the name for a family of related phosphoprotein *(The Columbia Electronic Encyclopedia Sixth ed.2011)* These proteins are commonly found in mammalian milk, making up 80% of the proteins in cow's milk and between 20% and 45% of the proteins in human milk. The largest structures in the fluid portion of the milk are "casein micelle" : aggregates of several thousand protein molecules with superficial resemblance to a surfactant micelle, bonded with the help of nanometer-scale particles of calcium phosphate (Chapman and Hall1995). Each casein micelle is roughly spherical and about a tenth of a micrometer across. There are four different types of casein proteins: s1-, s2-, -, and - caseins. Collectively, they make up around 76–86%of the protein in milk, by weight.

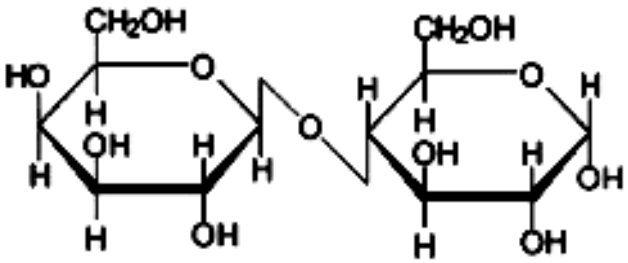


Fig. 2. lactose

Lactose is a disaccharide sugar composed of galactose and glucose that is found in milk (Moskowitz, H.R. 2009). Lactose makes up around 2–8% of milk (by weight), although the amount varies among species and individuals, and milk with a reduced amount of lactose also exists. It can be extracted from sweet or sour whey. The name comes from ***lac*** (gen. ***lactis***), the Latin word for milk, plus the ***-ose*** ending used to name sugars. It has a formula of $C_{12}H_{22}O_{11}$ and the hydrate formula $C_{12}H_{22}O_{11}{\cdot}H_2O$, making it an isomer of sugar.

Materials and Methodology:

Soya bean milk was prepared by soaking soya beans overnight. Swollen soya beans were then grounded to make fine paste. It was then filtered through muslin cloth. White filtrate was soya milk.

Casein Isolation: 20 ml of milk sample was taken. 15 ml of distilled water was added to it to make the volume about 35 ml. The mixture was then warmed to about 40°C. 10% acetic acid was added with constant stirring to the warm mixture until the precipitation was completed. The mixture was stirred for 10 minutes. Casein precipitate was filtered and washed thoroughly with water and then dried. The weight of the precipitate was taken (Fig.1.).

Lactose Determination: 100 ml of milk sample was heated till 55°C.10% acetic acid was added drop wise, with constant stirring till the liquid turned colourless. The mass of casein which was formed was removed. 4gm of Calcium Carbonate ($CaCO_{3(s)}$) was added to the remaining clear liquid. It was stirred and boiled. The remaining protein was precipitated out. Liquid was then filtered. Then the solution was heated till only 25 ml of solution left. It was allowed to cool and 100 ml of ethanol was added. Once the solution was cooled, it was filtered and again heated. As the solution cooled, lactose precipitated out.

Titration of soy curd and buffalo curd: 20 ml of curd sample was titrated against 0.1 N NaOH solutions for calculation of percentage of lactic acid. Phenolphthalein indicator was used. Titration was completed in 20 seconds (Fig. 3.).

Observation and calculation:

Calculation of casein percentage

Volume of milk taken in each case = 20ml

$$\text{Percentage of casein} = \frac{\text{weight of casein}}{\text{volume of milk taken}} \times 100$$

S. No.	Sample	Weight of Milk Taken	Weight of Casein	Percentage of Casein
1.	*Soya milk*	*20 ml*	*0.27 g*	*1.35 %*
2.	*Buffalo milk (skimmed milk)*	*20 ml*	*1.17 g*	*5.8 %*
3.	*Buffalo milk (full cream)*	*20 ml*	*1.22 g*	*6. 1 %*

Lactose Calculation

S. No.	Sample	Volume of Milk Taken	Weight of Lactose	Percentage of Lactose
1.	*Soya milk*	*100 ml*	*0.72 g*	*0.72 %*
2.	*Buffalo milk (full cream)*	*100 ml*	*2.58 g*	*2.58 %*
3.	*Buffalo milk (skimmed milk)*	*100 ml*	*2.55 g*	*2.55 %*

Calculation (Titration)

S. No.	Volume of curd solution	Burette reading			Concurrent reading
		Initial	*Final*	*Difference*	
1.	*10 ml*	*0.00*	*0.9*	*0.9*	
2.	*10 ml*	*0.9*	*1.8*	*0.9*	*0.9*
3.	*10 ml*	*1.8*	*2.7*	*0.9*	

Observation table for buffalo curd

S. No.	Volume of curd solution	Burette reading			Concurrent reading
		Initial	Final	Difference	
1.	10 ml	0.00	2.2	2.2	
2.	10 ML	2.2	4.4	2.2	2.2 ml
3.	10 ml	4.4	6.6	2.2	

Calculation

$$\% \text{ lactic acid} = \frac{\text{volume of 0.1N NaOH solution used for neutralization}}{\text{Weight of sample}} \times 0.009 \times 100$$

Calculation for soy curd

% lactic acid =

% lactic acid of soy curd = 0.081%

Calculation for buffalo curd-

% lactic acid = 2.2 x 0.009 x 100/ 10

% lactic acid = 0.198 %

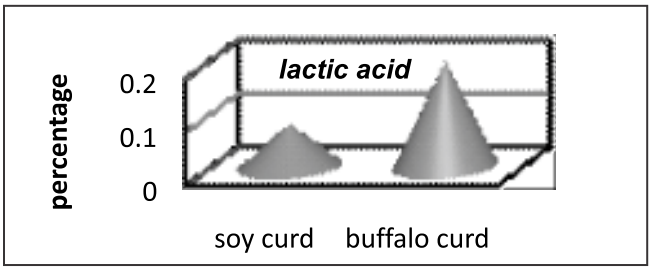


Fig.3. Graph showing lactic acid percentage in soy curd and buffalo curd

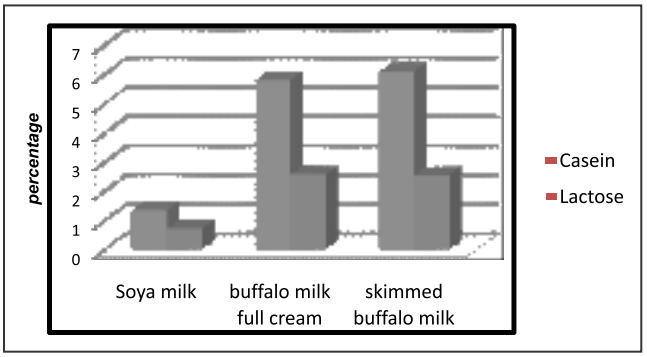


Fig.4. Graph showing casein and lactose content in milk samples

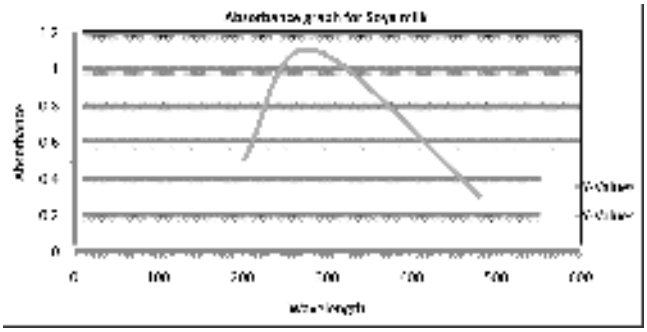


Fig. 5. Graph showing absorbance of soya milk in UV- Vis region

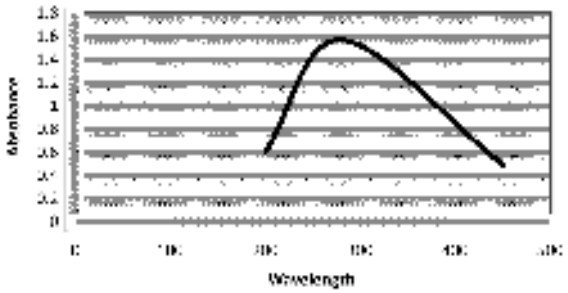


Fig. 6. Graph showing absorbance of buffalo milk

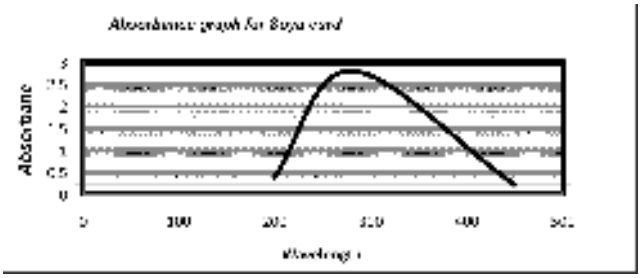


Fig. 7. Graph showing absorbance of soya curd

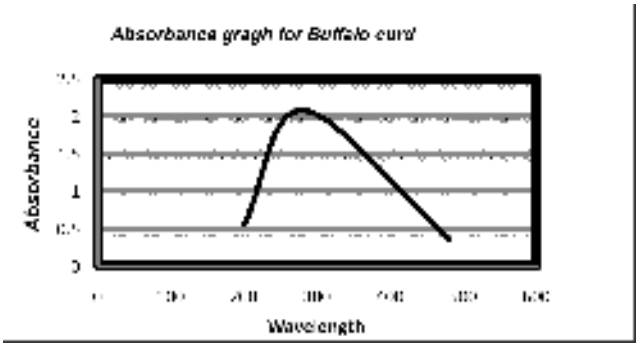
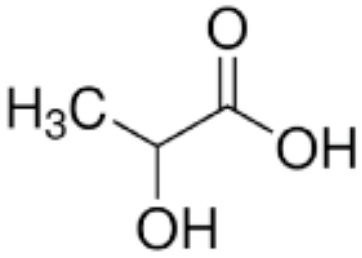


Fig. 8. Graph showing absorbance of buffalo curd



Lactic acid

Results and Discussion :

The casein content in soya milk was found to be 1.35% whereas the buffalo milk contains almost 5 times more casein protein. Skimmed milk contains 5.8% whereas full cream milk contains 6.1 % casein.

Soy milk contains 0.72 % lactose which was found to be three times less than lactose content in buffalo

milk. Skimmed milk contains 2.55 % whereas full cream milk contains 2.58 % lactose.

After titration buffalo curd was found to be more acidic than soya curd.

When the milk sample was passed through UV – Vis spectrophotometer peak was obtained at 280nm. This peak was due to casein protein. Amino group of casein protein is the reason for maximum absorbance at 280nm. The absorbance value for soya milk and buffalo milk at 280 nm was found to be 1.103 and 0.304, respectively. As the wavelength increased the value of absorbance decreased.

In the UV-Vis absorbance graph of the curd samples the reason for the maximum absorbance at 280 nm is the acidic group of lactic acid. Values for maximum absorbance of soya curd and buffalo curd at 280 nm are 2.803 and 2.802, respectively.

Conclusion:

From this experiment it is concluded that the lactose content of soya milk is negligible. So it can be the substitute for buffalo milk or any other animal milk source for those people who are unable to digest lactose because of lactose intolerance. It is also concluded that because of low casein and lactose content of soya milk it cannot be used as a substitute drink for buffalo milk for infants.

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