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Effect of Indian gooseberry juice on physico-chemical and sensory quality characteristics of soybean based yoghurt

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Abstract
Present work have been undertaken to formulate and evaluate the qualities of soybean based yoghurt fortified with Indian gooseberry juice. The soybean yoghurt is prepared from soymilk and microbial culture. Five treatments were used with sample code T_0, T_1, T_2, T_3 and T_4 i.e. 0, 2, 4, 6 and 8 percent fortification of Indian gooseberry juice. The prepared soybean yoghurt was evaluated for its sensory acceptability using 9 point hedonic scale. It was found that treatment T_2 containing 4 percent Indian gooseberry juice got the highest score as compared to other treatments. Hence this proportion was used for further study. Proximate composition of yoghurt revealed that increasing trends was found in carbohydrate, moisture and fiber where as decreased in ash, fat and protein content of yoghurt. The acidity and ascorbic acid content were increased and pH was decreased and mineral content were increased with different proportion of Indian gooseberry juice. It was concluded that from the research soybean yoghurt sample T_2 containing 96 percent soymilk and 4 percent Indian gooseberry juice was most desirable in terms of sensory and nutritional quality profile.

Keywords: Indian gooseberry juice, mineral content, soybean, sensory evaluation, yoghurt

Introduction
Soybean is derived from seeds *Glycine max* (L) of family-L*egumiodae* or *Fabaceae*. Taxonomically, the soybean belongs to the order, *Fabales*, the family, *Fabaceae*, the subfamily, *Faboidae* and the genus *Glycine*. The seeds are nearly spherical in shape with an average seed weight of 120-180 mg. The origin and history of soybean is not accurately known. In China it has been used for 5,000 years as a food and a component of drugs. The five largest soybean producing countries are USA, Brazil, Argentina, China and India (GFP, 2016). The total world production of soybean in 2015 estimated about 319.7 million tones. Global soybean production current year forecasted 314 million tones. Soybean is known as the **"**Golden bean**"** or the super legume of the twentieth century.
Kadam *et al.* (2012) [7] stated that legumes have been known as **"**a poor man**'**s meat**"**. They supply protein, complex carbohydrates, fiber and essential vitamins and minerals to the diet, which are low in fat and sodium and contain no cholesterol. Soy is nature**'**s richest source of proteins. The protein content of most beans averages 20-25 percent, but soybean contains about 40 percent protein. The proteins present in soy meet the amino acid needs of body, both for adults and children. Generally legumes proteins are deficient in essential sulfurated amino acid methionine. However soy protein contains enough of this important amino acid to meet adult needs. Protein in just 250 g of soybean is equivalent to protein in 3 liters of milk or 1 kg of meat or twenty four eggs. Soybean is cheap source of protein which can be exploits on large scale for controlling various malnutrition disorders in developing countries and remote areas.
Consumption of soybean is limits by contents of some anti nutritional compound which contributes beany flavor to soybean. Saponin and lipoxygenase enzyme are responsible for giving beany flavor to soybean which is founds undesirable. To make soybean free from beany flavor the different chemical treatments must to given to soybean seeds to remove the content of anti-nutritional compound. Soybean before processing treated by sodium bicarbonate or citric acid solution reduces the level of beany flavor to large extent.
Soybean milk has been prepared for hundreds of years in the orient by a standard method of soaking beans in water for several hours, followed in order by grinding with filtration and cooking for about 30 mins (Smith. 1999) [17].

Although this conventional process method is relatively simple the techniques and conditions have not been thoroughly investigated for producing a soymilk with a blend or desirable aroma. Soybean or vegetable milk or flu-changing chinse is reported to have been developed and used in china before the Christian era (Shibasaki *et al*., 2009) [15] by the philosopher who was credited with the first step in the processing of tofu and yuba. Soymilk is best alternate of milk for peoples who are suffering from lactose intolerance.

Aonla or Indian gooseberry (*Emblica officinalis*) is the fruit of deciduous tree found mainly in India. This plant belongs to the family *Euphorbiaceae*. The fruit of this plant is round shaped with vertical stripes. It is greenish yellow in color and tastes sour. The fruit is fibrous in nature. Aonla possesses the highest level of heat and storage-stable vitamin C known to man. Pectin and minerals like iron, calcium and phosphorus are also found abundantly in the fruit. It is a very powerful anti-inflammatory herb. Aonla is the richest source of natural vitamin C. It provides up to 900 mg/100 g of juice of the fresh fruit. It has the same amount of ascorbic acid or vitamin C present in two oranges. Due to high vitamin C content Aonla has anti oxidative properties.

Yoghurt is a coagulated milk product obtained by lactic acid fermentation of milk through the action of *S. salivariussubsp. thermophilus* and *L. delbrueckiisubsp. Bulgarcius* with or without addition of whole milk powder or skim milk powder or whey powder. The desirable microorganisms in the final product must be viable and abundant".

Present investigation formulated for studies on effect of Indian gooseberry juice on sensory, sensory and physico-chemical quality of yoghurt.

Material and Method

Material

Good quality soybean (*Glycine max)* and aonla fruit were procured from local market of parbhani.

Chemicals

Chemicals used in this investigation were of analytical grade. They were obtained from Essdee Marketing (Pune) and Viraj enterprises (Parbhani).

Packaging Material

Packaging material i.e. PVC (polyvinyl chloride) containers and PP (Polypropylene) pouches was purchased from local market.

Methods

Physic-chemical analysis

Physico-chemical analysis of soybean and aonla was carried out by method given by A.O.A.C (1990) [1].

Physico-chemical analysis of soy yoghurt

Different samples of product were analyzed for the pH, acidity, total soluble solid content according to their respective standard methods as

pH

pH was determined using digital pH meter (Ranganna, 1991) [12].

Titratable Acidity

The titratable acidity was measured as content of H+ ions by NaOH (0.1N) titration using phenolphthalein indicator (Ranganna, 1991) [12] by titrating sample against 0.1N sodium hydroxide (NaOH) using phenolphthalein as an indicator and per cent total acid were calculated by using given formula.

$$\%\text{Total Acidity} = \frac{\text{Titer x N of alkali x Volume x Eq.wt. of acid x 100}}{\text{Volume of sample x Wt. of sample x 1000}}$$

Ascorbic acid (Vitamin C)

Ascorbic acid content was determined by titration of a known weight of sample with 2, 6-dichlorophenol indophenol dye using metaphosphoric acid (Ranganna, 1991) [12]. The 2,6-dichlorophenol dye which is blue in alkaline solution and red in acid solution reduces ascorbic acid to a colorless form. Ascorbic acid was expressed as mg/100g by using given formula.

Dye Factor = 0.5/ Titre

$$\underset{(\text{mg}/100\text{g})}{\text{Ascorbic acid}} = \frac{\text{Titre} \times \text{Dye factor} \times \text{Volume made up x 100}}{\text{Aliquot of extract taken} \times \text{Wt. or volume of sample}}$$

Organoleptic evaluation of prepared product

Prepared yoghurt was evaluated for organoleptic characteristics like color, flavor, taste, and overall acceptability by a panel of semi trained judges. Samples were scored based on a nine point hedonic scale. Judges were asked to rate the product on 9 point Hedonic scale with corresponding descriptive terms ranging from 9 'like extremely' to 'dislike extremely'.

Measurement of theoretical energy value

Energy value is determined by using values of crude protein, crude fat and total sugar content of sample and considering that 1 g of protein yields 4 kcal energy, 1 g of fat yields 9 Kcal energy and 1 g carbohydrates yields 4 kcal energy. Total energy value in Kcal is calculated by adding above three energy values which gives energy value per 100 ml of sample (Saniah and Samsiah, 2012) [14].

Result and Discussion

Table 1: proximate composition of soybean

S. No	Parameters	Contents (%)
1	Moisture	6.80
2	Ash	5.20
3	Crude fat	18.80
4	Crude protein	37.62
5	Crude fiber	3.50
6	Carbohydrate	28.08

*Each value an average of three determinations

It was being observed from the data depicted in table-1 that the soybean flour contained 6.80 percent of moisture. This is expected since the sample has been subjected to drying to reduce the moisture content. Ash content of full fat soybean flour contained about 5.20 percent. Ash content is an indication of the level of minerals present in food material this suggests that soybean can help in boosting the mineral content of prepared product. Crude fat, crude protein, crude fiber and carbohydrate of soybean flour were observed 18.80 percent, 37.62 percent, 3.50 percent and 28.08 percent respectively.

The obtained results for the proximate composition of full fat soybean flour were found similar to that of results of Chinma and Gernah (2007) [3]. The results for the ash and crude fat are comparable to the results obtained by the Kuzniar *et al*. (2016) [8]. The observed differences may be due to environmental factors like climate and location etc.

Table 2: Proximate composition of soybean milk

S. No.	Parameters	Contents (%)
1	Moisture	90.32
2	Ash	0.32
3	Crude fat	1.99
4	Crude protein	2.87
5	Crude fiber	0.34
6	Carbohydrate	4.16

*Each value an average of three determinations

Soymilk is prepared by grinding soaked and heated soybean grain which is then stained to get soybean milk. The proximate composition of soybean milk was studied and the date was tabulated in table-2. The moisture content of soymilk was 90.32 percent. The ash, protein, fat, fiber and carbohydrate of soymilk were 0.32, 2.87, 1.99, 0.34 and 4.16 respectively. The similar result was obtained by the research finding outcome by Tunde-Akintunde and Souley (2009) [18].

Table 3: Proximate chemical composition of Aonla fruit

S. No	Parameter	Aonla
1	Moisture (%)	85
2	Total soluble solid (0Brix)	7
3	Acidity (%)	1.75
4	Protein (%)	0.61
5	Fat (%)	0.13
6	Ascorbic acid (mg/100g)	426
7	Ash (%)	0.6

*Each value is average of three determinations

The evaluations of proximate composition of food commodity were done for judging the nutritional quality. Moisture content was an important parameter in identifying the quality of fresh fruits. Fresh aonla fruits were analyzed for various chemical characteristics in Table-3. The moisture content of fresh aonla was 85.6 percent and these results were more comparable with result shown by (Ghorai and Sethi, 1996: Singh *et al*., 2006; Garg, 2010) [6, 16, 5]. Total soluble solids 70 Bx, acidity 1.75 percent, protein content was 0.61per cent, fat content was 0.13 per cent. Fresh aonla fruits are rich source of ascorbic acid 26mg per 100 g. the ash content was 0.6 per cent found to be more or less to those revealed by Parveen and Khatkar (2015) [11].

Table 4: Mineral composition of aonla and soybean

S. No	Content (mg/100g)	Aonla	Soybean
1	Calcium	26	241.23
2	Copper	0.59	3.22
3	Manganese	0.145	4.61
4	Iron	1.47	14.60
5	Zinc	0.11	4.87

*Each value is average of three determinations

The fresh aonla fruit was analyzed to determine the concentration of different minerals present in the fruit the mineral content result were tabulated in table-4. These minerals were calcium, copper, manganese, iron, and zinc. The concentrations of these minerals were 26 mg, 0.59 mg, 0.145 mg, 1.47 mg, 0.11mg. These results were more or less comparable with the result reported by Parveen and Khatkar (2015) [11]. It was found that calcium, copper, manganese, iron and zinc content of soybean was 241.23, 669.43, 4.61, 14.60 and 4.87 mg per 100 g respectively. Similar results were obtained with Rohini *et al*. (2015) [13].

Table 5: Sensory evaluation of soybean yoghurt fortified with Indian gooseberry juice

Sample	Color	Flavor	Taste	Overall acceptability
T_0	8.5	8	8.5	8.6
T_1	8	7.8	8	7.9
T_2	8.4	8.5	8	8.5
T_3	7.6	8	7.8	7.8
T_4	7.7	7.5	7.0	7.4
SE±	0.076	0.023	0.072	0.092
CD at 5%	0.222	0.083	0.265	0.398

*Each value is average of three determinations

Where
T_0: soymilk: aonla juice (100:00)
T_1: soymilk: aonla juice (98:02)
T_2: soymilk: aonla juice (96:04)
T_3: soymilk: aonla juice (94:06)
T_4: soymilk: aonla juice (92:08)

The data presented in table-5 for sensory evaluation of soybean yoghurt fortified with Indian gooseberry juice. Sensory evaluation is one of the best qualities deciding technique which involve perceptions of human senses. Color, flavor, taste and overall acceptability are important quality deciding parameter for yoghurt.

Color is first parameters which attract the consumer for the consumption of product. Color decides its freshness and clarity. The color value for control sample was 8.5. The sample T_2 got good score for color about 8.4. color value of yoghurt were changes with increase in proportion of aonla juice to yoghurt. Flavor is combination of taste, aroma and mouthfeel. It is one of the important quality deciding parameter which play important role in judging the quality of freshness, suitability and acceptance. The flavor of yoghurt changes with changing the proportion of juice to yoghurt and sample T_2 scored highest for flavor. The taste of sample was decreased with increasing ratio of juice to yoghurt. The result of sensory evaluation concluded that sample T_2 was scored highest for all the parameters and it was accepatable. And hence the sample T_2 was taken for further analysis. Similar results were found with Bristone *et al.* (2015) [2] who studied production and evaluation of yoghurt from mixtures of cow Milk, milk extract from soybean and tiger Nut.

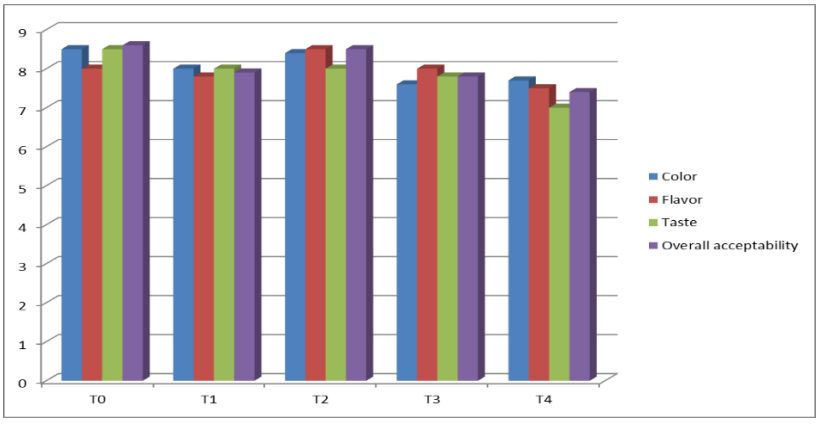

Fig 1: Sensory evaluation of soybean yoghurt fortified with Indian gooseberry juice

Table 6: Effect of Indian gooseberry juice on proximate composition of soybean yoghurt (per 100g)

Sample	Moisture	Ash	Fat	Protein	Fiber	Carbohydrate
T_0	81.09	0.86	2.18	3.42	1.20	11.25
T_1	81.21	0.85	2.12	3.39	1.27	11.16
T_2	81.29	0.84	2.03	3.33	1.34	11.17
T_3	81.36	0.84	1.99	3.28	1.39	11.14
T_4	81.43	0.83	1.95	3.21	1.46	11.12
SE±	0.098	0.076	0.034	0.076	0.011	0.078
CD at 5%	0.349	0.278	0.198	0.291	0.046	0.254

*Each value is average of three determinations

The data presented in table-6 showed the effect of aonla fruit juice on proximate composition of soybean yoghurt. The control sample has 81.09, 0.86, 2.18, 3.42, 1.2 and 11.25 percent moisture, ash, fat, protein, fiber and carbohydrate respectively. The fortification of Indian gooseberry juice to yoghurt results in increasing moisture and fiber content while decrease in ash, fat, protein and carbohydrate content of yoghurt. The moisture was increased from 81.21 to 81.43 percent. The ash was decreased from 0.85 to 0.83 percent. The fat content was decreased from 2.12 to 1.95 percent. The protein content was decreased from 3.42 to 3.21 percent. The fiber content was increased from 1.20 to 1.46 percent. The carbohydrate content was decreased from 11.25 to 11.12 percent. The similar results were obtained by the research finding of Park *et al.* (2011) [10].

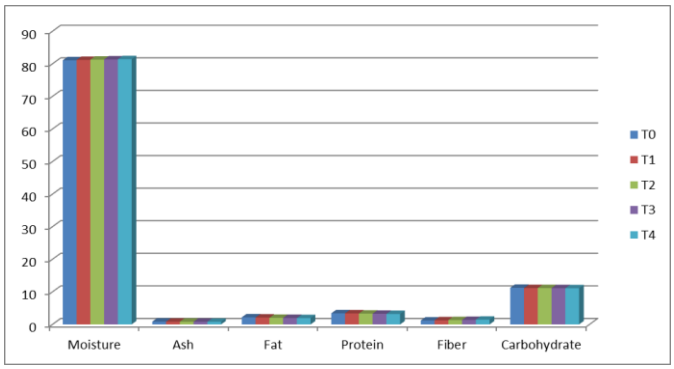

Fig 2: Effect of Indian gooseberry juice on proximate composition of soybean yoghurt (per 100g)

Table 7: Total energy value of low calorie herbal RTS beverage sample

Sample	Carbohydrate (Kcal)	Protein (Kcal)	Fat (Kcal)	Total energy (Kcal/100g)
Control (T_0)	45.28	13.68	18.99	77.95
T_2	44.68	13.32	18.27	76.27

Carbohydrate: 4 Kcal
Protein: 4 Kcal
Fat: 9 Kcal

The theoretical energy value of soybean yoghurt is presented in Table-7. Results revealed that energy provided by 100 ml of yoghurt was calculated theoretically by multiplying carbohydrates and protein with 4 Kcal and fat with 9 Kcal respectively (Saniah and Samsiah, 2012) [14]. It can be concluded from the Table-10 that 100 ml of soybean yoghurt (T_2) (76.27 Kcal/100ml) and for control sample energy value is around 77.95 Kcal/100ml.

Table 8: Effect of Indian gooseberry juice on physico-chemical quality of soybean yoghurt

Sample	Acidity (%)	pH	Ascorbic acid (mg/100g)
Control	0.84	4.2	4
T_2	0.87	4.1	53
SE±	0.012	0.034	0.055
CD at 5%	0.041	0.102	0.187

*Each value is average of three determinations

Data presented in table-8 revealed that control sample content ascorbic acid 4 mg/100g and has acidity and pH of about 0.84 percent and 4.2. The fortification of Indian gooseberry juice was results in increasing acidity, pH and ascorbic acid content i.e 0.87 percent, 4.1 and 53 mg/100g respectively. The similar results were in same align with the research work done by Ehirim and Onyeneke (2013) [4].

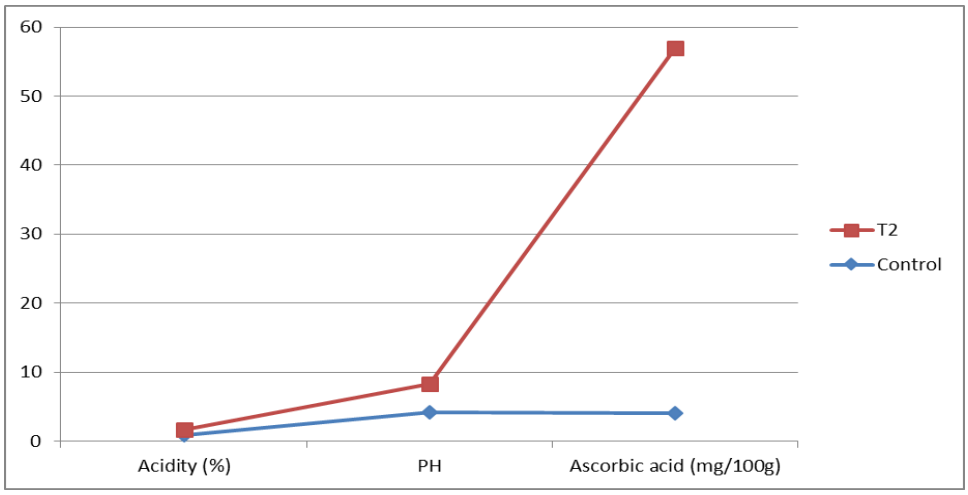

Fig 3: Effect of Indian gooseberry juice on physico-chemical quality of soybean yoghurt

Table 9: Effect of Indian gooseberry juice on mineral composition of soybean yoghurt

Sample	Calcium	Manganese	Copper	Iron	Zinc
Control	174.32	2.23	0.42	0.65	0.11
T_2	183.22	1.42	0.45	1.28	0.15
SE±	0.022	0.048	0.098	0.059	0.011
CD at 5%	0.086	0.153	0.329	0.134	0.045

*Each value is average of three determinations

The data presented in table-9 revealed that calcium, manganese, copper, iron and zinc content of control sample was 174.32, 2.23, 0.42, 0.65 and 0.11 mg/100g respectively. The sample T_2 contains calcium, manganese, copper, iron and zinc contents were 183.22, 1.42, 0.45, 1.28 and 0.15 mg/100g respectively. The addition of Indian gooseberry juice results in improvement in mineral content of yoghurt. The similar results were observed by Li *et al.* (2013) [9] who studied the microelement of soybean curd residue.

Fig 4: Effect of Indian gooseberry juice on mineral composition of soybean yoghurt

Conclusion

From the present investigation it was concluded that the soybean yoghurt sample T_2 containing 96 percent soymilk and 4 percent Indian gooseberry juice was most desirable in terms of sensory and nutritional quality profile. It was also concluded that with fortification of Indian gooseberry juice to soybean yoghurt results in increment in mineral and proximate composition of soybean yoghurt.

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