

Characterization and Acceptability of Vegan Yoghurt Developed by Extraction of Milk from Soybean, Barley and Coconut

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Received: 21 Dec 2020 | Revised accepted: 10 Feb 2021 | Published online: 18 Feb 2021
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ABSTRACT

Plant-based or non-dairy milk alternatives are the fastest growing segment in new product development category of functional beverages. Thus, changing the alternatives in milk-based yoghurt can be a really crucial step to incorporate functional nutrition in our diet. It can be high in protein, calcium, vitamins, and live culture, or probiotics, which enhance the gut micro flora. However, the soy-milk and coconut milk-based yoghurt with incorporating barley water enhances the probiotic properties and has several nutritional advantages over it. This yoghurt could a good source of probiotics as well as protein and fibre for the lactose intolerant population. The milk was extracted from soya beans, barley and coconut and the yoghurt was prepared using two live cultures lactobacillus bulgaricus and streptococcus thermophilus. This vegan yoghurt was produced using different concentrations of milk. The developed yoghurt was further tested on the basis of its organoleptic properties in seven different samples. All the sample were made to be evaluated by the people and sample 1(S1) which was prepared from equal concentrations of all the three milks was most acceptable and liked by all. From the whole population about 97.35% consumers accepted sample 1(S1). This developed yoghurt was found to be healthy source of probiotics as well as dietary fibre due to the incorporation of the barley milk. It can be used as therapeutic diet for ones who cannot eat due to some chronic illness.

Key words: Lactose intolerant, Therapeutic, Probiotics, Live cultures, Vegan

Milk is one of the most commonly consumed food items by human population since ages due to its nutritional value [1]. But nowadays milk consumption has raised several questions as the dairy milk may procure several allergies. Milk consumption has become a major problem for the ones suffering from lactose intolerance which is the inability of the person to fully digest sugar (lactose) which is present in dairy product [2]. So, to overcome this problem plant-based or non-dairy milk alternatives are the fastest growing segment in new product development category of functional beverages [3]. Most alternatives to this milk do not have a balanced diet compared to milk but they have some essential nutraceuticals with health enhancing properties to attract healthy consumers [4]. Thus, changing the alternatives in milk-based yoghurt can be a really crucial step to incorporate functional nutrition in our diet. People nowadays, are inclining towards plant milks and avoid the dairy products due to some major health concerns, like cholesterol and antibiotic residues in cow's milk which hinder the health of the consumer [4]. The need of the hour is the incorporation of vegan diet as it is cruelty free and lacks excessive cholesterol [6]. Yoghurt is a fermented dairy product and serves as a good probiotic which helps in proper digestion and absorption of nutrients [7]. Soya beans

are considered to be the second richest source of protein after the animal proteins [8]. Soy milk provides rich creamy texture, and a healthy nutritional profile, including essential omega-3 fatty acids and flavonoids that provide antioxidant, anti-inflammatory, and cardio protective properties [9]. As barley is the most fibre rich food grain and is known to have moderate amount of tocopherols, tocopherols and tocotrienols it assists in lowering the serum LDL cholesterol whereas soya beans are contemplated to be the richest source of protein after the animal protein [10]. The formulation of blended yoghurt would help surplus the diet and will also be good for digestion [11]. This study was conducted to successfully formulate vegan yoghurt of great nutritional value [12]. The major idea behind conducting this research is to develop an ideal source of probiotic yoghurt rich in dietary fibers and protein for the population which have difficulty in digesting lactose.

MATERIALS AND METHODS

Collection of raw materials

The present study was conducted at Babasaheb Bhimrao Ambedkar University, Lucknow, India. The raw materials like fresh tender coconut was purchased from the fruit market whereas soya beans and the barley mash were purchased from the main grain market of Lucknow. The lactobacillus bulgaricus and streptococcus thermophilus was isolated into a sterile container.

Different concentrations used in yoghurt manufacturing

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Preparation of soy milk, coconut milk and barley milk

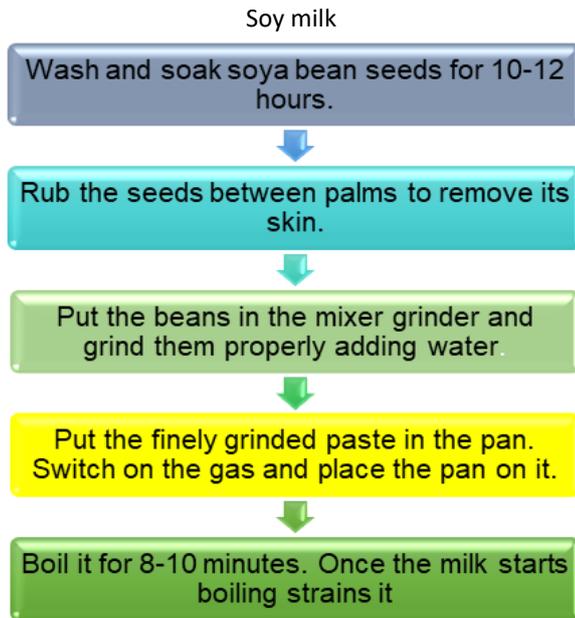


Fig 1 Steps for soy milk preparation

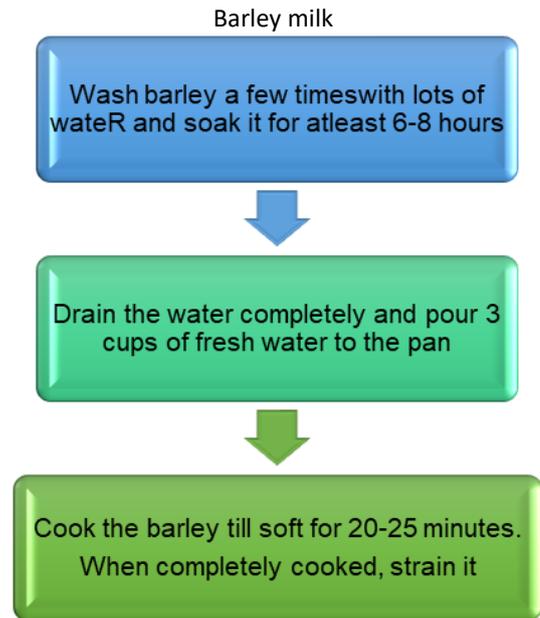


Fig 2 Steps for barley milk preparation

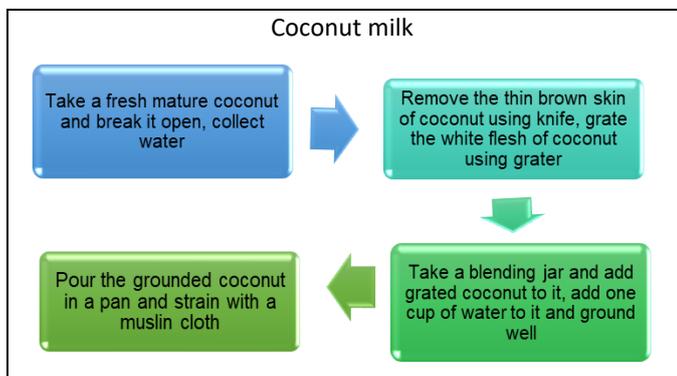


Fig 3 Steps for coconut milk preparation

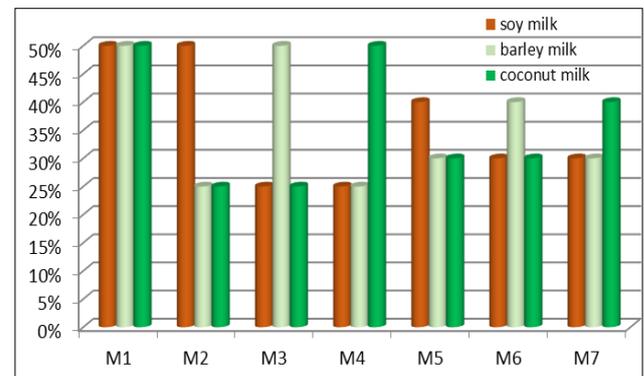


Fig 4 Graphical representation of different concentrations of milk in samples

Ten blended milk samples with different concentrations were taken for the study which comprises (a) soy milk, coconut milk and barley milk in same quantity (M₁): (b) soy milk (50%), barley milk (25%) and coconut milk (25%) (M₂): (c) soy milk (25%), barley milk (50%) and coconut milk (25%) (M₃): (d) soy milk (25%), barley milk (25%) and coconut milk (50%) (M₄): (e) soy milk (40%), barley milk (30%) and coconut milk (30%) (M₅): (f) soy milk (30%), barley milk (40%) and coconut milk (30%) (M₆): (g) soy milk (30%), barley milk (30%) and coconut milk (40%) (M₇): as described in (Table 1, Fig 4), with 2% sugar with some elaichi flavour. The milk prepared from soya bean seeds, coconut and barley mash was then boiled together at high flame, and after the blended milk is cooled for about 1-2 hours until it reaches room temperature. After the milk cools down the freeze *Lactobacillus bulgaricus* and *Streptococcus thermophilus* was added to the lukewarm milk.

Table 1 Different concentrations of samples

Yoghurt samples	Soy milk	Barley milk	Coconut milk
M ₁	50%	50%	50%
M ₂	50%	25%	25%
M ₃	25%	50%	25%
M ₄	25%	25%	50%
M ₅	40%	30%	30%
M ₆	30%	40%	30%
M ₇	30%	30%	40%

Sensory evaluation

I used the hedonic scale for the organoleptic evaluation of prepared blended yoghurt, as it's the most descriptive form of acceptance tests which includes a 9 point hedonic scale. It elaborates consumer's degree of acceptance and satisfaction. This study was conducted on about 50 people who were representative of our society and which comprised mostly the youth. The final product was presented in small earthen pots but was served in small disposable bowls. The consumers had to rate the yoghurt according to its taste, texture, aroma, and colour. They were given the hedonic rating card (Table 2) which shows 10 as "like extremely" and 1 as "dislike extremely".

Table 2 Hedonic score

Hedonic table and rating	Score
Like extremely	9
Like very much	8
Like moderately	7
Like slightly	6
Neither like nor dislike	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

Overall study design

The study design was prepared to evaluate the acceptability of prepared yoghurt, amongst the youth in respect to its quality. The acceptability of the developed yoghurt was evaluated on the basis of its taste, texture, colour and appearance. They were calculated in the table by obtaining standard deviation. It provides an overall concentrated result of the acceptance of blended yoghurt amongst the youth.

Standard deviation

$$S = \sqrt{\sum \frac{(x-\mu)^2}{n}}$$

Where

x= value in the data set,
 μ= mean of the data set and
 n=total population.

RESULTS AND DISCUSSION

The samples were distributed amongst the youth and were sensory evaluated on the basis of taste, aroma and appearance. The results are as follows:

Taste and flavour

The samples were evaluated and it was found that sample 1 (S₁) was more liked by the person amongst all the other seven samples, which means that the sample of developed yoghurt which had equal amount of all the three milks tasted the best (Table 3, Fig 5). According to the people, it was creamier and slightly sweeter in taste than the other samples which was because all the three milks were present in same amount so the fibre like taste couldn't overpower the whole flavour and the elaichi flavour was quite enhanced [13].

Table 3 Individual evaluation of taste and flavour among seven prepared samples

Members	Samples						
	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇
M ₁	9	9	8	8	9	9	9
M ₂	9	8	8	9	9	8	8
M ₃	8	9	7	8	8	9	9
M ₄	8	9	8	8	9	8	8
M ₅	8	9	8	8	8	9	9
M ₆	9	8	8	7	9	8	8
M ₇	8	9	9	8	8	9	9
M ₈	9	7	7	9	9	7	7
M ₉	8	7	8	7	7	7	8
M ₁₀	8	7	8	8	8	7	7
M ₁₁	7	8	8	7	7	8	8
M ₁₂	8	8	8	8	8	8	8
M ₁₃	7	7	7	7	7	8	7
M ₁₄	8	8	8	8	8	8	8
M ₁₅	8	7	7	7	9	7	7
M ₁₆	8	7	7	7	8	7	7
M ₁₇	9	8	8	7	9	8	8
M ₁₈	9	7	7	7	8	7	7
M ₁₉	9	8	8	9	9	8	8
M ₂₀	9	7	7	8	7	7	7
M ₂₁	9	7	6	9	9	7	8
M ₂₂	8	7	7	8	8	7	9
M ₂₃	9	8	8	9	9	8	8
M ₂₄	9	8	8	8	8	6	9
M ₂₅	9	9	9	8	8	9	9
Total	208	195	193	197	206	194	200

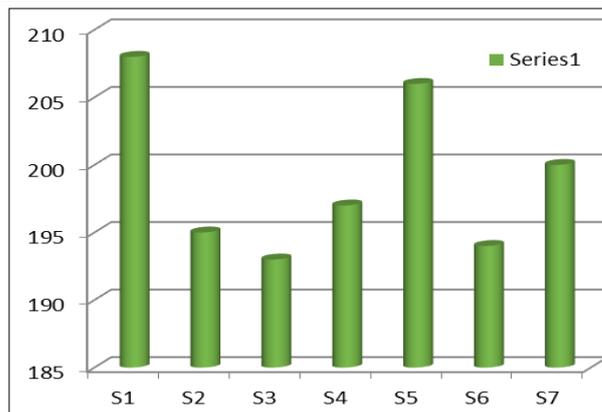


Fig 5 Graphical representation of taste and flavour of developed vegan yoghurt

Colour

Amongst all the yoghurt samples S₅ was more accepted in terms of colour than the other samples. According to the people it appeared creamy white uniformly spread all over the product (Table 4, Fig 6).

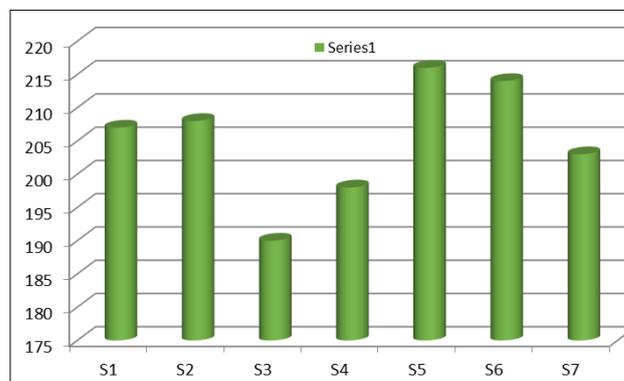


Fig 6 Graphical representation of colour of developed yoghurt

Table 4 Individual evaluation of colour of developed yoghurt

Members	Samples						
	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇
M ₁	7	9	8	8	9	8	9
M ₂	8	8	7	8	9	8	8
M ₃	8	8	8	7	8	8	8
M ₄	9	9	6	8	9	9	9
M ₅	8	8	8	8	8	8	8
M ₆	9	9	9	8	9	9	9
M ₇	8	8	8	9	8	8	8
M ₈	9	9	7	7	9	9	9
M ₉	8	8	8	7	8	7	8
M ₁₀	7	8	8	9	8	8	8
M ₁₁	9	9	9	9	9	9	7
M ₁₂	8	8	8	8	8	8	8
M ₁₃	7	7	7	7	7	7	7
M ₁₄	8	8	6	9	8	8	8
M ₁₅	9	9	8	8	9	9	9
M ₁₆	8	8	8	9	8	8	8
M ₁₇	9	9	9	9	9	9	8
M ₁₈	9	8	9	8	9	8	8
M ₁₉	7	8	7	8	9	7	9
M ₂₀	8	7	7	7	9	7	7
M ₂₁	9	8	6	7	9	8	9
M ₂₂	8	8	8	8	8	8	8
M ₂₃	9	9	6	8	9	7	7

M ₂₄	9	9	6	7	9	7	7
M ₂₅	9	9	9	7	9	7	9
Total	207	208	190	198	216	214	203

Appearance

S₁ was more accepted than other samples by the people as it appeared to have the flat and smooth surface with non-sticky consistency (Table 5, Fig 7).

Table 5 Table showing total evaluation of appearance of developed yoghurt

Members	Samples						
	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇
M ₁	9	8	9	9	8	7	8
M ₂	9	8	9	6	8	6	7
M ₃	8	8	8	8	7	6	7
M ₄	9	8	7	9	7	6	6
M ₅	8	8	8	8	8	7	7
M ₆	9	9	9	9	8	8	8
M ₇	8	8	8	8	8	7	7
M ₈	9	9	9	9	7	7	7
M ₉	8	8	6	8	8	6	6
M ₁₀	8	8	6	8	8	6	6
M ₁₁	9	7	7	6	8	6	6
M ₁₂	8	8	8	8	8	7	7
M ₁₃	7	7	7	8	7	6	6
M ₁₄	8	8	7	7	8	7	6
M ₁₅	9	8	8	7	7	7	7
M ₁₆	8	8	8	8	7	8	8
M ₁₇	9	9	9	9	9	7	7
M ₁₈	9	8	8	9	9	7	8
M ₁₉	9	8	8	8	8	7	7
M ₂₀	9	9	9	7	8	8	8
M ₂₁	9	9	9	8	7	6	6
M ₂₂	8	8	8	8	8	6	8
M ₂₃	9	7	7	9	7	6	8
M ₂₄	9	8	7	8	8	7	8
M ₂₅	9	7	6	8	8	6	7
Total	214	193	195	200	185	167	176

Table 6 Individual table showing overall acceptance

Members	Samples						
	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇
M ₁	9	7	7	8	9	8	9
M ₂	8	9	7	9	9	8	9
M ₃	8	8	8	8	8	8	8
M ₄	9	9	8	7	9	9	9
M ₅	8	8	8	8	9	8	8
M ₆	9	9	7	9	9	9	9
M ₇	8	8	8	8	8	8	8
M ₈	9	9	7	8	9	9	7
M ₉	8	8	8	7	9	8	8
M ₁₀	7	8	8	8	8	8	8
M ₁₁	8	9	9	9	9	9	9
M ₁₂	8	8	8	8	8	8	8
M ₁₃	7	7	7	7	7	7	7
M ₁₄	8	8	8	8	8	8	8
M ₁₅	9	9	7	9	9	9	9
M ₁₆	8	8	8	8	8	8	8
M ₁₇	8	9	7	9	9	9	9
M ₁₈	9	9	9	7	9	9	8
M ₁₉	9	7	6	8	9	8	7
M ₂₀	8	7	6	7	9	8	6
M ₂₁	9	8	8	7	9	7	6
M ₂₂	9	8	8	8	8	8	8
M ₂₃	9	9	9	9	9	9	9
M ₂₄	8	9	8	8	9	9	9
M ₂₅	9	9	8	9	9	9	9
Total	220	207	192	201	198	208	203

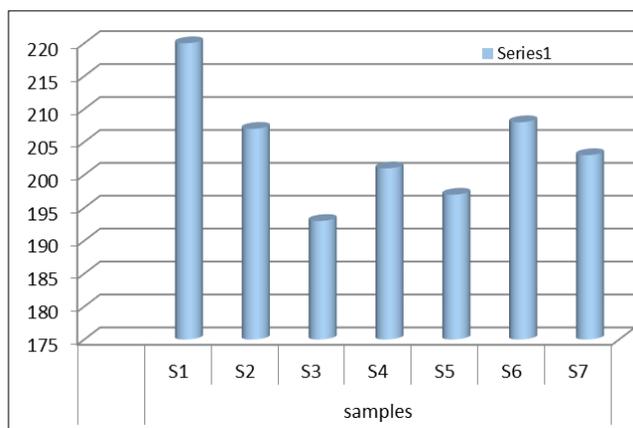


Fig 7 Graphical representation of appearance

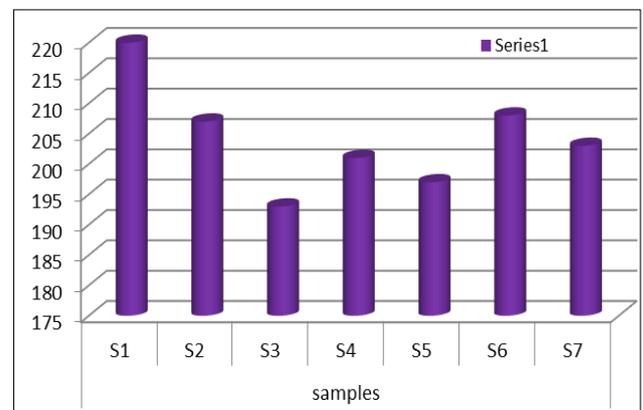


Fig 8 Graphical representation of overall acceptance

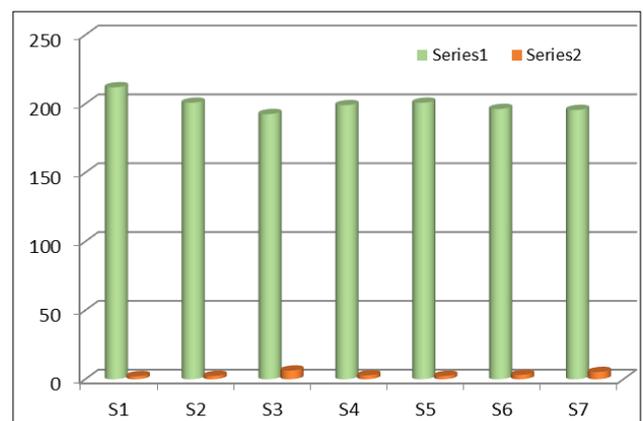


Fig 9 Graphical representation of series 1 (total average) and series 2 (standard deviation)

Overall acceptance

On the basis of all the above sensory characteristics of developed yoghurt, S₁ was the sample which was accepted the most amongst all as it contains equal amount of all three-plant milk (Table 6, Fig 8).

Overall calculation

The parameters on the basis of which the overall acceptance of the blended yoghurt was examined are taste or flavour, colour, appearance and overall acceptance. The calculated total average (series 1) and standard deviation (series 2) is shown in (Fig 9, Table 7). According to the graphs

and the statistical measurement the sample with least standard deviation was the most acceptable sample among all youth which contained soy milk, barley milk and coconut milk in same amount [14]. The samples don't have many variations in their colour, taste and appearance [15].

Table 7 calculation of all the parameters used for examining the acceptability

Parameters	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇
1	208	195	193	197	206	194	200
2	207	208	190	198	214	216	203
3	214	193	195	200	185	167	176
4	220	207	192	201	198	208	203
Total	849	803	770	796	803	785	782
Average	212.25	200.75	192.5	199	200.75	196.25	195.5
Standard deviation	6.23	5.192	2.378	4.15	5.193	2.826	2.631

CONCLUSIONS

The consumer acceptability of developed yoghurt prepared from the milk extracted from soya beans, barley and coconut was examined using a hedonic 9-point scale by the common people especially the youth. The samples were made to get tasted by total 25 people and they were asked to score the sample according to the taste/flavour, colour and its appearance. Total 7 samples were prepared using different concentrations of milk, there was not much variation among the samples but the sample 1 (S₁) was found to be more acceptable than the other 6 samples. S₁ had same concentrations of all the 3 plant-based milks and appeared to

have creamier sweeter taste, off white colour appearance and creamy smooth non sticky appearance. The samples were packed in small earthen pots which intensified its taste and the use of plastic cups was also avoided.

Acknowledgement

I would like to extend my gratitude and special thanks to Dr. Sunita Mishra, Dean Department of Home Science, Food Science and Nutrition and my supervisor Dr. Neetu Singh, Assistant Professor, Department of Home Science, Food Science and Nutrition for her guidance and valuable suggestions during the research work, without her support this could have not been possible.

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