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Use of Artificial Sweeteners in Indian Traditional Dairy Products†

K. Jayaraj Rao*, C. N. Pagote

Dairy Technology Section, National Dairy Research Institute (Southern Regional Station), India

***Corresponding author:** K. Jayaraj Rao, Dairy Technology Section, National Dairy Research Institute (Southern Regional Station), India. Tel: +919448969576; Email: jaysharm@yahoo.com

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Abstract

Artificial sweeteners possess high degree of sweetness and little calorific value. Their use in food products started ever since saccharin was discovered more than a century ago. In spite of some apprehensions about impact on health, they are being widely sold in market and even find legal sanction for use of some of them for edible purposes. Now, they are being tried in almost all the sweet products to replace sugar as sweetener. In some products such replacement is successful, while in some it is not because of flavor and stability related problems. Some workers are trying to promote the use of sweeteners by eliciting the synergistic action among the sweeteners. Milk based sweets are extremely popular in India and several efforts are being made to produce the sweets using artificial sweeteners in place of sugar. However, sugar replacement is definitely a disadvantage in many milk sweets prepared by heat desiccation, yet a consolation for those seeking low calorie foods or sugar free foods to satisfy their sweet palate. Use of the various artificial sweeteners in traditional milk sweets is described in this paper.

Keywords: Artificial Sweeteners; Bulking Agents; Bulk Sweeteners; Diabetic; Low Calorie; Milk Sweets; Traditional Dairy Products

Introduction

Thanks to the tremendous publicity given through social media, consumers are now aware of and have become more conscious of the undesirable effects of excess calories, fat and sugar. The consumption of low calorie sweeteners is on the rise due to increase in the number of obese and dietetic persons. So, understandably, low calorie sweeteners in 2002 accounted for almost 11% of the overall sweetener market compared to about 8% in 1990 [1]. Recent studies revealed that one out of every twelve urban Indians, above the age of forty, is likely to be diabetic by the year end 2025. The total number of people in the world with diabetes was projected to rise from 171 million (in 2000) to 366 million by 2030. India, China and the United States are among the top three countries estimated to have the highest number of people with diabetes i.e. 31.7, 20.8 and 17.7 million, respectively in 2000, which is expected to increase to 79.4, 42.3 and 30.3 million, respectively by 2030. India is home to world's second largest diabetic population after China. India has 5.1 crore diabetic persons, expected to touch 8 crores by 2030. About 21% people in Bangalore have one form or the other diabetes. Similarly, if we see the condition of obese patients in India, 15% of Indian population comes under obesity list. This information underlines the need for a specific segment of food products for such population, and justifiably research work is being carried out in this direction to develop appropriate technologies.

Justification for Low Sugar or Sugar Free Products

About two decades ago, unrestrained and ad lib consumption of sugar rich products was considered as no harm, only persons suffering from diabetes were barred from consumption of any sugar containing foods. But over the years, focus shifted from sugar consumption to calorie consumption and digestibility rate of consumed foods. Apart from sugar content, low calorie content is also catching attention because of health related issues including diabetes and obesity. Since sugar also is a source of relatively quick energy, its appropriateness for consumption has come into critical review not only for diabetes persons but also for healthy persons. As a result, even healthy persons are restricting their sugar intake because of health consciousness. This is because sugar consumption is related to diabetes which in turn is related to many other diseases such as dental caries, obesity, diabetes, hypertension, hyperglycemia, heart diseases etc. On the whole, dieticians recommending optimum and restricted intake of calories seems to be justified. So, low sugar or low calorie products market is increasing gradually. In order to replace sugar in products, varieties of sweeteners are being reported.

Use of Intense and Bulk Sweeteners

Intense sweeteners are hundreds of times sweetener than cane sugar. But there are certain problems associated with them viz. undesirable taste properties, [such as sweetness lag, undesirable and lingering aftertaste, narrow taste profile, or bitterness (for example, saccharin is generally reported to have bitter aftertaste, steviosides have menthol like aftertaste and aspartame has a delayed sweetness)], lack of bulking properties and stability problems during processing and storage (for example, aspartame loses its sweetness in aqueous solutions and is not stable at high temperatures).

Sugar does more than adding sweetness to a confectionery product. It provides bulk, lowers water activity and modifies the texture. High intensity sweeteners provide the sweet taste that is lost when sugar is removed, but they cannot perform other physical functions of sugar. For this reason, polyols (bulk sweeteners) and polymeric bulking agents (maltodextrin, fructooligosaccharides and polydextrose) (Figure 1) are needed when producing sugar free sweets. Polyols alone or combined with other sweeteners can be used to produce sweets/confections that are safe for diabetics. Alternative sweeteners which can be used to replace sugars fall into two basic categories. Those which are calorie free (often referred to as high intensity, intense, high potency, artificial or non-nutritive sweeteners), and those which are significantly reduced in calorie or bulk sweeteners. Intense sweeteners are those substances, which on weight basis are substantially sweeter than the common carbohydrate sweeteners such as sucrose**.**

(i) Fructooligosaccharides- *TATA Chemicals, Pune, India* **(ii) Maltodextrin**

(iii) Polydextrose

Figure 1: Bulking agents.

List of Sweeteners or Sugar Substitutes

The first invented and popular low-calorie sweetener was saccharin. It was discovered in 1878 and used for over 100 years now and seems to be the best researched sweetener. Since then, a number of other low-calorie sweeteners have been introduced and used all over the world. These are: **Intense sweeteners**: Aspartame, saccharin, sucralose, acesulfame, neotame, stevia, neohesperidin, cyclamate, thaumatin, dulcin, cyclamate glycine, alitame, glycyrrhizin (Figure 2A); **Bulk sweeteners**: Glycerol, sorbitol, mannitol, xylitol and maltitol (Figure 2B); Other sweeteners: Levulose. Sweetness levels of the some of the sweeteners visavis cane sugar are shown in Table 1.

Sweetener	Sweetness factor	Calorie per gm
Bulk sweeteners		
Sugar	100	4
Fructose	140	4
Xylitol	100	2
Maltitol	90	2
Glucose	70	4
Erythritol	60	0.2
Sorbitol	60	2
Isomalt	55	2
Mannitol	50	2
Intense sweeteners		
Sugar	1	4
Neotame	800	-
Sucralose	600	-
Saccharine	300	-
Acesulfame K	200	-
Aspartame	200	-
Cyclamates	30	-

Table 1: Sweetness energy content of a few sweeteners.

Figures 2(A-B): Sugar substitutes available in market.

Synergistic Effect of Sweeteners

According to Walters [2], synergy is the observation of a higher level of sweetness from a blend than would be expected if the sweeteners are additive. This permits the use of fewer sweeteners, which may result in cost savings. The elicitation of synergy among sweeteners indicates that different sweeteners may act at different sites on the receptor rather than competing for a single site. Improved taste profile is observed when different sweeteners have different off-tastes. The sweetness adds, while the off taste does not, and the overall taste quality is improved. Improved temporal profile can occur because some sweeteners have a fast onset of sweetness while others have a slower onset than sucrose; some sweeteners have a lingering sweetness while others clear quickly. For example, some high potency sweeteners, such as saccharin and acesulfame-K, have rapid onset of sweetness. Others, such as thaumatin and neotame, have slow onset and lingering sweetness. By blending two or more sweeteners, a temporal profile can be achieved which is closer to that of sucrose than any of the individual components [2]. Some of the blends which elicit synergistic effect in sweetness are: Saccharin + dulcin; Saccharin + cyclamate glycine; Saccharin + dulcin + cyclamate; Aspartame + saccharin; Aspartame + cyclamate; Aspartame + saccharin, lactose, mannitol, sorbitol; Acesulfame -K + aspartame; Acesulfame -K + aspartame, cyclamate, thaumatin, stevioside, and sucralose; Acesulfame -K + alitame; Sucralose+ saccharin, acesulfame-K, or stevioside, but not with sucralose or aspartame; Neotame + saccharin, acesulfame-K, aspartame, and sucrose.

Legal Issues

Food technologists and nutritionists have the responsibility of developing foods suitable for diabetic population and health conscious consumers. This can be done by using high intensity sweeteners and bulk sweeteners. However, this has to be facilitated by legal experts. This was indeed facilitated by FSSAI by according legal permission for use of non-conventional sweeteners in different foods. Even then, use of sugar substitutes received a cautious acceptance by consumers which is influenced by the adverse publicity of saccharin for being carcinogenic in nature. Several studies in this regard remained inconclusive. Sale of sugar free powder, which contains sucralose and maltodextrin, like Splenda Brand is not permitted by FSSAI. Artificial sweeteners permitted in sweets by FSSAI are shown in Table-2. Notwithstanding the legal approvals, efforts have to be made to check the indiscriminate use of the permitted sweeteners, especially local halwais. Regular monitoring of the sugar free products sold in the market has to be conducted to eliminate the possibility of misuse of the sweeteners.

Name of sweetener	Article of food	Maximum limit (ppm)
Aspartame	Halwa, Mysore pak, Boondi ladoo, Jalebi, Khoya burfi, Peda, Gulabjamun, Rasagolla and similar milk product-based sweets sold by any name	200
Sucralose		750
Saccharin Sodium		500
Aceslfame K		500
FSSAI – Food Safety and Standards Authority of India		

Table 2: Artificial sweeteners permitted in sweets by FSSAI.

Traditional Dairy Products

Traditional dairy products are India's largest selling and most profitable segment in dairy industry after liquid milk, accounting for about 50% of milk utilization [3]. Many traditional dairy products particularly khoa-based sweets have enormous market presence and tremendous consumer base in India and overseas as well. The other popular indigenous milk products such as rabri, shrikhand, basundi, payasam etc. are region specific. Among traditional dairy products, heat desiccated products have tremendous potential for value addition. Estimated market size (traditional plus organized) of heat desiccated products (rabri, burfi, basundi, etc.) and chhana based products (rasogolla, chhana podo, etc.) is estimated to be Rs. 520 billion. The major traditional sweets are: Burfi & its varieties, Sandesh & its varieties, Peda & its varieties, Basundi, Gulabjamun,

Kheer & its varieties, Rasogolla and Payasam its variants (Table 3).

Khoa based	Burfi and varieties, Peda and varieties, Lalmohan, Gulabjamun, Kalajamun, Pantua, Dharwad peda
Heat desiccated	Khurchan, Kunda, Balmithai, Langcha, Sorbhaja, Basundi, Kheer, Payasam, Phirni, Kalakand, Thirattupal, Milk cake, Sorpuriya
Chhana based	Rasogolla, Sandesh, Chhana jhili, Chhana jilebi, Rasaballi, Sitabhog, Rasmalai, Rajbhog, Khirmohan, Chhana murki, Cham cham, Chhana kheer, Chhana podo, Chhana bara

Table 3: Traditional sweets.

Traditional Low Calorie Dairy Foods

The traditional low calorie or sugar free sweets being sold in the market are: Diabetic burfi, Rasogolla, Gulabjamun, Milk cake, Peda, Sandesh, Rabri (Figure 3 and Table 4). These have a potential market for the benefit of calorie conscious people. Several halwais are manufacturing diabetic sweets; local sweet shops, Sundar Chemicals Pvt Ltd., Chennai, DIAT Foods, Mumbai, ZERO SUGAR, Bangalore are some of them. A brief survey conducted in Bangalore indicated that sweetness level was optimum in most of the sweets. There was no undesirable flavour, but slightly different from traditional flavour, unnatural and harsh. Overall, the diabetic sweets were of acceptable quality, sweetness perception and sweetness quality of the sweets was satisfactory.

Product	Workers
Sweet lassi, Rasogolla (Aspartame and Sorbitol)	Jayaprakash [4]
Burfi, Kalakand (containing 3.5% fat, 1.2% WPC, 15% Sorbitol and 8.17% Maltodextrin)	Gawande [5]; Prabha and Pal [6]
Gulabjamun	Chetana et al. [7]
Chhana podo (Sucralose and Maltodextrin)	Kumar [8]
Basundi (Sucralose and Maltodextrin)	Goel [9]

Table 4: Some of the diabetic sweets.

Figure 3: Some of the sugar free sweets.

Peda

The composition of peda is as follows: Moisture: 14.36%; Fat: 19.31%; Protein: 15.34%; Lactose: 15.25%; Ash: 2.47% and Sucrose: 33.27% [10]. Peda is prepared from khoa by mixing with sugar and heat treating it to dissolve the added sugar. The mixture is cooled and shaped into peda. Sugar can be replaced by adding aspartame or sucralose @ 0.0375%. However, care has to be taken not to heat the mixture beyond 60-70°C, otherwise sweetness of the intense sweeteners may be lost partially. The final quality of sugar free peda is good but slightly firmer and gummier than sugar containing peda.

Basundi

Basundi is prepared by heating and concentrating milk about twice the original volume, adding sugar and further concentration to about 2.5 times. Composition of basundi is given in Table-5. The basundi has a caramelized cooked sweet taste with pleasantness of

natural sugar. Sugar can be replaced with intense sweeteners like sucralose or aspartame, but these have to be added in warmer condition; it means that the milk has to be concentrated to the desired level, cooled to warm temperatures and then the intense sweeteners have to be dissolved in the concentrated milk. Goel [9] tried replacement of sucrose in basundi with various sweeteners such as aspartame, sucralose and stevia. It was found that replacements up to 100%, 50% and 20% of sugar levels were possible using sucralose, aspartame and stevia, respectively. Use of higher levels of replacements with aspartame and stevia resulted in off flavour in the product. Use of maltodextrin as bulking agent enhanced the viscosity of basundi. Studies have shown that sugar can be completely replaced with sucralose within FSSAI limits of 750 ppm. Whereas, use of aspartame can replace only 13% of the sugar within the permissible limits of 200 ppm. Sucralose has better stability towards product manufacturing conditions as compared to aspartame [11].

Characteristics	Sweetener			
	Sugar	Sucralose	Aspartame	Stevia
TS%	46.23	46.18	46.21	46.18
Fat	12.07	12.02	12.10	12.02
Protein	9.10	9.06	9.16	9.10
Carbohydrates	9.43	16.48	16.38	13.76
Ash	1.48	1.52	1.49	1.40
(Source: Goel [9])				

Table 5: Composition (%) of basundi.

Rabri

Composition of rabri is given in Table 6. Rabri is prepared by heating milk in a wide surfaced vessel and the milk skin formed is continuously removed and collected separately in another vessel to allow more skin formation on the surface of hot milk. When the volume is reduced to about 3 times, sugar is dissolved in the concentrated milk and the milk skin also is added back to the concentrated milk. This product is called rabri. Sugar substitutes can be used in place of sugar. Sucralose was found to be the best non-conventional sweetener compared to aspartame and acesulfame-k for the production of dietetic rabri. Shelf life of rabri containing sucralose was less than that of full sugar product. Irrespective of legal implications, it was possible to replace the sugar with sucralose up to 100% without any major drawbacks but only up to 50 % replacement was possible by aspartame and acesulfame-k. Beyond this level, aspartame and acesulfame-k containing sample showed some undesirable after taste. According to FSSAI [12], aspartame, acesulfame-k and sucralose are allowed up to 200, 500 and 750 ppm, respectively in milk sweets. Conforming to these values, it was possible to replace sugar in rabri by about 12.5, 30 and 100% using aspartame, acesulfame-k and sucralose, respectively. Aspartame containing samples gave some cooling sensation in the mouth and acesulfame-k containing samples had some bitter after taste. No significant difference was observed in the values of pH, hue, chroma, browning index and reflectance of full sugar and sugar replaced samples, the values ranging from 6.40-6.45, 85-88, 25-27.5, 31-35 and 82-84% respectively. Shelf-life of control sample and 100% sugar replaced rabri sample was about 15 and 10 days at 5^{o}C. Studies revealed that sucralose is the most suitable non-conventional sweetener compared to aspartame and acesulfame-k for the production of dietetic rabri. It can be used to completely replace sugar in rabri well within the FSSAI limits.

Particulars	Control	Aspartame, 200 ppm*	Acesulfame k, 500 ppm**	Sucralose, 341 ppm***
Total solids, %	50.00	49.02	47.51	40.91
Lactose, %	10.27	10.47	10.78	12.14
Protein, %	9.91	10.11	10.41	11.71
Ash, %	1.61	1.64	1.69	1.90
Fat, %	12.82	13.07	13.46	15.15
pH	6.43	6.43	6.43	6.43
Acidity, % lactic	0.37	0.38	0.38	0.45
Reflectance, %	83±1	83±1	83±1	83±1
(Source: Kumar [13])				

Table 6: Composition of rabri.

Burfi

Burfi composition is shown in Table 7. In the market, dry fruits are being mixed with fruit pulps, heat treated and being passed as sugar free 'burfi'. Milk-Burfi is prepared by taking khoa in a vessel, adding crystal sugar and heating it to dissolve the added sugar. The mixture is then poured into a tray for further shaping and cutting and packaging. In place of sugar, aspartame - 0.065% or sucralose - 0.0375% can be used to get the same sweetness. They had better sweetness perception among all other sweeteners tried. However, care has to be taken to avoid high temperatures. This burfi possessed slightly gummy and chewy body and texture, but was acceptable. Its shelf life was found to be 12 days at 5°C. Aspartame and neotame showed poor stability while sucralose showed excellent stability in burfi. Aspartame at the level of 0.065% in burfi scored highest in terms of sweetness perception and resembled the control. However, colour and appearance, body and texture, and overall acceptability scores were lower ($P < 0.05$) in aspartame- sweetened burfi than in the control. This is because sugar (sucrose) not only contributes towards the sweetness but also helps in development of desirable flavour and characteristic colour through Maillard browning and caramelisation. At higher levels of aspartame (0.07%) there was persistence of sweetness for longer periods, which imparted an unusual taste to the burfi. At this level, the actual level of consumption of aspartame in burfi is well within acceptable limits i.e. substantially below the Acceptable Daily Intake (ADI) of 50 mg/kg body weight/day [14].

Type pf burfi	Moisture, %	Protein %	Total ash, %	Fat, %	Kcal/100 g
Sorbitol	12.82	13.97	3.54	22.14	270
Sorbitol + Mannitol (90/10)	12.23	13.56	3.57	22.05	272
Sorbitol + Mannitol (80/20)	12.18	13.33	3.54	22.47	274
Maltodextrin + Polydextrose	13.57	13.23	3.52	23.90	332
Polydextrose	12.76	12.48	3.5	22.35	266
(Source: Chetana [15])					

Table 7: Burfi composition.

However, aspartame-sweetened burfi could not retain most textural attributes - hardness, adhesiveness, springiness and chewiness - except for cohesiveness, at all periods of storage. Gumminess was not retained by the aspartame-sweetened burfi whereas the control retained gumminess up to 3rd day of storage. Chewiness was retained by the aspartame-sweetened burfi up to the 3rd day of storage whereas it was not retained by the control even up to the 3rd day of storage. These changes in the textural attributes of both the burfi samples were due to loss of moisture during storage. Aspartame-sweetened burfi ranked significantly lower ($P < 0.05$) than the control for various textural attributes except cohesiveness initially, as well as at different periods of storage.

Kalakand

Kalakand is prepared by heat concentrating the milk, added with sugar and little citric acid and desiccated to a semisolid consistency. Varieties of kalakand are available in market namely Malai kalakand, Ajmeri kalakand, Alwar kalakand, mango, chocolate etc. Gawande [5] and Singh [16] used aspartame and sucralose, respectively in manufacture of kalakand. Kalakand was prepared with 0.025% of sucralose. The products prepared by aspartame and sucralose scored the highest in terms of sweetness perception and resembled control. However, the sweetener has to be added to warm product instead of adding during heat desiccation.

Chhana Podo

Chhana podo is a baked sweet milk-product very popular in Odisha. Composition of chhana podo is as follows: Starch: 7.2%; sugar: 20%; Fat: 23%; Ash: 0.9%; Protein: 16.4%; Moisture: 32.5% [17]. Dietetic chhana podo was prepared using sucralose and maltodextrin. The product was prepared with low fat milk i.e. 2% fat milk and maltodextrin was used as bulking agent. But only 50% replacement of sugar was possible. By these treatments, the calorie content was reduced by 25%. The dietetic chhana podo was slightly softer than the control product. The pH of dietetic podo was slightly higher than control but hardness was observed to be lower than control. Shelf -life of dietetic podo was 3-4 days at room temperature and 16-17 days at refrigerated temperature when packed in polyethylene pouches. The corresponding shelf life of the control podo was 7-8 days and more than 3 weeks at refrigerated temperature [8].

Rasogolla

Rasogolla is prepared by cooking chhana balls in 50% sugar syrup and then soaking the cooked balls in 40% sugar syrup. Rasogolla is relished not only for its pleasant sweet taste, but also its spongy and chewy body and texture. Consumer derives pleasure by chewing the spongy body when the sugar syrup oozes out of it. It contains Moisture: 45-55%; Fat: 5%; Protein: 5%; Sucrose: 45%

[10]. The sugar can be replaced by bulk sweeteners and intense sweeteners. It was shown that acceptable quality rasogolla could be prepared using sorbitol and aspartame as sweeteners. A combination of 41.77% sorbitol and 0.08% aspartame was found to be optimum for getting desired sweetness. Dietetic and diabetic rasogolla with acceptable quality can be prepared using chhana made from cow milk standardized to 2% milk fat. Chhana can be prepared by coagulating at 60°C, employing 1% citric acid maintained at same temperature and a final pH 5.4, followed by straining. Well kneaded chhana balls can be cooked and soaked at 40°Brix refined sugar solution to obtain dietetic rasogolla. For sugar free rasogolla, 40°Brix sorbitol solution is required for cooking of chhana balls followed by soaking in 40°Brix sorbitol solution containing 14.3 g / L aspartame. When packed in polyethylene terephthalate jars and stored at refrigeration temperature a shelf life of more than 40 days and not more than 6 days at room temperature was observed. Acceptance of dietetic and diabetic rasogolla decreased with increase in storage period [18].

Khoa Jalebi

Khoa jalebi is a khoa based traditional sweet and breakfast food item. It is tastier than maida based jalebi, hence more preferable. It is also preferred to eat during fasting days. It is widely consumed in Maharashtra and parts of Madhya Pradesh and Chattisgarh [19]. Composition of khoa jalebi is given in Table 8. The product has been characterized, and recently its technology has also been standardized [20]. Sugar free formulations developed for sugar free khoa jalebi are: 1) Sorbitol, 60 gm + Maltodextrin, 15 gm + sucralose (550 ppm) 2) Xylitol, 50 gm + Maltodextrin, 25 gm + sucralose (100 ppm) 3) Levulose mixture (60%) and 4) Sucralose mixture (60%) [21]. Khoa jalebi prepared with levulose (3) and sucralose mixture (4) formulations were the most acceptable. Khoa jalebi prepared with other formulations was slightly harder and chewier. But, overall quality indicated that the jalebi prepared with sugarless syrups were well acceptable. Shelf life of control khoa jalebi (containing sugar) was more than the sugar replaced jalebi, by about 3-4 days.

Constituent	Average±SD
Fat	14.932±3.4
Protein	4.892±2.0
Lactose	11.274±2.2
Moisture	22.788±4.7
Minerals	0.91±0.3
Total solids	77.21±4.7
(Source: Pagote and Rao [22])	

Table 8: Composition (%) of khoa jalebi.

Gulabjamun

Gulabjamun contains fried balls of khoa soaked in 50% sugar syrup. In the preparation of sugar free gulabjamun, the soaking solution has to be prepared using sugar substitutes. The most appropriate condition for making sugar free gulabjamun is: sorbitol, 54°B, temperature 65°C and duration of soaking, 3 h. Interestingly, sweets prepared with sugar replaced sorbitol and/or mannitol increased the shelf life of gulabjamun by almost two folds [15]. Composition of gulabjamun is given in Table 9.

Type of gulabjamun	Moisture,%	Protein, %	Total ash%	Fat, %	Kcal/100 g
Sugar	25.63	6.94	0.94	28.68	361
Sorbitol	31.83	6.3	0.60	25.41	254
Polydextrose	34.66	6.18	0.83	23.56	201
Maltodextrin + polydextrose	28.27	6.91	0.98	23.33	282
(Source: Chetana [15])					

Table 9: Composition of gulabjamun.

Payasam

Payasam is a south Indian delicacy of sweets similar to kheer of northern India. There are several varieties of payasam, depending on the region [23]. Owing to its popularity among people, dry mixes are being sold in the market, like vermicelli payasam mix, palada payasam mix, suji payasam mix etc. In Karnataka, poppy seeds and green gram payasam are popular. Attempts were made to formulate a dry mix of green gram-poppyseeds payasam. The ingredients used to prepare this payasam were green gram dal, poppy seeds, skim milk powder and sugar. The proportions of the ingredients were adjusted to get the desired flavour and consistency of the final product. The method of production was as follows: dal roasted to a light brown colour was ground to get coarse powder. The larger particles removed by sieving were further ground to smaller size. Poppy seed powder was also prepared in a similar way. Required proportions of dal, poppy powder and SMP were mixed to prepare dry mix base. The dry mix had the following chemical composition (%): moisture, 3.3; protein, 23.8; fat, 14.3; reducing sugar; 16.3;

starch, 30.3 and ash, 5.8. Payasam was prepared by reconstituting different levels of dry mix base and sugar in potable water. This product with a total solid level of 30% of which 50% was sugar had most acceptable quality. Trials were made to replace sugar with sucralose, an artificial sweetener keeping the solids level of other ingredients same as that in control. It was observed that the consistency/viscosity was high with the artificial sweetener. Hence, T.S. level was lowered to get desired consistency in sugar free samples. Payasam with 12.5 % dry mix base and 40 mg % sucralose compared well with the control with respect to flavour and consistency. Pieces of nuts like cashew, pista were roasted to light brown colour with minimum amount of ghee and added to the product at 2 to 3% level. This increased the acceptability of the product. The dry product could be kept well for 6 months at room temperature [24].

Cost Considerations

Since sugar is being replaced by costly sweeteners, the cost of the sugarfree sweets is expected to be higher. The cost escalation may be by 25-50% depending on the type of sweetener used. For example, the cost of full sugar rabri sample (control) was determined as Rs. 106.92 per kg. Cost of sucralose containing rabri was Rs.133.93 per kg. (25% higher) [13]. Cost of sugar substituted khoa jalebi was Rs. 334.72 to 1049.53 per kg depending on the sweetener combination used [25]. The cost of dietetic rasogolla and diabetic rasogolla_ is Rs 50 and Rs 37 per kg, respectively. The cost of DTR was less by Re 1 while that of DBR was more by Rs 12 as compared to control rasogolla (Rs 38 per kg) [18].

Conclusion

Permitted artificial sweeteners can be used in traditional dairy sweets to replace sugar content. Sensory quality of the products is adversely affected by replacing the sugar with artificial sweeteners, so necessary process modifications have to be made to overcome these adverse effects. Legal restrictions are to be kept in view while replacing the sugar in the products and proper regulatory mechanism should be in place to check the indiscriminate use of the permitted sweeteners. Sugar replaced products are costly because of costlier sweetener varieties. The question of whether products containing artificial sweeteners can be recommended for consumption by diabetics and obese people and the quantity to be consumed should be resolved by taking into consideration overall calorie intake of persons.

†: Based on Paper presented at 4th International Conference on Updating Food Technology: A Challenge Towards Public Health Nutrition, 7-8 May, 2014, JNU Campus, New Delhi

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