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Mini Review

An-overview on Buffalo Condensed Milk and its Products with Emphasis of Their Biochemical Properties

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Abstract. In this review an-overview is presented to study the effects of condensation, skimming and physio-chemical quality of buffalo milk. Skimming process had significant influences on chemical and sensory qualities of milk. Previous researchers discussed the remarkable changes in the physical and physio-chemical characteristics of condensed milk *i.e.* moisture, ash content and acidity, specific gravity of skimmed milk as compared to the whole milk. It has been also concluded from the different studies that the physical properties like, exterior, colour, flavour and body texture of milk were comparatively reduced by condensation and skimming and the density of skimmed milk appeared thinner and products achieved the variable score in different above mentioned physio-chemical properties. This review will discuss the effects of condensation and skimming on whole milk and their byproducts and their physical and physio-chemical properties in comparative aspects skimming and condensation whole milk.

Keywords: buffalo milk, condensed milk, density, physio-chemical properties

Introduction

Milk from domestic animals has been recognized universally because of good nutritious values and deliciousness with high digestibility including essential protein components, minerals, several vitamins and energy giving lactose and milk fat Nectarivory (2015) and Bhattarai (2014). In subcontinent, Pakistan is among the major producers of buffalo milk, ranks 4th in World after India, U.S.A. and Germany in top three positions, (Ali *et al*., 2016; Sarwar *et al*., 2009; Delgado, 2005).

Milk availability per capita in both countries of the subcontinent is very considerably greater than countries of Asia specially south east Asia where users from the metropolitans get partial % of the excess milk from suckling calves for consumption in market and home use, Muhammad *et al*. (2014) and Magliulo *et al*. (2013). Larger amount of milk is being wasted due to the inadequate processing and unhygienic conditions. Therefore the growing mandate for milk in heavily populous areas needs more improvement in quality and physical characteristics to avoid wastage of milk (Shah *et al*., 2016; Upadhyay *et al*., 2014; Batool *et al*., 2012).

To assess the value of milk nutrients and understanding the nature of food is essential to achieve the quality and reactions in different circumstances and treatments. It is fortunate to have a natural food like milk which can be administered easily and economically processed into milk products like concentrated milk, Khoa, Barfi, Mawa, Rabri *etc*. and fermented milk products like yoghurt, paneer, lassi and flavored cheese *etc.* by Meena (2015).

According to the food habits of different people milk is consumed in different forms. Various types of processed skimmed milk and its by-products are recognized and produced by skimming process in which fat rich portions of milk separated from whole milk either be achieved through natural creaming process *i.e.* gravity or through centrifugal method of cream separation, Kubota (2010).

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Skimming of milk is done to reduce the fat content of milk to use for the people concerned about the fat in the diet; to them skimmed milk is an outstanding substitute to the whole milk. It has many benefits for health *i.e.* Strong bones, energized body with abundant energy with only thing to compromise its taste and natural flavor because some people do not like the flavor but still few also appreciate the flavour by Campbell and Marshall (2016).

Traditional skimmed milk products in subcontinent. Condensed skimmed milk is usually used for increasing milk solids in ice cream, bakery goods and many other foods, Pandya and Khan (2008). However, its standard of specification is not reported in Pakistan, but several states require 20 or 27% total solids content. Moreover, the concentration of chemical components in condensed skimmed milk was reported as 10% protein, 0.3% (1.2%; DMB) fat, 73% moisture, 14.7% lactose and 2.3% (8.6%; DMB) ash, Olugbuyiro (2011) and Khan *et al*. (2008).

It was reported that buffalo milk was usually used for the manufacturing of indigenous sub continental condensed milk products (*i.e*. Rabri, Khoa, Kheer and Basundi), cultured products *i.e.* Dahi, Misti dahi (made by culturing a blend of buffalo milk and cane sugar) and Shrikhand, coagulated products (*i.e.* Paneer and Chhana) and formulated products (*i.e*. dried ice cream mix, butter powder, cheeses and dried flavoured milks) Jashubhai (2013) and Dilshad *et al*. (2010). However, variation in taste, flavour and chemical composition of condensed milk products has been reported in various parts of Pakistan and other countries of the subcontinent, Talpur *et al*. (2009) and Khaskheli *et al*. (2008).

It was also noted that heat treatment had significant effect on physico-chemical properties of cow and buffalo skimmed milks. When skimmed milk sample of cow and/or buffalo was subjected to following heat treatments: (i) 71 °C for 15 s, (ii) 95 °C for 10 min, (iii) 120 °C for 15 min and (iv) treatment (ii) followed by (iii), an increase in TS (Total Solids), viscosity, N (Nitrogen) content and decrease in total citrate content was observed. Milk pH was increased by (i) and (ii), but decreased by (iii) treatment. In general, values for measured parameters were higher for buffalo than for cow milks, Robinson *et al*. (2006), Robinson *et al*. (2002), Tamim and Robinson (1999).

Sensory and chemical qualities of condensed milk products *i.e.* Rabri were evaluated and it was found that the overall sensory scores for samples varied between 6.65 and 7.33 and significantly different ($P<0.05$) from one and other in all sensory attributes *i.e.* flavour, body/texture, colour, appearance and sweetness, Ghayal *et al*. (2015) and Chopde *et al*. (2013).

It was reported in the study that, the scientists concentrated five batches of pasteurized skimmed milk approximately by the method of ultra-filtration (UF). Chemical analyses of the skimmed milk and were done to determine the change in chemical composition that occurred during Ultra filtration method. Milk proteins were concentrated during this process from an average 3.42% in skimmed milk to 6.85, 13.51 and 17.1% in 02, 04 and 05-fold respectively, Kesenkas *et al*. (2017) and Ong *et al*. (2013). Milk fat similarly was concentrated from 0.11% in skimmed milk to 0.24, 0.45, and 0.60% in 3 steps UF method, respectively. Lactose content progressively decreased during UF from an initial 5.06% in skimmed retaining respectively. Total solids contents increased to a lesser extent, compared with protein and fat, from 9.19% in skimmed milk to 12.72, 17.80 and 23.91% using above discussed methods which reflects the loss of lactose and further solvable components, Jain (2015), Pivariu *et al*. (2014), Konuspayeva *et al*. (2009).

Physico-chemical composition of sub continental condensed milk products. Seasonal fluctuations in the production or in market demand were reported to be a cause of shortage in the supply milk. Shortage of fresh milk creates a demand for milk which can be kept for extended period of time at low storage costs. Condensed milk, a one of the dairy products is used to be in different parts of the World to fulfill the above demand of the community, Abdalla *et al*. (2013). The preparation steps of condensed milk consist of: receiving milk, standardization, heating (105-120 °C) for 1 to 3 min, evaporation under vacuum, homogenization, cooling (14 °C), filling in cans, sterilization (110-120 °C) for 15-20 min and cooling (20 °C). He further reported that acidity is slightly increased by condensation from that of normal milk and had a density of 1.070. The chemical constituents of unsweetened condensed milk include 8% fat, 18% milk solids not fat and 74% moisture, (Schuck *et al*., 2013; Pandya and Ghodke, 2007).

Survey has been conducted on traditional Indian milk products which included the products, Khoa-based sweets (Burfi), Chhana-based sweets (Rasagolla), concentrated sweets (Rabri, Kheer, Khurchan and Palpayasam), fermented sweets (Shrikhand), frozen

milk sweets (Kulfi), coagulated products (Chhana, Paneer), other fermented products (Dahi, Lassi, Misti), fat rich products (Ghee, Makkhan) and other concentrated products (Khoa). He reported that analysis of different concentrated sweets (Rabri, Kheer, Khurchan) had great variation in composition of the samples collected from Delhi, Haryana and Bombay by (Akhtar, 2015; Pandya and Khan, 2008).

The steps for the preparation of condensed milk, which consist of receiving and selection of milk, clarification, cooling, standardization, pre-heating, evaporation, homogenization, cooling, final standardization, packaging, sterilization and storage. It was further reported that averagely condensed milk contains 74.0% moisture, 7.0% protein, 7.74% fat, 9.76% lactose and 1.50% ash (5.8% ; DMB) by Ahmed *et al*. (2009) and Belitz *et al*. (2009).

According to the previous studies, buffalo skimmed milk was composed of 10.20% of total solids, 3.96% of protein, and 5.22% of lactose by ultra-filtration technique at 50 ºC to 23.50% total solid and 16.44% protein. Total solid contents *i.e.* fats, ashes and protein contents increased during ultra-filtration and lactose content decreased. The composition of permeate was influenced by the concentration as the concentration factor increased total solids, proteins and ash contents increased automatically. The rejection coefficients after 77% weight reduction were 52.52% for total solids, 94.95% for protein, 100% for fat and 52.04% for ash by Bihari (2012).

The studies were conducted on the concentrated commercial pasteurized skimmed milk. Ultra-filtration was conducted under various pH and temperature conditions and followed by a diafiltration step. Skimmed milk ultra-filtered at 50 °C was used for control. For each UF treatment, the composition and buffer capacity of the five times retentate and the permeation flux during concentration were determined. The final composition of the retentate was reported to be different for each UF treatment. Retentate obtained after diafiltration at 4 °C and pH 5.3 had the highest protein content and the lowest ash by Morin *et al*. (2008).

It was observed that the characteristic flavor in fresh raw milk and the impact was attributed with dimethyl sulfide and diacetyl, 2-methylbutanol and some other compounds like aldehydes. They also found considerable differences in flavor of skimmed milk and whole milk, and the influence of fat globules was reported to be responsible for the creamy rich tasty flavor, though milk was with dry matter contents also has enhanced the richness of taste. Authors assumed that compounds from flat globule membrane contributed to creaminess as authors and researchers further reported the physical presence of fat globules in flavour because of creaminess by Carbonell *et al*. (2002), McSweeney and Sousa (2000).

Another study was conducted on the different brands of s condensed milk sweet brands to assess the quality of condensed milk after sweetening. Samples were analyzed for physical and chemical properties, acidity percentage. Results indicated that there was no variation among different brands of sweetened condensed milk by Asaduzzaman *et al*. (2007). Raw buffalo milk was studied at different locations in China for chemical composition for average levels of components. The crude protein, fat, total solids and ash contents of milk from crossbreed buffalo were reported to be higher than those of buffalos by Han *et al*. (2012), Asaduzzaman *et al*. (2007).

Milk fat extracted by mechanical process contain less than 3% fat and about 9% total milk solids, and condensed milk resulting from removal of considerable portion of water from full cream milk with or without sugar shall contain not less than 9% of milk fat and the % age total milk solids was found as 31%. It was further reported that condensed milk resulting from the removal of a considerable portion of water from milk, skimmed with smaller larger or without sugar contained at least 26% of total milk solids if sweetened and 20% of total milk solids if not sweet, Ribeiro and Ribeiro (2010).

Condensed indigenous milk-based products “Rabri” from randomly selected *i.e.* two samples from each outlet from market were evaluated for sensory and chemical properties. Authors found that different components and concentration of Rabri were not the same expressively and varied in different samples. The % age content of moisture was also different. Energy values of Rabri varied between 315.59-400.15 Kcal/100 g while mean was recorded as 361.05±4.73 Kcal/100 g. The sensory values scores of Rabri were within the acceptable ranges. Scores were rated by panel of Judges for appearance, aroma, flavor, body-texture and overall sweetness were evaluated and given score by judges was in the range of other researches, Chauhan *et al*. (2014) and Khaskheli *et al*. (2008).

It was reported that skimmed milk or separated milk contain small amount of milk fat and most of the non-fat fraction of milk Priyatam (2015). Each 100g of skimmed milk provides about 34 to 38 Kcal of net energy to human body. It was further reported that buffalo skimmed milk contains 89.84% moisture, less than 0.10% fat, 4.06% protein, 5.18% lactose, 0.82% ash, 10.06% solids not fat and 10.16% total solids content, El-Salam and El-Shibiny (2011), Mahmood (2008). He further reported that the steps for the production of condensed milk involved receiving of good quality milk, filtration, standardization, preheating, evaporation, homogenization, cooling, adding stabilizer, packing, sterilization, cooling, shaking and storage. It was further reported that condensed skimmed milk contains 74.0% moisture, less than 0.5% milk fat, 9.3% protein, 14.0% lactose, 2.2% ash (8.5%; DMB), 25.5% solids not fat, and 26% total solid content by Solanki and Gupta (2014), Kethireddi (2011).

The milk was condensed through flash-heat to about 185 °F (85 °C) for some time, and then supplied towards the evaporator chambers to eliminate the water by Maurya (2016). They then concentrated the milk under vacuum pressure in a range between 30 to 40% solids. After cooling, the milk with approximately 40% powdered lactose, and to stimulate crystallization, Kumar (2015). Finally these were channeled into the sterilized vacuum sealed containers. It was reported that the condensed milk contained at least 28% by weight of total milk solids, 8% by weight of milk fat and evaporated milk contained at least 6.5% of milk fat by weight, 16.5% of milk solids by weight and 23% of total milk solids contents by weight, Chandan and Kilara (2010).

In sub-continent condensed milk was produced by vaporizing the part of water of whole milk traditionally by heating, or fully skimmed milk, by adding or without adding sugar, Arbuckle (2013). It was reported that condensed milk contains not less than 9% of milk fat, and not less than 31% milk solids and 40% sugar. Condensed milk in the UK and USA contained 9 and 7% fat, 31 and 25.9% total milk solids. Indian standard condensed milk contained 31% total milk solids, fat not less than 9%, and sucrose 40%, Pandya and Ghodke (2007).

Conclusions

Condensed or skimmed milk as compare to the fresh milk is extensively used as a constituent of many traditional sweets since long times due to its extended shelf life and slighter risk of putrefaction. It is also a rich source of calories and is more nourishing than the fresh milk prepared by evapourating a part of water from milk to improve the palatability through condensing and skimming which may have an impact on the quality of the product. Moreover, the quality of condensed/ skimmed milk needs more information on the physio-chemical and sensory properties as still the limited information of these products is available in the scientific literature. Bearing in mind the significance of its use in different forms, the present study is suggesting proposing more research to evaluate the effect of skimming and condensation on physiochemical and nutritional potentials of buffalo milk. Further advance studies are required to observe the effect of skimming and condensation on major components (protein and lactose), micronutrients (enzymes, vitamins and pigments), storage conditions and shelf life of the skimmed condensed milk.

Conflict of Interest. The authors declare no conflict of interest.

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