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Studies on physico-chemical and microbiological properties of sugar free peda manufactured from buffalo milk and soya milk

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Abstract
Sugar free peda manufactured from soya milk and buffalo milk was prepared from different combination of soya milk and aspartame. The product obtained was subjected for physico-chemical analysis and microbiological analysis. On an average value of carbohydrate content of peda with soya milk and aspartame was found to be 46.28, 46.84, 47.11 and 47.63 percent, protein 14.30, 14.85, 15.14 and 15.32 percent, fat 18.31, 17.96, 17.86 and 17.56 percent, ash 2.80, 2.33, 2.12 and 2.05 percent, moisture 18.33, 18.11, 17.94 and 17.84 percent, total solid 81.65, 81.91, 82.10, and 82.54 percent and acidity 0.34, 0.37, 0.39 and 0.40 percent, for treatment T_0, T_1, T_2 and T_3 respectively. It was also observed that as the soya milk and aspartame increased, there was increase in carbohydrate, protein, total solid and acidity and content of sugar free peda manufactured from soya milk and buffalo milk and decrease in fat, ash and moisture. It can be concluded that the soya milk and aspartame can be very well utilized for preparation of nutritious, palatable and low cost peda by blending 16 percent soya milk and 9 percent aspartame with 75 percent buffalo milk on weight basis.

Keywords: Physico-chemical, microbiological, sugar free peda manufactured, buffalo milk, soya milk

Introduction
The production of traditional milk products presents unique opportunity to the organized dairy sector in India as they have a huge mass appeal and the market for these products far exceeds that of western style dairy products. The traditional dairy products consumption is growing at an annual growth rate of more than 20%, but western dairy products the growth rates are relatively much lower 5-10% (Patil, 2009) [14]. Traditional Indian dairy products can be classified into six categories based on the principle of manufacture (Srinivasan and Anantakrishnan, 1964; De, 1980; Pal and Raju, 2007) [17, 6, 13]: i. Heat desiccated products ii. Heat and acid coagulated products iii. Fermented products iv. Products made with addition of cereals v. Clarified butter fat (ghee) vi. Frozen products. Khoa is the principal heat desiccated dairy product. It is also called as khoya, kava or mawa. Generally, buffalo milk is preferred for khoa making because it gives higher yields. It has a soft, loose body and a smooth granular texture and it suitable for the preparation of high-grade khoa sweets. The fat level is maintained to 4% and 5% for cow and buffalo milk, respectively. Lower levels of fat result in undesirable hard body and coarse texture (De, 1980) [6]. Beniwal *et al.*, (2010) [3]. standardized the buffalo milk for the production of khoa through a semi-automatic machine. Based on physico-chemical parameters and sensory evaluation, fat/SNF ratio of 0.61 in milk was found to be the most suitable for preparation of khoa.

Khoa is the most important heat desiccated dairy product and it is used as the base material for a large variety of sweet delicacies. Khoa or mawa, which is used as a base material for Indian sweets such as gulabjamun, kalajamun, burfi, kalakand, milk cake, peda, rabri, khurchan, basundi, pantua, kunda etc. Peda is a traditional dairy product and popular all over India. The production of peda exceeds that of any other indigenous milk based sweet (Aneja *et. al.*, 2002) [1]. Peda is prepared by mixing khoa with sufficient quantities of sugar in the ratio 3:1. Standardized method of manufacturing of peda from khoa of 72% total solids, khoa with 72% TS is heated up to 60^0C and then sugar added at the rate of 30% of khoa (Aneja *et. al.*, 2002) [1]. Buffalo milk khoa contains moisture 32.0%, fat 24.2%, protein 18.3%, lactose 22.0% and ash 3.5% (Srinivasan and Anantkrishnan, 1964) [17]. During production peda, continuous stirring cum scraping in the stir-frying process to dries out the moisture. Sugar added as a preservative for long shelf life of peda. If desired nuts and flavouring substances could also be added in peda.

Cardamom being commonly added for the flavouring of peda. Peda is whitish yellow in colour and it has a coarse grainy texture. Peda quality is determined by the quantity of added sugar, heating parameters and storage condition. Khoa has a uniform whitish colour with just a tinge of brown, a slightly granular texture, and a rich nutty flavour which is associated with a mildly cooked and sweet taste due to its higher concentration of lactose.

Soya milk is by soaking dry soybeans and grinding with water. Soybean provides high quality protein with high unsaturated fat and minimum saturated fat. It contains all the three major nutrients such as carbohydrate, protein and fat in sufficient quantity required for good nutrition, it also contains fiber, vitamins and minerals. The soy protein is highly digestible and contains all essential amino acids. Soy protein products contain high concentration (up to 1 g/kg) of isoflavones which exerts protective properties against breast, prostate, colon and lung cancers (Kirupa *et. al*., 2011) [9]. Soybean has more than twice the amount of minerals, especially calcium, iron, zinc and phosphorus than any other legume (Itapu, 2003 and Venter, 2004) [8, 20]. This milk is known as soymilk, soybean milk or soy juice and sometimes referred to as soy drink/beverage. Soybean has a number of phytochemicals, which offer health benefits such as cancer prevention, cholesterol reduction, combating osteoporosis. It doesn't contain galactose, a product of lactose breakdown, soy-based infant formulas can safely replace breast milk in children with galactosemia. Soymilk contains no lactose, which makes it a good alternative for lactose-intolerant. The consumption of soy protein selectively decreases total and low density level (bad) cholesterol and maintains high density level (good) cholesterol in individuals with elevated normal blood cholesterol level. The protective role of soy foods in a wide range of health conditions including cardiovascular diseases, cancer and osteoporosis (Messina and Setchell, 1994) [11]. Protein, with high biological value, lecithin and unsaturated fats, non-metabolizable carbohydrates such as stachyose and raffinose and biologically active compounds like isoflavones, phytoestrogens give to soy milk the ability to prevent especially the diseases of the digestive tube (Tham *et al.*, 1998) [19].

Aspartame is a synthetic and intense sweetener, which is almost 180-200 times sweeter than sucrose. It is a white crystalline, odorless intensively sweet powder has the molecular formula $C_{14}H_{18}N_2O_5$. The density of aspartame is 1.347g/cm3 with a high melting point, between 246-247 °C. It has a low calorific value. Aspartame is very much popular sweetener due to its reduced costs, attractive advertisements and assurance to contribute in weight management. Aspartame is popular among consumers lies down within the problems associated with sucrose consumption (Tandel KR, 2011) [18]. Aspartame helps in limiting the sucrose intake in the form of substituting sugar and also releases very low amount of energy. Aspartame is metabolized more slowly than sucrose, allowing blood sugar levels to remain more stable. Diabetics individuals with reactive hypoglycemia produce an excess of insulin after quickly absorbing glucose into the bloodstream (Bellisle and Drewnowski, 2007) [2]. Sucrose promotes tooth decay due to the fact that bacteria that naturally occur in the human oral cavity are able to efficiently use sucrose as a food source. Unlike sucrose, the micro flora present in the dental plaque does not utilize aspartame. Due to this property use of aspartame is recommended in the form of prescribe sugar free medicines whenever possible (Mackie, 1995; Bentley and Mackie, 1993) [10, 4]. Aspartame sweetener are commonly consumed foods such as diet sodas, cereals and sugar-free desserts, yoghurt, chewing gums, syrups, mouth fresheners, health drinks, candies, nutritional supplements and are being recommended for weight loss and for individuals suffering from glucose intolerance and type 2 diabetes mellitus (Portela *et al*., 2007) [15]. Aspartame treatment was also found as a leading cause of oxidative stress in immune organs like spleen, thymus, lymph nodes and bone marrow of folate deficient aspartame treated rats. Production of free radical production in such sensitive organs could contribute to low immunity and make the organ susceptible for infections (Choudhary AK and Devi RS 2014) [5].

Materials and Methods

The experiment "Studies on physico-chemical and microbiological properties of sugar free peda manufactured from buffalo milk and soya milk" was carried out in research lab, Warner College of Dairy Technology, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj-211007, U.P. (India).

Procurement and collection of ingredients.

Buffalo Milk: Fresh buffalo milk was procured from local market of Prayagraj for preparation of peda.

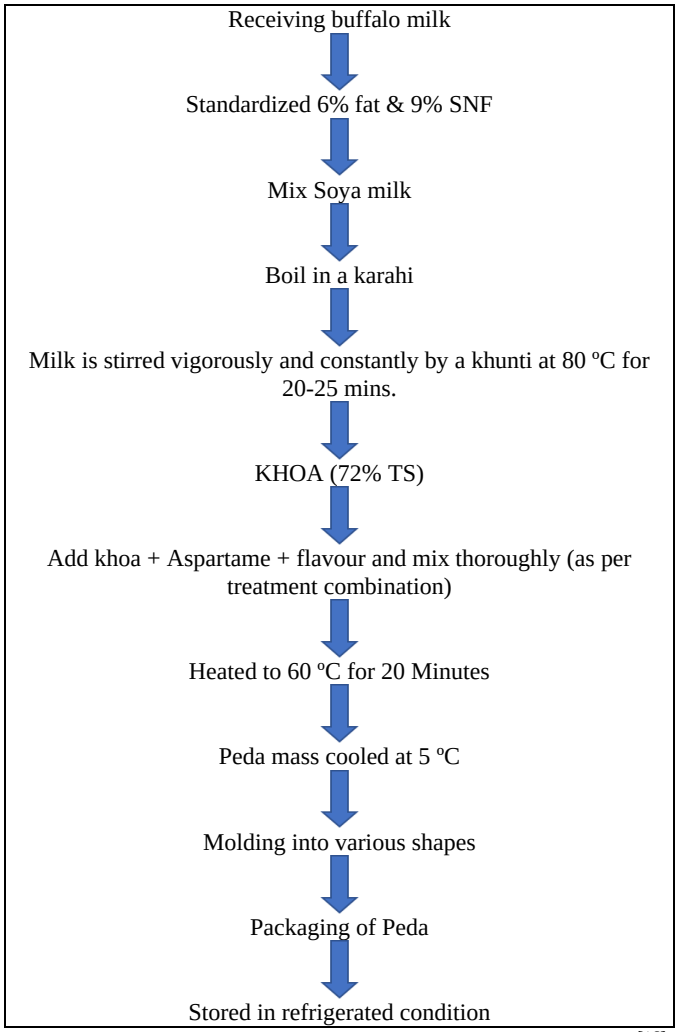
Soya Milk: Soya milk was purchased from local market of Prayagraj.

Aspartame: Aspartame was procured from Lucknow and used as a sweetening agent.

Cardamom: Cardamom was purchased from local market of Prayagraj.

Nuts and Flavouring agents: Nuts and flavouring agent were purchased from local market of Prayagraj.

Plan of work



(Singh *et al*., 2019) [16].

Fig 1: Flow diagram for manufacturing of sugar free Peda

Treatment Combination

T_0: Buffalo milk (100:00:00)
T_1: Buffalo Milk: Soya Milk: Aspartame (85:10:5)
T_2: Buffalo Milk: Soya Milk: Aspartame (80:13:7)
T_3: Buffalo milk: Soya Milk: Aspartame (75:16:9)

Physico-Chemical analysis

Total solids was estimated by method as per IS: 1479, Part -II (1961). Protein was determined by Kjeldahl method as per IS: 1479, Part-II (1961). Fat was estimated by IS: 2802 (1964). The moisture content of peda was estimated by drying method as per BIS: SP18, Part XI (1981). Sugar was estimated as per methods IS: 10501 (1983). Ash was determined by IS: 10501 (1983). Titratable acidity of sugar free peda was estimated as per methods IS: 1166 (1966).

Microbial analysis

SPC, Yeast & Mould count and Coliform test was estimated by methods IS; 1947, Part ; III (1992).

Statistical Analysis

The data was analyzed statistically by WASP SOFTWARE and Analysis of variance at 5% level of significance.

Number of treatments - 4
Number of replications - 5
Total number of samples - 20

Result and Discussion

Data collected on the different aspects were tabulated and analyzed statistically using the method of analysis of variance and critical difference. The significant and non-significant differences observed have been analyzed critically within and between the treatment combinations of sugar free peda.

Table 1: Mean value of different parameters of control and treatments of sugar free peda

Physico-Chemical Analysis					
Parameters	**T_0**	**T_1**	**T_2**	**T_3**	**C.D. at 5%**
Sugar + Lactose (%)	$46.28^{a}\pm0.02$	$46.84^{b}\pm0.06$	$47.11^{c}\pm0.05$	$47.63^{d}\pm0.01$	0.05
Protein (%)	$14.30^{a}\pm0.02$	$14.85^{b}\pm0.03$	$15.14^{c}\pm0.04$	$15.32^{d}\pm0.03$	0.05
Fat (%)	$18.31^{a}\pm0.01$	$17.96^{b}\pm0.03$	$17.86^{c}\pm0.02$	$17.56^{d}\pm0.04$	0.05
Ash (%)	$2.80^{a}\pm0.03$	$2.33^{b}\pm0.02$	$2.12^{c}\pm0.02$	$2.05^{d}\pm0.01$	0.03
Moisture (%)	$18.33^{a}\pm0.01$	$18.11^{b}\pm0.04$	$17.94^{c}\pm0.02$	$17.84^{d}\pm0.03$	0.04
Total Solid (%)	$81.65^{a}\pm0.01$	$81.91^{b}\pm0.04$	$82.10^{c}\pm0.05$	$82.54^{d}\pm0.06$	0.06
Titrable Acidity(%LA)	$0.34^{a}\pm0.03$	$0.37^{b}\pm0.02$	$0.39^{c}\pm0.04$	$0.40^{c,d}\pm0.01$	0.02
Microbiological Scores (CFU/gm)					
SPC ($x10^3$CFU/mg)	$10.20^{a}\pm2.03$	$9.20^{a,b}\pm1.72$	$8.00^{b,c}\pm1.67$	$7.20^{b,c,d}\pm1.16$	2.1312
Yeast and mould ($x10^1$CFU/mg)	$2.80^{a}\pm1.166$	$4.80^{b}\pm1.166$	$4.00^{a,b,c}\pm1.26$	$3.80^{a,b,c,d}\pm1.16$	1.35
Coliform ($x10^2$CFU/mg)	Nil	Nil	Nil	Nil	Nil

Physico chemical analysis of Sugar free Peda

Table 1 reveals that physico- chemical parameters of control and experiments of sugar free peda, Total sugar percentage of sugar free peda sample of different treatments, the highest mean carbohydrate percentage was recorded in sugar free peda sample of T_3 (47.63) followed by T_2 (47.11), T_1 (46.84) and T_0 (46.28). It was observed that increase the proportion of soya milk and aspartame decrease the mean value of sugar free peda from treatment T_0 to T_3 with significant differences ($P < 0.05$).

Protein percentage of sugar free peda sample of different treatments and control, the highest mean protein percentage was recorded in sugar free Peda sample of T_3 (15.32) followed by T_2 (15.14), T_1 (14.85) and T_0 (14.30). Sugar free peda indicates that increased in proportion of soya milk and aspartame in the blend decreased the protein percentage of sugar free peda with significant differences ($P < 0.05$).

Fat content of sugar free peda sample of different treatments, the highest mean fat percentage was recorded in sugar free peda sample of T_0 (18.31) followed by T_1(17.96), T_2 (17.86), T_3 (17.56). An addition of soya milk (10, 13 and 16 per cent) significantly decreases in fat (17.96, 17.86 and 17.56) in finished product as compare to control (18.31). The difference in the fat content of sugar free peda samples might be

attributed to the variation in the type of milk used (buffalo/soya milk) and their fat content and duration of desiccation. The results obtained in the finished products of sugar free peda were also similarly with the study of Nawadkar (2007) [12] and Gotarne (2011) [7].

Ash content of sugar free peda sample of control and experiments, the highest mean value of ash percentage was recorded in sugar free peda sample of T_0 (2.80) followed by T_1 (2.23), T_2 (2.12) and T_3(2.05). It was observed from the results, increase soya milk and aspartame, decrease the mean value of sugar free peda significantly (P<0.05).

Moisture percentage of sugar free peda sample of different treatments, the highest mean moisture percentage was recorded in sugar free Peda sample of T_0 (18.33) followed by T_1 (18.11), T_2 (17.94) and T_3 (17.84). An addition of different concentration of soya milk (10, 13 and 16 per cent) significantly decreases in moisture T_1(18.11), T_2(17.94) and T_3(17.84) in finished product as compare to control T_0(18.33). It could be observed that the moisture content of peda sample differed significantly (P<0.05). The variation in moisture content of sugar free peda samples might be mainly due to the difference in manufacturing methods, extent of desiccation, amount of sugar added and also difference in the chemical composition of base material used. The results obtained in the finished products of sugar free pada were similarly to those reported by Nawadkar (2007) [12].

Total solid content of sugar free peda sample of different treatments, the highest mean total solid percentage was recorded in sugar free peda sample of T_3 (82.54) followed by T_2 (82.10), T_1 (81.91) and T_0 (81.65). An addition of soya milk @ 10%, 13% and 16% significant increase in total solid T_1(81.91), T_2(82.10) and T_3(82.54) in finished product as compare to control T_0(82.54). The similar results was reported by Gotarne (2011) [7].

Titrable acidity percentage of sugar free peda sample of control and different treatments, the highest mean titrable acidity percentage was recorded in sugar free peda sample of T_3 (0.40) followed by T_2 (0.39), T_1 (0.37) and T_0 (0.34). It was observed from the results, increase soya milk and aspartame, increase the mean value of sugar free peda significantly (P<0.05).

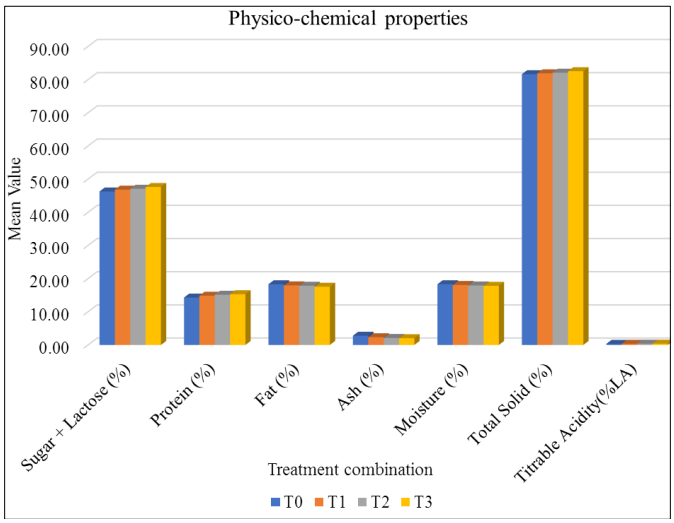


Fig 2: Graphical representation of average value of physico-chemical properties of sugar free Peda

Microbiological Analysis of sugar free peda

SPC (x10^3 CFU/gm) of sugar free Peda

SPC count of sugar free peda sample of different treatments, the highest mean SPC count was recorded in sugar free peda sample of T_0 (10.20) followed by T_1 (9.20) T_2 (8.00) and T_3 (8.00). It was observed from the results, increase proportion of soya milk and aspartame, decrease the mean value of SPC of sugar free peda.

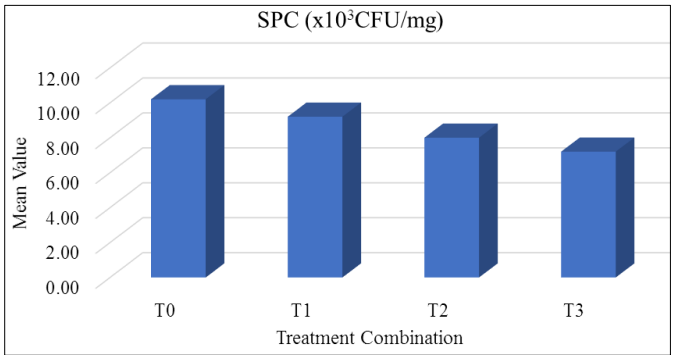


Fig 3: Graphical representation of average value of SPC (x10^3 CFU/gm) count in control and experimental sugar free Peda

Yeast and Mould (x10^1 CFU/gm) of sugar free Peda

From the perusal of data in table 1, Yeast and mould of sugar free peda sample of different treatments, the highest mean value of Yeast and mould was recorded in sugar free peda sample of T_3 and T_1(3.00) followed by T_0 and T_2(2.00).

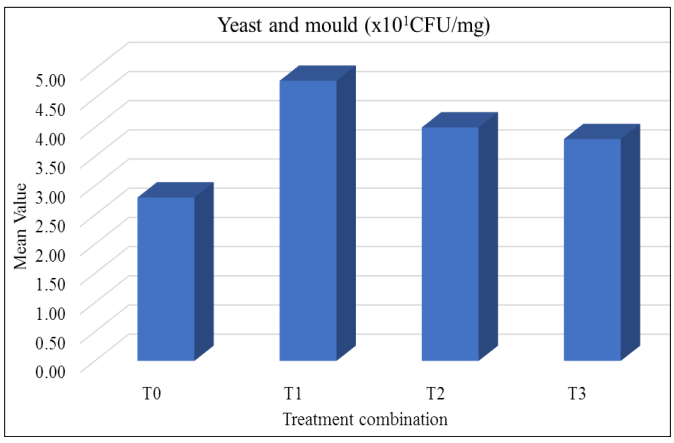


Fig 4: Graphical representation of average value of Yeast and Mould count in control and experimental sugar free Peda

Coliform (x10^2 CFU/gm) of sugar free Peda

Average Scores of coliform (x10^2 CFU/gm) in control and experimental of sugar free Peda was found nil.

Conclusion

Peda was prepared from buffalo milk and soya milk. Replacing of sugar by aspartame in peda has good health benefits. Soybean provides high quality protein with minimum saturated fat. It contains all the three nutrients viz., carbohydrate, protein and fat as well as fiber, vitamins and minerals. It has high PUFA content. Soymilk contains no lactose, which makes it a good alternative for lactose-intolerant. Aspartame is very popular artificial sweetener and sugar substitute with very low calorific value. Aspartame is used in many food and beverage products because it is a non-calorie sweetener, it is safe for consumption by diabetics and nondiabetics. The sugar free peda was prepared in optimized ratio of buffalo milk, soya milk and aspartame. From the result it is concluded, that on the basis of organoleptic evaluation, T_2 sugar free peda sample was optimised over the other sample under study. There was significant variation in respect of fat, protein, total sugar and total solids content in all of the peda samples examined. The optimised product contains carbohydrates (47.11%), protein (15.14%), fat (17.86%), ash (2.12%), moisture (17.94%), Total Solid (82.10%) and Titrable Acidity (0.39% LA). Along with the quite good number of lactic acid bacteria count in peda the occurrence of coliform is not present and yeast and mould were also observed. Now a days sugar free peda is widely accepted of diabetic and non-diabetic people.

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