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Enhancing the Nutritional quality of Dahi by incorporating sprouted Green Gram Flour

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ABSTRACT: Dahi is a traditional Indian yogurt made by fermenting milk with live cultures. It is known for its creamy texture, tangy flavor and probiotic properties, making it a popular ingredient in Indian cuisine and a staple in many households. The study focused on evaluating the physicochemical properties of dahi, added with sprouted green gram, including moisture, ash, protein, fat, dietary fiber, titratable acidity, total solids, vitamin C, and water holding capacity. Microbial analysis was also conducted to ensure safety. The results demonstrated that dahi samples supplemented with sprouted green gram flour exhibited lower moisture content but higher levels of ash, protein, dietary fiber and vitamin C compared to the control sample. Additionally, the water holding capacity was enhanced in the dahi with sprouted green gram flour (SGF added dahi 94.5 ± 0.07% and control dahi 89.17 ± 0.03). The microbial analysis confirmed that both the control and sprouted green gram flour dahi samples were safe for consumption. These findings suggest that incorporating sprouted green gram flour into dahi can improve its nutritional value and water holding capacity. This research could potentially provide a healthier alternative for consumers seeking a nutrient-rich yogurt option, thereby promoting better dietary choices.

Keywords: Dahi, Green gram, Dietary fibre, Vitamin C, Water holding capacity.

INTRODUCTION

Fermented dairy products have been an integral part of Indian culture for numerous years, with dahi, a well-known and nourishing fermented milk product, holding a prominent position among traditional offerings. Around 9% of the milk produced in India is utilized to produce fermented milk products (Singh, 2007). Nutritionally Dahi, is a food that is abundant in high-quality protein, essential vitamins, and minerals. It serves as a rich source of calcium and riboflavin. Dahi production involves a number of changes during fermentation that have a good impact on milk's protein, lactose, vitamin, and mineral content (Meena *et al*., 2023). While it contains all the nutrients found in milk, dahi offers them in a more easily digestible form. It has been reported that the calcium and phosphorus present in dahi are more readily assimilated by the body compared to milk (Ramanathan and Sivakumar 2013). Dahi, being a popular choice, is considered an ideal dietary option for individuals with sensitive digestive systems, particularly young children and the elderly.

Mung beans or green grams (*Vigna radiata* or *Phaseolus aureus*) are widely consumed by a large portion of the Indian population due to their abundance of high-quality protein, minerals and vitamins. Combining them with cereals creates an ideal combination of essential amino acids with excellent nutritional value. As per the 2017-2018 report on the pulse's revolution for food and nutritional security, published by the Crops Division of the Government of India, green gram is the country's fourth most cultivated pulse crop. Due to its exceptional nutritional value, it is often referred to as the "green pearl" (Nair *et al*., 2013). It is abundant in high-quality proteins that are easily digested, and it serves as an exceptional source of carbohydrates, essential fatty acids, vitamins, minerals, and fiber (Mubarak, 2005) and consumed in various ways, including as vegetables, sprouts, dhal, processed grain, fried beans, bean paste and incorporated into dishes such as noodles, bread, cakes, cold jellies, and desserts (Asif *et al*., 2013; Nair *et al*., 2013). Green gram has a dietary fiber content ranging from 14.57% to 24.5% (Lin and Lai 2006; Veena *et al*., 1995). The specific amount of dietary fiber may differ among different varieties of green gram, as observed through the analysis of two varieties. The study revealed that the VC variety of green gram contains a higher amount of dietary fiber compared to the GTN5 variety (Lin and Lai 2006). Consuming dietary fiber has been advised as

a treatment for gastrointestinal conditions such as gastroesophageal reflux disease (GERD), duodenal ulcers, inflammatory bowel disease, irritable bowel syndrome, diverticular disease, constipation, and hemorrhoids (Anderson *et al.,* 2009). The recorded ascorbic acid in green gram is 3.98 mg per 100 g (Oburuoga and Anyika 2012). Ascorbic acid is renowned for its strong antioxidant properties and plays a role in various biochemical processes (Zempleni *et al.,* 2013). This study aims to investigate the physico-chemical and microbial analysis of dahi (Indian yogurt) incorporated with sprouted green gram flour.

MATERIALS AND METHODS

Pasteurized homogenized toned milk and green gram was purchased from local market Wayanad

A. Preparation of sprouted green gram powder (SGF)

The green gram seeds were cleaned and washed with distilled water. They were then soaked in a water-to-seeds ratio of 1:2 for 7 hours at 32°C. After the desired soaking period, the water was drained, and the soaked seeds were washed again with distilled water to prevent the growth of microorganisms during sprouting. The moistened seeds were wrapped in a damp muslin cloth and placed at a controlled temperature of 35°C for 24 hours to stimulate sprouting. Subsequently, they were dried at the same temperature. The rootlets of the sprouted grains were manually removed by scrubbing. The sprouted grains were finely ground using an electric grinder and then sieved to obtain a fine powder. The milled sample was packed in an airtight plastic container and stored at room temperature for future use.

B. Preparation of dahi added with sprouted green gram flour

Control dahi was prepared according to the method prescribed by Aneja *et al*. (2002). For the preparation of SGF supplemented curd, minor modifications were made in the procedure. Pasteurized toned milk was obtained from the market and SGF at the level of 0.5%, 1%, 1.5% and 2% was added to the milk, ensuring thorough mixing. The mixture was boiled and held at a temperature of 90°C for 10 minutes. Afterward, the milk was allowed to cool down to approximately 37°C, and 1% dahi culture was added. The mixture was then incubated at 37°C for 7-8 hours and subsequently stored at a low temperature. The optimum level of SGF was selected based on sensory analysis and 1.5% was selected as optimum in terms of flavour, colour, body and texture and overall acceptability.

C. Determination of physicochemical properties

The physicochemical properties of the developed products, including their microbiological characteristics, were determined through various analyses. The moisture content was measured according to the method detailed in SP: IS: 18, Part XI, 1981. The titratable acidity was determined by the method given in Part I of IS: 1479 (ISI 1960). The ash content, dietary fiber content, protein content, crude fat content and vitamin C content were determined following the procedures outlined in AOAC (2003); AOAC (2012), Gerber method as described by Pearson (1976) and AOAC (1984), respectively. These analyses provide valuable information about the physicochemical properties of the products under investigation.

D. Water holding capacity

Water-holding capacity (WHC) of dahi samples was analysed by the method described by Rahila *et al.* (2016). Twenty grams of dahi were taken in 50 ml centrifuge tubes and centrifuged at 2000 rpm for 10 min. The weight of clear whey separated was measured and expressed as a gram of whey per 20 g of sample.

Calculation.

$$WHC\ (\%) = (ND-WE)/ND \times 100$$

ND- Native Dahi

WE- Whey Expelled

E. Microbiological analysis

The procedure recommended by the Indian Standards Institution (IS: SP-18, 1981) was utilized to assess the total microbial load, coliform count, and yeast and mold count in the curd samples.

F. Statistical analysis

Mean values and standard deviations of triplicate determinations were reported and statistical significance was set at $P < 0.05$. Analysis of variance was carried out to determine the difference between the control and the sample.

RESULTS AND DISCUSSION

A. Physico-chemical analysis

Table 1 presents the results of the physicochemical analysis. The moisture percentage in the control dahi was significantly higher ($P<0.001$) compared to the dahi incorporated with SGF. As indicated in the table, the moisture content of the SGF dahi sample was 74.13%, while the control dahi had 86.86% moisture. The lower moisture content in the dahi with SGF is attributed to the presence of solid particles, including high fiber and protein.

The ash content of the SGF incorporated dahi showed a significant increase ($P<0.05$) compared to the regular dahi. This rise can be attributed to the higher mineral content present in sprouted green gram. According to a study by Sumi and Devindra (2021), the ash content of green gram ranged from 2.91% to 4.26%. Key minerals found in green gram include sodium (24 ± 2.93mg/100g), potassium (1725 ± 52.20mg/100g), calcium (112.60 ± 9.31mg/100g), phosphorus (415 ± 15.0mg/100g), magnesium (150.20 ± 8.66 mg/100g) and iron (5.08 ± 0.12mg/100g) as reported by Zodape *et al.* (2010).

The protein content of the dahi containing sprouted green gram exhibited a significant increase ($P<0.05$), rising from 4.86 ± 0.02 to 3.91 ± 0.002 compared to the control sample. Green gram has a higher protein content, which becomes further enhanced during the sprouting process, thereby resulting in an elevated protein content in the dahi containing sprouted green gram. The average protein content of green gram ranges from 22.5% to 27.94% (Mekkaranikarthil and Bukkan 2021).

Fat content of the SGF added dahi did not exhibit any significant difference ($P<0.05$) compared to the control

dahi. This lack of difference can be attributed to the fact that the lower fat content present in green gram does not contribute to the fat content of the dahi samples., The reported fat content in green gram ranges from 0.12% to 2.31%, with the lowest and highest values recorded, respectively (Mekkaranikarthil and Bukkan 2021).

The dahi sample that added SGF had a dietary fiber content of 11.10 ± 0.28, whereas the control sample had no dietary fiber content. This significant difference can be attributed to the addition of sprouted green gram, which is well-known for its high fiber content. The fiber content of green gram can vary considerably, ranging from 2.9% to 17.04%, as reported in various studies (Mekkaranikarthil and Bukkan 2021).

Acidity of dahi enriched with SGF powder does not show any significant difference (P< 0.05) with control dahi. As the low level of SGF does not possess any acidity to dahi.

The vitamin C content slightly increased in the SGF added dahi sample compared to the control dahi from 0.7 ± 0.04mg/100g to 1.5 ± 0.05mg/100g (P < 0.05). According to Oburuoga and Anyika (2012) the ascorbic acid content of green gram was found to 3.98mg/100g

A significant difference (P< 0.05) in water holding capacity (WHC%) was observed between the control and SGF added dahi samples, with the SGF added dahi sample demonstrating higher water holding capacity (SGF added dahi 94.5 ± 0.07% and control dahi 89.17 ± 0.03). These results may be attributed to the water retention by swollen polydextrose and the increased bond between the network of milk gel, making it stronger. It is suggested that polydextrose could serve as a potential cryoprotectant, as its cryoprotective effects may be linked to the numerous hydroxyl groups available for hydrogen bonding with proteins, leading to increased protein hydration, reduced surface tension of water, and decreased aggregation (denaturation) (Park *et al.,* 1993).

B. Microbial analysis

The result of microbial analysis is given in table 2. The total plate count of dahi sample is higher as compared to control sample. There is no coliform and yeast and mold present in control dahi and dahi sample which means that both the dahi sample and control are microbiologically safe and no contamination is found.

The Total Plate Count (TPC) in the sample group (225 × 10^{-5}) was slightly higher than the control group (195 × 10^{-5}), possibly due to the addition of sprouted green gram flour, creating a favorable environment for microbial growth. However, the TPC values were within acceptable limits for dahi consumption according to regulatory standards (International Dairy Federation, 2018). Both the control and sample groups showed no presence of coliform bacteria, indicating good hygiene during production and processing. Similarly, there was no yeast and mold contamination in both groups, which is crucial for maintaining the safety and quality of dairy products. It is important to note that microbial counts can vary based on production practices and storage conditions. Implementing quality assurance protocols and ongoing monitoring are vital to ensure the safety of dahi products fortified with sprouted green gram flour during storage, transportation, and distribution.

Table 1: Physicochemical parameters of dahi samples.

Physicochemical parameters	Dahi incorporated with SGF (1.5%)	Control dahi
Moisture (%)	74.13 ± 0.008^a	86.86 ± 0.44^b
Ash (%)	0.97 ± 0.003^a	0.71 ± 0.003^a
Protein (%)	4.86 ±0.020^a	3.91 ± 0.002^b
Fat (%)	3.49 ± 0.01^a	3.46 ± 0.03^a
Dietary Fibre (%/w)	11.10 ± 0.28^a	0.00^b
Titrable acidity (% lactic acid)	0.786 ± 0.003^a	0.75 ± 0.003^a
Vitamin C (mg/kg)	1.5 ± 0.056^a	0.7 ± 0.04^b
Water holding capacity (%)	94.5 ± 0.07^a	89.17 ± 0.03^b

Superscripts having the same alphabets does not differ significantly along same rows.

Table 2: Microbiological quality of dahi samples.

Microbiological parameters	TPC	Coliform count	Yeast and mold count
Control dahi	195 × 10^{-5}	Nil	Nil
SGF incorporated dahi	225× 10^{-5}	Nil	Nil

CONCLUSIONS

The physicochemical analysis of the dahi samples revealed several significant differences between the control dahi and the dahi incorporated with sprouted green gram flour (SGF). The dahi with SGF had a lower moisture content, which can be attributed to the presence of solid particles, including high fiber and protein. The ash content of the SGF dahi increased significantly, indicating a higher mineral content present in sprouted green gram. The protein content of the dahi with SGF also showed a significant increase, reflecting the higher protein content of green gram, which is further enhanced during the sprouting process. The fat content did not differ significantly between the two types of dahi, likely because the lower fat content of green gram does not contribute significantly to the fat content of the dahi samples. The dahi with SGF exhibited a significant dietary fiber content, while the control dahi had no dietary fiber content. This can be attributed to the high fiber content of green gram. The acidity of the dahi samples did not differ significantly, as the low level of SGF did not contribute acidity. The vitamin C content slightly increased in the dahi with

SGF, potentially due to the addition of green gram, which contains ascorbic acid. Finally, the SGF-added dahi demonstrated a higher water holding capacity, which may be attributed to the water retention by swollen polydextrose and increased bond between the milk gel network. Overall, these findings highlight the positive effects of incorporating sprouted green gram flour into dahi, enhancing its nutritional profile and water holding capacity.

FUTURE SCOPE

The study demonstrates that incorporating sprouted green gram flour into dahi can significantly enhance its nutritional value, with higher levels of ash, protein, dietary fiber, and vitamin C compared to the control sample. This suggests that sprouted green gram flour is a promising strategy for improving the nutritional quality of dahi. Additionally, the dahi samples with sprouted green gram flour exhibited improved water holding capacity, leading to enhanced texture, consistency, and stability. The addition of sprouted green gram flour, rich in protein, dietary fiber and vitamins can provide additional health benefits, including addressing protein deficiencies and promoting digestive health. These findings offer valuable insights for the development of dairy products with enhanced nutritional profiles, positioning dahi with sprouted green gram flour as a healthier and more appealing option for consumers seeking nutritious and functional food choices. Further research should optimize the incorporation level of sprouted green gram flour and consider scalability and commercial viability. Safety and quality assurance protocols, including shelf-life studies, are crucial for ensuring the safety and quality of fortified dahi products. Promoting consumer awareness and education about the nutritional benefits of dahi with sprouted green gram flour is vital, requiring effective communication strategies to encourage consumer acceptance.

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Conflict of Interest. None.

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