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Techno-Functional Assay and Quality Assessment of Yogurt Supplemented with Basil Seed Gum Powder

Mavra Javed[1*]
https://orcid.org/0000-0001-6999-3475

Summer Rashid[2]
https://orcid.org/0000-0002-8609-214X

Waqas Ahmed[1]
https://orcid.org/0000-0002-2082-4301

Hamza Javed[3]
https://orcid.org/0000-0003-3024-6645

Hafiz Muhammad Shahbaz[1]
https://orcid.org/0000-0002-5092-6800

[1]University of Veterinary & Animal Sciences, Department of Food Science & Human Nutrition, Lahore, Pakistan; [2]Minhaj University, Department of Food & Nutrition, Lahore, Pakistan; [3]Shalamar Medical & Dental College, Lahore, Pakistan.

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Correspondence: javedmavra@gmail.com - Tel: +92-302-3284442 (M.J.).

HIGHLIGHTS

- The term ‘yoghurt’ relates to the Turkish word ‘Jughurt’ and to yogurmark ‘to knead’ and yogum ‘dense’ or ‘thick.’
- The method of manufacture for different yogurt products is nevertheless quite like yoghurt production. The difference is in the use of specific cultures, incorporation of additives, curd treatment, and method of packaging.
- Consumers may seek for low-fat dairy products, which may suffer from a lack of sensory quality
- The incorporation of basil seed gum into yogurt is one of the conceivable ways to promote health benefits.

Abstract: The study was conducted to investigate physiochemical, techno-functional, and sensory attributes of yogurt supplemented with basil seed gum. Two levels of gum as 0.5% and 1% was used to develop a product. The product was stored for 21 days at 4°C and assessed on each 3rd day for texture properties such as cohesiveness, adhesiveness and stringiness, pH, and sensory evaluation. Proximate analysis showed moisture content 10.76%, protein content 16.93%, fat content 6.93% fiber content 27.25%, ash content 4.95% and carbon content 33.18%. Basil seed gum showed water holding capacity 30.94mL/g, oil holding capacity 2.8mL/g, and solubility of 30g mass of gum in 1 liter of water with no occurrence of swelling of gum in 15mL water. pH level significantly decreased during the trial. In texture properties, cohesiveness, adhesiveness, and stringiness amount were significantly decreased throughout the trial. Overall acceptability of yogurt was improved after supplementing with basil seed gum.

Keywords: basil seeds; techno-functional analysis; water extraction; basil seed gum; physiochemical analysis; supplemented yogurt.

INTRODUCTION

Among all those functional ingredients accessible to the purchaser, dairy commodities are leading priority for buyer necessity because of their depth in nutrients and giving a pool of calcium that can alleviate osteoporosis and colon cancer. Most testimonies demonstrate probiotic functional food facilitates in colon cancer risk and utilized in the management of liver diseases. It also enhances the lifespan of microbiota to fight with pathogens. Different probiotics and yogurts have been developed come up with properties like anticarcinogenic, anti-hypertensive, antimicrobial and antimutagenic, and antidiabetic. These dairy products are famous among consumer and capturing the attention of food industries [1]

Dairy products are food matrix owing to their intricacy and health benefit. One of the most nutrient-dense foods is yogurt which is a rich source of calcium and a high-quality protein with minerals such as potassium, iodine, magnesium, and phosphorus with vitamins as B5, B12 B2, and vitamin A, vitamin D. More than 10 million content of bacteria/g milk is sufficient to ferment milk along with the production of volatile fatty acids, B vitamins, peptides, conjugated linoleic acid, and aminobutyric acid. Due to its complexity, it helps to manage diabetes, obesity, cardiovascular diseases along with alteration of microbiome. According to dietary guidelines people have been told to focus on food instead of nutrient to avoid lifestyle diseases. According to Danish scientist, Arne Astrup daily consumption of full fat or reduced-fat yogurt and fermented products should be part of a balanced diet to diminish the possibility of persistent ailments by selecting one food-based single nutrient [2]

Basil (Ocimum basilicum L.) belongs to the Lamiaceae family with the genus Ocimum consisting of 50 to 150 species. It is reported that Basil is considered to have low caloric and low-fat value with a rich source of minerals calcium and potassium and vitamin A and C, fiber, and little amount of protein [3]. Traditions of basils are different ranging from religious to culinary and from culinary to pharmacological. It is also used in different historical and ritual beliefs. Different studies also reported different pharmacological activities such as antimicrobial, anti-cancer, anti-oxidant, antiviral, antiallergic, anti-inflammatory, anti-diabetic, anti-malarial, insecticidal, anti-ulcer, anti-stress, immunomodulatory, antarthritic, cardiovascular, anxiolytic and sedative, antiosteoporosis, cytotoxic, anti-colic, phytoremediator effect, antihypertensive, antithrombotic and antiplatelet activity [4]

Farhamand reported that gum has a shear thinning property with a great yield of stress-bearing quality. Basil seed gum solution at different level (0.1% -1.2%, wt/wt) can act as an emulsifying agent, foaming agent, suspending agent, fat replacer, and gelling agent [5]

An unhealthy lifestyle and growing urbanization have an advantage to numerous unhealthy food choices. Fatty food transformed normal body metabolism into an abnormal and unsettling pathway that raises fat ratio in the body. The instant research project is an attempt to develop a product to enhance product nutrition value with quality. Notwithstanding all the attributes of basil seed gum none of research has been accomplished in academic establishments of Pakistan using dairy products. Basil seeds gum was utilized because of its accessibility and availability to every range of economical person and its unique nutritional characteristics that gives benefits to every group of communities. Basil seed gum-based yogurt was utilized in this instantaneous research due to its consumption in Pakistan as a staple food. Some households are consuming it as a condiment while others eat it with a proper meal. Because of its short shelf-life, people purchase yogurt in small packages. So instant research focus was to improve product shelf life, texture, the sourness of yogurt to make it favorable for people. Further research should be suggested to evaluate its effect on other food products and to enhance quality parameters**.**

MATERIAL AND METHODS

Materials

Whole Milk and basil seeds were purchased from the local market. Starter culture *was* bought from the head of the Department of food sciences and human nutrition, University of Veterinary and Animal Sciences, Lahore. It was purchased from cultures for health (Lactina starter culture yogurt *L. Bulgaricus, S. Thermophilus* YBG-SC-0001).

Proximate analysis

Basil seeds were analyzed for proximate analysis. Proximate includes total ash content, crude fiber, total protein, moisture content, nitrogen-free content. Methods mentioned in AACC (2000) were followed

Extraction of basil seed gum

Basil seeds were carefully scrubbed from stones and dirt. Basil seeds were washed and kept in a beaker. Beaker was filled with water according to the seed ratio. 50:1 (w/w) water seed ratio was maintained throughout the procedure. Beaker was kept in the water bath. The temperature of the water bath was set to 68.71°C. Beaker was kept in a water bath for 20 minutes and stirred continuously [6] Gum was extracted from the sample by applying mechanical force followed by [7]. Mucilage was separated from seeds by using a rubber spatula to seeds on a mesh screen. Separated gum from seeds was shifted to a 50 mL Eppendorf tube. The sample was centrifuged (Benchtop centrifuge MIKRO series Model MIKRO 220 classic) for 20 min at 6000rpm. This polysaccharide was dried in a drying oven at 45°C until the water was completely evaporated from the sample. It was ground to make it powder form completely. It was stored in packets for 24hour at 4°C.

Techno-functional tests of basil seed gum

There was some test performed on basil seed gum to check its capacity.

Water holding capacity

The water holding capacity of basil seed gum was achieved by following the method as described by [8] Purposely 1g of sample was stirred with 15mL of distilled water. A 50mL centrifuged tube was used for this procedure. At room temperature, the gum was soaked overnight. It was centrifuged at 15,000×g for 20minutes. The free water was discarded and absorbed water was weighted. Water holding capacity was expressed in a gram of water per gram of dry matter.

Oil holding capacity.

Oil holding capacity was measured by using the method mentioned [9] 1g of sample stirred with 10mL of corn oil and then centrifuged at 7125×g for 20min. This was expressed as the number of grams of oil held by 1.0 gram of sample.

Solubility

Solubility of basil seed gum was measured as 1g of sample was dissolved in 10mL of water until complete dissolution. It was measured as the number of grams of sample dissolved in one liter of distilled water [10]

Swelling capacity

The swelling capacity of basil seed gum was measured by following the method as mentioned [11]. 1g of sample was weighed and kept in a 100 mL measuring cylinder having 15mL of water and left to swell overnight at room temperature. Swelling capacity was measured as a millimeter of swollen sample per gram of initial dry matter.

Preparation of yogurt

Yogurt was produced by following the modification of the method mentioned by [12]. Milk was bought from a local market near the University of Veterinary and Animal Sciences, Lahore. Milk was boiled for 10 minutes and cooled at room temperature. Two levels of basil seed gum-based yogurt were made. 14g of basil seed gum powder was added to the milk and stirred properly. Milk was heated to a temperature of 85°C for 10 minutes. 5g of starter culture (L. Bulgaricus, S. Thermophilus YBG-SC-0001) was completely dissolved into the milk. Once the starter culture was completely dissolved into the milk, this milk was slowly poured into the rest of the milk and mix it properly. Milk was poured into disposable bowls in equal amounts and covered bowls with plastic lids. It was incubated in an incubator placed in a food analysis laboratory at the Quality Operational Laboratory of the University of Veterinary and Animal Sciences, Lahore. The temperature of the incubator was set to 41 °C for 12hours. Each basil seed gum-based yogurt was labeled according to the days on which the sample was taken for further testing. 0.5% basil seed gum-based yogurt was also made by the same method mentioned earlier. The only difference was the amount of basil seed gum powder. In making

of 0.5%, basil seed gum-based yogurt 7g powder of basil seed gum was mixed properly. Further steps were the same as mentioned before.

Shelf life

The product was stored in a refrigerator at 4°C for 21 days. Assessment of sample was done after every third day of storage.

Product tests

pH

The pH was determined by a pH meter at 20°C. First, it was confirmed that the pH meter (mV/ISE Meter - HI5222) was calibrated properly with a buffer solution at pH 4, pH 7, and pH 10. The test was repeated three times for accurate results. During the test, the pH electrode was washed with distilled water to avoid contamination done by carryover test. pH electrode was dipped carefully into the sample. The reading of pH was noted until the screen showed a stable reading of pH.

Texture

Basil seed gum-based yogurt was analyzed for texture analysis. For this test texture analyzer (model: FRTS-100N-I IMADCO, LTD. MADE IN JAPAN) was used for Cohesiveness, adhesiveness, and hardness. The equipment contained a cylindrical probe at a speed of 70mm/min in a straight direction. The sample was leveled on a tray and the probe was inserted 20mm into the surface. Hardness was the force penetration in the first attempt of insertion and estimated in g. cohesiveness was the breaking of hydrogen bonding and the degree of deformed before the damage. Adhesiveness is the work of forces required to avoid the attractive forces between sample and probe.

Sensory evaluation

To check the liability of the product. According to (Kaur & Riar, 2020) Sensory evaluation was performed by using a 7-point hedonic ranking scale. Different random panelists were selected for this evaluation. All panelists knew sensory attributes and awareness to evaluate the product. The sample was evaluated on the 1st day, 3rd day, 6th day, 9th day, 12th day, 16th day, 19th day, and 21st day. The sensory panel included 9 participants (6 females and 3 males, between the age of 30 to 50). They all had previous knowledge of sensory evaluation criteria. The sample was put in small bowls which were coded in 3-digits and served in front of the panel. The panel were guided to consume water and eat crackers between sample testings. Parameters of the sensory evaluation were color, gloss, the intensity of yogurt aroma, the intensity of yogurt sour smell, fatty flavor, graininess, taste, and sour taste. The odor was tested by using a sense of smell after removing the lid of the bowl except for other parameters. Scores higher than 4 were considered positive. Grades less than 4 were considered negative. Grade 4 was considered a neutral response.

Statistical analysis

Data were confirmed in Statistical Package for the Social Science spss version No.22. One-way ANOVA at the level of $P < 0.05$ significance value was applied to obtain accurate results. Mean ± standard deviation was also used in the analysis of data. Significance of a difference between the means of measured experimental values was analyzed by descriptive statistics ($P < 0.05$)

RESULTS

Proximate Analysis

Proximate analysis of basil seed is accomplished to evaluate the proximate assay. According to results fiber content of basil seeds are 27.25% with moisture 10.76%, protein 16.93%, fat approximately 7%, ash 4.95% and total carbohydrate content 33.18% details are mentioned in Table 1

Table 1. proximate assay of basil seeds

Proximate Assay	%
Moisture	10.76±1.07
Protein	16.93±1.67
Fat	6.93±1.10
Fiber	27.25±2.64
Ash	4.95±1.92
CHO	33.18±1.54

Techno-functional analysis

Techno functional analysis includes water holding capacity, oil holding capacity, solubility test, and swelling capacity. Table 3.2 shows that the water holding capacity of 1gram of basil seed gum powder was 30.94 g of water. 1g of basil seed gum powder held 2.8±0.1 g oil. Solubility saturation of basil seed gum powder at 58.8°C of temperature is 30g in 1 liter of water. Basil seed gum powder swelling was not held in water**.**

Table 2. Analysis of functional properties of basil seed gum powder

Functional property	Unit	Results
Water Holding Capacity (WHC)	g water/g DM	30.94±0.95 of water held by 1 gram of gum sample
Oil Holding Capacity (OHC)	g oil/g DM	2.8±0.1 of oil held by 1g of sample
Solubility Test (ST) Temp 58.5°C	liter/g DM	30±1.5 of basil seed gum mass dissolved in 1liter of distilled water
Swelling Capacity (SC)	mL/g DM	there is no occurrence of swelling of gum in 15mL of distilled water

Product shelf life

Product basil seed gum-based yogurt was stored for 21 days. In those 21 days pH, texture, protein content, and sensory evaluation were done to check the product acceptability, its quality, and consumer remarks about the product. The result showed that basil seed gum-based yogurt was accepted from 0 days to the 18th day. After the 18th-day yogurt was inconsumable due to fungus growth.

pH

It has been noted there is a significant variation in the pH of both product samples. There is also a significant interaction between treatments and the storage period of yogurt. Variation in the pH of yogurt can be noticed within different storage days. The mean difference of yogurt pH is decreased in 1% basil seed gum as compared to the 0.5% treated group. The lowest pH value is a note at the 3rd day of storage for 1% yogurt and the highest pH range is for 0.5% yogurt. For 0.5% yogurt, the pattern for pH is slightly decreasing over days as compared to 1% yogurt.

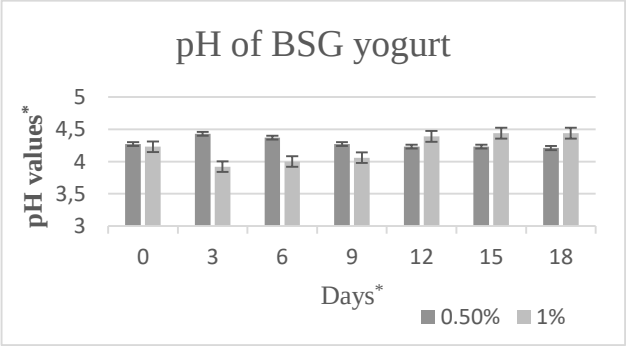

Figure 1. pH values of yogurt containing basil seed gum powder during different storage days. Yogurt treated with basil seed gum has significantly (p≤0.05) affect during storage (days) and pH.

Texture

From Table 3, it has been noted that there is no significant effect of cohesiveness, adhesiveness, and hardness of yogurt treated with 0.5% treatment group. Yogurt treated with 1% basil seed gum powder has a significant effect on texture parameters. Over the period of storage effect of treatment on the hardness of yogurt has not significant mean value change. Cohesiveness over the period of storage highest mean vale is noticed at 12 for 1% treatment. The adhesiveness of the 1% treatment group is decreased over a period of storage as compared to the 0.5% treatment group.

Table 3. Mean values of textural change of different sample treatment groups parameters during the storage period. -

	Day	Treatment 0.5%	Treatment 1%
F-value		**.400^{ns}**	**4.007***
Cohesiveness (second bite area/first bite area)	0	0.65^{a}	0.64^{a}
	3	0.48^{b}	0.54^{ab}
	6	0.45^{ab}	0.68^{a}
	9	0.55^{a}	0.57^{b}
	12	0.61^{a}	0.69^{a}
	15	0.66^{a}	0.65^{a}
	18	0.62^{ab}	0.45^{ab}
Adhesiveness (mJ)	0	1.67^{a}	1.44^{a}
	3	1.66^{a}	1.43^{a}
	6	1.65^{a}	1.54^{a}
	9	1.81^{a}	1.11^{a}
	12	1.45^{a}	1.09^{a}
	15	1.33^{a}	1.05^{a}
	18	1.10^{a}	1.11^{a}
Hardness(g)	0	0.13^{a}	0.12^{a}
	3	0.14^{ab}	0.11^{a}
	6	0.13^{a}	0.11^{a}
	9	0.10^{a}	0.10^{ab}
	12	0.57^{a}	0.15^{a}
	15	0.10^{a}	0.10^{a}
	18	0.07^{b}	0.01^{b}

[1]means values of different treatment groups have been presented. *Significant at P<0.05. means in a column represented by different letters have a significant difference between storage time at P<0.05.

Sensory evaluation

The results of the sensory evaluation have been mentioned in table No 4. Fortifying yogurt with basil seed gum did not change the sensory attributes in adverse manner. Overall acceptability of product was good according to panelist. According to panelist all the sensory attributes parameters are the same after treating the yogurt with basil seed gum powder. Fortification of yogurt did not change the parameters which included color, gloss, yogurt aroma, sour odor, fatty flavor, taste, sour taste, after taste. Panelist gave almost same score for these parameters. Graininess texture of yogurt was improved with fortification of yogurt with basil seed gum powder. With increase percentage of gum powder texture of yogurt was smoother according to panelist score.

Table 4. sensory evaluation of yogurt prepared with basil seed gum powder. Sensory para meters are represented in mean± S.D. All the means of treatment attributes are significant from other treatment P<0.05

Sensory Attributes	Yogurt groups	0 day	3rd day	6th day	9th day	12th day	15th day	18th day	F
Color	0.5%	6.2±0.4^{a}	5.8±0.4	6.2±0.4	6.0±0.7	6.0±0.0	6.2±0.4	6.0±0.4	**0.67^{ns}**
	1%	6.0±0.0	5.6±0.8	6.2±0.4	5.6±0.8	6.4±0.5	6.0±0.0	5.9±0.6	
Gloss	0.5%	5.6±0.5	5.4±0.5	5.6±0.5	6.2±0.8	6.0±0.7	6.4±0.5	5.7±0.6	**0.19^{ns}**
	1%	6.0±0.7	5.8±0.8	5.9±0.4	6.2±0.8	6.2±0.4	6.4±0.5	5.9±0.6	

Cont. Table 4

Yogurt aroma	0.5%	5.8±0.4	5.2±0.8	6.0±0.7	5.2±0.8	5.8±0.4	6.0±0.0	5.6±0.6	**0.21^{ns}**
	1%	5.8±0.4	5.2±0.8	5.6±0.8	5.2±0.8	5.8±0.8	6.0±0.0	5.6±0.7	
Sour odor	0.5%	5.6±0.8	5.0±1.0	5.2±0.8	5.6±1.2	5.2±1.3	5.6±1.1	5.3±0.9	**0.63^{ns}**
	1%	5.0±0.7	4.8±0.8	5.2±0.8	5.8±0.8	6.0±0.0	5.8±0.4	5.4±0.7	
Fatty flavor	0.5%	5.8±0.4	4.4±0.8	4.8±0.8	6.0±0.4	5.4±0.5	5.8±0.4	5.4±0.8	**1.60^{ns}**
	1%	6.0±0.0	4.2±1.3	6.2±1.0	6.0±0.7	5.8±0.8	6.0±0.0	5.7±1.0	
Graininess	0.5%	6.0±0.0	5.4±0.8	4.8±0.83	5.8±0.4	6.0±0.4	5.6±0.8	5.5±0.73	**4.25***
	1%	6.0±0.0	4.4±0.5	6.2±1.0	5.8±0.4	6.0±0.0	6.2±0.4	5.7±0.8	
Taste	0.5%	5.0±0.5	5.0±1.0	6.2±0.8	5.0±1.0	5.8±1.0	5.8±0.4	5.5±0.8	**0.12^{ns}**
	1%	6.0±0.0	5.0±1.0	6.4±0.8	5.4±1.5	6.2±0.4	6.0±0.0	5.8±0.9	
Sour taste	0.5%	6.2±0.4	5.0±1.0	4.6±0.5	5.8±1.3	5.6±0.5	5.8±1.3	5.5±0.9	**0.62^{ns}**
	1%	6.0±0.7	4.8±1.3	5.4±0.8	5.8±0.4	5.6±0.5	6.2±0.4	5.6±0.8	
After taste	0.5%	6.2±0.4	5.8±0.4	5.8±1.3	6.0±0.0	6.2±0.2	6.2±0.8	6.2±0.7	**1.12^{ns}**
	1%	6.4±0.5	6.0±1.0	6.2±0.8	6.2±0.8	6.4±0.4	5.4±0.8	6.0±0.7	

DISCUSSION

Yogurts have been attributed to a therapeutic, dense diet and adequacy for nutrients. Yogurt consumption prevalence is increasing according to recent studies. It is estimated that 64% of women and 41% of men consumed yogurt once per week. Yogurt consumers have a high intake of fiber, calcium, potassium, magnesium, potassium, vitamin A and vitamin B_{12} as compared to non-consumers. According to American dietary guidelines these nutrients are considered to be shortfall nutrients because these nutrients current low consumption is leading to low impact on health [13]

The current study percentage of carbohydrates and protein is low as compare to[14]. Proximate mineral and polyphenol analysis of basil seed was performed by the researcher. The proximate analysis procedure was followed by AOAC 2000. The water holding capacity of basil seed gum was performed to measure the amount of water absorbed by basil seed gum. results are related to Hussain It represented the hydrophilic fraction and showed a range of water holding capacity of

10 g sample is 28.49±1.82 to 32.82±0.9 [15]. The oil holding ability of mucilage depends upon the number of non-polar molecules that can bind oil droplets. Gum extraction at high temperatures affects the capacity of molecules to bind oil droplets. Soaking time is also a major factor for changing the oil holding capacity of mucilage When seeds are soaked for a long time with high temperature it affects mucilage oil holding capacity [16]

Solubility of gum value is close enough to previous research[17]. Basil seed gum edible films are hydrophobic in nature and has low solubility content without the addition of glycerol. Basil seed gum water solubility different from other seeds gum due to the existence of high fraction molecules and the presence of fatty acids molecules that also affects the solubility of gum. Existing study swelling index was not opposite to previous researches because of the different nature of gum and the different procedure to estimate swelling index [18].

The shelf life of yogurt was retentive as compared to simple homemade yogurt due to the inoculation of basil seed gum that alleviates the production of nutrient components. It was noted that the behavior of starches was changed during the storage of yogurt[19]. Present results showed a pH range of 0.5% and 1%

of yogurt. 0.5% basil seed gum-based yogurt pH range was high as compared to 1.0%. The pH range of basil seed gum-based yogurt was decreased due to the addition of basil seed gum. Basil seed gum act as a stabilizer for yogurt. The most suitable pH range for yogurt is considered 3.7 to 4.7 according to food technologist [20]

Textural parameters of basil seed gum base yogurt have similarities with Quince seed mucilage. It can increase bulkiness and full fat and the appearance of full-fat yogurt. As it was also used in yogurt as a fat replacer in the amount of 0.03%, 0.5%, 0.1%. Tests were performed for texture, syneresis, and acidity of quince seed gum-based yogurt. In texture properties, the range of thickness and firmness was 0.56 to 0.44 N as compared to another sample[21]. In another study, commercially fat replacers were used to investigate the properties of yogurt. Seven yogurt samples were prepared by using different concentrations of whey protein concentrate, microparticulate whey protein, and modified tapioca starch. Yogurt was stored for 5days at 4°C. The result showed thickness and cohesiveness of these samples range from 0.77 to 0.86 N which is higher due to protein structure[22].

Data has demonstrated difference in textural properties due to variations in milk type, starter culture, and environment. sensory evaluation of food products linked to quality of food with consumer acceptance and preferences. Results showed the highest scores for all parameters of the sample and great acceptability by consumers. Study findings are related to previous findings mentioned above [23] So, basil seed gum had a positive impact on sensory attributes of yogurt with reduction of fat. Overall acceptance of basil seed gum-based yogurt was improved in the current study due to basil seed gum powder.

CONCLUSION

This study aims to investigate the effect of basil seed gum supplementation on yogurt. Comprehensive results of proximate, techno-functional testing of basil seed gum showed a better understanding of mucilage. This study also demonstrated that the addition of basil seed gum has improved the texture and quality of yogurt. The sensory properties of yogurt were enhanced with the addition of basil seed gum powder. It was concluded that the addition of 1% basil seed gum in yogurt helped in achieving optimal results. This study may help producers to develop yogurt with improved quality properties, texture, nutrition value, and sensory attributes. Basil seed gum could be a new hydrocolloid acting as a richness for yogurt.

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