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Standardization of value added synbiotic juices

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ABSTRACT

Synbiotic foods containing probiotics and prebiotics are good for human health. The most well-known food based strategies to modulate the composition of the intestinal microbiota are the dietary use of Prebiotics, Probiotics and their combination Synbiotics. The aim of this work was to develop synbiotic juices, as alternative to dairy probiotic products, containing the probiotic culture *Bacillus coagulans* and Sabja seeds as prebiotic. Probiotic *Bacillus coagulans* (0.2g) and prebiotic sabja seeds was added at the level of 0.5, 1 and 1.5 per cent in fruit juices like papaya, pineapple and pomegranate, respectively. These synbiotic juices were evaluated by a panel of judges using score card with nine point hedonic scale rating. The sensory attributes like colour, flavour, consistency, taste and overall acceptability of 1.5% Synbiotic juices (SPJ3, SPAJ3 and SPOJ3) secured highest scores than 0.5 and 1 per cent synbiotic juices. Nutrient analysis like carbohydrate, protein, crude fibre, â- carotene, vitamin C, iron, zinc, magnesium and physico-chemical parameters like pH, acidity, total soluble solids, antioxidants, flavonoids and total polyphenol were analysed in both control and 1.5 per cent sabja seeds added synbiotic juices *viz*., papaya, pineapple and pomegranate. The results revealed that the nutrients and Physico-chemical parameters like carbohydrate, protein, crude fibre, β- carotene, vitamin C, iron, zinc, magnesium, antioxidant, flavonoids and polyphenol were high in 1.5 per cent sabja seeds added synbiotic juices than control juices. Hence the synbiotic juices can be recommended for all age groups.

Key Words : Prebiotic, Probiotic, Synbiotic, fruit juices, Sabja seeds, *Bacillus coagulans*

INTRODUCTION

Functional foods are products that have been enriched with added nutrients or other substances that are considered to provide health benefits over and above their nutritional value (Williamson, 2009). Functional food is a part of an everyday diet and is demonstrated to offer health benefits and to reduce the risk of chronic disease beyond the widely accepted nutritional effects (Olejnik and Sip, 2005). The Greek meaning of the word probiotics is 'for life' which are viable live microorganisms when administered inadequate amounts confer a health benefit on the host (Fuller, 1989). Some selected strains of *Lactobacillus, Bifidobacterium, Streptococcus, Lactococcus* and *Saccharomyces* have been promoted in food products because of their reputed health benefits (Ouwehand *et al.*, 1999).The commercial interest in functional foods containing probiotics strains has consistently increased due to the awareness of the benefits for gut health and disease prevention

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and therapy (Gonzalez *et al.,* 2011). Probiotic bacteria *Bacillus coagulans* MTCC 5856 has been in the market as a dietary ingredient for nearly two decades, under the trade name LactoSpore®. It is a room temperature stable, lactose free and non-genetically modified probiotic preparation with GRAS status. The strain MTCC 5856 has the ability to withstand high heat and has been included in functional baked foods (Majeed and Prakash, 2008).

Prebiotics are an alternative for probiotics. They are defined as " a non-digestible food ingredient which beneficially affects the host by selectively stimulating the growth and /or activity of one or a limited number of bacteria in the colon and thus improving the host health. Several criteria have to be fulfilled when a substance is to be classified as prebiotic: safety, stability, organoleptic properties, resistance to digestion in the upper bowel and fermentability in the colon, as well as ability to promote the growth of beneficial bacteria in the gut (Gibson, 2004).The consumption of prebiotics has been associated with reduced risks of certain diseases. These include the suppression of diarrhea associated with intestinal infections; reduced risk of osteoporosis because inulin promotes the uptake of calcium and thereby increases bone mass; reduced risk of obesity and of developing Type 2 diabetes; neutralization of toxic products and decreased frequency of colon cancer; stimulation of immunity (Quera *et al.,* 2005).

Seeds of the sweet basil plant called Sabja are used frequently in the traditional Indian medicinal system. It is native to Asia, particularly Maharashtra in India. The scientific name of sabja seeds is *Ocimum basilicum.* The seeds when soaked in water absorb water and swell to many times their original size with a gelatinous covering (Begum, 2016). Sabja seeds are very good for digestion as it has carminative properties. It provides relief from flatulence, cramps, indigestion and constipation problems. It helps the body to clean the toxin. Recently, beverages based on fruits, vegetables, cereals and soybeans have been proposed as new products containing probiotic strains: particularly, fruit juices have been reported as a novel and appropriate medium for their content of essential nutrients (Luckow *et al.,* 2006).

Keeping all these above points in to consideration, the present study was undertaken with the following objectives.

– To formulate synbiotic fruit juices by incorporating probiotic strain (*Bacillus coagulans*) and prebiotic sabja seeds.

– To assess the sensory evaluation and nutrient content of the formulated synbiotic juices.

METHODOLOGY

The present investigation was carried out in the Nutrition Research Laboratory of the Department of Human Nutrition and Nutraceuticals, Fatima College (Autonomous), Madurai. Probiotic *Bacillus coagulans* was purchased from Sami labs, Bangalore. Prebiotic Sabja seeds and fruits like papaya, pineapple and pomegranate and sugar were purchased from local shop in Kaalavasal, Madurai.

Preliminary preparation of fruit juices :

The fresh ripened fruits (papaya, pineapple and pomegranate) were purchased from the local market. The fresh fruits were cleaned, washed, peeled and cut into pieces and the juice was extracted by using juicer.

Preparation of synbiotic juices :

The synbiotic juices were prepared by incorporating 0.2g of *Bacillus coagulans* as probiotics and sabja seeds as prebiotics in different proportions like (0.5g, 1g and 1.5g) in fruit juices viz., papaya, pineapple and pomegranate. Probiotic *Bacillus coagulans* and prebiotic sabja seeds are shown in Plate 1.

Plate 1 : Probiotic *Bacillus coagulans* **Prebiotic Sabja seeds**

Development of synbiotic papaya juice

The synbiotic papaya juice was prepared by incorporating 0.2 g of probiotic *Bacillus coagulans* and prebiotic sabja seeds in different proportions like 0.5 g (SPJ1), 1 g (SPJ2) and 1.5 g (SPJ3), respectively. The measured amount of sugar was added in synbiotic papaya juice and it was mixed well for 30 minutes and refrigerated at 4° C. The prepared synbiotic papaya juice is shown in plate 2.

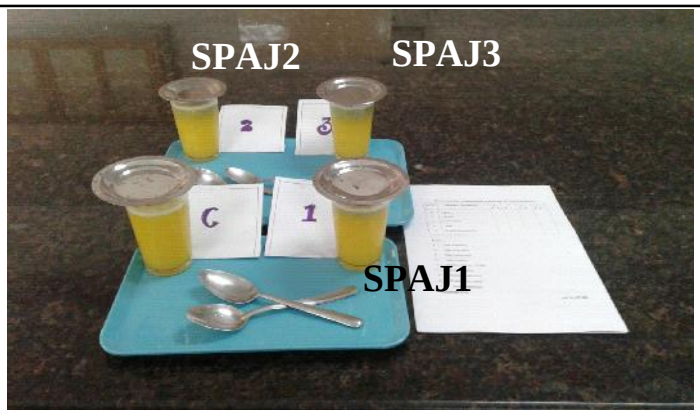
C - Control papaya juice
SPJ1 – 0.5 g of sabja seeds added synbiotic papaya juice
SPJ2 –1 g of sabja seeds added synbiotic papaya juice
SPJ3 –1.5 g of sabja seeds added synbiotic papaya juice

Plate 2 : Synbiotic papaya juice

Development of synbiotic pineapple juice :

The synbiotic pineapple juice was prepared by incorporating 0.2 g of probiotic *Bacillus coagulans* and prebiotic sabja seeds in different proportions like 0.5 g (SPAJ1), 1 g (SPAJ2) and 1.5 g (SPAJ3), respectively. The measured amount of sugar was added in synbiotic pineapple juice

and it was mixed well for 30 minutes and refrigerated at 4° C. The prepared synbiotic pineapple juice is shown in Plate 3.



C - Control pineapple juice
SPAJ1 – 0.5g of sabja seeds added synbiotic pineapple juice
SPAJ2 –1g of sabja seeds added synbiotic pineapple juice
SPAJ3 –1.5g of sabja seeds added synbiotic pineapple juice

Plate 3 : Synbiotic pineapple juice

Development of synbiotic pomegranate juice :

The synbiotic pomegranate juice was prepared by incorporating 0.2g of probiotic *Bacillus coagulans* and prebiotic sabja seeds in different proportions like 0.5g (SPOJ1), 1g (SPOJ2) and 1.5g (SPOJ3), respectively. The measured quantity of sugar was added in synbiotic pomegranate juice and it was mixed well for 30 minutes and refrigerated at 4°C. The prepared synbiotic pomegranate juice is shown in Plate 4.

C - Control pomegranate juice
SPOJ1 – 0.5g of sabja seeds added synbiotic pomegranate juice
SPOJ2 –1g of sabja seeds added synbiotic pomegranate juice
SPOJ3 –1.5g of sabja seeds added synbiotic pomegranate juice

Plate 4 : Synbiotic pomegranate juice

Organoleptic evaluation :

Synbiotic juices (papaya, pineapple, and pomegranate) were prepared by incorporating probiotic Bacillus coagulans at a level of 0.2 g and prebiotic sabja seeds at a level of 0.5g, 1g and 1.5g, respectively. It was evaluated by a panel of judges using score card with nine point hedonic scale rating.

Nutrient analysis :

The development and evaluation of synbiotic juices (papaya, pineapple and pomegranate) were subjected to nutrient analysis namely carbohydrate, protein, crude fibre, β-carotene, vitamin C, iron, zinc, magnesium and physicochemical parameters like total soluble solids (TSS), pH, acidity, total phenols, flavonoids, total antioxidants.

Statistical analysis :

The results obtained in the analysis of the value added synbiotic juices *viz.*, papaya, pineapple, and pomegranate were statistically analysed by using paired T- test.

RESULTS AND DISCUSSION

Acceptability of control and synbiotic papaya juices :

Synbiotic papaya juice was prepared by incorporating 0.2g of *Bacillus coagulans* and sabja seeds at the level of 0.5, 1 and 1.5 per cent, respectively and the acceptability for each sensory attributes is discussed in Table 1.

Table 1 : Mean scores obtained for the overall acceptability of control and synbiotic papaya juices

Sensory attributes	Colour	Flavour	Consistency	Taste	Overall acceptability	Overall mean scores
Control	8.8	8.5	8.7	9	9	8.8
SPJ1	8.7	8.3	8.2	8	8	8.2
SPJ2	8.7	8.2	8.3	8.4	8	8.3
SPJ3	8.8	8.5	8.5	8.4	9	8.6

SPJ1 – 0.5g of Sabja seed added synbiotic papaya juice.
SPJ2 – 1g of sabja seed added synbiotic papaya juice.
SPJ3 – 1.5g of sabja seed added synbiotic papaya juice.

Among the synbiotic papaya juices, the overall acceptability scores for Control, SPJ1, SPJ2 and SPJ3 were 9, 8, 8 and 9, respectively. The overall mean scores for SPJ 1 and SPJ 2 were 8.2 and 8.3, respectively whereas in SPJ 3 the overall mean score was 8.6 with high acceptable flavour (8.5), consistency (8.5) and taste (8.4). The results revealed that SPJ3 secured highest scores in all the sensory attributes followed by SPJ2 and SPJ1 and the overall mean scores of SPJ3 was more or less equal to that of the control sample.

Acceptability of control and synbiotic pineapple juices :

Synbiotic pineapple juice was prepared by incorporating 0.2g of *Bacillus coagulans* and sabja seeds at the level of 0.5, 1 and 1.5 per cent, respectively and the acceptability for each sensory attributes is discussed in Table 2.

Among the synbiotic pineapple juices, the overall acceptability scores for control, SPAJ1,

Table 2 : Mean scores obtained for the overall acceptability of control and synbiotic pineapple juices

Sensory attributes	Colour	Flavour	Consistency	Taste	Overall acceptability	Overall mean scores
Control	8.9	8.7	8.8	9	9	8.9
SPAJ1	8.6	8.3	8.3	8	8	8.2
SPAJ2	8.6	8.5	8.5	8.4	8.5	8.5
SPAJ3	8.8	8.6	8.8	8.9	9	8.8

SPAJ1 – 0.5g of Sabja seed added synbiotic pineapple juice.
SPAJ2 – 1g of sabja seed added synbiotic pineapple juice.
SPAJ3 – 1.5g of sabja seed added synbiotic pineapple juice.

SPAJ2 and SPAJ3 were 9, 8, 8.5 and 9, respectively. The overall mean scores for SPAJ1 and SPAJ2 were 8.2 and 8.5, respectively whereas in SPAJ3 the overall mean score was 8.8 with high acceptable flavour (8.6), consistency (8.8) and taste (8.9). The results revealed that SPAJ3 secured highest scores in all the sensory attributes followed by SPAJ2 and SPAJ1 and the overall mean scores of SPAJ3 was more or less equal to that of the control sample.

Acceptability of control and synbiotic pomegranate juice :

Synbiotic pomegranate juice was prepared by incorporating 0.2g of *Bacillus coagulans* and sabja seeds at the level of 0.5, 1 and 1.5 per cent, respectively and the acceptability for each sensory attributes is discussed in Table 3.

Table 3 : Mean scores obtained for the overall acceptability of control and synbiotic pomegranate juice

Sensory attributes	Colour	Flavour	Consistency	Taste	Overall acceptability	Overall mean scores
Control	8.8	8.6	8.9	8.9	8.9	8.8
SPOJ1	8.4	8.4	8.4	8.5	8.5	8.4
SPOJ2	8.6	8.5	8.7	8.7	8.7	8.6
SPOJ3	8.7	8.6	8.9	9	9	8.8

SPOJ1 – 0.5g of Sabja seed added synbiotic pomegranate juice.
SPOJ2 – 1g of sabja seed added synbiotic pomegranate juice.
SPOJ3 – 1.5g of sabja seed added synbiotic pomegranate juice

Among the synbiotic pomegranate juices, the overall acceptability scores for control, SPOJ 1, SPOJ2 and SPOJ3 were 8.9, 8.5, 8.7 and 9, respectively. The overall mean scores for SPOJ1 and SPOJ2 were 8.4 and 8.6, respectively whereas in SPOJ3 the overall mean score was 8.8 with high acceptable flavour (8.6), consistency (8.9) and taste (9). The results revealed that SPOJ3 secured highest scores in all the sensory attributes followed by SPOJ2 and SPOJ1 and the overall mean scores of SPOJ3 was more or less equal to that of the control sample.

Nutrient analysis of control and synbiotic juices :

The nutrient content of control and 1.5% sabja seed added synbiotic juices are given in the Table 4.

The carbohydrate, protein, crude fibre, β- carotene and vitamin C content of control papaya juice were 10g, 0.21g, 0.4g, 280.34μg and 18mg and in 1.5% sabja seed added synbiotic papaya juice (SPJ3), it was 15g, 0.6g, 0.6g, 310.16 μg and 18.25 mg, respectively. The iron, zinc and

Table 4 : Nutrient content of control and synbiotic juices

Nutrients	Control	SPJ3	Control	SPAJ3	Control	SPOJ3
Carbohydrate (g)	10	15	14	15	14.5	16
Protein (g)	0.21	0.6	0.25	0.32	0.67	0.80
Crude Fibre (g)	0.4	0.6	0.25	0.45	2.35	2.72
β – carotene (μg)	280.34	310.16	9.50	14.50	0	5.20
Vitamin C (mg)	18	18.25	14.25	15.10	7.72	7.78
Iron (mg)	0.30	0.75	1.5	1.65	0.75	1.32
Zinc (mg)	0.05	0.4	0.06	0.2	0.32	0.41
Magnesium (mg)	6	9	14	19	20.25	26.6
Paired 'T'Test	S	S	S	S	S	S
Sign(2- tailed)	0.02		0.04		0.04	

magnesium content of the control papaya juice were 0.30mg, 0.05mg and 6.0mg and in 1.5% SPJ3, it was 0.75mg, 0.4mg and 9mg, respectively.

The carbohydrate, protein, crude fibre, β- carotene and vitamin c content of control pineapple juice were 14g, 0.25g, 0.25g, 9.50μg and 14.25mg and in 1.5% sabja seed added synbiotic pineapple juice (SPAJ3), it was 15g, 0.32g, 0.45g, 14.50 μg and 15.10mg, respectively. The iron, zinc and magnesium content of the control pineapple juice were 1.5mg, 0.06mg and 14mg and in 1.5% SPJ3, it was 1.65mg, 0.2mg and 19mg, respectively.

The Carbohydrate, protein, crude fibre, β- carotene and vitamin c content of control pomegranate juice were 14.5g, 0.6g, 2.35g, 0 μg and 7.72mg and in 1.5% sabja seed added synbiotic pomegranate juice (SPOJ3), it was 16g, 0.8g, 2.75g, 5.20 μg and 7.78mg, respectively. The iron, zinc and magnesium content of the control pomegranate juice were 0.75mg, 0.32mg and 20.25mg and in 1.5% SPJ3, it was 1.32mg, 0.41mg and 26.6mg, respectively. The statistical analysis of data revealed that there was a significant difference between the control and the 1.5% sabja seed added synbiotic juices.

Physico-chemical parameters of control and synbiotic juices :

The physico-chemical parameters of control and 1.5% sabja seed added synbiotic juices are given in Table 5.

The pH, acidity, Total Soluble Solids (TSS), antioxidants, flavonoids and total polyphenol content of control papaya juice were 4.6, 1.6%, 12 ° bx, 1.5mmol, 20.4mg RE and 127mg GAE and in 1.5% sabja seed added synbiotic papaya juice (SPJ3), it was 4.3, 1.8%, 14 °Bx, 2.1mmol,

Table 5 : Physico-chemical parameters of control and synbiotic juices

Physico-chemical parameters	Control	SPJ3	Control	SPAJ3	Control	SPOJ3
pH	4.6	4.3	3.6	3.2	3.2	3.0
Acidity (%)	1.6	1.8	1.6	2.0	2.8	2.9
Total Soluble Solids (^{0}Bx)	12	14	10	12	16	17
Antioxidants (mmol)	1.5	2.1	1.6	2.2	2.1	2.7
Flavonoids (mg RE)	20.4	24.6	26.2	30.6	28.1	33
Total polyphenol (mg GAE)	127	129.2	110	112	173	181.2
Paired 'T' Test	S	S	S	S	S	S
Sign(2- tailed)	0.028		0.032		0.05	

24.6mg RE and 129.2mg GAE, respectively.The pH, acidity, Total Soluble Solids (TSS), antioxidants, flavonoids and total polyphenol content of control pineapple juice were 3.6, 1.6%, 10 °Bx, 1.6mmol, 26.2mg RE and 110mg GAE and in 1.5% sabja seed added synbiotic pineapple juice (SPAJ3), it was 3.2, 2.0%, 12 °Bx, 2.2mmol, 30.6mg RE and 112mg GAE, respectively. The pH, acidity, Total Soluble Solids (TSS), antioxidants, flavonoids and total polyphenol content of control pomegranate juice were 3.2, 2.8%, 16 °Bx, 2.1mmol, 28.1mg RE and 173mg GAE and in 1.5% sabja seed added synbiotic pomegranate juice (SPOJ3), it was 3, 2.9%, 17 °Bx, 2.7mmol, 33mg RE and 181.2mg GAE, respectively. The statistical analysis of data in Table 5 revealed that there was a significant difference between the control and 1.5% sabja seed added synbiotic juices.

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