African Journal of Food Science Vol. 5(16), pp. 817-832, 23 December, 2011
Available online http://www.academicjournals.org/ajfs
DOI: 10.5897/AJFSX11.003
ISSN 1996-0794 ©2011 Academic Journals

Review

Synergy of dairy with non-dairy Ingredients or product: A review

Hirpara Krupa, Jana Atanu H.* and Patel H. G.

Department of Dairy Technology, S. M. C. College of Dairy Science, Anand Agricultural University, Anand – 388 110, Gujarat State, India.

Accepted 21 November, 2011

Milk is considered to be a wholesome food. Any food product made out of milk will obviously be highly nutritious. However, milk per se has certain limitations like allerginicity, lactose intolerance, cholesterol, saturated fat content, etc. With advancement in technology, several dairy derived ingredients are being produced that when used in conjunction with other food ingredients in food manufacture can yield 'value-added' products that have balanced nutrition, and exhibiting superior functionalities as well as 'wellness' in food application. This implicates the synergy of dairy with other food ingredients/products; such combination exhibits effects that are probably not obtained when either ingredient is used singly. Typical examples are products derived from a blend of milk and vegetable milk; Mozzarella cheese as pizza topping; milk crumb for milk chocolate; blend of vegetable oil and milk fat for Fat spreads; milk solids in baked goods; blend of milk, barley and wheat flour in Malted milk food and so on. The food products encompassing dairy and non-dairy ingredients include; filled milk and milk products, cheese analogues, *gulabjamun* mix powders, fruited yoghurts, etc. Literature pertaining to some popular traditional Indian sweetmeats which utilizes other valued food ingredients has also been reviewed. Dairy together with fruit and vegetable ingredients may get transformed into 'functional foods' that is gaining grounds in recent years.

Key words: Dairy ingredients, food ingredients, synergy, functionality, economy.

INTRODUCTION

Milk is considered to be an adequate source of valuable macronutrients (fat, protein, lactose), vitamins and micronutrients (minerals), making it a 'wholesome food'. It can serve as an excellent carrier product for extra nutrient, and if enriched or fortified it can satisfy the nutritional needs of the population. Non-dairy ingredients find a critical role in synergy of the chemical constituents of dairy foods to enhance their sensory, nutritional profile, at the same time influencing the cost of the resultant product. Dramatic increases in the cost of milk have sent prices of milk ingredients skyrocketing – threatening the profitability of dairy and other food products.

*Corresponding author. E-mail: atanujn@gmail.com. Tel: +91-02692-261744, +91-09375012630. Fax: +91-02692-261314.

In spite of remarkable increase in milk production, the milk and milk products are out of reach of the vulnerable groups of weaker section of society due to its high cost. This calls for development of low cost and healthy substitute for milk and milk products (Wang, 1980). The search for a new and unconventional source of protein, carbohydrates, fat, vitamins, minerals and other health beneficial ingredients to meet the requirement of the ever-expanding population is the dire need of the present day. Some people are skeptical about consuming milk and milk products due to health consciousness; keeping away from saturated fats, cholesterol, lactose (for those ailing from lactose intolerance), etc.

Driven by consumer's lifestyle, their demographics, socio-economic, cultural background and their environment, a whole range of new product formulations have evolved to suit the palate of the varied consumers.

The consumer is shifting towards 'light' foods with low calories and adopting 'functional foods' that is going to improve their health and well-being too. In fact, blending functional ingredients into dairy based foods helps increased sale of dairy foods (Berry, 2002). Hence, there is a need to merge non-dairy ingredients with dairy based ingredients and products to attain the previous mentioned objectives with attendant savings in cost, enhanced appearance, taste, texture and even functionality.

There are tremendous prospects for fermented dairy ingredients in food products due to increasing interest in 'healthy foods', increasing internationalization of food tastes and continuing interest in additive free ingredient labels. The fermented dairy ingredients include, the traditional fermented products (cheese, yoghurt); form-modified fermented dairy ingredients (cheese and yoghurt powders); flavour-modified fermented dairy ingredients (enzyme modified cheese); and functionally engineered fermented ingredients (ethanol, lactic acid, cultured whey) (Main, 1991). The synergy of several such dairy with non-dairy ingredients/products has been discussed in this article.

MILK SOLIDS WITH OILSEEDS

Safflower

Safflower petal extract has therapeutic properties exerting beneficial effect to those ailing from hypertension, cerebral thrombosis and helps in lowering blood cholesterol. A 'Golden milk shake' has been prepared from a blend (4.5% fat) of cow milk and safflower milk utilizing 3.0% safflower petal extract and orange flavour (0.5 ml/lit.), 10.0% sugar and 0.4% Na-alginate as stabilizer. Such milk shake prepared from a blend of cow milk and safflower milk (1:1 w/w) is recommended (Kashid et al., 2007).

Softy ice cream has been prepared from a blend of buffalo milk and safflower milk (75:25) along with cream and skim milk powder (SMP), which was sensorily quite similar to that of control made using milk solids only (Andhare et al., 2004).

Safflower seed based fat spread has been prepared from 'chakka' (product obtained by removal of whey from fermented curd) made from a blend of buffalo milk and safflower milk (1:1); additives incorporated were: 1.0% trisodium citrate, 1.5% common salt, 0.1% potassium sorbate and 10.0% of cheese as flavouring. The low-fat spread had low cholesterol and was rich in poly unsaturated fatty acid (PUFA) compared to the product made from cow/buffalo milks; the cost and calorie was also lower for the developed spread (Deshmukh et al., 2003).

Rasogolla (an Indian delicacy made out of chhana – acid coagulum from milk) has been successfully prepared from a blend of cow milk and safflower milk (50:50). The product made from such milk blend was 13.0% cheaper than the one made exclusively from cow milk (Lokhande et al., 2010).

Soybean

Owing to the worldwide shortage of food, attempts have been made to find alternative sources of protein, particularly for the nations where malnutrition exists. Soybeans particularly are plentiful, relatively inexpensive and rich in protein. Soy-based foods may provide additional benefits for the consumer due to their hypolipidemic, anti-cholesterolemic, anti-atherogenic properties and reduced allergenicity. They provide an alternative source of protein for people who are allergic to milk protein.

Soybean provides high quality protein with minimum saturated fat. Soybean contains all the three nutrients viz., carbohydrate, protein and fat required for good nutrition, as well as fiber, vitamins and minerals. It has high PUFA content. Soybean has more than twice the amount of minerals, especially calcium, iron, zinc and phosphorus than any other legume (Itapu, 2003; Venter, 2004). Soy protein is highly digestible (92 to 100%) and contains all essential amino acids. Soy protein products contain high concentration (up to 1 g/kg) of isoflavones that exerts protective properties against breast, prostate, colon and lung cancers.

The products made from soymilk include; soya milk (milk alternative), Tofu (paneer analogue), Sufu (Cheese analogue), etc. Several food products have been made utilizing a blend of cow/buffalo milk with soya milk. The comparison of soy milk with cows' milk is shown in Table 1.

Products made from a blend of milk (Cow/Buffalo milk) and soya milk

Soy milk is low in fat, carbohydrate, calcium, phosphorus, and riboflavin, but high in iron, thiamin, and niacin in comparison with cows' milk. Soy milk contains higher amount of protein than buffalo milk and is deficient in sulfur containing amino acids. Soy milk is characterized by beany or soy flavor which can be modified by lactic acid fermentation. Replacing a part of milk with soy milk, used in making fermented milk products or other products would enrich its nutritional value and decrease the cost too. Some examples of products derived from blend of milk and soy milk are given in Table 2.

Acceptable *paneer* that was fit for frying applications was prepared by substituting 5.0 to 10.0% of buffalo milk with soya milk, butter milk or skim milk prepared byreconstitution of skimmed milk powder (SMP) (Sharma et al., 1998).

Table 1. Comparison of cows' milk with soya milk.

Nutritional profile (g/100 g)	Cows' milk	Soya milk
Fat	3.50	2.30
Protein	3.40	3.60
Carbohydrate	4.60	3.40
Lactose	4.60	-
Cholesterol (mg/100g)	10.00	-
Calorie (K.cal.)	64.0	49.0
Fatty acids		
Saturated (% of total fat)	63.50	14.0
Polyunsaturated (% of total fat)	3.00	63.5

Source: Zeki (1992).

Table 2. Food products made from a blend of milk and soy milk.

Product	Effects	Reference
Ice cream	Formulation composed of soy milk (8% TS), SMP, cream (60% fat), sugar and stabilizer. Soybean variety PK-472 was found suitable. Low-cost, acceptable product with high protein content (5.09 vs. 3.34% in control) was obtained, except for slight beany flavour, chalky taste and low overrun.	Sutar et al. (2010)
Kulfi (Indian ice cream like product without any overrun)	Inclusion of soy milk to cow milk (30:70) to have 4.1% fat, 11.3% TS imparted a creamy yellow color to Kulfi, adding slight richness. The body and texture and melt down quality were improved on inclusion of soya milk in the milk blend. Kulfi having soya solids had higher protein (10.3 vs. 7.4%), TS (51.6 vs. 47.6%), but had lower fat content.	Selvarani and Kalyani (2000)
Shrikhand (fermented, sweetened milk product derived from *chakka* – partly dehydrated yoghurt)	Blending milk with soy milk (40:60, w/w) yielded *chakka* suitable for *Shrikhand* making. The protein content of *Shrikhand* with soymilk supplementation was 8.8% on dry matter basis.	Deshpande and Jha (2008)
Paneer/chhana-like product (acid coagulated Indian milk based delicacy)	Combined cow/toned milk and soy milk (30:70, w/w) had no adverse effect on quality of *chhana* analogue with respect to flavour and hardness; the yield was increased. The fat content of *paneer*-like product tended to decrease with increase in level of soy milk in the blend.	Biswas et al. (2002); Jain and Mhatre (2009), Singh et al. (2010) and Uprit and Mishra (2004)
Cottage cheese	Cottage cheese has been made from blend of buffalo skim milk (9.4% TS) and soy milk (1.7% fat, 8.7% TS) (85:15, w/w) using LF-40 starter culture and 0.2% Na-alginate as stabilizer. The product yield was greater (22.85% vs. 19.95%) and the free fatty acid (FFA) was lower when made from blended milk compared to control made from buffalo skim milk.	Rastogi and Jha (1998)
Yoghurt	A mango flavoured soy-fortified yoghurt was standardized comprising of 78.2% standardized milk (2.95% fat, 9% SNF), 14.7% soy milk (8.2% TS) and 7.1% of mango pulp (18% TS). The product was similar to traditional product.	Kumar and Mishra (2003)

Soy-based yoghurt has been successfully made that compared well with cow milk based yoghurt that comprised of 22.0% soya solids, 4.0% sucrose, 2.0% corn starch, 0.3% Na-citrate, water and fermented using

Table 3. Composition of some soy based solids.

Soya product	Composition (%)		
	Moisture	Fat	Protein
Defatted soy flour	6.0	0.6	53.0
Full-fat soy flour	6.0	20.5	41.0
Soy protein concentrate	6.7	0.3	66.2
Soy protein isolate	4.7	<0.1	92.8

5.0% of mixed starter culture (Nsofor and Chukwu, 1992). Yoghurt was made from a blend of skim milk and soy milk containing saccharified rice solution in various proportions (75:25 to 25:75, w/w) by lactic fermentation. The proportion of skim milk and soy milk did not have any effect on the titratable acidity of product; the product was similar to the one obtained from skim milk (Park et al., 2005). A low-cost probiotic whey milk beverage has been prepared from a blend comprising of buffalo milk cheese whey, cow skim milk and soy milk (Macedo et al., 1999).

Products from blend of milk and value added soya solids

Vegetable protein isolates are most acceptable products for dairy application because of their fine particle size and dispersability. The functional properties of emulsification, emulsifying stability, color and flavour/odour are critical factors in dairy applications (Johnson, 1975). Some of the value-added soy based products including soy protein isolates (SPI) are depicted in Table 3. The applications of such soya solids is highly suited for dairy-type products such as coffee whiteners, liquid whipped toppings, pre-whipped toppings and toppings of other emulsified food items to replace sodium-caseinate. Other applications include concentrated beverage powders, frozen deserts, sour cream, sour cream dips and related cheese-like products. Soy protein ingredient has been used in emulsion-type cheeses to replace up to 50.0% of sodium-caseinate. Full-fat and defatted soyflours have been used successfully as a major ingredient in low-cost replacement for milk solids in beverages for human consumption (Ohr, 1997; Singh et al., 2008).

The soluble soy protein concentrates (SPC) and SPI are useful in manufacture of soy-based baby foods. Soy protein formulas are recommended for those infants who are allergic to milk protein and those who have lactose intolerance (Ohr, 1997).

Soy based diabetic frozen dessert has been developed by replacing 30.0% of SMP with defatted soya flour and containing 1.5% cocoa powder and sweetening agent comprising of 0.07% aspartame/0.05% saccharin with 15.0% sorbitol. The resultant product had greater melting resistance and was comparable to control frozen dessert in sensory aspects (Nandakumari and Reddy, 2009).

Soy *khoa* when incorporated to milk based *khoa* (heat desiccated milk product (~ 60.0% TS) having semi solid consistency) (1:1) resulted in sensorily acceptable *Gulabjamun* (Indian sweetmeat made out of *khoa,* fried in fat and preserved in sugar syrup) with marked improvement in its texture that was ascribed to the improved sugar syrup absorption. Such soy based *Gulabjamun* had significantly greater protein, phosphorus and iron content and was cheaper than control *khoa*-based *Gulabjamun* (Soni et al., 2011). Defatted soy flour when used to substitute wheat flour up to level of 6.66%, yielded highly acceptable *Gulabjamun* that was superior to control with regard to flavour and overall acceptability; the protein content increased (18.01 vs. 14.05% protein in control) while fat content of fried and sugar syrup soaked *Gulabjamun* decreased (15.01 vs. 22.12% fat in control). All the textural parameters viz., hardness, cohesiveness, springiness, gumminess, chewiness increased with increase in wheat flour substitution level (Singh et al., 2009). Soyflour and whole milk powder (WMP) based *Gulabjamun* premixes as well as 'Ready-to-serve' *Gulabjamun*, based on such combination has given successful results; up to 40% of WMP could be substituted by soya flour (Saxena et al., 1996).

Soya solids in the form of full fat soya flour (FFSF) has potential to replace up to 21.6% of milk solids in preparation of 'Milk chocolate' made by panning process. The resultant chocolate was cheaper and had higher protein content (12.16 vs. 10.16% in control) and calorie than the one devoid of soya solids. Since FFSF is 8 times cheaper than milk solids, there was cost reduction too (Gojiya and Patel, 1998).

PRODUCTS MADE FROM A BLEND OF MILK AND COCONUT MILK

Young coconut milk contains carbohydrates (mainly sucrose and some starch), lipid and minerals like P, Ca and K. Coconut protein is rich in lysine, methionine and tryptophan (Seow and Gwee, 1997). Yoghurt had been made from mixtures of cow milk and coconut milk in different combinations (Imele and Atemnkeng, 2001) or

even from blend of coconut milk and SMP (Davide et al., 1990); this practice would be an interesting option in high coconut producing regions and countries.

MILK BASED PRODUCTS CONTAINING BARLEY SOLIDS

The nutritive value of barley is similar to those of wheat that is, 2.3% fat, 12.5% protein, 73.5% carbohydrate and high in fiber content. It is rich in non-starch polysaccharide β-glucans that has beneficial impact on lowering blood cholesterol and glycemic response (Bourdon et al., 1999; Jadhav et al., 1998).

Malted milk powder invented by William (1883) of USA made an instant success and continues to remain so due to its nutritive value, palatability, digestibility and convenience. It caters to the consumers' requirement as a milk substitute in milk deficient areas and to people who cannot digest pure milk. The presence of malt enhances the taste and contributes to brown colour of the reconstituted beverage (Dhillon, 2005). Malt extract, cream, concentrated skim milk (malt solids: milk solids ratio of 40:60) and water were blended to have mix having 45.0% total solids (TS), which was subsequently spray dried to obtain malted milk powder. The malted milk powder had 8.42% fat, 16.42% protein and 3.72% moisture. Increasing the TS of the mix from 40.0 to 45.0%, led to an increase in bulk density, solubility index and dispersibility, however the wettability, sinkability and flowability of resultant powder tended to decrease (Banerjee and Ladkani, 1985). Another malted milk powder had 3.29% moisture, 7.55% fat, 13.19% protein, 72.4% carbohydrates and 3.66% ash (Dhillon, 2005). Even cocoa powder is permitted as an ingredient in Malted milk food by the Indian food regulation (PFA, 2009).

MILK SOLIDS WITH VEGETABLES

Reduction by 50.0% in risk of developing some forms of cancer has been reported through intake of 400 to 600 g of fruit and vegetable per day (Heber, 2004). Broccoli is one of the richest sources of health promoting glucosinolates, antioxidants and essential nutrients viz., fibre, Ca, Mg, Se, Zn, ascorbic acid, folate, β-carotene, etc. Cheese has health promoting characteristics associated with certain immune functions in the body due to bioactive peptides and conjugated linoleic acid (CLA). Cheese is rich in minerals like Ca, Mg, P and fat soluble vitamins and possesses anti-caries function. A blend of Blue cheese powder containing up to 10.0 to 20.0% of freeze dried broccoli sprouts powder was acceptable as a novel 'health-promoting' food. Such cheese powder had total antioxidant capacity (ascorbic acid equivalent), total polyphenols (gallic acid equivalent), total chlorophyll and total carotenoids of 53.5, 4504.2, 147.1 and 59.8 µg/g dry weight basis (DWB), respectively (Sharma et al., 2011).

Carrot is rich in β-carotene (concentration of 39.6 and 23.9 mg/100 g in fresh and powdered carrot respectively), the precursor of vitamin A and contains an appreciable amount of vitamin B_1, B_2, B_6 and anthocyanin pigment. The sweetness of carrot is due to presence of sucrose, maltose and glucose. Carrot intake may enhance immune system, and protect against high blood pressure, osteoporosis, cataracts, arthritis, bronchial asthma and urinary tract infection (Beom et al., 1998). Buffalo or cow skim milk was blended with carrot juice (7.0% TS) and added with 8.0% sugar and 0.2% gelatin to prepare a nutritious beverage; levels above 20.0% carrot juice incorporation resulted in sedimentation (Singh et al., 2005). A sterilized carrot *kheer* (sweetened concentrated milk) has been developed using milk added with 8.0% sugar, dry fruit and 30.0% of shredded carrot that was previously cooked in ghee. The technology of preparing carrot *burfi* (*Khoa* based sweetmeat) is very popular in India whose method has been standardized (Mathur, 2008); the product had 8.2% fat and 33.3% TS (Qureshi et al., 2007). A kheer mix has been formulated based on dehydrated carrot, skim milk, sugar, corn flour, cashew and cardamom (Manjunatha et al. 2003). A healthy bottle gourd *halwa* (similar to *burfi*) has been successfully standardized (Dalal, 2008).

Cheese powders with additional flavour profiles such as cheese with bacon, onion or tomato, are products that would be suitable for quiches, pizzas and pasta meals (Anon., 1994b).

MILK SOLIDS WITH FRUIT

Fruit are invariably used for flavouring of several dairy products. However, due to the presence of phytochemicals in most of the fruits, its involvement has increased looking at the 'wellnesses' of the product containing it. Fruits are rich sources of various important phyto-nutrients namely, vitamins, minerals, antioxidants and dietary fibers. Incorporation of fruits in milk products not only aids in 'value-addition' and 'product diversification', but also helps in checking the post harvest losses.

Merging of dairy products and fruit beverage markets with the introduction of 'juiceceuticals' like fruit yogurt beverages that are typical examples of hybrid dairy products offering health, flavour and convenience. Some of the virtues of fruit are depicted in Table 4. Typical examples related to inclusion of fruit solids in dairy based products include ice cream and frozen desserts, stirred yoghurt, fat spreads, etc. These are discussed subsequently.

Table 4. Characteristics of fruit pulp/juice important for value-addition to milk foods.

Fruit	Characteristics of fruit important for food product development	Reference
Pomegranate	High in vitamin C and K, folate, thiamin; minerals like K, Cu and Mn providing ~ 234 k.cal./100g. It is low in saturated fats and sodium. Potent in several antioxidants and has antiviral activity. Prevents intestinal disorder, dysentery, worms and diarrhea. Claimed to lower cholesterol and reduce risk of certain cancer (breast, skin, prostate, lung).	Konowalchuk and Speirs (1976)
Mango	Rich in β-carotene (445 µg/100 g) an antioxidant and vitamin C (28 mg/100 g), vitamin B_6 (134 mg/100 g). Supplies minerals viz., Ca, Mg, Fe and Zn. The tartaric acid, malic acid and a trace of citric acid help to maintain the alkali reserve of the body.	Kadam et al. (2009)
Banana	Rich in K (~ 440 mg/100 g) and low in Na (~ 1 mg/100 g) – suitable for hypertensive persons. It is a calming food due to large content of tryptophan that is converted to serotonin, an inhibiting brain neurotransmitter. It is a good internal lubricator for the intestine, beneficial in the treatment of constipation and ulcers. It is a good source of vitamin C, B group vitamins, folate, niacin, riboflavin and pantothenic acid.	Kumar et al. (2001) and Laxminarayana et al. (1997)
Cherry	High level of antioxidants, rich source of β-carotene (20.0% more than blueberries and strawberries), vitamin C and vitamin K. It has good quantum of minerals like Fe, Mg and K.	Hedrick et al. (1969)
Blueberry	Amply packed with vitamins C and K, along with Mn and antioxidants. It contains high amount of anthocyanins. They boost enzymes that grow new nerve cells in the brain (important for memory). They contain tannins which are astringent to the digestive system and reduce inflammation.	Camine et al. (2006)
Concentrated grape juice	Concentrated grape juice has 82.0% solids, 0.63% protein having high mineral especially Ca and Fe (5-10 mg/100 g). High iron may find use for patients suffering from anemia.	Ozturk and Oner (1999)

Milk beverage containing fruit pulp

A banana flavoured milk beverage includes a banana and a glass of milk, with a dash of vanilla (Kumar et al., 2001). Buffalo skim milk added with 10.0% guava pulp and 4.0% sugar yielded acceptable pasteurized beverage; use of 0.05% carrageenan was necessary for preparing sterilized guava beverage. The pH of guava pulp was 4.4 which decreased the pH of beverage to 6.4 (Ibrahim et al., 1993a). Standardized 1.0% fat milk added with 20.0% mango pulp, 2.0% sugar and 1.0% of total milk protein powder yielded a highly acceptable mango milk beverage (Ibrahim et al., 1993b).

Mango *burfi* and Mango milk powder

Highly acceptable mango *burfi* was prepared from buffalo milk using 15.0% Alphonso mango pulp (w/v of milk), 5.0% sugar (w/v of milk) and 0.15% turmeric powder (w/v of milk) added at pat formation stage of *khoa* (Kadam et al., 2009). Use of mango pulp helped in imparting desired color to *burfi*, obviating the addition of synthetic colour. A mango milk powder has been prepared through spray drying process (Sharma et al., 1974).

Cherry based fat spread

A highly acceptable fruit flavoured fat spread has been developed using the formulation: Cream (45% fat) – 42.7%, sugar – 15.0%, butter – 15.0%, cherry concentrate – 25.0%, cherry isolate flavour – 2.0%, imitation sweet cherry – 0.3%, carboxy methyl cellulose (CMC) – 0.5% and red colouring (Hedrick et al., 1969).

Blueberry based frozen dessert

A low-fat frozen dessert has been prepared containing the healthy components of both soybeans and blueberries. The formulation of such frozen dessert is depicted in Table 5 which provided 139 calories/100g of product. A serving size of 150 ml provided 6.25 g of soy protein and 56.0 mg of anthocyanin/100g of frozen dessert (Camire et al., 2006). Incorporation of milk in this formulation would make it sensorily more acceptable.

Raspberry based yoghurt

Acceptable quality stirred yoghurt has been made by

Table 5. Formulation of a low-fat frozen dessert using soya solids and blue berry.

Ingredients	Rate (%)
Silken Tofu	48.46
Soy milk	12.16
Blue berry puree (12^{o} Brix)	5.33
Sucrose	21.89
Litesse (Fat replacer)	4.86
Gel star	0.55
Salt	0.05
Juicy blues	5.33
Vanilla	1.37
Lemon juice	0.63

Source: Camire et al. (2006).

blending raspberry concentrate (64^{o}Brix) at levels of 10.0% with pectin 0.5% rate, post incubation to obtain stirred fruit yoghurt (Ramaswamy and Basak, 1992). Yoghurt has been made utilizing concentrated grape juice (82.0% TS) at the rate of 10.0% by volume of milk. Inclusion of grape concentrate increased the fermentation time and decreased the viscosity of product; use of stabilizer was felt necessary (Ozturk and Oner, 1999).

Fruit Shrikhand

Shrikhand is an Indian fermented product made out of Dahi (yoghurt like), from which part of whey is removed and mixed with sugar and flavouring. Fruit based *shrikhand* has been prepared wherein fruits like apple, papaya (paw-paw), mango gave good result (Bardale et al., 1986; Vagdalkar et al., 2002); even cocoa powder complemented papaya in fruit *shrikhand*.

Banana milk shake powder

Banana milk shake powder has been prepared from cow milk blended with '*Musa cavendishii*' banana (5:1). Carboxy methyl cellulose was used at 0.015% to the milk before homogenization (100 bar) to improve its mouth feel. The mix was spray-dried employing inlet and outlet air temperatures of 160 to 180 and 85 to 95°C, respectively. Ground sugar was dry blended to have a sugar content of 42.5% (Laxminarayana et al., 1997).

Fermented milk containing fruit juices

Recently, there has been an increased trend to fortify cultured milk products with fruit juices/pulps. Addition of fruit preparations, fruit flavors, and fruit purees has enhanced versatility of flavor, texture, color, variety to fermented milks. Incorporation of fruits in traditional fermented milk products not only aids in 'value-addition' and 'product diversification' but also helps in checking the post harvest losses. Processed fruits are more widely employed, added to cultured milk in forms like fruit purees, fruit pieces, fruit syrup/juices, crushed fruit, frozen/osmo-dehydrofrozen fruits, fruit preserves, etc. (Tamime and Robinson, 1999); the level of fruit ranging from 4.0 to 20.0% depending on the type of fruit and its concentration (Nila et al., 1987; Desai et al., 1994; Ozturk and Oner, 1999; Venizelou et al., 2000). Mango pulp and pineapple juice could be used satisfactorily up to 20.0% level in preparation of fruit Yoghurt (Desai et al., 1994). Highly acceptable pomegranate yoghurt could be produced using 10.0% fruit pulp and 6.0% sugar (Kale et al., 2008). Coisson et al. (2005) evaluated the use of *Euterpe oleracea* fruit juice as a natural functional colorant for yogurt. The fruit juice is dark purple with a high anthocyanin and phenolic content. The novel natural colorants from *E. oleracea* juice could be considered as 'functional' ingredients for their anti-oxidant and anti-radical activity.

MILK SOLIDS WITH NUTS

Cashew, among other nuts, is prized by all for its delectable flavor. Cashew nut is reported to have on average 6.2% moisture, 43.2% lipid, 19.6% protein, 27.2% carbohydrate, 4.9% sugars, 2.7% ash and 2.4% dietary fiber (Sathe et al., 2009). Raw cashew nut kernels are reported to contain appreciable levels of bioactive compounds such as β-carotene (9.57 µg), lutein (30.29 µg), zeaxanthin (0.56 µg), α-tocopherol (0.29 mg), gamma-tocopherol (1.10 mg), thiamin (1.08 mg) per 100 g of dry matter (DM) (Trox et al., 2010). Cashew nuts had the highest calorific value (765 k.cal./100 g edible

portions) amongst other nuts (pistachio, walnut, groundnut, pecan, and almond); the calorie contribution was 7.3% from proteins, 36.0% from carbohydrates and 56.7% from fats. The predominant fatty acid in cashewnut is oleic acid (Spell, 1976).

Cashew nut burfi are Indian sweets containing sugar/jaggery, fat, milk solids and cashew nuts. The standardized recipe comprised of 22.1% cashewnuts, 11.05% whole milk powder, 44.2% sugar, 11.05% hydrogenated vegetable fat, 0.55% cardamom powder and the remaining 11.05% is water. The cashew nut burfi had 8.5% moisture, 24.1% fat, 8.7% crude protein, 56.77% carbohydrate, 1.13% ash and contributed to 480 k.cal/100g of product (Satyanarayana et al., 1993).

The roasted peanuts (that is, groundnuts) are potent source of nutrients viz., about 40.6% oil, 18.4% crude protein, 36.11% carbohydrate, 2.41% crude fibre and 1.41% ash; they are rich in minerals viz., sodium 0.57%, potassium 0.55%, calcium 1.25%, magnesium 0.24%, iron 0.46%, zinc 0.50 and phosphorus 0.69% (Ayoola and Adeyeye, 2010).

Groundnut burfi was made using roasted groundnuts, sugar, milk powder, condensed milk and flavourings. Since groundnuts are rich in protein, such groundnut based burfi, may be useful in alleviating protein malnutrition in underdeveloped countries (Khan et al., 2008).

MILK SOLIDS WITH COCONUT

Desiccated coconut is reported to have about 3.0% moisture, 55.0% fat, 2.50% ash and less than 0.3% acidity expressed as lauric acid (Leon and Delores, 2005). Dehydrated coconut when incorporated in product manufacture contributes to the typical taste and texture.

Coconut burfi is a popular traditional sweet of South India. The presence of coconut in burfi makes it prone to rancidity. Use of dehydrated coconut powder and jaggery helped in producing reduced moisture coconut burfi. The mouth feel provided by dehydrated coconut powder is liked by consumers. The product had shelf life of 6 months at 26°C when packaged in laminate pouches, without using preservatives (Satyanarayana et al., 1990; Gupta et al., 2010).

DAIRY INGREDIENTS IN CONFECTIONERY PRODUCTS

Milk solids have a prominent role to play in confectionery products like 'Milk chocolate' and 'White chocolate'. The type of milk powders that have been utilized in the manufacture of milk chocolate include: (a) Roller dried whole milk powder (RWMP), (b) spray dried whole milk powder (SWMP), (c) high-fat powder, (d) buttermilk powder, (e) whey powder, (f) spray dried skimmed milk powder (SSMP) + Anhydrous milk fat (SMPAF)/cream (dried together in fluidized bed drier). Many aspects of chocolate manufacture and storage (that is, tempering conditions, melt rheology, hardness, bloom stability) were dependent on the level of milk fat in milk powder. Free milk fat available to mix with cocoa butter in chocolate and particle characteristics are the most important factors determining chocolate processing conditions and quality; other factors include powder particle size, structure and air inclusion (Twomey and Keogh, 1998).

Milk ingredients influences consumers liking of milk chocolate through the quality driving parameters of particle size/sandiness, viscosity/melting mouth feel and milk flavour. Milk fat status exerted more influence than differences between spray and roller dried powders. High free fat cream powders (42.0 to 75.0% fat) were most suitable for 'Cream chocolates'. Fillers like lactose could replace some sucrose and whey protein concentrates (WPCs) can partially replace SMP (Bolenz et al., 2003).

The spray dried and roller dried WMP are reported to contain 2.0 to 3.0 and 25.0 to 60.0% free fat respectively; SSMP had no free fat at all. Some manufacturers mimic a high free fat milk powder by blending Anydrous milk fat (AMF) with SMP. Hence, RWMP is ideal for use in milk chocolate while SSMP does not perform well. Powders that contain high free fat can interact directly with cocoa butter in chocolate. High free fat level resulted in reduced chocolate viscosity, making it easier to process the chocolate and providing an economy in cocoa butter usage. The free fat content influenced the tempering conditions needed to ensure proper crystallization of cocoa butter in chocolate. Barring for RWMP, the chocolates made with higher free milk fat levels, including SMPAF showed greater resistance to 'fat bloom'. The sensory quality of chocolate made utilizing different types of milk powders were in decreasing order for: SWMP>SSMP>RWMP=SMPAF (Liang and Hartel, 2004). The properties of milk powders influencing the chocolate properties are shown in Table 6.

Milk chocolate crumb

'Milk chocolate crumb' is a vacuum dried, crystallized mixture made from milk, sugar and cocoa liquor. The process of drying this mixture developed a strong caramel flavour that makes crumb chocolate very popular amongst consumers. In absence of cocoa liquor, it is referred to as 'Milk crumb' or 'Blokmilk'. This mixture when adequately heated and due to the presence of anti-oxidative components of cocoa, the dried powder had extended shelf life of 9 to 12 months at ambient temperature. The 'Chocolate crumb' comprises of sucrose – 53.0%, milk solids – 32.0%, chocolate liquor – 14.0% and moisture – 1.0%. The chocolate

Table 6. Properties of milk powders and their influence on chocolate properties.

Properties of milk powder	Properties of chocolate or processing conditions
Particle size and distribution	Flow properties
Particle shape	Refining operations (particle size distribution)
Surface characteristics of particles	Tempering conditions (cocoa butter crystallization)
"Free" fat level	Hardness/snap
Particle density	Bloom stability
Flavor attributes	Flavor profile

Source: Liang and Hartel (2004).

manufacturing process proceeds more quickly and economically when using crumb, than by incorporating the separate ingredients (Campbell and Pavlasek, 1987).

DAIRY INGREDIENTS IN CARAMELS

Caramel typically consists of sugar, corn syrup, milk protein and vegetable fat; water, salt, vanilla, and emulsifiers (lecithin, glycerol mono-stearate) are optional ingredients. Milk proteins have traditionally been used in the confectionary industry for contributing distinct flavor, color, and texture, with sweetened condensed milk (SCM) and milk powders being the most popular. Casein contributes a firm and chewy texture to caramels upon heating, while lacking stickiness and toughness. Large sucrose crystal formation may be inhibited by the ability of caseins to bind water. Surfactant properties are provided by caseins, aiding in the formation of a homogeneous product (Flint, 2003).

SCM is used for flavor, color, and cold flow control in caramels. It is quite stable due to lower water content and added sugar. Proteins especially casein, create a firm and chewy confection upon heating, heighten moisture retention and control free and bound water in the system (Campbell and Pavlasek, 1987). Casein and whey proteins also provide emulsion stability when lipids are one of the ingredients in confections. The use of whey protein in confectionary products is of interest for flavor, color and structural effects. Whey solids have been used in the production of caramel and are reported to enhance the browning reaction due to the increase in lactose content (Flint, 2003).

Hydrolyzed and demineralized whey syrup finds good application in confectionery market, especially soft caramels. Hard caramels can be made from hydrolyzed whey syrup, provided the formulation includes caseinates. The hydrolyzed whey syrup can also form raw material for manufacture of caramel syrup that is used as an intermediate product for confectionery center (Anon, 1994a).

WPCs can be substituted for SCM in caramels with an end point temperature of 116°C. The flavour of product so obtained is superior, however, the texture score is reduced due to greater chewiness and stickiness compared to use of sweetened condensed skim milk in caramels (Flint, 2003).

DAIRY INGREDIENTS IN BAKED PRODUCTS

Milk solids in baked goods

Milk, butter, buttermilk, yoghurt, kefir, whey, quarg and dried milk protein or SMP have been tried out as one of the valued ingredient in various types of bread, and whole milk, butter and fresh cheese in fine bakery goods (Bruemmen and Bretschneider, 1984). The dairy products most frequently used in white (toasting) bread are milk (fresh and dried) and dried sour cream plus buttermilk, whilst in wheat flour bakery goods and fine bakery goods, the dairy products of choice are quarg – fresh or dried, whipping cream, butter and butter oil (Bode, 1982).

Whey solids

Aqueous solution of whey containing pectin at the rate of 15.0 to 20.0% by weight of flour added to dough helped in improved the quality and nutrition of resultant bread (Harper and Jakubczyk, 1983; Kolpakova et al., 1990). Presence of lactose in whey stimulated the growth of yeast and reduced the fermentation time in bread making (Liepinyaz, 1991). Lactose hydrolyzed whey solids can also be used to replace part of sweeteners in baking industry, over and above reducing the fermentation time in bread making. Some applications of such whey syrup include bread, biscuits, cakes, savoury goods, caramels, fillings, pastes and cereal bars (Nip, 2006). Whey solids provided shortening or tenderizing effect in cake and sponge products (Anon., 1985; Tow, 1985; Pomeranz, 2002).

'Breading' or 'crumb coatings' used on fried products contains whey as a critical ingredient. Whey solids acted as an emulsifier and have good water binding properties.

Whey designed for use in bakery products should preferably be demineralized and adequately heat treated to denature whey proteins. Addition of 0.20% di-ammonium phosphate (on flour basis) can correct for most of the suppressant activity of sweet whey on loaf volume and crumb structure (Anon., 1994a).

Substitution of milk powders by WPC (25.0 to 35.0% protein) in bakery products can be very cost-effective and can increase the functionality (acid solubility, gel formation, whipping ability) of the system. WPC, especially heat-treated ones, acts as a functional ingredient conferring protective effect on the gluten network in the frozen dough and also in baking performance (Jacobson, 1997; Kenny et al., 2001).

Buttermilk solids

Buttermilk either in fluid, concentrated or dried form has been used in the manufacture of some bakery products such as bread, biscuits, cakes, etc. It is a valuable ingredient in specialty bakery products requiring short texture, without excessive dryness. Buttermilk solids at usage level of 3.0% of flour weight have been recommended (Patel and Jana, 1994).

Fermented dairy products

Bread made with fermented dairy products had higher levels of lactic acid, ethanol, and diacetyl compared to control breads. The aroma of bread made using dairy ingredients was pleasant (cheese-type) and more intense than that of the control. Dried fermented (using *L. casei* subsp. *rhamnosus* with or without *L. helveticus* and *S. thermophilus*) dairy ingredients made out of milk plus whey (1:1, 20.0% TS) can be used as flavour enhancers in bread making processes with short fermentation periods (1.0 to 2.0%, dry basis) or in sourdough bases (up to 10.0%, dry basis) (Gelinas and Lachance, 1995).

Fractionated butter fat/dried cream

High melting fat fraction is suitable for croissants, Danish pastry and puff pastry; low-middle melting fat fraction for cakes and biscuits such as short bread, and low-melting fat fraction has been found beneficial in butter creams (Patel and Jana, 1994). Dried cream has broader applications in bakery products (Lane, 1985; Parkinson, 1984).

Chhana podo

Chhana podo is a baked Indian delicacy made by mixing chhana with *maida/suji* (ground wheat flour) and sugar and then baked in a manner similar to baking of cake. The puffed, brown coloured crust product has a spongy, soft texture. Milk has to be standardized to 4.0 to 4.5% fat, *maida/suji* is recommended at 5.0% level, while sugar is required at levels ranging from 25.0 to 35.0% and water may be used at the rate of 30.0% by weight of chhana. The product is baked at 150 to 200°C/50 to 80 min (Ghosh et al., 1998; Kumar et al., 2002; Sawant et al., 2010).

CHEESE AS AN INGREDIENT IN FOODS

Cheese is an extremely versatile food product that has a wide range of textures, flavour and end uses. Cheese is used in a wide variety of prepared foods including appetizers, soups, sauces, casseroles, crackers, fillings in pastry and pies. The most popular usage is as a topping on pizzas and as cheese slices in hamburgers and cold (sub) sandwiches. Cream cheese is used as an ingredient in cheese cakes and in spreads (Lucey, 2008). The types of cheese that is suited for a particular baked food item is furnished in Table 7.

Enzyme modified cheese (EMC), an intense cheese flavour concentrate produced by using enzyme technology and cheese base from milk using a combination of membrane filtration, fermentation and evaporation are some of the sought-after valued flavouring and bodying ingredient for food. EMC is manufactured from rapidly ripened cheese-curd slurries, in cheese-like form, powder form or as a heavy paste which is stable under refrigeration. EMC can be used as an ingredient in processed cheese, as a flavouring in imitation cheese products, and as a flavour enhancer in cheese sauces, soups and dips. Some of the desirable properties of cheese base for application in food include ease of dispersibility in water, low flavor, smooth creamy mouth feel and stability during storage (Sutherland, 1991).

Cheese as pizza topping

Pizza is enjoyed especially with cheese topped on it prior to baking. The favoured cheese being Mozzarella, though other cheeses like Provolone, Feta and Parmesan are also used. Swiss cheese may also be used for such applications. Some classic examples of cheeses that find application as pizza topping include:

Mozzarella cheese

Undoubtedly, the most popular cheese intended for pizza application is low-moisture part skim Mozzarella cheese,

Table 7. Type of cheese recommended for a particular bakery product.

Cheese variety	Bakery item in which cheese is a prized ingredient
Mature Cheddar cheese	Cheese biscuits and straws, cheese sticks, specialty breads, Hamburger, buns, muffins
Dried Cheddar cheese	Snack foods, dry prepared mixes
Lancashire cheese	Cottage and fish pies
Cottage cheese	Sour dough formulations, muffins, devils food cake, yellow layer cake, lemon pudding, thick sauces for casseroles
Bakers' cheese (Green or dried)	Cheese cakes, pastries
White cheese (Fromage Blanc)	Cheese cakes
Quarg cheese	Cakes, cheese-cream baked goods, fillings, some confectioneries
Mozzarella cheese	Pizza, cheeseburger, tacos
Romano, Parmesan, Provolone	Pizza

Source: Patel and Jana (1994).

also referred to as 'Pizza cheese'. The functionality inherent in such cheese for baking applications includes good shredability, meltability and stringiness. Some degree of browning and fat leakage may be considered acceptable.

The Mozzarella cheese should be sufficiently firm to allow shredding and when cooked, it should exhibit good meltability, stretchability and elasticity. Free-oil formation and browning/blistering are also important. On baking in a conveyor pizza oven with high velocity air flow at high temperature, an aged (1 to 3 weeks at 4°C) cheese should develops a moist, glistering appearance with discrete dark patches, scattered over the surface of the melt with no evidence of shred outlines. The mouth feel of the melted cheese should be smooth and moderately chewy (Jana, 2001; Early, 2003). The presence of such unique functional characteristics in Mozzarella cheese enables it to dominate the fast-food market.

Provolone cheese

Non-smoked provolone has a nutty flavour, creamy texture, and is easy to grate and use. Smoked provolone has a more robust, smoky taste. Provolone can be used by itself, or in a combination with Mozzarella for pizza topping (Hazen, 2005; Beggerow, 2008).

Cheddar cheese

From white to orange, from mild to sharp, Cheddar is a good cheese for pizza. Cheddar melts well, but does not stretch, so it is always used in combination with Mozzarella or Provolone. The more Cheddar you use in the blend, the milder it should be; sharp varieties can dominate the flavour of the pizza (Hazen, 2005; Beggerow, 2008).

Romano and Parmesan cheese

These cheeses are most often used dried and grated over pasta dishes and on pizza. Their flavour can be quite robust, especially the dried and grated ones. Parmesan is also available as fresh, and can be sliced or grated. Fresh parmesan has a better all-around flavour for pizza than the dried ones (Hazen, 2005; Beggerow, 2008).

Feta cheese

Feta cheese is cured in brine. It is an excellent cheese to use in combination or all by itself for pizza. It's salty, earth flavour holds up well after baking (Beggerow, 2008).

Swiss cheese

Swiss is a very flavorful, salty cheese that is not liked by everyone on pizza. It can add a great accent to a pizza, but its strong flavor limits its usage in mixture with other cheese at less than 10.0% level. Swiss can get rubbery after melting and hence used alone sparingly (Beggerow, 2008).

DAIRY INGREDIENTS IN FORMULATED FOODS

Formulated foods are those which involve a recipe/formulation of several ingredients in a balanced proportion so as to yield a product with desired quality attributes. Examples include Gulabjamun mix powder, instant beverage mixes, etc.

Gulabjamun mix powder

Gulabjamun mix powder is formulated from SMP,

Table 8. Formulation of instant hot beverage mixes.

Ingredients	Hot cocoa mixes	Instant coffee beverages
NFDM, whey, butter milk powder	30-40	10
Sucrose, lactose or other carbohydrate solids (Corn syrup solids, Maltodextrin)	30-50	60-80
Cocoa	4.00	0
Instant coffee	0	4.00
Fat	0-8	1-5
Stabilizer, emulsifier, fortificant	1-2	1-2

Chandan and Kilara (2011).

hydrogenated vegetable fat, *maida* semolina (product of wheat milling), baking powder, ground cardamom with or without WPC. The composition of a typical Gulabjamun mix powder is 6.07% moisture, 18.50% fat, 17.62% protein, 53.18% carbohydrates and 4.65% ash. Roller dried WMP is preferred over spray dried one for such purpose. The cost of *Gulabjamun* mix powder utilizing roller-dried and spray-dried WMP was computed to Rs. 36 and Rs. 38/kg, respectively (www.nrdcindia.com). The formulation of *Gulabjamun* mix powder comprised of roller dried skim milk, bleached wheat flour semolina, butterfat, baking powder and ground cardamom in the proportion of 43.5, 25.0, 15.0, 15.0, 1.5 and 0.1, respectively (Ghosh et al., 1984). Instant *Gulabjamun* mix has been prepared using a blend of spray dried WPC and SMP (40:60, w/w); whey protein subjected to a pre-treatment of 90°C for 10 min for denaturation gave best results. Other ingredients in the formulation were 25.0% refined wheat flour, 2.0% baking powder and 15.0% butter (Vani and Jayaprakasha, 2004).

Burfi containing ghee residue

A value-added ghee residue based burfi named 'Chocsidu' was made employing processed ghee residue, khoa, sugar and chocolate in the proportion of 52.2:24.5:20.8:2.5 and compared with control based on khoa, sugar and chocolate only. The fresh ghee residue was processed by suspending in 0.5% boiling aqueous Na_2CO_3 for 30 min., followed by draining for same period. The resultant burfi had higher fat and protein, at the same time having lower lactose and ash compared to control burfi (Verma and De, 1978).

Instant hot beverage mixes

Today's consumers expect beverage mixes that gives them the pleasure of all the ingredients combined together and that should have easy dispersibility when reconstituted in water; a classical example of such formulation is provided in Table 8.

MILK SOLIDS WITH VEGETABLE OILS – FILLED DAIRY PRODUCTS, CHEESE ANALOGUES AND FAT SPREADS

Filled products

Filled products are the one in which milk fat is replaced completely by vegetable oils and fats. This is mainly done to have a dietetic product without cholesterol and with low levels of saturated fats. Typical examples include filled milk, filled whipped cream, filled ice cream, etc. Corn, olive, groundnut oil were found suitable for preparing 'filled strawberry yoghurt' containing 1.5% vegetable oil. The filled yoghurt had higher proportion of PUFA and mono unsaturated fatty acids compared to the one made using AMF as fat source (Barrantes et al., 1994).

Non-dairy coffee whitener

The formulation for a non-dairy coffee whitener/creamer comprised of (on dry matter basis) 60.0 to 65.0% corn syrup solids and maltodextrin, 20.0 to 32.0% vegetable oil having 35 to 40°C melting point, 2.0 to 5.0% Na-caseinate, 1.0 to 3.0% disodium phosphate, 1.0 to 3.0% emulsifier, stabilizer and cream flavour (Gardiner, 1977).

Cheese analogues

Analogue cheese, cheese substitute of imitation cheese are synonyms for diverse type of cheese materials that use vegetable oils instead of butter fat and contain casein or caseinates as the protein source. The protein source can also be from vegetable (soyabean, groundnut) sources. The texture and flavour profile of such cheese analogues is governed by the type of oil, protein, starch, hydrocolloid and emulsifying salts used in the formulation. The vegetable oil is required to be partly hydrogenated or suitably modified (fractionation, interesterification) in order to elevate its melting point to a level near to that of milk fat (Chavan and Jana, 2007).

Typical examples of formulation of Mozzarella and

Table 9. Formulation for cheese analogues.

Mozzarella cheese analogue		Imitation Kasher cheese	
Ingredients	**Percentage**	**Ingredients**	**Percentage**
Ca-caseinate	14.39	Rennet casein	22.90
Peanut protein isolate	14.39	Soy protein isolate	6.62
Vegetable oil (partly hydrogenated)	20.17	Hydrogenated cottonseed oil	21.28
Emulsifying salt	0.75	Emulsifying salt	1.78
NaCl	1.83	NaCl	1.42
Acidifying agent	1.38	Carrageenan	0.10
Cheese flavouring	1.00	Cheese flavouring	1.00
Water	46.09	Water	44.90

Source: Krishnaswamy and Patel (1968), Berger et al. (1993).

Kasher cheese analogue are given in Table 9.

Mixed fat spreads

A good example of mixed fat spread is 'Bregott', developed and marketed by the Swedish Dairies Board. The product was made using ripened cream (35.0% fat, pH 4.6 to 4.7) to which refined soy bean oil was added (at levels of 20.0% of total fat) and after ageing churned to obtain fat spread that had superior spreadability at refrigeration temperature (Wilbey, 1986). Safflower seed based fat spread has been prepared from *chakka* (partly dehydrated dahi) obtained from a blend of buffalo milk and safflower milk (1:1); the additives were 1.0% tri-sodium citrate, 0.1% potassium sorbate, 1.5% common salt and 10.0% of cheese as flavouring. The low-fat spread had low cholesterol and was rich in PUFA compared to product made from cow/buffalo milks; the cost and calorie was also lower for the former product (Deshmukh et al., 2003). Spreads with increased content of ω-3 fatty acids have been developed using olive oil (Mortensen, 2009).

CARBON DIOXIDE AS AN INGREDIENT IN RAW MILK AND FIZZY DAIRY DRINKS

Incorporation of carbon dioxide to milk retards the growth of some psychrotrophic Gram negative organisms and improves the overall quality of the pasteurized milk obtained thereafter. Even there is a marked extension in the keeping quality of raw milk (Hotchkiss et al., 2006).

Use of carbon dioxide for carbonation of pasteurized milk prior to manufacture of yoghurt (Calvo et al., 1999) as well as for carbonation of the cooled finished product (Karagul-Yuceer et al., 1999, 2001) has been successfully attempted. The carbonated version of each flavour was preferred by the sensory panelists. The population of *E. coli* decreased to non detectable levels in the product during 60 days of refrigerated storage.

CONCLUSIONS

There are several limitations which have influence on wide consumption of milk, like cost, allergic potential, lactose intolerance, cholesterol, saturated fat content, etc. Classical examples of synergy of milk solids with other food ingredients include the Chocolate crumb, malted milk powder, stirred fruit yoghurt, ice cream, processed cheese food, cheese as pizza topping, milk bread, cheese biscuits, etc. The flavour of milk solids is appreciated by one and all. The functionality of milk constituents viz., proteins, fat, lactose, minerals have a profound positive influence on the quality of non-dairy food product, when dairy ingredients are used in such product mix. Even the interactions between the components of dairy and other food products have a bearing on the sensory and rheological characteristics of resultant food item. Combining the neutraceutical components of dairy and non-dairy based food item, a new 'value added' product can emerge that can cater to the ever increasing demand for 'wellness food' by the 'health conscious' consumers. With further research on dairy ingredients and their interaction with other food constituents and ingredients, more and more new 'novel' products would be launched for 'enjoyment' and 'wellness' of the varied consumers.

REFERENCES

Andhare BC, Baswade SV, Mule RS, Patil RA, Jadhav VS (2004) The sensory evaluation of softy ice-cream from safflower milk blended with buffalo milk. J. Dairying Foods Home Sci., 23: 22-27.

Anon. (1985). Ingredient characteristics: Dairy – Eggs, milk, whey. Bakers Digest. August, p. 19.

Anon. (1994a). Whey hydrolysis at Maelor. Dairy Ind. Intl.. 59: 21-23.

Anon. (1994b). Powder performance. Dairy Ind. Intl., 59: 42-44.

Ayoola PB, Adeyeye A (2010). Effect of heating on the chemical composition and physico-chemical properties of *Arachis hypogea* (groundnut) seed flour and oil. Pak. J. Nutr., 9: 751-754.

Banerjee B, Ladkani BG (1985). Physico-chemical properties of spray malted milk powder. Asian J. Dairy Res., 4: 189-192.

Barrantes E, Tamime AY, Sword A (1994). Oils versus milk fat. Dairy

Ind. Intl., 59: 25-30.
Bardale PS, Waghmare PS, Zanzad DM, Khedkar DM (1986). The preparation of shrikhand like product from skim milk chakka by fortifying with fruit pulps. Indian J. Dairy Sci., 39: 480-483.
Beggerow Alan (2008). Types of cheese for pizza. www.ezinearticles.com/?Types-of-cheese-for-pizzaandid:1188372.
Beom J, Yong S, Myung H (1998). Antioxidant activity of vegetables and blends in iron catalyzed model system. J. Food Sci. Nutr., 3: 309-314.
Berger W, Klostermeyer H, Merkenich K, Uhlmann G (1993). Raw materials and added ingredients. In: Processed Cheese Manufacture (Joha Guide). Klostermeyer H. (Ed.), Ladenburg, pp. 94-97.
Berry D (2002). Healthful ingredients sell dairy foods. Dairy Foods, 103: 54-56.
Biswas PK, Chakraborty R, Choudhuri UR (2002). Effect of blending of soy milk with cow milk on sensory, textural and nutritional qualities of chhana analogue. J. Food Sci. Technol., 39: 702-704.
Bode J (1982). Important milk products for bakeries. Brot and Backwaren, 30: 65-67.
Bolenz S, Theissenhusen T, Schape R (2003). Influence of milk components on properties and consumer acceptance of milk chocolate. Eur. Food Res. Technol., 261: 28-33.
Bourdon IW, Yokoama P, Davis C, Hudson R, Backus D, Richter B, Knuckle B, Schneeman BO (1999). Postprandial lipid, glucose, insulin and cholecystokinin responses in men fed barley pasta enriched with β-glucan. Am. J. Clin. Nutr., 69: 55-63.
Bruemmen JM, Bretschneider F (1984). Milk products in bakery goods. Deutsche Milchwirtschaft., 35: 1173-1177.
Calvo MM, Montilla A, Cobbs A (1999). Lactic acid production and rheological properties of yogurt made from milk acidified with carbon dioxide. J. Sci. Food Agric., 79: 1208-1212.
Camire ME, Dougherty MP, Teh YH (2006). Frozen wild blueberry-tofu-soymilk desserts. J. Food Sci., 71: S119-123.
Campbell B, Pavlasek S (1987). Dairy products as ingredients in chocolate and confections. Food Technol., 41: 78-85.
Chandan RC, Kilara A (2011). Dairy Ingredients for Food Processing. Chandan RC and Kilara A. (Eds.), John Wiley and Sons Inc., Iowa, USA.
Chavan RS, Jana A (2007). Cheese substitutes: An alternative to natural cheese – A Review. Intl. J. Food Sci. Technol. Nutr., 2: 25-39.
Coisson JD, Travaglia F, Piana G, Capasso M, Arlorio M (2005). *Euterpe oleracea* juice as a functional pigment for yogurt. Food Res. Int., 38: 893-897.
Dalal T (2008). Healthy halwas - Bottle gourd halwa. In: Mithai. Chapter 3. Sanjay and Co. Pub., Mumbai, pp. 53-54.
Davide CL, Peralta CN, Sarmago IG, Sarmago LJ (1990). Yoghurt production from a dairy blend of coconut milk and skimmed milk powder. Phillippine J. Coconut Stud., 11: 51-58.
Desai SR, Toro VA, Joshi SV (1994). Utilization of different fruits in the manufacture of yoghurt. Indian J. Dairy Sci., 47: 870-874.
Deshmukh MS, Patil GR, Sontakke, AT, Kalyankar SD, Padghan PV (2003). Storage study of low-fat spread from safflower milk blended with buffalo milk. J. Dairying Foods and Home Sci., 22: 63-66.
Deshpande S, Jha K (2008). Suitability of soy milk for development of shrikhand. J. Food Sci. Technol., 45: 284-286.
Dhillon LS (2005). Manufacturing of malt-milk based food products in India. Indian Dairyman, 57(4): 59-60.
Early R (2003). Raw material selection: dairy ingredients. In: Chilled Foods – A Comprehensive guide. Stringer M and Dennis C (Eds.), 2nd Edn., Woodhead Pub. Ltd., Cambridge, pp. 48-53.
Flint MP (2003). Comparison of sweetened condensed skimmed milk and whey protein ingredient in caramels. Thesis submitted to Graduate Faculty of North Carolina State University.
Gardiner DS (1977). Non-dairy creamer compositions. United States Patent No. 4 046 926.
Gelinas P, Lachance O (1995). Development of fermented dairy ingredients as flavor enhancers for bread. Cereal Chem., 72(1): 17-21.
Ghosh BC, Rajorhia GS, Dharam Pal (1984). Formulation and storage studies of gulabjamun mix powder. J. Dairy Sci., 37: 362-268.
Ghosh BC, Rao KJ, Kulkarni S (1998). Chhana podo – baked Indian delicacy. Indian Dairyman, 50: 13-14.
Gojiya N, Patel SM (1998). Soymilk chocolate by panning process. J. Dairying Foods Home Sci., 17: 149-156.
Gupta V, Vijayalakshmi NS, Ashwin B, Anbarasu K, Vijayalakshmi G, Prakash M, Indiramma AR, Rangarao GC, Ramesh BS (2010). Shelf life enhancement of coconut *burfi* – an Indian traditional sweet. J. Food Qual., 33: 329-349.
Harper T, Jakubczyk T (1983). Heat induced changes in whey protein concentrates as related to bread manufacture. NZ. J. Dairy Sci. Technol., 19: 229.
Hazen C (2005). Endless pizza possibilities. www foodproductdesign.com / articles /2005 /02/endless-pizza-possibilities.aspx.
Heber D (2004). Vegetables, fruits and phytoestrogens in the prevention of diseases. J. Postgrad. Med., 50: 145-149.
Hedrick T, Markakis P, Wagnitz S (1969). Cherries in spreads and Cottage cheese sauce. J. Dairy Sci., 52: 2057-2059.
Hotchkiss JH, Warner BG, Lee EYC (2006). Addition of carbon dioxide to dairy products to improve quality: A comprehensive Review. Comp. Rev. Food Sci. Food Safety, 5: 158-168.
Ibrahim MKE, El-Abd MM, Mehriz AM, Ramadan FAM (1993a). Preparation and properties of guava milk beverage. Egypt J. Dairy Sci., 21: 59-68.
Ibrahim MKE, El-Abd MM, Mehriz AM, Ramadan FAM (1993b). Preparation and properties of Mango milk beverage. Egypt. J. Dairy Sci., 21: 69-81.
Imele H, Atemnkeng A (2001) Preliminary study of the utilization of coconut in yoghurt production. J. Food Technol. Afr., 6: 11-12.
Itapu S (2003). Soybean and application in Indian food industry In: Technical Bulletin of American Soybean Association and United Soybean Board. American Soybean Association New Delhi, pp. 1-4.
Jacobson KA (1997). Whey protein concentrates as functional ingredients in baked goods. Cereal Foods World, 42: 138-141.
Jadhav SJ, Lutz SE, Ghorpade VM, Salunkhe DK (1998). Barley: Chemistry and value-added processing. Crit. Rev. Food Sci. Nutr., 38: 123-171.
Jain SK, Mhatre SS (2009). The textural properties of soy paneer. Intl. J. Dairy Technol., 62: 584-591.
Jana A (2001). Mozzarella cheese and pizza – the compatible partners. Beverage and Food World, 28: 14-19.
Johnson DW (1975). Use of soyproducts in dairy product replacement. J. Am. Oil Chem. Soc., 52: 270-271A.
Kadam RM, Bhambure CV, Burte RG, Joshi SV (2009). Process standardization for manufacture of Mango Burfi. In Souvenir of the National seminar on 'Novel Dairy and Food Products of the Future' organized by DSC Alumni Association and SMC College of Dairy Science, Anand Agricultural University, Anand on 19th September, 2009, pp. 177-183.
Kale KG, Chavan KD, Pawar BK, Bhosale DN (2008). Influence of levels of fruit and sugar on chemical composition of pomegranate yoghurt. J. Dairying Foods Home Sci., 27: 11-18.
Karagul-Yuceer Y, Coggins PC, Wilson JC, White CH (1999). Carbonated yoghurt: Sensory properties and consumer acceptance. J. Dairy Sci., 82: 1394-1398.
Karagul-Yuceer Y, Wilson JC, White CH (2001). Formulation and processing of yoghurt affect the microbial quality of carbonated yoghurt. J. Dairy Sci., 84: 543-550.
Kashid UB, Sontakke AT, Shinde DB (2007). Manufacture of golden milk shake from cow milk blended with safflower milk. J. Dairying Foods Home Sci., 26: 159-163.
Kenny S, Wehrle K, Auty M, Arendt EK (2001). Influence of sodium caseinate and whey protein on baking properties and rheology of frozen dough. Cereal Chem., 78: 458-463.
Khan MA, Semwal AD, Sharma GK, Yadav DN, Srihari KA (2008). Studies on the development and storage stability of groundnut (*Arachis hypogea*) burfi. J. Food Qual., 31: 612-626.
Kolpakova VV, Nazarenko EA, Yukalo VG, Trilinskaya EA, Mikholap LG, Mikhailova IV (1990). Bread production. USSR Patent SU 1 563 650. Cited in Dairy Sci. Abstr., 53: 2185.
Konowalchuk J, Speirs JI (1976). Yoghurt preparation using pomegranate. J. Food Sci., 41: 103-117.

Krishnaswamy MA, Patel JD (1968). Imitation cheese spread based on peanut protein. Milchwissenschaft, 23: 618-622.
Kumar P, Mishra HN (2003). Optimization of mango soy-fortified yogurt formulation using response surface methodology. Intl. J. Food Prop. 6: 499-517.
Kumar P, Tyagi SM, Chauhan GS, Sharma HK (2001). Physico-chemical changes during fermentation of banana-whey blended beverages. Egypt. J. Dairy Sci., 29: 53-61.
Kumar S, Khamrui K, Bandyopadhyay P (2002) Process optimization for commercial production of chhana podo. Indian Dairyman, 54: 61-65.
Lane R (1985). Dairy cream and the baking industry. Baking Today, 6: 10-12.
Laxminarayana GS, Ghosh BC, Kulkarni S (1997). Technology of ready-to-use banana milk shake powder. J. Food Sci. Technol., 34: 41-45.
Leon Sonia Y de, Delores Milagros I (2005). Coconut. In: Processing Fruits – Science and Technology, Chapter 29, Barrett DM, Somogyi LP, Ramaswamy HS (eds.), 2nd edn., CRC Press.
Liang B and Hartel RW (2004). Effects of milk powders in milk chocolate. J. Dairy Sci., 87: 20-31.
Liepinyaz A (1991). Development of technology for dried and lactic acid flour concentrate. Cited in Dairy Sci. Abstr., 54: 2675.
Lokhande AT, Deshmukh VS, Adangale SB, Khating LE, Walkunde TR (2010) Formulation of Rasogolla from cow milk blended with safflower milk. J. Dairying Foods Home Sci., 29: 185-188.
Lucey JA (2008). Some perspectives on the use of cheese as a food ingredient – A Review. Dairy Sci. Technol., 88: 573-594.
Macedo RF, Renato J, Freitas S, Pandey A, Soccol CR (1999). Production and shelf-life studies of low cost beverage with soymilk, buffalo cheese whey and cow milk fermented by mixed cultures of *Lactobacillus casei* ssp. *shirota* and *Bifidobacterium adolescentis*. J. Basic Micro., 39: 243-251.
Main A (1991). Fermented dairy products as food ingredients. CSIRO Food Res. Quart., 51: 120-125.
Manjunatha SS, Kumar BL, Mohan G, Das DK (2003). Development and evaluation of carrot kheer mix. J. Food Sci. Technol., 40: 310-312.
Mathur S (2008). Carrot burfi. In: Indian Sweets. Ocean Book Ltd. Pub., pp. 35-36.
Mortensen BK (2009). Production of yellow fats and spreads. In: Dairy Fats and Related products. Tamime AY (ed.), Blackwell Pub. Ltd., pp. 167-194.
Nandakumari K, Reddy KY (2009). Development of soy based diabetic frozen dessert. Indian J. Dairy Sci., 62: 369-373.
Nila DV, Rathi SD, Ingle VM (1987). Studies on qualities of fruit yoghurt. Indian Food Packer, 41: 19.
Nip WK (2006). Sweeteners. In: Bakery Products Science and Technology, Chapter 7, Hui YH (Ed.), 1st edn., Blackwell Pub., pp. 147-148.
Nsofor LM, Chukwu EU (1992). Sensory evaluation of soy milk-based yoghurt. J. Food Sci. Technol., 29: 301-304.
Ohr LM (1997). Fortifying for the health of it. Prepared Foods. 166 : 55-60.
Ozturk BA, Oner MD (1999). Production and evaluation of yoghurt with concentrated grape juice. J. Food Sci., 64: 530-532.
Park DJ, Sejong O, Hyung K, Mok C, Kim Sae H, Imm JY (2005). Characteristics of yogurt-like products prepared from the combination of skim milk and soymilk containing saccharified-rice solution. Intl. J. Food Sci. Nutr., 56 : 23-34.
Parkinson CS (1984). Uses of dairy ingredients in baked products. J. Soc. Dairy Technol., 37: 125-127.
Patel HG, Jana AH (1994). Dairy ingredients in bakery products – A Review. Beverage and Food World, 21: 14-19.
Pomeranz Y (2002) Functionality of whey and casein in fermentation and in bread baking by fixed and optimized procedures. Cereal Chem., 73: 309-316.
Prevention of Food Adulteration (2009). The Prevention of Food Adulteration (PFA) Act, 1954 along with the Prevention of Food Adulteration Rules, 1955 as amended by the PFA (7th Amendment) Rules, 2009, Universal Law Publishing Co. Pvt. Ltd., Delhi, India.
Qureshi MA, Goel BK, Uprit S (2007). Development and standardization of sterilized carrot kheer. Egyp. J. Dairy Sci., 35: 195-197.
Ramaswamy HS, Basak S (1992). Pectin and raspberry concentrate effects on the rheology of stirred commercial yoghurt. J. Food Sci., 57: 357-360.
Rastogi G, Jha YK (1998). Quality characteristics of cottage cheese prepared from buffalo skim milk and soymilk. J. Dairying Foods Home Sci., 17: 157-164.
Sathe SK, Monaghan EK, Kshirsagar HH, Venkatachalam M (2009). Chemical composition of edible nut seeds and its implications in human health. In: Tree Nuts – Composition, Phytochemicals and health effects. Shahidi F, Alasalvar C (Eds.), Chapter 2, CRC Press, pp. 12-29.
Satyanarayana Rao TS, Kaverappa NM, Hemaprakash Reddy T, Jayaraman KS (1990). Development of ready-to-eat traditional Indian sweet dishes based on jaggery and coconut. J. Food Sci. Technol., 7: 355-358.
Satyanarayana Rao TS, Hemaprakash Reddy T, Jayaraman KS (1993). Studies on the development of cashewnut burfi. J. Food Sci. Technol., 30: 462-464.
Sawant ST, Jayashri U, Pisal A, Desale RJ, Kadam DG (2010). Study on sensory qualities of chhana podo from cow milk. J. Dairying Foods Home Sci., 29: 193-196.
Saxena S, Ramachandran Lata, Singh S, Sharma RS (1996). Preparation and chemical quality of Gulabjamun premixes and sensory quality of ready-to-serve Gulabjamuns made from soy flour and milk solids. Indian Food Packer, 50: 41-52.
Selvarani V, Kalyani P (2000). The effect of soymilk on the quality of Kulfi. J. Dairying Foods Home Sci., 19: 46-49.
Seow CC, Gwee CN (1997). Coconut milk: chemistry and technology. Int. J. Food Sci. Technol., 32: 189-201.
Sharma HK, Singhal RS, Kulkarni PR (1998). Characteristics of fried paneer prepared from mixtures of buffalo milk, skimmed milk, soy milk and buttermilk. Intl. J. Dairy Technol., 5: 104-107.
Sharma KD, Stahler K, Smith B, Melton L (2011). Antioxidant capacity, polyphenolics and pigments of broccoli cheese powder blends. J. Food Sci. Technol., 48: 510-514.
Sharma SP, Bhanumurthi JL, Srinivasan MR (1974). Manufacture of mango milk powder by spray drying. J. Food Sci. Technol., 11: 171-174.
Singh C, Grewal KS, Sharma HK (2005). Preparation and properties of carrot flavoured milk beverage. J. Dairying Foods Home Sci., 24: 184-189.
Singh AK, Kadam DM, Saxena M, Singh RP (2009). Efficacy of defatted soy flour supplementation in Gulabjamun. Afr. J. Biochem. Res., 3: 130-135.
Singh Preeti, Kumar R, Sabapathy SN, Bawa AS (2008). Functional and edible uses of soy protein products. Comprehensive Rev. Food Sci. Food Safety, 7: 14-28.
Singh PK, Goyal RK, Shah SK (2010). Studies on selection of optimum substitution level of cow milk with soy solids to manufacture low-fat paneer. Indian J. Dairy Sci., 63: 92-96.
Soni D, Subhash R, Jana AH (2011). Nutritional quality of soy-khoa based Gulabjamun. Beverage and Food World, 38: 66-69.
Spell E (1976). The chemical composition and calorific value of commercial nuts. Gordian, 76: 341-347.
Sutar N, Sutar P, Singh G (2010). Evaluation of different soybean varieties for manufacture of soy ice cream. Int. J. Dairy Technol., 63: 136-142.
Sutherland BJ (1991). New cheese products as food ingredients. CSIRO Food Res. Quart., 51: 114-119.
Tamime AY, Robinson R (1999). Yoghurt Science and Technology. 2nd edn., Woodhead Publishing Ltd., Cambridge, England, pp. 320-340.
Tow GJ (1985). Some uses of milk in baked products. Baking Today. 5: 17-18.
Trox J, Vadivel V, Vetter W, Stuetz W, Scherbaum V, Gola U, Nohr D, Biesalski HK (2010) Bioactive compounds in cashew nut (*Anacardium occidentale* L.) kernels: effect of different shelling methods. J. Agric. Food Chem., 58: 5341-5346.
Twomey M, Keough M.K. (1998). Milk powder in chocolate. Farm and Food, Spring, 8: 9-11.
Uprit S, Mishra HN (2004). Instrumental texture profile analysis of soy

fortified pressed chilled acid coagulated curd (Paneer). Int. J. Food Prop., 3: 367-368.
Vagdalkar AA, Chavan BR, Morkile VM, Thalkari BT, Landage SN (2002). A study on preparation of shrikhand by using cocoa powder and papaya pulp. Indian Dairyman., 54: 49-51.
Vani RK, Jayaprakasha HM (2004). Formulation of instant gulabjamun mix from the admixture of spray dried milk powder and whey protein concentrate. J. Food Sci. Technol., 41: 244-247.
Venizelou M, Kehagias C, Samona A, Koulouris S (2000). Survival of yoghurt characteristic microorganisms in fruit yoghurts prepared under various conditions. Egypt. J. Dairy Sci., 28: 169-182.
Venter SC (2004). Health benefits of Soybean and soy products- A review, Soya update, 7-10: 12-13.
Verma BB, De S (1978). Preparation of Chocsidu-burfi from ghee-residue. Indian J. Dairy Sci., 31: 370-374.
Wang H (1980). The importance of traditional fermented foods. Bio Sci., 30: 402-404.
Wilbey RA (1986). Production of Butter and Dairy-based spreads. In: Modern Dairy Technology, Advances in Milk Processing. Robinson RK.(Ed.), Elsevier Appl. Sci. Pub., London, 1(3): 93-129.
Zeki B (1992). Soymilk and related products. In: Technology of Production of Edible Flours and Protein Products from Soybeans. C FAO Pub., Viale delle Terme di Caracalla, 8: 3-4.