Formulation and quality evaluation of (*Pennisetum glaucum* incorporated) value-added paneer by Response Surface Methodology

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Abstract: Paneer is a South Asian variety of soft cheese. It is rich in protein but deficient in fibre. Efforts were initiated to prepare a fibre rich paneer by addition of pearl millet flour (*Pennisetum glaucum*). For the formulation of value-added product, 10 samples variation were developed including standard, (88.96 to 100 mL) cow’s milk (CM) and pearl millet flour (PMF) (0.17 to 5.82 g). The experiment was designed by Central Composite Rotatable Design to optimize the CM, and PMF concentration for the development of value-added product with dietary fibre, and to evaluate proximal, textural and sensory characteristics of the product. For optimization, the levels of incorporation of CM and PMF were taken as variables whereas overall acceptability (OAA) as response. The optimum level of CM and PMF obtained using numerical optimization was found to be 95:3. PMF incorporated paneer had high carbohydrate (3.72g), protein (16.95g) and fibre (0.66g) content but low in fat (17.08g). Texture analysis reported higher hardness, chewiness and adhesiveness for formulations developed by addition of >4 g millet flour. Sensory scored revealed that paneer with 90 mL CM and 1g of PMF (V₂) and 92.5 mL CM and 3g of PMF (V₉) had highest overall acceptability (8.50 to 8.60). Therefore it was concluded that the incorporation of PMF for the formulation of value-added paneer was a great success and furthermore it will be helpful for developing value-added dairy products for the developing countries.

Keywords: Cow’s milk, Dietary fibre, Paneer, Pearl millet flour

Introduction

India has witnessed a remarkable growth in milk production during the last few decades due to the success of the Operation Flood Programme, which is one of the world’s largest and successful integrated dairy development programs initiated in 1970’s (Khan et al. 2014). Cow’s milk plays an important role in human nutrition since milk is one of the primary sources of nutrients in diets. Paneer is a variety of soft cheese obtained by acid and heat coagulation of milk. It is a non-fermented, non-renneted, non-melting, and unripened type of cheese. It is an indigenous milk product obtained through acid coagulation of heated milk and subsequent removal of whey. Paneer is a rich source of protein available at lower cost and form an important source of animal protein for vegetarians. Biological value of protein in paneer ranges from 80-86 (Shrivastava et al. 2017).

According to FSSAI (2011), paneer shall not contain more than 70.0% moisture and <50.0% milk fat (dry matter). Good quality paneer is characterized by marble white colour, mildly acidic taste, nutty flavour and spongy body according to FSSAI (PFA 2010). Paneer contains 50-60% of moisture, 23-25% fat, 17-18% protein 2-2.5% lactose and 1.5-2.0% minerals (Kumar et al. 2011). It is also a good source of fat-soluble vitamins A and D according to Bureau of Indian Standard (BIS 1983).

Millets are major food sources for millions of people, especially those who live in hot, dry areas of the world. Millets are comes under *Poaceae* family, and classified as-maize, sorghum, and Coax (Job’s tears) under the grass sub-family, *Panicoidae* (Yang et al. 2012). They are grown mostly in marginal areas under agricultural conditions in which major cereals fail to give substantial yields (Adekunle, 2012). Millets are important foods in many underdeveloped countries due to their ability to grow under adverse weather conditions like limited rainfall. In contrast,
millet is the major source of energy and protein for millions of people in Africa. It has been reported that millet has many nutritional and medical functions like- hypoglycaemic, cardio protective, colon cancer anticipatory and prebiotic actions (Obilana et al. 2002).

Millet is a drought resistant crop and can be stored for a long time without insect damage (Adekunle et al. 2012); hence, it can be important during famine. There are many varieties of millets. The four major types are Pearl millet (*Pennisetum glaucum*), which comprises 40% of the world production, Foxtail millet (*Setaria italica*) (Obaliana et al. 2002), Proso millet or white millet (*Panicum miliaceum*), and Finger Millet (*Eleusine coracana*).

Pearl millet (*Pennisetum glaucum*) has been chosen for this study because it is the most widely grown type of millet. It can tolerate difficult climatic conditions such as drought, low soil fertility and high temperature, and can also grow in areas where other cereal crops, such as maize (*Zea mays*) or wheat (*Triticum aestivum*), would not survive. Pearl millet grain is highly nutritious, with 8–19% protein, low starch, high fibre (11.3g/100 g), high amount of antioxidant and micronutrient concentrations (iron, calcium and zinc) than rice, wheat, maize and sorghum (Lestienne et al. 2005; Sade, 2009; Yadav et al. 2014).

A considerable amount of literature has already identified the need for the formulation of value-added paneer like- designer paneer made up of ragi and wheat (Narayanan, 2014), cottage cheese or paneer prepared with coconut, millet, soy milk and pulses (Azeez et al. 2016) and fermented rice milk paneer (Amini et al. 2019). But in the present study for the formulation of value-added paneer pearl millet is used with milk because, over the last three decades the consumption of group 1 (unprocessed/minimally processed) and group 2 (processed culinary ingredients) foods has been replaced by group 3 ultra-processed food products, which is deficient in fibre. On the other hand, fibre used to play key role in our diet because of its expedient effect on hyperlipidaemia, hyperglycaemia, constipation, colon cancer, and obesity (Srilakshmi, 2012).

Therefore, the study was aimed to formulate a value-added paneer with high nutritional value. Hence the present study investigation was under taken with objectives to optimize the formulation of fibre rich paneer using Response Surface Methodology. Moreover, the effect of incorporation on proximal, textural and sensory parameters of the formulated value-added paneer samples was also estimated.

### Materials and Methods

#### Materials

Pearl millet has been selected as a sample because it has high protein, and fibre content as well as long shelf life. Pearl millet was collected from Jaisuriya shop (Salem), milk from Avin milk store (Periyar University), and lemon from local market of Salem, Tamil Nadu.

#### Processing of pearl millet

Pearl millet seeds (1kg) were stored and thoroughly washed using warm (65°C) water. It was sun dried at 45 - 48°C for 10 days and milled by using locally fabricated attrition mill. The powdered samples were passed through sieve (125mm) in order to obtain fine pearl millet flour and, stored in a plastic container at room temperature.

#### Optimization of value-added paneer using Response Surface Methodology (RSM)

A CCRD analysis was used to optimize and evaluate the effect of two variables (Cow's milk and pearl millet flour) on response (OAA). Based on previous preliminary experiments, the variable ranges were determined and presented with their coded and actual values in Table 1. The proportion of milk and flour was expressed as a fraction of the mixture and for each treatment combination, the sum of the components proportion was ≤ to 100; where -

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(xi = x1 + x2 <100%)
\]

#### Standardization and optimization of value-added paneer procedure

Value-added paneer was prepared by mixing pearl millet flour with fresh milk and 10 composite samples were prepared in which one treatment was control, and 9 samples variation were mixed at different ratio as given in Table 1.

#### Procedure for making value-added paneers

Cow’s milk was filtered and transferred to stainless steel pan. Pearl millet flour was added with the fresh milk and heated to 120°C to control contamination from millet, and harmful bacterial growth, then subsequently cooled to 70°C. Coagulation of milk was performed by adding citric acid solution and then coagulated
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mass was allowed to settle for 5 minutes. Then whey was drained, curd collected and filled in to muslin cloth to facilitate the expulsion of whey. The muslin cloth with the coagulated mass was pressed. Then the pressed mass was immersed in the chilled water. Then the obtained paneer samples were sliced in to pieces (Fig. 1).

Proximate analysis of value-added paneers

Nutrient analysis was performed for carbohydrate, protein, fat, and fibre (soluble and insoluble) of the samples. Carbohydrate, protein, and fat were determined according to the method of AOAC (2000). Soluble, insoluble, and total fibre content were calculated according to the AOAC (2016) 993.19, 991.42, 991.43.

(Total carbohydrate (g): = 100-weight in grams × [protein + fat + water + ash + alcohol] in 100 g of food)

Texture analysis of value-added paneers

The texture profile of value added paneers were performed using Perten Instruments TVT 6700 texture analyser. The instrument was fitted with a 35 mm cylinder probe (P/35). Samples were tested after a period of exactly 10 min had elapsed following cooking (Bourne, 1978). Measurements were performed at room temperature (~28°C). Calibration settings used were the 5 kg load cell with a return trigger path at 15 mm. The measurement mode settings for double cycle compression (pre-test, test and post-test) were set to a speed of 1.0 mm/sec; trigger type at auto-10 g; and data rate: 200 pps, based on force-time curves of the Texture Profile Analysis and the graphs obtained were analysed for hardness, springiness, stickiness, cohesiveness, chewiness, and adhesiveness.

Sensory evaluation of value-added paneers

Value-added paneer samples were subjected to sensory evaluation using 9-point hedonic scale (1=dislike and 9= like extremely). Sensory attributes were evaluated by 10 panel members of six replications colour, appearance, texture, flavour, taste, and overall acceptability.

Statistical analysis of value-added paneers

The data obtained in the experiment was analysed statistically for the test of significance using complete randomized design and randomized block design for one-way analysis of variants. The data acquired from various experiments were recorded as mean ± standard deviation (SD). To determine the level of significance critical difference (CD) was calculated between the treatment means. The data was analysed by using SPSS software package and MS Excel 2010.

Results and Discussion

Predicted optimization was performed for sensory attribute and overall acceptability by imposing desirability constraints. Table 2 shows that constraints were imposed for paneer with better sensory attributes, and desirable value of both independent and dependent variables. The maximum score that can be achieved with the desirable value of overall acceptability scores was 9. On the basis of these calculations good millet incorporated paneer could be made when the milk: pearl millet ratio is 95:3. The effect of overall acceptability scores varied from 6 to 9 (like slightly to like extremely). Fig 2 shows that with increase in cow’s milk and pearl millet there was an upsurge in sensory score of overall acceptability, and then slight diminution in further increase in

Fig. 1 Flow chart for preparation of value-added paneers

| Process Parameters | Target | Experimental Design | Optimum values |
|--------------------|--------|---------------------|----------------|
| Cow’s Milk         | In range | 90                  | 95             |
| Pearl Millet       | In range | 1                   | 3              |
| Responses          | Maximum | 6                   | 9              |
| OAA                |         |                     |                |
variations. Same result was reported by Gull et al. (2015) in their work optimization of millet supplemented pasta.

Effect of milk and pearl millet flour on sensory score of overall acceptability could be described by the following equation:

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(\text{Overall acceptability} = +9.00 + 0.1250 \text{ Cow's milk} + 0.12 \text{ Pearl millet} - 0.2500 \text{ Cow's milk} \times \text{ Pearl millet} - 0.0625 \text{ Cow's milk}^2 - 0.06 \text{ Pearl millet}^2)
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\(R^2\) was found to be 0.59 (Table 3), indicating that 59% of the variability in the response could be explained by the model. The “Predicted R-Squared” of -1.88 is in reasonable agreement with the “Adjusted R-Squared” of 0.30.

(Overall acceptability = -23.39 + 0.57 Cow’s milk + 2.53 Pearl millet - 0.025 Cow’s milk × Pearl millet - 0.002 Cow’s milk^2 - 0.015 Pearl millet^2)

Table 3 Effects of cow’s milk and pearl millet flour on overall acceptability of paneer using Responses Surface Methodology

| Source             | Sum of Squares | Mean Square | F-value |
|--------------------|----------------|-------------|---------|
| Model              | 0.5481         | 0.1096      | 2.05    |
| A-Cow’s Milk(CM)   | 0.1250         | 0.1250      | 2.33    |
| B-Pearl Millet(PM) | 0.1250         | 0.1250      | 2.33    |
| AB                 | 0.2500         | 0.2500      | 4.67    |
| A^2                | 0.0272         | 0.0272      | 0.5072  |
| B^2                | 0.0272         | 0.0272      | 0.5072  |
| Residual           | 0.3750         | 0.0536      |         |
| Lack of Fit        | 0.3750         | 0.1250      |         |
| R^2                | 0.59           |             |         |
| Adjusted R^2       | 0.30           |             |         |
| Predicted R^2      | -1.88          |             |         |

Values are the mean ± Standard Deviation (SD) value are determined with a range of p<0.05

Proximate analysis of value-added paneers

Table 4 displays that total fibre content was high in V8 (0.66±0.01) with milk and millet flour ratio (92.5:5.8). The high fibre content might be related to the addition of pearl millet flour. Similar results are also reported by Singh et al. (2019), in the nutritional evaluation of ladoo prepared with pearl millet.

Comparing with standard, carbohydrate (3.72 ± 0.02 g), and protein (16.95 ± 0.03 g) content were high in V8. Whereas, fat content was high in standard associating with other variables (18.72 ± 0.51 g). Relating the obtained figures of nutritional profile, (+1.88 g) raised in carbohydrate, and (+ 2.4 g) of protein might be due to the presence of carbohydrate and protein in millet flour. These results are in agreement with Murthy et al. (2016) and, Kumar et al. (2018), while they worked on complementary food prepared from malted wheat and foxtail millet and, pearl millet based spread. In associating with standard V8 has low fat content (-1.64g) it might be due to the incorporation of millet flour (3 g) in milk (92.5 mL).
also reported by Shivakumar et al. (2014) in millet based paneer kheer work.

**Texture analysis of value-added paneers**

Measured textural parameters of value-added paneer samples were given in Table 5. The value of hardness ranges in V₉ was about 2.30 to 13.87 N, springiness 0.66 to 0.93 mm, stickiness -0.40 to -0.13 N, cohesiveness 0.89 to 1.20, chewiness 1.97 to 10.94 N and adhesiveness 0.03 to 0.22 J.

**Hardness and chewiness**

Hardness is most commonly evaluated characteristics while determining paneer texture. Chewiness is the energy required to masticating a solid food product to make it ready to eat for swallowing. V₈ has (13.87 N) maximum hardness and chewiness (10.94 N). It could be related to the presence of millet flour, as inclusion rate >4 used to increase hardness and chewiness, also agreed by Jain et al. (2009) in the study of textural properties analysis of soy paneer.

**Springiness**

Springiness is the rate and extent to which a deformed material goes back to its original condition after the force has removed. Springiness was high in V₁ (0.93 mm) and low in V₃ (0.66 mm). This was also might be related to incorporation of millet flour. Inclusion rate > 4 used to decrease springiness, also discussed by Uprit et al. (2004) in their study textural analysis of soy fortified paneer.

**Stickiness and adhesiveness**

Stickiness and adhesiveness is distinct as the force necessary to overcome the attractive forces between surface of the product and the surface of the material. V₂ (score -0.13 N, 0.22 J) has high stickiness and adhesiveness with incorporation rate of (5.8 g PMF). Whereas, V₈ (score-40 N, 0.04 J) has low stickiness and adhesiveness comparing to standard with incorporation rate of (0.017 g PMF). Increased rate of stickiness and adhesiveness might be due to the adhesive nature of millet flour as reported by Dharmaraj et al. (2012) in their work physicochemical and textural characteristics of expended finger millet.

**Cohesiveness**

Table 4 Proximate analysis of value-added panners

| Sample Milk:Millet | Soluble | Fibre (g) | Carbohydrate (g) | Protein (g) | Fat (g) |
|--------------------|---------|-----------|------------------|-------------|--------|
| Standard           | -       | -         | 1.84 ± 0.62      | 14.55 ± 0.57 | 18.72 ± 0.51 |
| V₉ (90:1)          | 0.09 ± 0.02 | 0.02 ± 0.02 | 0.11 ± 0.01      | 1.92 ± 0.03 | 14.74 ± 0.03 | 18.23 ± 0.02 |
| V₈ (95:1)          | 0.09 ± 0.02 | 0.02 ± 0.02 | 0.11 ± 0.01      | 2.09 ± 0.13 | 14.95 ± 0.03 | 18.23 ± 0.06 |
| V₇ (90:5)          | 0.45 ± 0.03 | 0.11 ± 0.02 | 0.56 ± 0.04      | 2.61 ± 0.08 | 15.12 ± 0.09 | 18.04 ± 0.04 |
| V₈ (95:5)          | 0.45 ± 0.03 | 0.11 ± 0.06 | 0.56 ± 0.04      | 3.07 ± 0.03 | 15.85 ± 0.01 | 17.63 ± 0.01 |
| V₉ (88.9:3)        | 0.27 ± 0.01 | 0.07 ± 0.03 | 0.34 ± 0.04      | 3.05 ± 0.03 | 15.36 ± 0.02 | 17.86 ± 0.05 |
| V₈ (96.03:3)       | 0.27 ± 0.01 | 0.07 ± 0.03 | 0.34 ± 0.04      | 3.13 ± 0.01 | 15.51 ± 0.02 | 17.76 ± 0.02 |
| V₇ (92.5:0.17)     | 0.53 ± 0.01 | 0.13 ± 0.01 | 0.66 ± 0.01      | 3.72 ± 0.02 | 16.95 ± 0.03 | 17.41 ± 0.01 |
| V₈ (92.5:5.8)      | 0.27 ± 0.01 | 0.07 ± 0.03 | 0.34 ± 0.04      | 3.45 ± 0.04 | 16.14 ± 0.11 | 17.08 ± 0.02 |

1 Values are the mean ± Standard Deviation

Table 5 Textural characteristics of value added paneers

| Products Milk:Millet | Hardness (N) | Springiness (mm) | Stickiness (N) | Cohesiveness (N) | Chewiness (g) | Adhesiveness (J) |
|----------------------|-------------|-----------------|---------------|------------------|---------------|------------------|
| Standard             | 2.30±0.01   | 0.76±0.02       | -0.35±0.03    | 1.0±0.12         | 6.66±0.03     | 0.03±0.05        |
| V₉ (90:1)            | 4.91±0.87   | 0.93±0.07       | -0.24±0.00    | 1.16±0.24        | 5.32±1.6      | 0.05±0.02        |
| V₈ (95:1)            | 2.45±1.25   | 0.78±0.33       | -0.20±0.31    | 0.96±0.06        | 1.97±1.4      | 0.10±0.80        |
| V₇ (90:5)            | 4.76±0.66   | 0.66±0.29       | -0.17±0.04    | 1.20±0.04        | 3.72±1.5      | 0.11±0.18        |
| V₈ (95:5)            | 4.01±0.79   | 0.92±0.09       | -0.13±0.01    | 0.91±0.01        | 3.28±0.41     | 0.07±0.08        |
| V₉ (88.9:3)          | 7.90±3.43   | 0.80±0.16       | -0.19±0.05    | 0.89±0.01        | 5.25±1.8      | 0.07±0.06        |
| V₈ (96.03:3)         | 4.93±1.04   | 0.78±0.28       | -0.36±0.24    | 1.00±0.17        | 3.74±1.3      | 0.05±0.04        |
| V₇ (92.5:0.17)       | 5.39±0.60   | 0.74±0.10       | -0.40±0.01    | 0.94±0.00        | 3.78±0.72     | 0.04±0.12        |
| V₈ (92.5:5.8)        | 13.87±4.22  | 0.71±0.04       | -0.13±0.01    | 1.14±0.22        | 10.94±1.9     | 0.22±0.05        |
| V₆ (92.5:3)          | 7.66±0.43   | 0.71±0.18       | -0.22±0.01    | 1.04±0.17        | 5.92±2.6      | 0.07±0.31        |

1 Values are the mean ± Standard Deviation (SD) of 6 determinants with a range of p<0.05
Table 6 Mean organoleptic scores of developed value-added paneers with pearl millet1

| Variations Milk/Millet | Colour     | Appearance | Texture | Flavour | Taste | Overall Acceptability |
|------------------------|------------|------------|---------|---------|-------|-----------------------|
| Standard               | 8.80 ± 0.42<sup>ab</sup> | 8.70 ± 0.48<sup>ab</sup> | 8.70 ± 0.67<sup>bc</sup> | 8.30 ± 0.48<sup>c</sup> | 8.30 ± 0.48<sup>c</sup> | 8.40 ± 0.51<sup>b</sup> |
| V<sub>9</sub>(90:1)     | 8.10 ± 0.73<sup>ab</sup> | 8.00 ± 0.66<sup>bc</sup> | 8.10 ± 0.56<sup>bed</sup> | 7.20 ± 0.78<sup>ab</sup> | 7.20 ± 0.78<sup>ab</sup> | 8.00 ± 0.66<sup>ab</sup> |
| V<sub>9</sub>(95:1)     | 8.00 ± 1.05<sup>a</sup> | 8.00 ± 1.05<sup>a</sup> | 8.50 ± 0.52<sup>ded</sup> | 7.70 ± 0.48<sup>bc</sup> | 7.70 ± 0.48<sup>bc</sup> | 8.60 ± 0.51<sup>b</sup> |
| V<sub>9</sub>(90:5)     | 7.40 ± 0.96<sup>bc</sup> | 7.40 ± 0.96<sup>bc</sup> | 7.70 ± 0.67<sup>bc</sup> | 7.70 ± 0.67<sup>bc</sup> | 6.90 ± 0.31<sup>a</sup> | 7.80 ± 0.63<sup>a</sup> |
| V<sub>9</sub>(95:5)     | 7.40 ± 0.51<sup>a</sup> | 7.40 ± 0.51<sup>abc</sup> | 7.90 ± 0.73<sup>bcde</sup> | 7.40 ± 0.84<sup>abc</sup> | 7.30 ± 0.67<sup>b</sup> | 7.90 ± 0.73<sup>b</sup> |
| V<sub>9</sub>(88.9:3)   | 7.60 ± 0.84<sup>abc</sup> | 7.60 ± 0.84<sup>abc</sup> | 7.40 ± 0.69<sup>abc</sup> | 7.50 ± 0.52<sup>bcd</sup> | 7.50 ± 0.52<sup>bcd</sup> | 8.00 ± 0.73<sup>b</sup> |
| V<sub>9</sub>(96.03:3)  | 7.60 ± 0.84<sup>abc</sup> | 7.60 ± 0.84<sup>abc</sup> | 8.00 ± 0.94<sup>abcd</sup> | 7.80 ± 0.42<sup>abcde</sup> | 7.70 ± 0.48<sup>cde</sup> | 8.00 ± 0.66<sup>ab</sup> |
| V<sub>9</sub>(92.5:0.17) | 8.20 ± 0.63<sup>ab</sup> | 8.20 ± 0.63<sup>ab</sup> | 8.20 ± 0.78<sup>bcde</sup> | 8.40 ± 0.69<sup>d</sup> | 8.40 ± 0.69<sup>de</sup> | 8.00 ± 0.94<sup>b</sup> |
| V<sub>9</sub>(92:5:5.8) | 7.60 ± 0.84<sup>abc</sup> | 7.60 ± 0.84<sup>abc</sup> | 8.00 ± 0.81<sup>abcd</sup> | 7.20 ± 0.91<sup>abcde</sup> | 7.20 ± 0.91<sup>abcde</sup> | 7.80 ± 0.91<sup>cde</sup> |
| V<sub>9</sub>(92:5:3)   | 7.90 ± 0.87<sup>c</sup> | 7.90 ± 0.87<sup>c</sup> | 8.40 ± 0.69<sup>abcd</sup> | 8.80 ± 0.91<sup>abcd</sup> | 8.80 ± 0.91<sup>abcd</sup> | 8.50 ± 0.52<sup>bc</sup> |
| F-value                | 2.710<sup>e</sup> | 2.364<sup>e</sup> | 2.527<sup>e</sup> | 7.0738<sup>f</sup> | 7.708<sup>fg</sup> | 2.051<sup>fg</sup> |

1Values are the mean ± Standard Deviation (SD) of 6 determinants. The values are determined using Duncan’s Multiple Range Test (p<0.05).

**- Highly Significant (P ≤ 0.01), *- Significant (0.01<P≤0.05), NS – Not Significant (P> 0.05)

Which is well-defined as the extent to which a material can be deformed before its rupture depends upon the strength of internal bond. V<sub>9</sub>(1.20) has maximum cohesiveness and V<sub>9</sub>(0.89) minimum. In general cohesiveness used to increase as result of addition of high proportion of millet flour or long time storage condition. As explained by Shrivastav et al. (2010) in textural analysis of paneer with pressure and superheated steam.

Sensory evaluation of value-added paneers

As mentioned in Table 6, with regards to the attribute colour and appearance, all the 9 variables differs significantly with standard, it’s might be due to the addition of millet flour (0.17- 5.8 g of PMF). Same result also reported by Solanki et al. (2018) in their work preparation of millet kheer. Textural characteristics did not define any significant difference between V<sub>9</sub> (score 8.50) (95 mL CM and 1 g PMF), and V<sub>8</sub> (score 8.40) (92.5 mL CM and 3 g of PMF) with standard because of minimal inclusion rate of PMF (1 to 3 g), but they use to differ significantly with other variables. In flavour and taste aspects, V<sub>9</sub> did not vary significantly from standard with an inclusion rate of 0.17 PMF. But V<sub>8</sub> (8.80) differ significantly in association with control, it’s might due to the presence of (3 g) of PMF, same result was reported by Mannuramath et al. (2015) in their work little millet incorporated functional bread.

The overall acceptability score did not differ significantly with standard for the paneers prepared with 95 mL CM and 1 g PMF (V<sub>9</sub>) and 92.5 mL CM and 3 g PMF (V<sub>9</sub>) and found to be satisfactory by the panellist. This shows that millet flour incorporation improved the sensory quality of paneer sample up to 3 g level, but further increase led to reduction of sensory score. These results are comparable with singh et al. (2017) in the study preparation of mint paneer.

Conclusions

According to the result of the study it is concluded that Response Surface Methodology was effective in the formulation of value added product with 95 mL cow’s milk and 3 g pearl millet flour. Incorporation rate (>5 PMF) used to improve nutritional quality especially for fibre and protein however, overall acceptability decreased. Therefore, the value-added product with a ratio of cow’s milk and pearl millet flour 90:1(V<sub>9</sub>) and 92.5:3(V<sub>9</sub>) found to be accepted by sensory panellists. Current study has suggested that inclusion of millet flour (>4) increased hardness, chewiness and adhesiveness of the product. After improving the nutritional quality V<sub>9</sub> reported good fibre (0.34g) and protein (6.14g) content along with the overall acceptability. Therefore, with a certain outcome the attempt to formulate a value added product with fibre has been successfully attained. Further studies are recommended on shelf life and effect of packaging on the value-added product.

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