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Mardasuklang Laso
M.Sc. (Dairy Technology) Scholar, Dairy Technology Department, Warner College of Dairy Technology, SHUATS, Prayagraj, Uttar Pradesh, India

DK Thompkinson and
Emeritus Scientist
Dairy Technology Department, Warner College of Dairy Technology, SHUATS, Prayagraj, Uttar Pradesh, India

Dr. Rekha Rani,
Assistant Professor (Dairy Technology) Dairy Technology Department Warner College of Dairy Technology, Sam Higginbottom University of Agriculture, Sciences and Technology (SHUATS), Prayagraj, Uttar Pradesh, India

Correspondence
Dr. Rekha Rani,
Assistant Professor (Dairy Technology) Dairy Technology Department Warner College of Dairy Technology, Sam Higginbottom University of Agriculture, Sciences and Technology (SHUATS), Prayagraj, Uttar Pradesh, India

Development of dietetic sweet spread using soy and peanut milk based Channa

Mardasuklang Laso, DK Thompkinson and Rekha Rani

Abstract
There are two types of spreads available in the domestic market, namely butter and cheese spread. Sweet spreads have become a part of the daily diet across countries, boosting their demand. Sweet spread comprises jams, marmalades, jellies, chocolate spreads, honey and nut-based spreads. The markets for such products are high. The goodness of soy milk and peanut milk with their high protein and nutritional value has been known throughout the world. Attempts has been made to use vegan milk for preparation of channa like products and then use it to convert into a dietetic sweet spread with the help of non-caloric sweetener. Soy milk and peanut milk have been used in three ratios 50:50, 60:40 and 40:60 for the preparation of acceptable quality channa using citric acid (1%) and calcium lactate (0.8%) as coagulant. Based on the sensory parameters acceptable quality of soy: peanut milk channa was obtained by mixture of soy and peanut milk in the ratio of 60:40 and using citric acid as a coagulant. The acceptable scores for various sensory parameters of soy: peanut milk based channa were as follows: color and appearance (7.53), flavor and taste (7.33), body and texture (7.43) and overall acceptability (7.43). The cereal milk based channa was used as base material for the production of Dietetic sweet spread by using two levels of artificial sweetener sucralose i.e. (500 ppm and 700 ppm). The acceptable scores for various sensory parameters of dietetic sweet spread were as follows: sweetness (8.07), color and appearance (7.90), texture (8.64), flavor and taste (7.90), spreadability (8.54) and overall acceptability (8.22). The prepared dietetic sweet spread was found to contain total solids 45.35%, fat 6.90%, protein 14.55%, total carbohydrate 20.00%, ash 3.91% and moisture 54.65%. The microbiological quality of dietetic sweet spread was analyzed for standard plate count (SPC) was found to be 13.50×10^3 cfu/g, Coliform was found absent and Yeast and Mould was found to be 4.50×10^1. The product was at par as per FSSAI.

Keywords: sweet spread, sucralose, channa, peanut, soymilk

1. Introduction
A spread is a food that is spreadable properties, generally with a knife onto food such as bread and crackers. Butter and soft cheese are typically spreads. There are mainly two types of spreads available in the domestic market, namely, butter and cheese spreads. High cost of butter in addition to its high-saturated fatty acids, cholesterol contents, high calorific value and poor spreadability at temperature below 15°C limits its consumption (Prajapati *et al.*, 1991) [18]. Cheese spread, though meets all the nutritive requirements of the people of all age groups, is not so popular among Indian population because of its characteristic flavor and religious sentiments of the people (presence of calf rennet in cheese is disliked by vegetarians).
Channa may be considered as one of the semi soft coagulated milk product having high moisture content. According to legal standards, it shall not contain more than 70% moisture and milk fat content should not be less than 50% of the dry matter (FSSAI, 2017) [7]. Channa is a soft coagulated product which is used as a base to make indigenous sweets such as rosogulla, kheer sagar, channa kheer and ras malai and sandesh and many more. Tewari and Sachdeva (1991) [29] developed channa based spread. Channa was made from cow or buffalo milk standardized to fat: SNF ratio of 1:3. Lower temperature of coagulation resulted in a softer chhana and consequently better body and texture of the spread. Reddy *et al.* (2000) [21] suggested a process for manufacture of protein enriched low-fat butter spread containing channa. The standardized method consisted of communition of channa to a fine paste and addition of butter @ 40% followed by incorporation of 2% salt and blending for 30 min. Butter and skim milk channa were blended in 70:30, 60:40 and 50:50 (w/w) proportions in the preparation of spreads. Reddy *et al.* (2001) [21] used skim milk chhakka and chhana in production of a dairy based spread.
Soy milk is an excellent source of protein. Unlike most plant-based proteins, which contain some, but not all, of the amino acids, soy contains all nine essential amino acids. Each cup of

unsweetened, plain soy milk provides 7g of protein. Drinking soy milk also boost calcium and iron. Our body relies on the calcium from your diet to maintain dense and strong bone tissue. Since the 1970s there has been a marked increase in the consumption of traditional soya foods and the development of other soya foods which simulate traditional meat and dairy products such as soya milk, soya sausages, soya cheese and soya yogurts. The key benefits of soya are its high protein content, vitamin, minerals and insoluble fiber. The soya bean has been transformed into a number of popular soya based foods such as Miso, Tempeh and Tofu.

Peanut milk compares favorably well with cow's milk and may be used as substitute. Peanut milk is a non-dairy beverage created using peanuts and water. Recipe variations include salt, sweeteners and grains. It does not contain any lactose and is therefore suitable for people with lactose intolerance. Peanut is highly nutritious and it has been found that one pound of peanut butter contains more calories, protein, minerals and vitamins than one pound of beef steak. Peanut milk retains the nut's natural soluble fiber, which also helps lower cholesterol (Jain, 2018) [13]. Peanut milk moisture is 89.28%, carbohydrate 3.78%, protein 3.23%, fat 3.53% and ash 0.18%. Source: (Yadav *et al*., 2016) [32].

Sucralose: Sucralose is a new high quality intense sweetener, which is suitable for use in wide range of food products from carbonated beverages to baked goods. It is white crystalline and solid produced by selective addition of chlorine atoms to sucrose. It is 600 times sweeter than sugar and its chemical structure is slightly different from glucose. It gives no bitter after taste, soluble in water and stable at high temperature (Renwick, 2006) [23]. It is calorie free because it is not absorbed into the body. It does not promote tooth decay. Various commercial foods can be prepared by using this. It is considered safe even in large amounts. Sucralose can withstand high temperature of UHT and pasteurization process and can even be used in cooking, baking and extrusion. It is particularly stable in acidic products, such as carbonated soft drinks, and in other liquid based products (e.g., sauces, jelly, milk products, processed fruit drinks). No measurable loss of sucralose occurred during processing and throughout shelf life. Sucralose is considered safe for all segments of the population, including people with chronic health problems such as diabetes. A study of 128 people with diabetes, in which sucralose was administered at a dose approximately 3 times the maximum estimated daily intake, showed no adverse effects on any measure of blood glucose control (Grotz *et al.*, 2003) [9]. It is considered safe even in large amounts. Acceptable daily intake is 15 mg/litre body wt/day. Sucralose is easily soluble in water and stable at high temperature. It is 600 times sweeter than sugar and it is calorie free because it is not absorbed in the body. Therefore, it is considered safe for all segments.

However, these products are loaded with very high carbohydrate contents *and* made by addition of nearly 40% sucrose. Such high content of sucrose is not suitable for persons already suffering from diabetes. The use of artificial sweeteners does not add to calories and they typically don't raise blood sugar.

The present study was under taken to use vegetable milk based channa for preparation of dietetic sweet spread using artificial sweetener.

2. Materials and Methods

Peanut and soy seeds were purchased from local market of Allahabad. Sweetener (sucralose) was procured from Bhagyoday and Company, Jamnagar, Gujarat. As coagulant citric acid was obtained from M/s Loba Chemicals Ltd. Mumbai and calcium lactate was procured from Hi-Media laboratories, Mumbai.

2.1 Preparation of soy milk

Soy milk was first cleaned and soaked overnight (12 hours) with the water to seed ratio 2: 1, v/v. During soaking 0.05% sodium bicarbonate ($NaHCO_3$) was added. The soaked seeds were then blanched for 20 min. The re- hydrated seed underwent wet grinding with warm water in the ratio 1: 8 w/v (weight/volume) and the obtained slurry was passed through double layered cheese cloth to obtain soy milk (Figure 1).

2.2 Preparation of peanut milk

Peanut milk**:** The peanut grains were first roasted on slow fire for about 1.5–2.0 min. The roasted grains were then soaked in 1: 3 quantity of portable water for 8 hours. The soaked peanut grains were then grinded in high speed electric using 1:8 parts of warm water. The grinder mixture thus obtained was passed through a double layered filter cloth and the clear filtrate was collected as peanut milk (Figure 2).

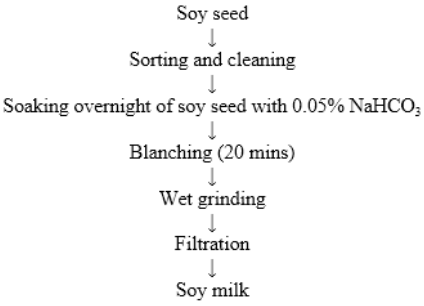

Fig 1: Flow diagram for preparation of soy milk

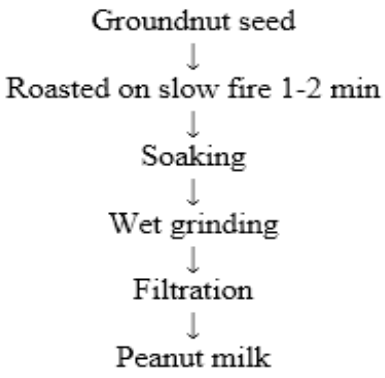

Fig 2: Flow diagram for preparation of peanut milk

2.3 Preparation of soy and peanut based channa

Channa is a heat and acid product which is generally produced from cow or buffalo milk or standardized milk or even skim milk. Bovine milk channa has been prepared and used as spread along with other ingredients. Here attempts have been made to prepare channa from cereal milk. Soy and peanut milk was mixed in three different ratios (50:50, 60:40 and 40:60). The blended milk samples were coagulated by two different coagulants citric acid (1%) or calcium lactate (0.8%) in order to obtain the acceptable quality of channa (Figure 3).

2.4 Preparation of dietetic sweet spread

Vegetable based channa was used as base material for the production of Dietetic sweet spread by using two levels of sweetener sucralose (500 ppm and 700 ppm). Soy: peanut milk blended in 60:40 proportions was used for making channa, which was then blended thoroughly with sucralose in two different levels (500 ppm *and* 700 ppm) in order to obtain the suitable dietetic spread (Figure 4).

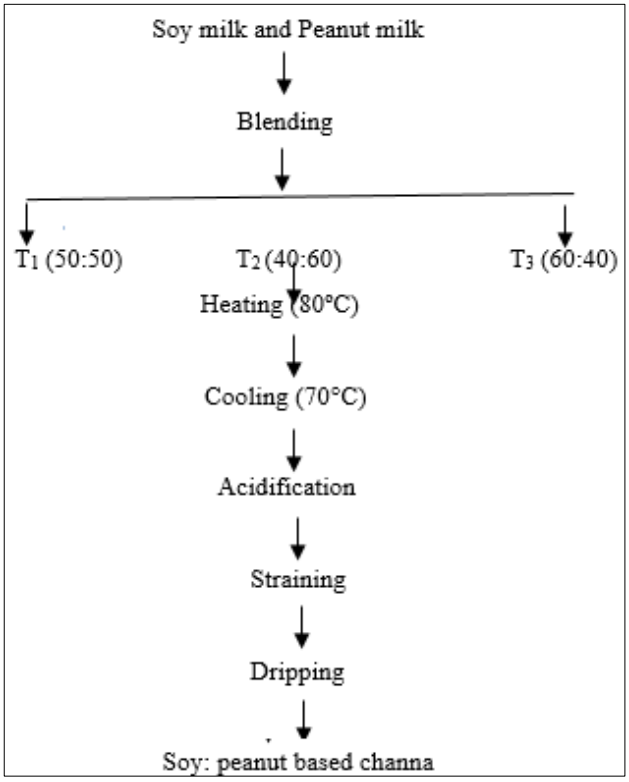

Fig 3: Flow diagram for preparation of soy: peanut milk based channa

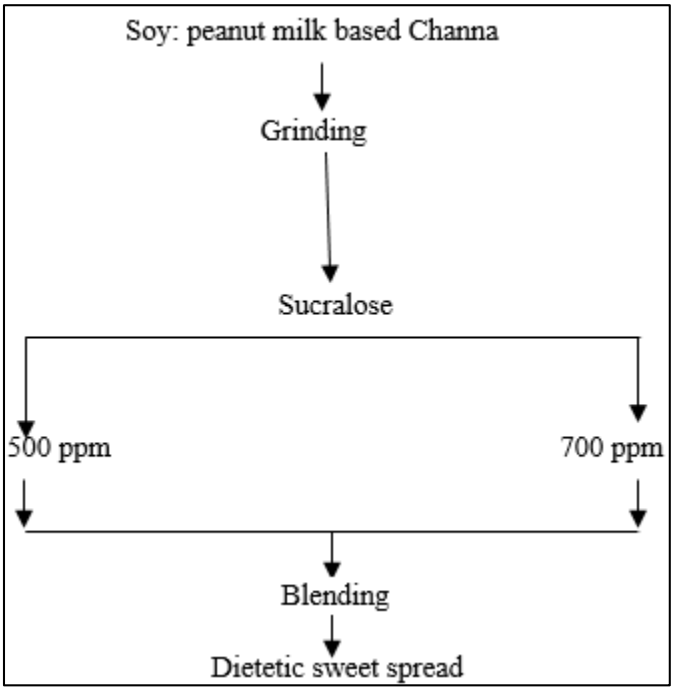

Fig 4: Flow diagram for preparation of dietetic sweet spread

2.5 Analytical Methods

2.5.1 Chemical analysis

Total Solid (TS) and moisture content of the developed product were determined by the method in the dietary supplement by the gravimetric method described in AOAC (2000) [2]. Fat content was determined by acid digestion method (Indian Standards, 1995) [12]. Total protein content was estimated by Kjeldhal method (AOAC 2000) [2]. - Ash content was determined by the method describe by Kent and Jones (1962). Total Carbohydrate content of the developed product was estimated by difference method.

2.5.2 Microbiological analysis

The dietetic sweet spread was examined for microbiological quality through standard plate count, coliform and yeast and mould tests. Enumeration of coliform and total number of viable bacteria (standard plate count) count of dietetic sweet spread was done by the method described by Hought *et al.* (1993) [11] using Mac Conkey and Nutrient agar as nutrient medium agar. The spread was ascertained for yeast and mould count using the method suggested by (Marshall, 1993) [16] using Potato Dextrose Agar.

3. Result and discussion

3.1 Preparation of channa

3.1.1 Selection of coagulant for preparation of channa using sensory attributes

During this study attempts have been made to prepare vegan based milk channa and use the same as a base for preparation of acceptable quality of dietetic sweet spread to substitute jams and jellies that are used as sweet spread. To achieve the objectives, the study was divided into two phases. During first phase of study attempts were made to prepare acceptable quality of channa using different ratios of soy and peanut milk (50:50; 60:40 and 40:60). The blended vegan milk sample were coagulated by two different coagulants (citric acid 1% and calcium lactate 0.8%). The samples of channa thus prepared were subjected to sensory evaluation by selected panel of judges to ascertain the quality of channa obtained. During phase two the most acceptable sample of channa obtained, phase one was selected for further preparation of dietetic sweet spread, where sucrose was replaced using a non-caloric sweetener (sucralose). The results obtained for during investigation are discussed here under.

3.1.1.1 Effect of coagulants on colour and appearance of channa

It is more important than taste and odor. By the sense of sight, size, shape and color of the food and other characteristics such as transparency, opaqueness, turbidity, dullness and gloss could be perceived. Color increases the attractiveness of the product and it is the prime factor which also determines the flavor, texture nutritive value and wholesomeness. Appearance is first important attributes in selection of food. Appearance of any food commodity can be judged by the eye. Appearance may be in term of color, size, shape uniformity and absence of defects.

The Table 1 indicates that when 1% citric acid was used as coagulant, highest mean scores 7.53 was obtained by the sample of channa prepared when soy: peanut milk was admixed in the ratio of 60:40.

Table 1: Sensory scores of Channa using different coagulants

Treatments	Citric acid 1%	Calcium lactate 0.8%
Color and appearance		
T_1 (50:50)	6.58[a]±0.14	6.31 [a] ±0.18
T_2 (60:40)	7.53 [b]±0.04	7.04 [b] ±0.01
T_3 (40:60)	6.63 [a] ±0.16	6.12 [a] ±0.04
C.D. (5%)	0.44	0.48
Flavor and taste		
T_1 (50:50)	6.12 [a] ±0.05	6.12 [a] ±0.01
T_2 (60:40)	7.33 [b] ±0.20	7 [b] ±0.08
T_3 (40:60)	6.5 [a] ±0.08	6.3 [a] 8±0.05
C.D. (5%)	0.71	0.29
Texture		
T_1 (50:50)	6.63 [a] ±0.08	6.47 [a] ±0.28
T_2 (60:40)	7.43 [b] ±0.09	7.2 [a] ±0.06
T_3 (40:60)	6.76 [a] ±0.06	6.32 [a] ±0.17
C.D. (5%)	0.49	1.01
Overall acceptability		
T_1 (50:50)	6.44 [a] ±0.12	6.3 [a] ±0.07
T_2 (60:40)	7.43 [b] ±0.04	7.08 [b] ±0.05
T_3 (40:60)	6.63 [a] ±0.05	6.27 [a] ±0.06
C.D. (5%)	0.27	0.29

Mean ± SE, n=3, mean value with different superscript within a column differ significantly (P<0.05).

The lowest score of 6.58 was obtained by the sample of channa prepared using 50:50 ratio of soy: peanut milk. Similarly when calcium lactate (0.8%) was used as a coagulant, the highest score of 7.04 was obtained by the channa sample made using 60:40 ratio of soy: peanut milk. The lowest score (6.12) was obtained by the channa sample made using (40:60) ratio % of soy: peanut milk blend.

Table 2: ANOVA of Mean sum of square for effect of citric acid and calcium lactate on channa sensory attributes

	Color and appearance	Flavor and Taste	Texture	Overall acceptability
	Citric acid			
Treatments	0.86 [S]	1.16 [S]	0.55 [S]	0.82 [S]
Replication	0.18 [NS]	0.05 [NS]	0.01 [NS]	0.08 [NS]
	Calcium lactate			
Treatments	0.71 [S]	0.62 [S]	1.82 [S]	0.63 [S]
Replication	0.08 [NS]	0.02 [NS]	0.21 [NS]	0.03 [NS]

From the ANOVA (Table 2) the mean sum of square indicates that that there exists a significant difference between the treatments T_2 (60:40) than T_1 and T_3 of on color and appearance score of channa samples, when citric acid and calcium lactate is used as coagulant. Further, the mean score in Table 1 indicate that the samples of channa obtained using citric acid have scores higher as compared to the scores obtained by samples prepared using calcium lactate. This could have been due to added turbidity to the samples causing dullness to its color and appearance. This indicates that citric acid was a better coagulant that did not bring much change in color and appearance of channa, irrespective of levels of ratios. Best soy and peanut milk ratio was found to be 60:40.

3.1.1.2 Effect of coagulants on flavor and taste

Flavor is a combination of taste, smell/aroma and feeling (astringency, bite etc. Especially in spices, wine and coffee) in short it is combination of taste and aroma. Flavor embraces the senses of taste, smell and a composite sensation known as mouth feel. Taste is due to sensation felt by tongue. Taste is limited to sweet, sour salty and bitter. The dimension of these can be measured chemically and can be related to the consumer's preferences. Aroma is due to stimulation of olfactory senses with volatile organic compounds.

The Table 1 indicates that highest scores were 7.33 obtained when soy: peanut milk was admixed in the ratio of 60:40 and 1% citric acid was used as a coagulant. The lowest score of 6.12 was obtained by the sample of channa prepared using 50:50 ratio of soy: peanut milk. Similarly when calcium lactate (0.8%) was used as a coagulant, the highest score of 7.00 was obtained by the channa sample made using 60:40 ratio of soy: peanut milk. The lowest score (6.12) was obtained by the channa sample made using (50:50) ratio % of soy: peanut milk blend. ANOVA results indicates that there exist a significant difference between the treatments for flavor and taste score of channa samples, when citric acid is used as coagulant, which is evident from differences between calculated value F Values (11.81) and the tabulated F value (6.94). The calculated value is greater than tabulated value at 5% level of significance. Therefore, the differences were significant. From the ANOVA results it was found that there is a significant difference between the treatments for flavor and taste scores of channa samples, when calcium lactate is used as a coagulant, which is evident from differences between calculated value F Values (38.21) and the tabulated F value (6.94). The calculated value is greater than tabulated value at 5% level of significance. Therefore, the difference was significant. Further, it may be noted that channa prepared, using citric acid as coagulant, scored higher for flavor and taste as compared to calcium lactate coagulated samples. This may have been due to sour taste of such samples imparted due to use of calcium lactate resulting in lower scores.

3.1.1.3 Effect of coagulants on texture

It is overall assessment of the feeling by mouth and hand or it is sense of touch by hand and mouth. Mouth feel is a product's physical and chemical interaction in the mouth. It is a concept used in many areas related to the testing and evaluation of foodstuffs, such as wine tasting and rheology. It is evaluated from initial perception on the palate, to first bite, through mastication to swallowing and aftertaste. Mouth feel is often related to a product's water activity, hard or crisp products having lower water activities and soft products having intermediate to high water activities

The Table 1 indicates that highest scores were 7.43 obtained when soy: peanut milk was admixed in the ratio of 60:40 and 1% citric acid was used as a coagulant. The lowest score of 6.63 was obtained by the sample of channa prepared using 50:50 ratio of soy: peanut milk. Similarly when calcium lactate (0.8%) was used as a coagulant, the highest score of 7.20 was obtained by the channa sample made using 60:40 ratio of soy: peanut milk. The lowest score (6.32) was obtained by the channa sample made using (40:60) ratio % of soy: peanut milk blend.

From the above ANOVA (Table 2) results it is clear that there exist a significant difference between the treatments on texture score of channa samples, when citric acid is used as coagulant, which is evident from differences between calculated value F Values (11.83) and the tabulated F value (6.94). The calculated value is greater than tabulated value at 5% level of significance. Therefore, the differences were significant. From the ANOVA results, Table there is a clear significant difference between the treatments for texture scores of channa samples, when calcium lactate is used as a coagulant, which is evident from differences between

calculated value F Values (9.00) and the tabulated F value (6.94). The calculated value is greater than tabulated value at 5% level of significance. Therefore, the difference was significant. Further, it may be noted that channa prepared, using citric acid as coagulant, scored higher for texture as compared to calcium lactate coagulated samples.

3.1.1.3 Effect of coagulants on overall acceptability

Overall acceptability was tested by 7 consumers, using a 9-point hedonic scale and ranked the samples from the least to the most intense according to color and appearance, texture and flavor and taste. The results obtained were subjected to analysis of variance which revealed significant differences in the acceptability of the different samples.

The Table 1 indicates that highest scores were 7.43 obtained when soy: peanut milk was admixed in the ratio of 60:40 and 1% citric acid was used as a coagulant. The lowest score of 6.44 was obtained by the sample of channa prepared using 50:50 ratio of soy: peanut milk. Similarly when calcium lactate (0.8%) was used as a coagulant, the highest score of 7.08 was obtained by the channa sample made using 60:40 ratio of soy: peanut milk. The lowest score (6.27) was obtained by the channa sample made using (40:60) ratio % of soy: peanut milk blend.

Further, the results obtained were subjected to statistical analysis for two types of coagulants. From the above ANOVA results (Table 2) it is clear that there exist a significant difference between the treatments on overall acceptability score of channa samples, when citric acid is used as coagulant, which is evident from differences between calculated value F Values (57.12) and the tabulated F value (6.94). The calculated value is greater than tabulated value at 5% level of significance. Therefore, the difference was significant. ANOVA indicates that there is a clear significant difference between the treatments on overall acceptability scores of channa samples, when calcium lactate is used as a coagulant, which is evident from differences between calculated value (39.34) F Values and the tabulated F value (6.94). The calculated value is greater than tabulated value at 5% level of significance. Therefore, the difference was significant. Further, it may be noted that channa prepared, using citric acid as coagulant, scored higher for overall acceptability as compared to calcium lactate coagulated samples.

From the above study it may be concluded that acceptable quality of soy: peanut milk channa was obtained by using 1% citric acid solution as a coagulant and it resulted in higher score as compare to the use of calcium lactate 0.8%. It is evident from above study that channa prepared from soy: peanut milk mixed in ratio of 60:40 provided acceptable quality of cereal based milk channa. Therefore, this ratio was selected for preparation of channa in further study for the preparation of dietetic sweet spread.

3.1.2 Chemical and microbiological analysis of channa

Based on the sensory attributes of channa prepared using different ratios of soy: peanut admixture, channa prepared from the mixture of (60:40) using different coagulant. The sample of channa thus prepared was subjected to chemical and microbiological analysis. The results obtained with respect to chemical composition are presented in Table 3.

Table 3 indicates that the moisture content of channa sample prepared using citric acid at 1% as a coagulant ranges from 54.33 – 58.01 with an average of 56.17, whereas the moisture content of the channa sample prepared using calcium lactate at 0.8% used as a coagulant ranges from 59.09 – 56.69 with an average of 57.89. Fat content of channa sample prepared using citric acid at 1% as a coagulant ranges from 8.29 – 7.45 with an average of 7.87, whereas the fat content of the channa sample prepared using calcium lactate at 0.8% used as a coagulant ranges from 5.70– 6.75 with an average of 6.23.

Table 3: Proximate chemical composition of soy: peanut based channa

Treatments	Citric Acid 1%	Calcium lactate 0.8%
Moisture	56.17±1.30	57.89±0.85
Fat	7.87±0.42	6.23±0.37
Protein	18.22±1.69	14.6±1.14
Total carbohydrate	15.86±2.29	18.46±1.03
Ash	1.89±0.10	2.83±0.58
Microbiological analysis of soy: peanut based channa		
Constituents	Citric Acid 1%	Calcium lactate 0.8%
SPC (cfu/g)	$13.5\pm0.35\times10^3$	$(14.5\pm0.35)\times10^3$
Coliform(cfu/g)	NIL	NIL
Yeast and Mould (cfu/g)	$5\pm0.71\times10^1$	$4\pm0.71\times10^1$

Protein content of channa sample prepared using citric acid at 1% as a coagulant ranges from 16.53–19.91 with an average of 18.22, whereas the protein content of the channa sample prepared using calcium lactate at 0.8% used as a coagulant ranges from 16.21–12.99 with an average of 14.60. Total carbohydrate content of channa using citric acid at 1% as a coagulant ranges from 19.10 –12.61 with an average of 15.86, whereas the total carbohydrate content of channa sample prepared using calcium lactate at 0.8% as a coagulant ranges from 17.00–19.91 with an average of 18.46 and ash content of channa sample prepared using citric acid at 1% used as a coagulant ranges from 1.75 – 2.02 with an average of 1.89, whereas the ash content of the channa sample prepared using calcium lactate at 0.8% as a coagulant ranges from 2.00 –3.65 with an average of 2.83.

Ray and De (1953) [20] reported that major milk constituent in channa prepared from cow milk was 53.4 %moisture, 24.8% fat, 17.4% protein, 2.1 % lactose and 2.0% ash, whereas, buffalo milk channa contained 51.6% moisture, 29.6% fat, 14.4% protein, 2.3% lactose and 2.0% ash. According to De (1980) and Sachdeva and Singh (1985) [29], with the fall in pH (5.5-5.0) the moisture retention and yield of channa decreased. Channa made from cow's milk coagulated at pH 5.0 was sensorily superior to the one coagulated at pH 5.5 (Vishweshwaraiah and Anantakrishnan, 1985). However at coagulation pH of 5.0 the moisture, TS recovery and yield were lower. Tewari *et al.* (1991) [29] prepared channa/paneer spread from cow and buffalo milk, testing 3.0% fat and 9.0% SNF and 3.3% fat and 10.0% SNF, respectively. They observed that cow milk channa /paneer spread contained 62.5 % moisture, 15.9% fat, 17.5% protein, 2.2% lactose, 1.9% ash and pH while buffalo milk channa/paneer spread contained 63.8 % moisture, 15.4% fat, 16.2% protein, 2.4% lactose, 2.2% ash and pH 5.0. Ray and De (1953) [20] reported that major milk constituent in channa prepared from cow milk was 53.4% moisture, 24.8% fat, 17.4 %protein, 2.1%lactose and 2.0% ash, whereas, buffalo milk channa contained 51.6% moisture, 29.6% fat, 14.4% protein, 2.3% lactose and 2.0% ash.

3.2 Dietetic sweet spread

Different proportions of soy and peanut milk were used for preparation of acceptable quality of channa. Based on the

sensory properties the most acceptable quality of channa was prepared from soy and peanut blend ratio of 60: 40. The channa prepared from this blend was further used for the preparation of dietetic sweet spread. For this purpose artificial sweetener (Sucralose) was chosen as a suitable sweetener because it is easily soluble in water and stable at high temperature. It is 600 times sweeter than sugar and it is calorie free because it is not absorbed in the body. Therefore, it is considered safe for all segments. Soy: peanut milk based channa was blended thoroughly with sucralose in two different levels (500 ppm and 700 ppm) in order to obtain the suitable spread. The samples thus prepared were subjected to sensory evaluation by selected panel of judges to ascertain the quality of dietetic sweet spread. The results obtained for various sensory parameters are presented in Table 4.

3.2.1 The effect of sweetness score of dietetic sweet spread samples

The preference and liking optima towards sweetness of the product was determined by subjecting the product to consumer liking which was rated on 9 point hedonic scale as per the given score card. The dietetic sweet spread samples prepared using different levels of sucralose addition were subjected to various sensory attributes. The results obtained for sweetness attribute are represented in Table 4.

Table 4: Sensory scores of dietetic sweet spread samples

Constituent	500 ppm	700 ppm
Sweetness	7.34±0.09	8.07±0.03
Color and Appearance	7.42±0.10	7.9±0.04
Texture	7.31±0.03	8.64±0.05
Flavor/Taste	7.54±0.08	7.9±0.06
Spreadability	7.44±0.02	8.54±0.08
Overall acceptability	7.41±0.04	8.22±0.05

Mean ± SE, n=3

The Table 4 indicates that the sweetness score of dietetic sweet spread ranges from 7.11– 7.53 with a mean of 7.34 was obtained by the sample prepared using 500 ppm of sucralose and whereas the dietetic sweet spread sample having 700 ppm of sucralose, the sweetness scores ranged from 8.00–8.16 with a mean of 8.07. The results obtained was further analyzed statistically and presented in Table 5.

Table 5: ANOVA of Mean sum of square for effect of sweetener on sweet spread sensory attributes

	Sweetness	Color and appearance	Texture	Flavor and taste	spreadability	Overall acceptability
Treatments	0.81 ^{S}	0.36 ^{S}	2.64 ^{S}	0.19 ^{S}	1.83 ^{S}	0.99 ^{S}
Replication	0.03 ^{NS}	0.04 ^{NS}	0.01 ^{NS}	0.05 ^{NS}	0.02 ^{NS}	0.02 ^{NS}

3.2.2 The effect of color and appearance score of dietetic sweet spread samples

The dietetic sweet spread prepared from different levels of sucralose were subjected to various sensory attributes. The results obtained for color and appearance attribute are presented in Table 3. The color and appearance score of dietetic sweet spread ranges from 7.16–7.55 with a mean of 7.42 was obtained by the sample prepared using 500 ppm of sucralose and whereas the dietetic sweet spread sample having 700 ppm of sucralose, the color and appearance scores ranged from 7.83–8.01 with a mean of 7.90.

3.2.3 The effect of texture score of dietetic sweet spread samples

The samples of dietetic sweet spread prepared using different levels were assessed for texture attribute through sensory evaluation. Table 4 indicates that the texture score of dietetic sweet spread ranges from 7.28–7.38 with a mean of 7.31 was obtained by the sample prepared using 500ppm of sucralose whereas the dietetic sweet spread sample having 700 ppm of sucralose, the texture scores ranged from 8.52–8.70 with a mean of 8.64.

The mean indicate that the samples of dietetic sweet spread obtained using 700ppm sucralose have scored higher as compared to samples having 500ppm of sucralose.

3.2.4 The effect of flavor and taste score of dietetic sweet spread samples

The samples of dietetic sweet spread prepared using different levels were assessed for flavor and taste attribute through sensory evaluation. The above Table 4 indicates that the flavor and taste score of dietetic sweet spread ranges from 7.33–7.75 with a mean of 7.54 was obtained by the sample prepared using 500 ppm of sucralose and whereas the dietetic sweet spread sample having 700 ppm of sucralose, the flavor/taste scores ranged from 7.83–8.05 with a mean of 7.90. The results obtained was further analyzed statistically.

ANOVA results clear that there exist a significant difference between the treatments on flavor and taste score of dietetic sweet spread when sucralose is used as a sweetener, which is evident from differences between calculated value F values (26.27) and the tabulated F value (18.51). The calculated value is greater than tabulated value at 5% level of significance. Therefore, the difference was significant.

3.2.5 The effect of spreadability score of dietetic sweet spread samples

Spreads are semi-solid foods rich in fat which should flow easily when deformed. They classified as water/oil emulsions with different formulation consisting fat, water, emulsifiers, stabilizers, salt, antioxidants, and other ingredients. Spreadability is an extremely important attribute of spread as it is related to how easy the product is uniformly distributed over a surface.

The samples of dietetic sweet spread prepared using different levels were assessed for spreadability attribute through sensory evaluation. Table 4 indicates that the spreadability score of dietetic sweet spread ranges from 7.41– 7.50 with a mean of 7.44 was obtained by the sample prepared using 500 ppm of sucralose and whereas the dietetic sweet spread sample having 700 ppm of sucralose, the spreadability scores ranged from 8.35–8.75 with a mean of 8.54.

3.2.6 The effect of overall acceptability score of dietetic sweet spread

The samples of dietetic sweet spread prepared using different levels were assessed for overall acceptability attribute through sensory evaluation. The above Table 4 indicates that the overall acceptability score of dietetic sweet spread ranges from 7.31 – 7.52 with a mean of 7.41 was obtained by the sample prepared using 500 ppm of sucralose and whereas the dietetic sweet spread sample having 700 ppm of sucralose, the

overall acceptability scores ranged from 8.15–8.35 with a mean of 8.22. The results obtained was further analyzed statistically

The mean score in Table 4 indicate that the samples of dietetic sweet spread obtained using 700 ppm sucralose have scored higher with respect to sweetness, colour and appearance, texture, flavor and taste, spreadibility and overall acceptability as compared to samples containing 500 ppm of sucralose.

The ANOVA Table 5, it is clear that there exist a significant difference between the treatments on sweetness, colour and appearance, flavor and taste, spreadability and overall acceptability of dietetic sweet spread when sucralose is used as a sweetener. Therefore, the difference was significant. This indicates that sample containing 700 ppm sucralose scored better in sweetness attribute of dietetic sweet spread.

Babubhai (1999) [3] developed a technique for production of low fat sweetened dairy spread. In this study, the rate of sugar in the spread was optimized taking three levels ratios (60.0, 62.5 and 65%). The developed product was subjected to sensory evaluation, which showed that the score for color and appearance, flavor, body and texture was highest for the spread made with a sugar ratio of 62.5%. Reddy (2000) [21] suggested a process for manufacture of protein enriched low-fat butter spread containing channa. The standardized method consisted of communition of channa to a fine paste and addition of water of butter at 40 % level followed by incorporation of 2 % salt and blending for 30 min. Butter and skim milk channa were blended in 70:30, 60:40 and 50:50 (w/w) proportions in the preparation of spreads. Based on the various physico-chemical and sensory attributes use of 40 % channa was found to be best suited for the preparation of butter spread.

3.2.1 Chemical and microbiological analysis of dietetic sweet spread

Based on the sensory attributes the most acceptable quality of dietetic sweet spread was prepared from soy and peanut blend ratio of 60: 40. For this purpose artificial sweetener (Sucralose) was chosen as a suitable sweetener. The sample of dietetic sweet spread thus obtained was subjected to chemical and microbiological analysis. The results obtained with respect to chemical composition is presented in Table 6.

Table 6: Proximate analysis of dietetic sweet spreads

Constituents	Citric Acid 1%
Moisture	54.65±1.45
Fat	6.9±0.14
Protein	14.55±1.10
Total carbohydrate	20±0.07
Ash	3.91±0.14
Microbiological parameters	
SPC (cfu/g)	$13.5\pm0.35\times10^3$
Coliform(cfu/g)	NIL
Yeast and Mould (cfu/g)	$4.5\pm0.35\times10^1$

The above Table 6 indicates that the moisture content of dietetic sweet spread prepared from soy: peanut based channa ranges from 56.70 – 52.60 with an average of 54.65, fat content of dietetic sweet spread prepared from soy: peanut based channa ranges from 6.70-7.10 with an average of 6.90, protein content of dietetic sweet spread prepared from soy: peanut based channa ranges from 12.99-16.10 with an average of 14.55, total carbohydrate content of dietetic sweet spread prepared from soy: peanut based channa ranges from 19.90-20.09 with an average of 20.00 and ash content of dietetic sweet spread prepared from soy: peanut based channa ranges from 3.71-4.11 with an average of 3.91.

The above Table 6 indicates that the SPC of dietetic sweet spread sample prepared from soy: peanut based channa ranges from 14×10^3 -13×10^3 and yeast and mould count of dietetic sweet spread prepared from soy: peanut based channa sample ranges from 5×10^1 - 4×10^1.

4. Conclusion

In view of experimental results obtained during investigation it may be concluded that an acceptable quality of channa could be made using soy and peanut milk in the ratio of 60:40 using 1% citric acid as a coagulant. The channa thus obtained indicates that the scores, as per 9 point hedonic scale, falls between liking of good and very good. The channa thus prepared can be successfully used for the preparation of dietetic sweet spread with added sucralose (700 ppm) as a non-caloric sweetener. The acceptability scores for various sensory parameters of dietetic sweet spread indicates that the scores were adjudged as very good as per hedonic scale. Due to paucity of time storage studies could not be performed. Therefore, it is suggested that such studies be taken up to assess the keeping quality of the product. From the results obtained through this study it may be concluded that vegan milk based channa could be used for preparation of highly acceptable quality of dietetic sweet spread for diabetic personals without compromising on sweetness parameter.

5. References

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