

Formulation and Quality Evaluation of *Cicer arietinum* L. Milk Paneer

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Paneer is the soft cheese variety made from coagulation of milk with the help of acid. This study aimed to make the vegan paneer used with *Cicer arietinum* milk as it is one of the good sources of all essential nutrients. *Cicer arietinum* contains protein, fat, carbohydrates, dietfiberibre, beta carotene, B- complex vitamins, and minerals. The *Cicer arietinum* milk paneer was formulated in different variations by incorporating 75%, 50%, and 25% of *Cicer arietinum* milk into cow's milk. On sensory evaluation, 75% of *Cicer arietinum* milk incorporated paneer was found to be highly acceptable and was subjected further for nutritional and phytochemical analysis. The formulated paneer was highly significant in all nutrients and was found to be low cost so it is affordable for all economic groups when compared with the control paneer made only from cow's milk.

Keywords: Bengal gram; Chick pea; *Cicer arietinum*; Lactose intolerance; Paneer; Vegan.

Cicer arietinum also called chick pea or bengal gram is one of the earliest cultivated legumes, in the middle east dating back to 7500 years.¹ *Cicer arietinum* is grown in more than 50 nations although developing countries produce more than 95 percent of the crop.² *Cicer arietinum* is differentiated by the size, shape, and color of its seeds. Desi chickpeas are wrinkled and come in a variety of colors including brown, yellow, orange, black and green. These are normally offered split or dehulled. It is a good source of carbohydrates and protein, with high amount of protein content than other pulses. Except for sulfur-containing amino acids, chickpea provides large levels of all essential amino acids, which can be supplemented by including cereals in the daily diet. *Cicer arietinum* has highly nutritionally important unsaturated fatty acids such as linoleic acid and oleic acid, despite its modest lipid content. Vitamins such as thiamine,

riboflavin, niacin, pantothenic acid and pyridoxine, folate, beta carotene which is a precursor to vitamin A are abundant in *Cicer arietinum*. Phosphorous, magnesium, iron, potassium, copper, manganese, zinc, and calcium are all found in minerals present in *Cicer arietinum*.³ *Cicer arietinum* hydrolyzed protein has been linked to a variety of biological activities like antioxidant and free radical scavenging, as well as antifungal activity, metal chelating ability, and angiotensin 1- converting enzymes (ACE) suppression, are among them. Increased nutritional bioavailability, improved protein digestibility, and improved palatability can all be achieved with proper processing. The bioavailability of polyphenolic chemicals is also improved by heat processing. *Cicer arietinum* like other pulses contains antinutritional elements that can be decreased or eliminated using various cooking methods.⁴

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Processing time, temperature, and moisture level are three major elements that determine the nutritional quality of *Cicer arietinum*.⁵ Alkaloids, phytic acids, oligosaccharides, and phenolic compounds like tannins and saponins are some of the anti-nutritional compounds found in chickpea.⁶ *Cicer arietinum* is well-known for its delectable nut-like flavor and high protein content. *Cicer arietinum* is high in dietary fiber and is one of the healthiest food available. They offer carbohydrates to those who are insulin resistant or have diabetes. *Cicer arietinum* is low in fat and high in soluble and insoluble fibre, both of which aid to lower total and LDL cholesterol. Chickpea is a good source of folate and protein. Folate is a water-soluble B vitamin that is found naturally in foods and helps people to avoid colorectal cancer.⁷

Paneer, a soft, unaged, acid set, not melting curd cheese made by curdling heated milk with lemon juice, vinegar or any other food acid is one of the most common cheeses used in Indian cuisine, and it has a simple, fresh, versatile flavour which makes it highly used in an assortment of recipes⁸. Different types of paneer made from soy, egg yolk, egg albumin, moringa are available. In this line, this study is framed with the objective to formulate bengal gram dhal milk paneer and to determine its physical properties, acceptability, nutritional and phytochemical composition.

MATERIALS AND METHODS

Procurement of raw materials

All the ingredients for the development of the bengal gram dhal milk paneer like bengal

gram dhal, cow's milk and lemon were procured from the local market in Salem and stored at room temperature until they were used in analysis and further processing.

Processing of raw materials

Bengal gram dhal was purchased and checked any infestation or damage. Good quality bengal gram dhal were taken and soaked in water at room temperature overnight until, they were soft enough to bite.

Formulation of bengal gram dhal milk paneer

The different proportion of selected and cleaned raw bengal gram dhal was soaked in water overnight. Due to the absorption of water, the weight of dhal increased thrice. The soaked dhal was ground to form a paste from which milk was extracted for formulating different variations of paneer. The extracted Bengal gram dhal and the mentioned quantity of cow's milk as shown in table-1 were brought to boil for 10ml, added 5 ml of lemon juice as coagulum. Give a good stir for 1 min. Milk began to curdle immediately and milk solids separated from the whey. The whey water was drained. The done paneer was rinsed well a few times under running water until it was clear of lemon juice. Rest the paneer to curdle in a muslin cloth for 15 min by tying tightly. The paneer was allowed to freeze for 1 hour after cooling. After freezing the paneer settled and cut into desired size and shape. The proportion of ingredients mentioned in table-1 yielded 65 gms of paneer.

The prepared paneer was stored in an airtight container at refrigeration temperature and the shelf life of the paneer was up to 10 days. While, the shelf life of paneer was reported to be only six

Table 1. Ingredients for the formulation of different variations of bengal gram dhal milk paneer

| Ingredients | Control | Variation I | Variation II | Variation III |
|-----------------------|---------|-------------|--------------|---------------|
| Bengal gram dhal milk | - | 75 ml | 50 ml | 25 ml |
| Cow's milk | 100 ml | 25 ml | 50 ml | 75 ml |
| Lemon | 5 ml | 5 ml | 5 ml | 5 ml |

Table 2. Physical characteristics of bengal gram dhal milk paneer

| S.no | Physical Characteristics | Variation I | Variation II | Variation III |
|------|--------------------------|-------------|--------------|---------------|
| 1. | Height | 2 cm | 2 cm | 1.5 cm |
| 2. | Weight | 25 g | 18 g | 15 g |
| 3. | Diameter | 3.5 cm | 3 cm | 2.5 cm |

days at refrigeration temperature 10°C without much deterioration in quality, but the freshness of the product was lost after 3 days; while at room temperature paneer did not keep well for more than 1 day in a study by Dhamala, Chandra Kanta (2018).⁹

Physical properties of different variations of developed paneer

Height and Thickness

The paneer was cut into five cubes and was placed one over another on a plate and the total height was measured using the thread and measuring scale then the reading was divided by 5 to get the thickness of one cube of paneer.

Weight

The paneer was shifted to plate and it was placed in the weighting balance to determine the weight of the product respectively.

Diameter

The diameter of the paneer was measured with the measuring scale.

Acceptability of the product by organoleptic evaluation

All the developed variations of bengal gram dhal milk paneer were subjected to organoleptic evaluation to assess the maximum acceptability of the products. The quality attributes in term of colour, appearance, flavour, texture, taste and overall acceptability were evaluated by untrained judges using score card with 9-point a hedonic rating scale.

Nutritional and Phytochemical analysis of the accepted variation of developed paneer

The nutrients and phytochemicals in the accepted variation of bengal gram dhal milk paneer was assessed by NSI diet calculator and standard laboratory procedures.^{10, 11, 12}

Table 3. Mean organoleptic values of the developed paneer

| Parameters | Colour | Appearance | Taste | Texture | Flavour |
|---------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Control | 8.7±0.48 ^c | 8.7±0.48 ^c | 8.8±0.42 ^b | 8.4±0.52 ^b | 8.6±0.52 ^c |
| Variation I | 8.3±0.48 ^c | 8.3±0.48 ^c | 8.4±0.52 ^b | 8.3±0.67 ^b | 8.5±0.71 ^c |
| Variation II | 6.7±0.67 ^a | 6.7±0.67 ^a | 6.9±0.74 ^a | 6.9±0.57 ^a | 6.9±0.32 ^a |
| Variation III | 7.4±0.52 ^b | 7.4±0.52 ^b | 7.2±0.63 ^a | 7.0±0.94 ^a | 7.4±0.52 ^b |
| Sig | 0.000 * | 0.000 * | 0.000 * | 0.000 * | 0.000 * |

*= significance at 5% level

Values are expressed as mean ± standard deviation of triplicate values. Samples with different superscripts within a column are significantly differently from one another at (pd⁰0.05).

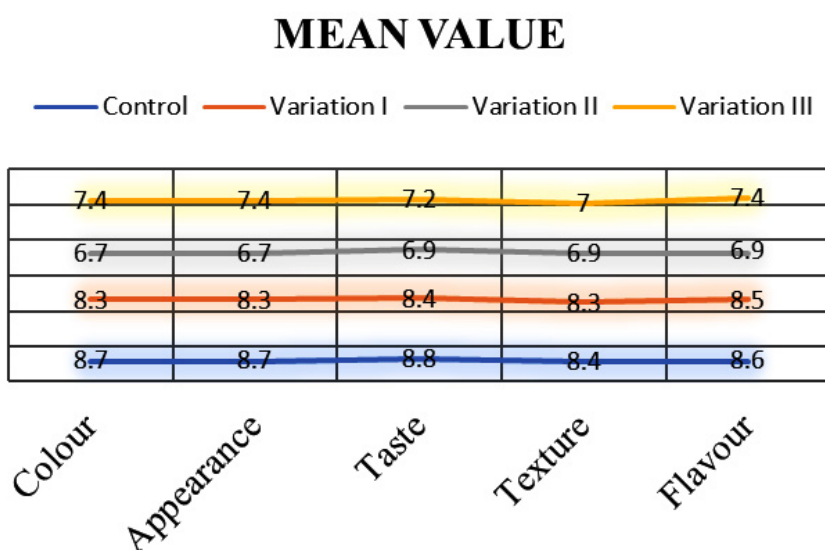


Fig. 1. Mean organoleptic values of the developed paneer

Statistical analysis

The data obtained from the various experiments were subjected to descriptive statistical analysis using IBM SPSS software.¹³

RESULTS AND DISCUSSION

Physical properties of bengal gram dhal milk paneer

The physical characteristics of developed paneer were evaluated. The parameters such as height, weight and diameter were studied and the results are presented in table 2.

The physical parameters of the bengal gram dhal milk paneer includes height, weight and diameter of the product. Final value means measuring the physical character of the product after it was done. It is observed from table-2 that

the composition of cow's milk has impact on the physical parameters of developed variations of paneer.

Organoleptic evaluation of the different variations of developed bengal gram dhal milk paneer

The ingredients such as bengal gram dhal, cow's milk and lemon have been added, to make paneer, with variable effects on its quality. The developed paneer was organoleptically evaluated using 9-point hedonic rating scale. Totally 30 untrained respondents were used for sensory analysis.

Results of Duncan multiple range tests showed that there was significant difference ($p < 0.05$) between the control and all the variations of paneer on the basis of colour, appearance, taste, texture, flavour and overall acceptability. Results

Table 4. Mean overall acceptability of control and developed variations of paneer

| Variations | Mean \pm SD (Overall acceptability) | Sum of Squares | Mean of Squares | F Value | P Value |
|---------------|--|----------------|-----------------|---------|---------|
| Control | 8.8 \pm 0.42 | 21.300 between | 7.100 between | 24.113 | 0.000m |
| Variation I | 8.5 \pm 0.53 | Groups 10.600 | Groups 0.294 | | |
| Variation II | 7.0 \pm 0.47 | within Groups | Within Groups | | |
| Variation III | 7.5 \pm 0.71 | | | | |

*= significance at 5% level

Table 5. Comparison of nutrients of 100 gms of control and bengal gram dhal milk paneer

| S. no | Nutrients | Quantity (Control) | Quantity (Bengal gram dhal milk paneer) |
|-------|-----------------------|--------------------|---|
| 1. | Energy (Kcal) | 257.89 | 321.56 |
| 2. | Carbohydrates(g) | 12.41 | 6.5 |
| 3. | Protein (g) | 18.86 | 12.1 |
| 4. | Fat(g) | 14.78 | 7.2 |
| 5. | Dietary Fibre(g) | - | 0.5 |
| 6. | Iron(mg) | 0.9 | 2.57 |
| 7. | Calcium(mg) | 476 | 95 |
| 8. | Folic acid(mcg) | 93.31 | 15 |
| 9. | Vitamin A ((mcg)) | 4.39 | 78 |
| 10. | Thiamine (mg) | 0.02 | 0.37 |
| 11. | Riboflavin (mg) | 0.1 | 0.4 |
| 12. | Niacin (mg) | 0.13 | 1.83 |
| 13. | Pantothenic acid (mg) | 0.49 | 0.18 |
| 14. | Pyridoxine (mg) | 0.04 | 0.07 |
| 15. | Zinc | 2.74 | 3.65 |

Table 6. Qualitative analysis of phytochemicals

| S.no | Test analysis | Sample |
|------|--------------------------|--------|
| 1. | Total Phenolic Compounds | + |
| 2. | Total Flavonoids | + |

(+ Present; - Absent)

of sensory evaluation of the paneer prepared with 75%, 50% and 25% of Bengal gram milk incorporation in cow's milk along with control is presented in the table-3. In the sensory evaluation, variation I got the maximum score in comparison with control, variation II and variation III. Variation I score was observed to be the highest for all the sensory characteristics with an overall acceptability of 8.5 ± 0.53 , representing that variation 1 was highly accepted by the panel members.

The above table concludes that the mean and standard deviation of all the variations are significantly different between the groups. Also, the p-value is 0.000 which is lower than 0.05, thus it can be concluded that there was a significant difference in overall acceptability of all the variations of developed paneer. A study on paneer formulation by incorporating soy- groundnut milk and carrot juice have shown that the texture and other organoleptic parameters declined with increase in these value addition components.^{14,15}

Nutritional analysis of the accepted variation of paneer

Table -5 represents the nutritional profile of 100 gms of Bengal gram dhal milk paneer and control paneer.

From the above table, it is clearly evident that the energy and dietary fibre were high in Bengal gram dhal milk paneer than control, while protein content was slightly low, carbohydrates and fat were more in control paneer. Micronutrient's profile shows that iron, vitamin A, thiamine, riboflavin, niacin, pyridoxine and zinc were found to be more in Bengal gram dhal milk paneer when compared to control paneer. Similarly, a study on carrot juice incorporated paneer has shown an increased concentration of micronutrients like calcium, iron and beta-carotene.¹⁵

Phytochemical analysis of bengal gram dhal milk paneer

The above table shows that the accepted variation of bengal gram dhal milk paneer is a source

of total phenolic compounds and total flavonoids. Phytonutrients like flavonoids have beneficial anti-inflammatory effects and they protect body cells from oxidative damage that can lead to diseases like cardiovascular disease, diabetes, cancer, and cognitive diseases like Alzheimer's and dementia.

CONCLUSION

Bengal gram dhal (*Cicer arietinum L.*) milk paneer is low cost compared to commercial milk paneer and it is affordable even to people of low economic group. Lactose intolerance subjects can tolerate cow's milk to an extent of 240 ml. Since, the developed and accepted variation of paneer consists only of 25ml cow's milk, this paneer can be recommended for lactose intolerance subjects too. Dhal milk paneer also prove to be a reliable source of protein, dietary fibre and micronutrients. However, further clinical trials are required to study the complete potential of bengal gram dhal milk and its products as a substitute for cow's milk.

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Conflict of Interest

The authors declare no conflict of interest.

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