Journal of Food and Dietetics Research

Original Article

Influence of pseudo-stem and kodo millet on quality parameters of paneer

Peerkhan Nazni[1], Shanavas Raisunnisa[1]

[1]Nutrition and Dietetics, Periyar University, Periyar Palkalai Nagar, Salem-636011, Tamilnadu-India.

***Corresponding author:**
Nazni P
Nutrition and Dietetics,
Periyar University, Periyar
Palkalai Nagar, Salem-636011,
Tamilnadu-India

naznip@gmail.com

Received : 12-January-2021
Accepted : 03-February-2021
Published : 03-April-2021

Doi: 10.48165/JFDR.2021.1102

Quick Response Code:

ABSTRACT

Objectives: This study was performed to find out the effect of different types of food grade acids on the on the quality of banana pseudo-stem (PS) powder and kodo millet (KM) flour incorporated paneer.

Material and Methods: Three different types of food grade acids such as citric acid, tartaric acid and malic acid each at 2, 3, 4, and 5 percentage concentrations were added to assess the physiochemical, textural and organoleptic parameters of banana pseudo-stem (PS) powder and kodo millet (KM) flour incorporated paneer.

Results: The moisture, protein, ash, yield, soluble, insoluble and total fiber of PSKM paneer increased with the increasing strength of the food grade acid. However, the specified parameters for PSKM paneer made using coagulants at 2, and 3 percent levels were statistically comparable ($P > 0.05$) except insoluble fiber content. Most of the textural and sensory characters of the PSKM paneer decreased with increasing concentration of the food grade acid. The type of coagulant also showed variations in the majority of the constitutions of PSKM paneer. The KMF paneer samples made with citric acid and tartaric acid had significantly higher ($P < 0.05$) values for moisture, protein, fat ash, total yield, soluble fiber, insoluble fiber and total fiber than PSKM paneer made with malic acid at all concentrations. No significant difference was seen in textural characteristics and sensory scores among all the samples.

Conclusion: Hence, to fabricate PSKM paneer with the majority desirable characteristics from pseudo stem powder and kodo millet flour, it is recommended that citric acid and tartaric acid at 5 percent concentration can be utilized as coagulants.

Keywords: Pseudo-stem, Kodo millet flour, Citric acid, Tartaric acid, Malic acid, Paneer

INTRODUCTION

Milk and Milk products are described as nature's ideal food for the human beings and they are also better sources of various essential nutrients required for human health.

Traditional dairy products in Indian's market are blooming well using various food technology concepts. Using various food processes such as coagulation and fermentation, about 55% of the milk produced in India is transformed into a range of traditional food products in which 7% was exclusively used to produce three products namely dahi, lassi, and shrikhand and which may be equivalent to western products like yogurt, stirred yogurt, and quarg, respectively.

Among various countries, India is considered as one of the major milk-producing country in the globe. Traditional dairy products in Indian's market are blooming well using various food technology concepts. Using various food processes, about 55% of the milk produced in India is transformed into a range of traditional food products.[1]

Coagulation is one of the process in which hot milk is coagulated either with lemon juice or with vinegar or with any organic or food acids which will produce a popular dairy product with soft nature called paneer.[2] In India about 5% of the produced milk is converted into paneer

products, which costs about ₹1050 crore.[3] Paneer consist of 55% moisture, 18% protein, 2.2% carbohydrate, 26% fat, and 2.0% of minerals.[4] Milk products like paneer do not contain any dietary fiber even though they are considered as perfect food. In these circumstances, milk and milk products considered as a vehicle for dietary fiber would enhance the diet's healthfulness as a whole to improve the human health.[5]

Adding cereal-bran as a fiber source in the milk products would enrich them nutritionally and also made them attractive. Apart from adding value to the milk products, it is progressively more important in the marketing point of view in the dairy business. The consumers have acknowledged these value-added products due to its low cost and high nutritive value, which helps to improve the community health in a numerous way.[6] Kodo millet is considered one of the ancient millet grains of the earth. It is highly rich in dietary fiber and various minerals and antioxidants.[7] Consumption of whole grains with high fiber content has health-promoting benefits like heart disease prevention, insulin resistance, obesity, diabetes, ischemic stroke, and breast cancer. Hence, they are called "nutricereals."[8] The inclusion of dietary fiber in the form of millet flour in dairy products, mainly in paneer, may influence the final product's textural and sensory characters.

Banana is largely produced in India. It is cultivated predominantly for their fruit and to some extent for flower bud, trunk, and pseudo-stem and leaves.[9] The core part of the pseudo-stem is tender and has been used as food in many parts of India. This core part is very rich in fiber along with vitamin B6 and potassium.[10]

Different types of coagulants at various concentrations were applied in order to improve the overall quality characteristics of the Kodo millet flour incorporated paneer preparation. Intense effect on the physiochemical, compositional, functional, and sensory qualities of paneer was described due to the use of different coagulants at various concentrations.[11-13]

So, the current research study was carried out to estimate the effect of various types of food grade coagulants such as citric acid, malic acid, and tartaric acid at different strengths on various parameters of Kodo millet incorporated paneer and also to find out the coagulant strength and type better suited for Kodo millet incorporated paneer.

MATERIAL AND METHODS

The local market was the primary source for cow's milk (Aavin parlor, Tamil Nadu, India), Kodo millet flour (B&B organics, Tamil Nadu, India), and food-grade citric acid (Crown foods, Maharashtra, India), malic acid, tartaric acid (Foodvit, Gujarat, India) and fresh lemon from the local market of Salem, Tamil Nadu, India. All the reagents for various analyses used in this study were of food-grade.

Preparation of banana pseudo-stem powder

Fresh banana pseudo-stem was procured from the local market and the outer crust was peeled off using blades. After peeling, the obtained central core part was sliced into 5 mm cubes and dried in a hot air oven at 60°C for 10 hours. The dried material was powdered, sieved with 60 mm mesh and stored in an air tight container for further use.

Preparation of paneer

The cow's milk was warmed up to 90°C without hold, cooled to 70°C; from that point forward, 2.5 g of prepared banana-pseudo stem powder and 2.5 g of Kodo millet flour was added and coagulated. About four different strengths such as 2, 3, 4, and 5% concentrations of three different coagulants namely citric acid, malic acid and tartaric acid, and lemon juice (control) were added to the cow's milk mixer and stirred continuously till clear whey was separated from the coagulated mass. The temperature of the coagulum was maintained at 65°C and left uninterrupted for the period of ten minutes. Then the whole content was filtered using the fine muslin cloth to drain the whey from the coagulum. Required stainless steel hoops with holes at both bottom and all sides are used to facilitate the quick and efficient release of whey from the coagulum. Clean muslin cloth was spread over the hoops and pressed with the pressure of 250 kg wt.m^2 for about 10 min. The pressed curd's block was cut into 5 × 5 × 5 cm dimension cubes and the same was immersed in ice-cold water at 4°C for 30 minutes. The immersed paneer was drained properly and measured to achieve the final yield of the paneer.

Determination of physicochemical characteristics

The PSKM paneer sample was analyzed for moisture using Moisture analyzer (Shimadzu Corporation, Kyoto, Japan), crude protein, crude fat, crude ash, soluble and insoluble fiber, and total dietary fiber according to the AOAC method[14] and pH was assessed using a digital pH meter (Testo 206 pH2 I, India). The yield of the paneer was obtained by the calculation method. All analyses were carried out in triplicate.

Determination of textural characteristics

Texture Analyzer (Perten Instruments, TVT 6700 series, Sweden) was used to assess various textural parameters. A stainless steel cylinder probe with a 25 mm diameter was used to imitate the teeth chewing action with a maximum trigger force of 50 mN. Using the probe the paneer samples were compressed at a depth of 7 mm at a test speed of 2.0 mm/s and a data rate of 500 pps. The observers recorded the hardness (N), springiness, cohesiveness, chewiness (N), and adhesiveness (J) of the KMF paneer samples in triplicates and noted the average values.

Determination of sensory characteristics

Sensory characteristics of PSKM paneer samples were determined by using 30 semi-trained panelists by using nine-point hedonic scale in which scores 1 and 9 demonstrates extremely dislike and extremely like, respectively. The sensory qualities assessed include appearance, flavor, body and texture, and overall acceptance.

Statistical analysis

The obtained data were analyzed using SPSS version 11.0 software. Two-way ANOVA with significance difference of the means and the variance of the group means were tested using Duncan Multiple range test at the level of $p < 0.05$. The overall means between the percentage of coagulant concentration and between the types of coagulants were compared to derive the results.

RESULT AND DISCUSSION

Physicochemical characteristics of PSKM paneer

The physicochemical qualities of the PSKM paneer investigated in the current study are given in Table 1. Increase in the strength of the coagulant from 2%, 4%, and 5% has showed no significant change in the moisture content irrespective of the coagulant type used in the PSKM paneer. Sachdeva and Singh[15] reported that the coagulant strength was inversely associated to the moisture level in paneer. This result was in contrast with the present study results regarding the moisture content. Hence, we can use coagulant concentration either to improve or reduce the moisture content as needed or which will not deviate from the legal standards of the paneer.

Significant variation was observed in the moisture content with different coagulant types. Lemon juice treated paneer was having highest moisture content and the lowest was noted in the malic acid PSKM paneer. The obtained results are in non-agreement with Joshi et al.[16] in which they reported paneer made with tartaric acid had the highest moisture retention and with citric acid had the lowest value.

The protein content of the PSKM paneer prepared using 2% and 3% coagulant had significantly lower content ($p \leq 0.05$) compared to 4% and 5% coagulant. Raise in total solids may be responsible for the raise in protein content in PSKM paneer. Significantly higher ($p \leq 0.05$) protein content was observed in the PSKM paneer coagulated with citric acid and tartaric acid compared to malic acid. Poor recovery of milk solids may be responsible for the low-level protein content in the malic acid PSKM paneer.

Increase in the concentration of the coagulant proportionally decreases the fat content in the PSKM paneer. Based on the type of coagulant, highest fat content was observed in lemon juice (control) and citric acid PSKM paneer followed by tartaric acid and malic acid. Decrease in fat recovery is directly related to the decrease in fat content.

The ash level in the PSKM paneer increased little by little with the increase in the coagulant concentration level. Considerably greater ash content was resulted by using citric acid and tartaric acid compared to malic acid but lower than the control paneer.

The pH level in the PSKM paneer decreased little by little with the increase in the coagulant concentration level. Significant difference ($p \leq 0.05$) in pH level was noted between citric, tartaric, and malic acid coagulated PSKM paneer. Significantly greater pH was resulted in malic and citric acid PSKM paneer than tartaric acid and all the three values are lower than the pH value of control paneer.

Regarding the total yield of PSKM paneer adding 4% and 5% concentration of coagulant yield high and similar content of paneer followed by 3% and 2%. Both citric and tartaric acid showed the highest yield followed by malic acid and lemon juice (control).

Mild raise in the coagulant concentration consistently increased both soluble and total fiber fractions in the PSKM paneer. However, based on the coagulant type, highest fiber content was observed in citric acid PSKM paneer ($p \leq 0.05$) followed by tartaric and malic acid PSKM paneer. Addition of pseudo-stem powder and Kodo millet flour is responsible for fiber increase in the paneer sample, while no fiber (zero) was noted in the control paneer sample.

Texture characteristics of PSKM paneer

The textural characteristics of paneer play a remarkable part in terms of quality and customer acceptability. The texture qualities were assessed from the Texture Profile Analysis (TPA), shown in Table 2. Hardness is a very frequently taken parameter in assessing the texture quality of the paneer. The effect of pseudo-stem powder and Kodo millet flour with the type of coagulants and percentage of coagulants on the paneer's hardness is presented. Paneer with a lower concentration of the coagulant had increased hardness, and higher coagulants (5%) had decreased the hardness. An increase in the coagulant concentration decreases the fibers' tensile strength present in the pseudo-stem powder and Kodo millet flour, incorporated in the paneer, thus decreasing the hardness. Tensile strength is very closely related to the hardness of the product. The hardness values so obtained were in the range as already reported in the results of soy paneer.[17,18] Results on the type of coagulant showed that the highest hardness was observed by lemon juice and lowest by the tartaric acid coagulated PSKM paneer.

From the present experimentation, it can be observed that with an increase in the concentration of the coagulant

Table 1: Changes in physico-chemical characteristics of PSKM paneer due to coagulants type and concentrations.

Concentration (%)	Control paneer	PSKM citric acid Paneer	PSKM malic acid paneer	PSKM tartaric acid paneer	Mean
Moisture (%)					
2%	16.49 ± 0.47	7.85 ± 0.42	7.94 ± 0.45	6.47 ± 0.29	9.69 ± 4.16[2]
3%	16.74 ± 0.39	7.15 ± 0.49	5.35 ± 0.34	6.19 ± 0.33	8.86 ± 4.81[1]
4%	16.99 ± 0.46	6.95 ± 0.43	7.33 ± 0.36	8.14 ± 0.56	9.86 ± 4.35[2]
5%	18.92 ± 0.20	7.20 ± 0.67	6.56 ± 0.45	7.14 ± 0.34	9.96 ± 5.42[2]
Mean	17.28 ± 1.06[c]	7.29 ± 0.56[b]	6.80 ± 1.07[a]	6.99 ± 0.85[ab]	
Protein (g)					
2%	11.05 ± 0.03	18.07 ± 0.03	17.06 ± 0.04	17.54 ± 0.01	15.93 ± 2.96[1]
3%	11.15 ± 0.03	18.24 ± 0.01	17.23 ± 0.03	17.65 ± 0.03	16.06 ± 2.99[2]
4%	11.22 ± 0.02	18.37 ± 0.03	17.35 ± 0.03	17.72 ± 0.03	16.16 ± 3.01[3]
5%	11.36 ± 0.02	18.45 ± 0.03	17.40 ± 0.01	17.84 ± 0.02	16.27 ± 2.98[4]
Mean	11.20 ± 0.12[a]	18.28 ± 0.15[d]	17.26 ± 0.14[b]	17.69 ± 0.12[c]	
Fat (g)					
2%	23.15 ± 0.01	17.97 ± 0.02	17.05 ± 0.04	17.55 ± 0.03	18.93 ± 2.57[3]
3%	23.24 ± 0.04	17.81 ± 0.02	16.94 ± 0.01	17.40 ± 0.01	18.85 ± 2.67[2]
4%	23.36 ± 0.03	17.75 ± 0.02	16.87 ± 0.03	17.36 ± 0.04	18.84 ± 2.75[2]
5%	23.43 ± 0.04	17.61 ± 0.15	16.74 ± 0.02	17.21 ± 0.02	18.75 ± 2.84[1]
Mean	23.29 ± 0.12[d]	17.79 ± 0.14[c]	16.90 ± 0.12[a]	17.38 ± 0.13[b]	
Ash (g)					
2%	4.03 ± 0.02	2.53 ± 0.04	1.64 ± 0.02	2.03 ± 0.02	2.56 ± 0.95[1]
3%	4.17 ± 0.02	2.64 ± 0.03	1.73 ± 0.02	2.24 ± 0.02	2.70 ± 0.95[2]
4%	4.23 ± 0.03	2.75 ± 0.04	1.81 ± 0.02	2.33 ± 0.02	2.78 ± 0.94[3]
5%	4.37 ± 0.01	2.85 ± 0.03	1.92 ± 0.01	2.45 ± 0.04	2.90 ± 0.95[4]
Mean	4.20 ± 0.13[d]	2.69 ± 0.13[c]	1.78 ± 0.11[a]	2.26 ± 0.16[b]	
pH					
2%	5.49 ± 0.02	3.54 ± 0.01	4.01 ± 0.06	3.56 ± 0.05	4.15 ± 0.83[4]
3%	5.38 ± 0.01	4.34 ± 0.16	3.24 ± 0.01	3.25 ± 0.06	4.05 ± 0.93[3]
4%	5.26 ± 0.03	3.17 ± 0.02	3.99 ± 0.09	3.34 ± 0.10	3.93 ± 0.86[2]
5%	5.34 ± 0.04	2.90 ± 0.01	3.90 ± 0.05	2.89 ± 0.06	3.76 ± 1.05[1]
Mean	5.37 ± 0.09[d]	3.49 ± 0.57[b]	3.79 ± 0.33[c]	3.26 ± 0.26[a]	
Yield (g/1000 ml)					
2%	154 ± 2.00	180 ± 1.53	157 ± 3.00	183 ± 3.61	169 ± 13.93[1]
3%	155 ± 4.51	195 ± 1.53	158 ± 2.08	185 ± 4.36	173 ± 18.42[2]
4%	152 ± 1.53	191 ± 2.08	183 ± 3.21	190 ± 3.60	179 ± 16.57[3]
5%	158 ± 1.53	183 ± 0.58	186 ± 2.52	190 ± 8.00	179 ± 13.45[3]
Mean	155 ± 3.24[a]	187 ± 6.44[c]	171 ± 14.59[b]	187 ± 5.49[c]	
Soluble Fibre (g)					
2%	0.00 ± 0.00	1.65 ± 0.02	0.85 ± 0.03	1.25 ± 0.02	0.93 ± 0.64[1]
3%	0.00 ± 0.00	1.75 ± 0.02	0.93 ± 0.02	1.36 ± 0.02	1.01 ± 0.68[2]
4%	0.00 ± 0.00	1.87 ± 0.03	1.04 ± 0.01	1.44 ± 0.03	1.09 ± 0.73[3]
5%	0.00 ± 0.00	1.95 ± 0.01	1.16 ± 0.02	1.54 ± 0.03	1.16 ± 0.76[4]
Mean	0.00 ± 0.00[a]	1.80 ± 0.12[d]	0.99 ± 0.12[b]	1.40 ± 0.12[c]	
Insoluble Fibre (g)					
2%	0.00 ± 0.00	2.90 ± 0.04	2.70 ± 0.04	2.87 ± 0.01	2.12 ± 1.28[1]
3%	0.00 ± 0.00	2.90 ± 0.02	2.73 ± 0.03	2.89 ± 0.02	2.13 ± 1.29[1]
4%	0.00 ± 0.00	2.87 ± 0.03	2.71 ± 0.02	2.87 ± 0.04	2.11 ± 1.28[1]
5%	0.00 ± 0.00	2.88 ± 0.02	2.68 ± 0.06	2.92 ± 0.02	2.12 ± 1.28[1]
Mean	0.00 ± 0.00[a]	2.89 ± 0.03[c]	2.70 ± 0.04[b]	2.89 ± 0.03[c]	
Total Fibre (g)					
2%	0.00 ± 0.00	4.56 ± 0.02	3.56 ± 0.03	4.12 ± 0.03	3.06 ± 1.88[1]
3%	0.00 ± 0.00	4.65 ± 0.03	3.66 ± 0.04	4.25 ± 0.02	3.14 ± 1.93[2]
4%	0.00 ± 0.00	4.74 ± 0.01	3.75 ± 0.02	4.31 ± 0.01	3.20 ± 1.96[3]
5%	0.00 ± 0.00	4.83 ± 0.02	3.83 ± 0.05	4.47 ± 0.01	3.28 ± 2.02[4]
Mean	0.00 ± 0.00[a]	4.70 ± 0.11[d]	3.70 ± 0.11[b]	4.29 ± 0.13[c]	

Column-wise (numerals) and row-wise group means (alphabets) with different superscripts differ significantly ($P \leq 0.05$); Mean ± S.E.; N = 5

Table 2: Changes in textural characteristics of PSKM paneer due to coagulants type and concentrations.

Concentration (%)	Control paneer	PSKM citric acid Paneer	PSKM malic acid paneer	PSKM tartaric acid paneer	Mean
Hardness (N)					
2%	6.90 ± 0.19	8.05 ± 1.21	6.52 ± 0.80	4.39 ± 0.26	6.47 ± 1.52^{2}
3%	7.54 ± 0.91	4.84 ± 3.21	7.23 ± 0.16	3.12 ± 0.23	5.59 ± 2.49^{12}
4%	8.37 ± 2.79	4.50 ± 1.33	2.62 ± 0.39	6.03 ± 3.31	5.38 ± 2.93^{12}
5%	8.24 ± 0.03	2.62 ± 1.34	3.64 ± 0.54	3.08 ± 0.64	4.40 ± 2.44^{1}
Mean	7.76 ± 1.40^{b}	5.00 ± 2.64^{a}	5.01 ± 2.06^{a}	4.06 ± 1.98^{a}	
Springiness					
2%	0.94 ± 0.02	0.99 ± 0.02	0.97 ± 0.01	0.92 ± 0.06	0.95 ± 0.04^{2}
3%	0.86 ± 0.19	0.68 ± 0.28	0.97 ± 0.04	0.13 ± 0.01	0.66 ± 0.37^{1}
4%	0.96 ± 0.02	0.69 ± 0.53	0.12 ± 0.04	0.88 ± 0.06	0.66 ± 0.41^{1}
5%	0.98 ± 0.09	0.73 ± 0.44	0.82 ± 0.25	0.49 ± 0.37	0.75 ± 0.33^{1}
Mean	0.94 ± 0.09^{b}	0.77 ± 0.34^{ab}	0.72 ± 0.38^{a}	0.60 ± 0.37^{a}	
Cohesiveness					
2%	1.04 ± 0.27	0.90 ± 0.02	0.97 ± 0.12	1.17 ± 0.24	1.02 ± 0.19^{2}
3%	1.11 ± 0.21	0.88 ± 0.08	0.91 ± 0.01	−4.13 ± 4.58	-0.31 ± 3.02^{1}
4%	1.26 ± 0.09	0.86 ± 0.04	0.79 ± 0.04	1.00 ± 0.17	0.98 ± 0.21^{2}
5%	0.89 ± 0.01	1.20 ± 0.28	0.90 ± 0.02	0.13 ± 1.12	0.78 ± 0.64^{2}
Mean	1.08 ± 0.20^{b}	0.96 ± 0.19^{b}	0.89 ± 0.09^{b}	-0.46 ± 3.02^{a}	
Chewiness (N)					
2%	6.67 ± 1.82	7.08 ± 1.37	6.01 ± 0.70	4.73 ± 1.20	6.13 ± 1.47^{2}
3%	7.16 ± 2.45	2.96 ± 2.74	6.71 ± 0.06	−1.42 ± 1.23	3.85 ± 3.97^{1}
4%	9.87 ± 3.99	3.01 ± 2.52	0.22 ± 0.11	4.76 ± 2.30	4.47 ± 4.30^{1}
5%	7.21 ± 0.22	2.46 ± 1.99	2.68 ± 0.95	1.15 ± 1.49	3.38 ± 2.65^{1}
Mean	7.73 ± 2.51^{b}	3.88 ± 2.71^{a}	3.90 ± 2.78^{a}	2.31 ± 3.05^{a}	
Adhesiveness (J)					
2%	0.07 ± 0.06	0.03 ± 0.06	0.00 ± 0.00	0.00 ± 0.00	0.03 ± 0.05^{1}
3%	0.90 ± 1.21	0.27 ± 0.06	0.03 ± 0.06	19.27 ± 2.20	5.12 ± 8.61^{23}
4%	0.33 ± 0.25	8.20 ± 14.12	20.93 ± 1.81	0.07 ± 0.06	7.38 ± 10.74^{3}
5%	0.10 ± 0.00	2.96 ± 4.88	0.00 ± 0.00	6.63 ± 8.03	2.43 ± 4.90^{12}
Mean	0.35 ± 0.63^{a}	2.87 ± 7.24^{ab}	5.24 ± 9.49^{b}	6.49 ± 8.94^{b}	

Column-wise (numerals) and row-wise group means (alphabets) with different superscripts differ significantly ($P \leq 0.05$); Mean ± S.E.; N = 5

from 3% to 5% in the PSKM paneer, there is no significant change in the springiness value, but there is a minor variation ranging from 0.66 to 0.75, and these results are in accordance with the values obtained for the soy paneer.[17,18] The type of coagulant indicated the lowest springiness in tartaric acid and the highest value in lemon juice–treated PSKM paneer. Cohesiveness is a significant textural characteristic of the paneer. In this study, it can be seen that with an increase in the concentration of the coagulant in the PSKM paneer, there is no significant change in the cohesiveness value except the 3% treated paneer. However, there is a minor variation ranging from 0.74 to 0.98, and these results are in harmony with the values obtained for the soy paneer.[17,18] Results on the type of coagulant indicated, lowest cohesiveness was observed in the tartaric acid–treated PSKM paneer with significant difference between the other three coagulants. As the character of the protein matrix and the degree of fat distribution contribute to the cohesiveness, so these changes in cohesiveness with an increase in the concentration of the coagulants maybe because of the condensed network structure commonly viewed in whole milk coagulated foodstuffs because of their fibrous structure present in both pseudo- stem powder and Kodo millet flour incorporated in the paneer. It was noted that as the concentration of the coagulants increases in the PSKM paneer, there is a change in the value of chewiness. Results on the type of coagulant showed the highest chewiness in the lemon juice–treated PSKM paneer with a significant difference between the rest of coagulants.

Regarding adhesiveness, it was noted that the concentration of the coagulants in the PSKM paneer increased, the adhesiveness increased except 5% level which showed lower value compared to 3% and 4% incorporation of coagulant. Results agree with those reported earlier by researchers who found that adhesiveness varied inversely with the coagulant solution's concentration.[17,18] Results on the effect of type of coagulants revealed that the highest adhesiveness was observed in the tartaric acid–treated PSKM paneer and significantly lowest by the lemon juice–treated (control)

paneer. This insignificant increase or decrease in the adhesiveness formed during the paneer's coagulation is due to the fibrous structure contributed by the pseudo-stem powder and Kodo millet flour added to the paneer.

Sensory characteristics of PSKM paneer

Table 3 shows the sensory characteristics of PSKM paneer. It is observed that, there is no significant difference either with the concentration of the coagulant or the type of coagulants regarding the appearance scores of the PSKM paneer. The appearance scores for the reconstituted milk denoted by Shahnawaz et al.[19] were in accord with the results of the current study. The flavor score of the PSKM paneer was decreased by increasing the coagulants concentration. Addition of 5% coagulant has made the taste of PSKM paneer more acidic. Results are in agreement with Shahnawaz et al.,[19] who stated that decrease in flavor scores was observed when increase in level and concentration of the acid was done. No significant ($p \geq 0.05$) difference on flavor scores was observed between citric, malic, and tartaric acid treated PSKM paneer. Yet, slightly enhanced flavor was observed in citric acid PSKM paneer compared to other coagulants.

Increased level of coagulant concentration had showed no significant change in the body and texture scores of the PSKM paneer. Higher concentration of the acid coagulant has altered the body and texture scores of PSKM paneer due to denaturation of milk proteins, thus affecting milk proteins interaction with each other and also with water molecules which make the PSKM paneer harder and dryer yielding low scores for body and texture. A different pattern was observed by Shahnawaz et al.[19] in which increase in the coagulant concentration has decreased the body and texture of KMF paneer. Lemon juice treated paneer had higher values of body and texture scores followed by malic acid, citric and tartaric acid treated PSKM paneer. Increased retention of moisture with unlocked and loose texture may be responsible for the lesser body and texture scores in tartaric acid PSKM paneer. Findings from Shahnawaz et al.[19] reported that lower scores in body and texture was observed in reconstituted milk based paneer treated with malic acid.

Increase in the acid concentration overall decreased the overall acceptability in PSKM paneer. The effect of type of coagulants on overall acceptability was comparable between citric, tartaric, and malic acid treated PSKM paneer, but the scores were significantly lower ($p \leq 0.05$) than the control paneer. The lower scores on overall acceptability in tartaric acid PSKM paneer are in contrast with the results of Pal et al.[20] who revealed lower overall acceptability scores for malic acid paneer. Addition of 3% concentration of citric and malic acid

Table 3: Changes in sensory characteristics of PSKM paneer due to coagulants type and concentrations.

Concentration (%)	Control paneer	PSKM citric acid Paneer	PSKM malic acid paneer	PSKM tartaric acid paneer	Mean
Appearance					
2%	8.20 ± 1.30	7.80 ± 1.30	8.40 ± 0.89	7.80 ± 0.84	8.05 ± 1.05[1]
3%	8.40 ± 0.89	8.00 ± 1.00	8.40 ± 0.89	7.60 ± 0.89	8.10 ± 0.91[1]
4%	8.40 ± 0.89	8.20 ± 0.84	8.20 ± 0.84	7.80 ± 1.30	8.15 ± 0.93[1]
5%	8.00 ± 0.71	8.40 ± 0.55	8.00 ± 0.00	8.40 ± 0.89	8.20 ± 0.62[1]
Mean	8.25 ± 0.91[a]	8.10 ± 0.91[a]	8.25 ± 0.72[a]	7.90 ± 0.96[a]	
Flavour					
2%	8.60 ± 0.55	7.20 ± 1.64	7.60 ± 1.95	7.20 ± 1.64	7.65 ± 1.53[1]
3%	8.20 ± 1.30	7.20 ± 2.49	7.20 ± 1.64	6.80 ± 1.79	7.35 ± 1.79[1]
4%	7.80 ± 1.64	7.00 ± 2.35	6.80 ± 1.64	7.00 ± 1.87	7.15 ± 1.79[1]
5%	6.80 ± 1.30	6.80 ± 2.28	6.40 ± 2.19	6.80 ±1.64	6.70 ± 1.75[1]
Mean	7.85 ± 1.35[a]	7.05 ± 2.04[a]	7.00 ± 1.78[a]	6.95 ± 1.61[a]	
Body and Texture					
2%	8.40 ± 0.89	7.20 ± 1.64	7.80 ± 1.79	6.80 ± 1.48	7.55 ± 1.50[1]
3%	7.80 ± 0.45	7.60 ± 1.34	8.20 ± 1.30	7.40 ± 1.14	7.75 ± 1.07[1]
4%	8.20 ± 0.84	7.80 ± 0.84	7.60 ± 1.14	7.40 ± 1.34	7.75 ± 1.02[1]
5%	7.60 ± 0.89	7.60 ± 0.89	7.40 ± 0.89	7.60 ± 0.55	7.55 ± 0.76[1]
Mean	8.00 ± 0.79[a]	7.55 ± 1.15[a]	7.75 ± 1.25[a]	7.30 ± 1.13[a]	
Overall acceptability					
2%	8.40 ± 0.89	7.60 ± 1.52	8.00 ± 1.41	7.40 ±1.34	7.85 ± 1.27[1]
3%	8.20 ± 0.84	8.00 ± 1.00	8.00 ± 1.41	7.40 ± 1.14	7.90 ± 1.07[1]
4%	8.20 ± 1.30	8.00 ± 1.00	7.40 ± 0.89	7.60 ± 1.14	7.80 ± 1.06[1]
5%	7.60 ± 1.14	7.80 ± 0.84	7.20 ± 1.30	7.40 ± 0.89	7.50 ± 1.00[1]
Mean	8.10 ± 1.02[a]	7.85 ± 1.04[a]	7.65 ± 1.23[a]	7.45 ± 1.05[a]	

Column-wise (numerals) and row-wise group means (alphabets) with different superscripts differ significantly ($P \leq 0.05$); Mean ± S.E.; N = 5

has produced more acceptable sensory scores of PSKM paneer. Yet, all the PSKM paneer samples had scored the overall scores in the range of like moderately (7) to like very much (8).

CONCLUSION

Utilization of 5% concentration of citric acid and tartaric acid is recommended for the manufacture of pseudo-stem powder and Kodo millet flour incorporated paneer with high protein content, high yield, high total fiber content, lesser hardness, and also with desirable sensory characteristics.

Declaration of patient consent

Patient's consent not required as there are no patients in this study.

Financial support and sponsorship

Nil.

Conflicts of interest

Dr. Nazni Peerkhan is on the editorial board of this journal. She has no conflict of interest.

REFERENCES

1. Swapna G, Chavannavar SV. Shrikhand - value added traditional dairy product. Int J Food Nutr Sci 2013;2:45–51.
2. Jagannath A, Ramesh MN, Varadaraj MC. Response surface model for predicting the behavior of Yersinis Enterocolitica in paneer – a heat and acid coagulated milk product. Acta Horticulturae 2001;566:487–91.
3. Kanawjia SK, Singh S. Technological advances in paneer making. Indian Dairyman 2000;52:45–50.
4. Makhal S, Sen DC. Exploration of attributes influencing the quality of paneer – a review. J Dairying Foods Home Sci 2001;20:71–19.
5. Singh G, Kumar A, Kumbhar BK, Dar BN. Optimization of processing parameters and ingredients for development of low-fat fibre-supplemented paneer. J Food Sci Technol 2015;52:709–19.
6. Nayak SK, Pattnaik P, Mohanty AK. Dietary fiber: a low calorie dairy adjunct. Indian Food Ind 2000;19:268–71.
7. Deshpande1SS, Mohapatra D, Tripathi MK, Sadvatha RH. Kodo millet-nutritional value and utilization in Indian foods. J Grain Processing Storage 2015;2:16–23.
8. Shahidi F, Chandrasekara A. Millet grain phenolics and their role in disease risk reduction and health promotion: a review. J Funct Foods 2013;5:570–81.
9. Desai CS, Desai CD, Desai SK, Mistry PS, Patel JM, Vaidya HB. Preparation of flavored candy from central core of banana pseudostem. Asian J Dairy Food Res 2016;35:341–2.
10. Lakshman R, Dawn CP. Ambrose, Dtiroutchelvame. Studies on banana centre core flour prepared by different drying methods. Current Agri Res J 2015;3:55–9.
11. Sachdeva S, Singh S. Use of non-conventional coagulants in the manufacture of paneer. J Food Sci Tech 1987;24:317–9.
12. Pal MA, Beniwal BS, Karwasra RK. Comparative efficacy of citric and malic acids as coagulants for paneer manufacture. Indian J Dairy Sci 1999;52:156–9.
13. Kumar S, Rai DC, Verma DN. Effect of different levels of lactic acid on the physicochemical and sensory attributes of buffalo milk paneer. Indian J Anim Res 2008;42:145–9.
14. AOAC (2003) Official methods of analysis, 18th ed. Association of Official Analytical Chemists (Washington); 2003.
15. Sachdeva S, Singh S. Optimisation of processing parameters in the manufacture of paneer. J Food Sci Tech 1988;25:142–5.
16. Joshi SV, Majgoankar SV, Toro VA. Effect of different coagulants on yield and sensory quality of chhana prepared from milk of cow, buffalo and goat. Indian J Dairy Sci 1991;44:380–3.
17. Uprit S, Mishra HN. Instrumental textural profile analysis of soy fortified pressed chilled acid coagulated curd (paneer). Int J Food Properties 2004;7:367–78.
18. Jain SK, Mhatre S. The textural properties of soy paneer. Int J Dairy Technol 2009;62:584–91.
19. Khan SU, Pal MA, Wani SA, Salahuddin M. Effect of different coagulants at varying strengths on the quality of paneer made from reconstituted milk. J Food Sci Technol 2014;51:565–70.
20. Pal MA, Beniwal BS, Karwasra RK. Comparative efficacy of citric and malic acids as coagulants for paneer manufacture. Indian J Dairy Sci 1999;52:156–9.

How to cite this article: Nazni P, Raisunnisa S. Influence of pseudo-stem and kodo millet on quality parameters of paneer. J Food Diets Res 2021;1(1):7–13.