International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(1): 1360-1363

Received: 06-11-2017
Accepted: 07-12-2017

Shanta Peter
Assistant Professor, Warner College of Dairy Technology SHUATS, Allahabad, Uttar Pradesh, India

Avinash Singh
Assistant Professor, Warner College of Dairy Technology SHUATS, Allahabad, Uttar Pradesh, India

Sangeeta Shukla
Assistant Professor, Warner College of Dairy Technology SHUATS, Allahabad, Uttar Pradesh, India

Correspondence
Shanta Peter
Assistant Professor, Warner College of Dairy Technology SHUATS, Allahabad, Uttar Pradesh, India

Effect of incorporation of chicory powder on organoleptic, physico-chemical analysis, rheological and microbiological aspects of frozen yoghurt

Shanta Peter, Avinash Singh and Sangeeta Shukla

Abstract
The present study was conducted on preparation of symbiotic frozen yoghurt by using chicory powder as a prebiotic in presence of *S. thermophillus* and *L. bulgaricus* as probiotic cultures. Frozen yoghurt can serve as an excellent vehicle for dietary incorporation of probiotic bacteria along with prebiotic for maximum health benefit. Chicory a natural source of inulin (prebiotic) can be incorporated in lower level owing, to its strong and intense colour and bitter taste, which to some extent can be balanced by chocolate flavour. Three treatments were formulated viz., T_3 with 2.5% chicory powder followed by T_2 with 1.5% chicory powder and T_1 with 0.5% chicory powder. Incorporation of 2.5% of chicory powder in the symbiotic frozen yoghurt gave the best result based on the viable bacterial count. Symbiotic frozen yoghurt with 0.5% chicory powder scored highest value for organoleptic parameters like colour and appearance, flavour and taste. In T1, average, TS% was 35.44%, fat % was 5.2, melting resistance was found to be 7.54%, hardness was 2024.16g, consistency was 27.6, cohesiveness was -18.54, viscosity was -7.52. The highest average *Streptococcus thermophilus* (10^7cfu/g) count in the symbiotic frozen yoghurt sample before freezing was recorded as T_3 (46.0) followed by T_2 (26.8), T_1 (15.8) and T_0 (8.8). The highest average *Lactobacillus bulgaricus* (10^7cfu/g) count was in the symbiotic frozen yoghurt sample before freezing was recorded as 15x10^7cfu/g in T_3, 12x10^7cfu/g in T_2, 5.6x10^7cfu/g in T_1 and 5.2x10^7cfu/g in T_0.

Keywords: Frozen symbiotic yoghurt, chicory, honey, physico-chemical, microbial properties

Introduction
Yogurt is one of the most popular fermented milk products worldwide and has gained widespread consumer acceptance as a healthy food. It provides an array of nutrients in significant amounts, in relation to its energy and fat content, making it a nutrient dense food. In particular, yogurt can provide the body with significant amounts of calcium in bio available form. Furthermore, yogurt has many health benefits beyond the basic nutrition it provides, such as improved lactose tolerance, a possible role in body weight and fat loss, and a variety of health attributes associated with probiotic bacteria (Mckinley, 2005) [6] Frozen yogurt is a low acid product a pH range of 5.76 to 6.72 and a titrable acidity (expressed as lactic acid) range of 0.20 to 0.60, the composition of frozen yogurt varied considerably in protein (2.77 – 9.12%), fat (4.3- 9.5%), ash (0.76- 1.17%), and total solids (25.70 – 38.83%) for 11 commercial vanilla flavoured frozen yogurt products (Schmidt *et al*., 1997) [8]. For the retention of usefulness of lactic acid bacteria, it is necessary not only to promote its growth but also to inhibit death of its cells and further, it is required to maintain a high viable cell count in the final product during storage. Freezing with agitation kills a large portion of added lactobacilli. Death of probiotic bacteria in frozen desserts reduces the potential to produce health benefits. The freezing step is especially critical as it negatively affects both viability and physiological state of bacteria (Gilliland, 1979) [4]. Honey acts as a cryoprotective agent. Honey is composed of sugars like glucose and fructose and minerals like magnesium, potassium, calcium, sodium chloride, sulphur iron and phosphate. It contains vitamins C, B1, B2, B6, B5 and B3. Honey is easily digested, good source of antioxidants, has low calorie level, rapidly diffuses through the blood, supports blood formation. Chicory is a perennial herb with a long tap root. It has condensed, round stems, numerous light or dark green leaves and pale blue flowers.

The leaves have a bitter taste; flowers open at sunrise and close at dusk. Some investigators have analyzed the chemical composition of fresh chicory roots as follows: Fresh chicory root typically contains, by dry weight, 68% inulin, 14% sucrose, 5% cellulose, 6% protein, 4% ash, and 3% other compounds (Pazola 1987) [7]. Chicory is most often consumed as a tea. In addition to being a prebiotic food, chicory root has also been shown to help alleviate both diarrhoea and constipation. It may also offer protection against cardiovascular disease, cancer and can boost our immune health. Chicory is one of the richest sources of vitamin A which is very useful for the eyes. The root, when roasted and ground, is often used as an ingredient to mix with coffee, or is taken as a beverage on its own. Inulin is naturally present in chicory and has a multitude of characteristics beneficial to functional foods. The use of non-digestible oligosaccharides (inulin) can improve, taste, texture & moisture in many foods. Inulin has gelling characteristics that can be used to make low fat cheeses, soups and table spreads. Its melting properties allow for easy processing of frozen desserts (Tungland, 2002) [9]

Considering the characteristics of chicory, the present study has been undertaken to explore the feasibility of manufacturing a symbiotic frozen dessert with addition of *Streptococcus thermophillus* and *Lactobacillus bulgaricus* cultures, chicory and honey and thereafter evaluate the organoleptic, physic-chemical, rheological and microbiological parameters of the developed product.

Materials and methods

Preparation of frozen symbiotic yoghurt

For control frozen yoghurt mix was prepared by using skim milk powder and homogenised cream with 25% fat and 16% milk solid not fat with the addition of 18 % sweetening agent (sucrose) and 0.3/0.2% stabilizer and emulsifier. The mix was standardized to a total solid content of 35% by addition of skim milk. The mix was homogenized and then pasteurized and cooled to 42ºC and yoghurt culture was added at 2.0%. The mix was then incubated at 42ºC till we achieve an acidity of 0.6 %. Then the mix was aged at 5ºC and frozen in a batch freezer to an overrun of 70%. For experimental frozen yoghurt mix was prepared by using skim milk powder and cream with 25% fat and 16% milk solid not fat. With the addition of 18 % sweetening agent (16% sucrose and 2% honey) and 0.3/0.2% stabilizer and emulsifier. The mix was standardized to a total solid content of 35% by addition of skim milk. The mix was homogenized and then pasteurized and cooled to 42ºC and yoghurt culture was added at 2.0% then chicory powder was added at 0%, 0.5%, 1.5% and 2.5% for T_0 T_1, T_2 and T_3 respectively. Then mix was then incubated at 42ºC to an acidity of 0.6%. The mix was aged at 5ºC and frozen in a batch freezer to an overrun of 70%.

Organoleptic evaluation

Sensory attributes including colour, flavour, texture, taste and overall appearance of yogurt was determined by hedonic rating as recommended by Clark *et al.,* 2009 [3].

Physico-chemical evaluation

The samples were analysed for moisture, total solids, fat, protein, carbohydrate, ash, overrun, melting resistance, titratable acidity as per the procedure laid down in AOAC, 1996 [1].

Textural analysis

Texture parameters of the final product like Hardness, firmness, consistency, cohesiveness, index of viscosity/ consistency was determined by using texture analyser (Stable micro system).

Microbiological parameters

The microbial analysis i.e. bacterial count of yoghurt were estimated by using standardized procedure as described by Marshall, 1993 [5]. Study of viable count of individual strains of probiotic (*L. bulgaricus and S. thermophillus* using ST Agar and MRS Agar) added in the mix before freezing without addition of honey was carried out. Also viable count of probiotic strains (*L. acidophillus, S. thermophillus* using ST Agar and MRS Agar) added in frozen dessert after addition of honey (cryoprotective agent) was investigated.

Statistical analysis

The data obtained during the investigation was analysed for ANOVA using MS Excel software, 2007.

Result and Discussion

Effect of addition of chicory on organoleptic scores of frozen yoghurt

The mean flavour and taste score observed in the symbiotic frozen yoghurt sample in treatment T_0, T_1, T_2 and T_3 was observed to be 7.96, 8.18, 7.84 and 7.12 respectively. There was significant difference (P<0.05) between the average flavour and taste score among treatments. The mean colour & appearance score observed in the symbiotic frozen yoghurt sample in treatment T_0, T_1, T_2 and T_3 was observed to be 8.32, 8.16, 7.96 and 7.12 respectively. There was significant difference (P<0.05) between the average colour and appearance score among treatments. The mean body & texture score observed in the symbiotic frozen yoghurt sample in treatment T_0, T_1, T_2 and T_3 was observed to be 7.84, 7.84, 7.48 and 8.00 respectively. There was significant difference (P<0.05) between the average body and texture score among treatments. From the above observations it can be inferred that with increase in chicory powder content, flavour and taste score, colour and appearance score decreased whereas body and texture score increased as the chicory powder concentration increased. The increased body and texture score with the increase in chicory powder content may be attributed to the fact that the carbohydrates present in chicory might have contributed to firm body and texture and therefore treatments with increased chicory content fetched increased sensory scores as compared to the scores of treatment with lower content of chicory content. The organoleptic scores of different treatments are presented in fig.1.

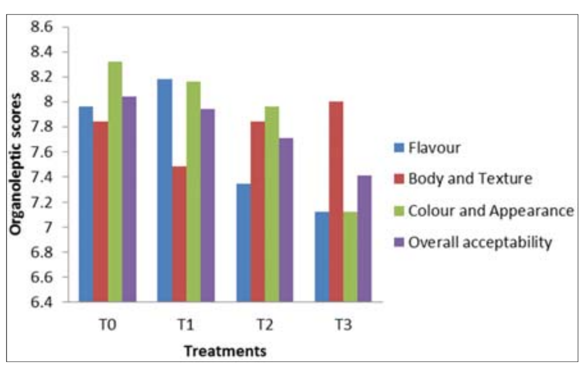

Fig 1: Effect of addition of chicory on physic-chemical aspects of frozen yoghurt

The mean moisture % observed in the symbiotic frozen yoghurt sample in treatment T_0, T_1, T_2 and T_3 was observed to be 64.62, 64.56, 64.62 and 64.40 respectively. There was no significant difference (P>0.05) between the average moisture % among treatments. The mean total solids % observed in the symbiotic frozen yoghurt sample in treatment T_0, T_1, T_2 and T_3 was observed to be 35.38, 35.44, 35.58 and 35.60 respectively. There was no significant difference (P>0.05) between the average moisture % among treatments. The mean fat % observed in the symbiotic frozen yoghurt sample in treatment T_0, T_1, T_2 and T_3 was observed to be 5.24, 5.20, 5.10 and 5.06 respectively. There was significant difference (P<0.05) between the average fat % among treatments.

The mean titratable acidity (expressed as lactic acid%) observed in the symbiotic frozen yoghurt sample in treatment T_0, T_1, T_2 and T_3 was observed to be 0.602, 0.60, 0.60 and 0.6 respectively. There was no significant difference (P>0.05) between the average titratable acidity % among treatments. The average overrun% observed in the symbiotic frozen yoghurt sample in treatment T_0, T_1, T_2 and T_3 was observed to be 70.27, 70.28, 70.30 and 70.31 respectively. There was no significant difference (P>0.05) between the average overrun % among treatments. The average melting resistance observed in the symbiotic frozen yoghurt sample in treatment T_0, T_1, T_2 and T_3 was observed to be 7.38, 7.54, 7.96 and 8.76min respectively. There was significant difference (P<0.05) between the average melting resistance among treatments.

The increased melting resistance values with the increase in chicory powder content may be attributed to the fact that the carbohydrates present in chicory might have contributed to firm body and texture resulting in increased resistance to melting and therefore treatments with increased chicory content had more melting resistance compared to the values of treatment with lower content of chicory content. The physic-chemical parameters of different treatments are presented in table 1.

Parameters	T0	T1	T2	T3
Total Solid%	35.38	35.44	35.58	35.6
Fat%	5.24	5.2	5.1	5.06
Titratable Acidity (%LA)	0.6	0.6	0.6	0.6
Overrun%	70.27	70.28	70.3	70.31
Melting Resistance(min)	7.38	7.54	7.96	8.76

Effect of addition of chicory on rheological parameters of frozen yoghurt

The highest mean hardness in the symbiotic frozen yoghurt sample was recorded as 2551.44g in T_3 followed by 2160.52g in T_2, followed by 2024.16g in T_1 and in T_0, the average hardness was 2018.32g. There was significant difference among average hardness between all the treatments. The mean consistency values for T_0, T_1, T_2 and T_3 was recorded as 531.36g.s, 495.96g.s, 437.42g.s and 430.14g.s respectively. There was significant difference among different treatments regarding the average consistency values. The highest mean cohesiveness in the symbiotic frozen yoghurt sample was recorded as -16.92g in T_3 followed by -17.54g in T_2 followed by -17.61g in T_0 followed by -18.54g in T_1. There was significant difference between the average cohesiveness values among different treatments. The highest mean index of viscosity consistency was recorded in the symbiotic frozen yoghurt sample of T_3 (9.24g.s) followed by T_2 (7.34g.s), T_0 (-2.08g.s) and T_1 (-7.52g.s). There was significant difference between the average cohesiveness of T_0-T_1, T_0-T_2, T_0-T_3, T_1-T_2, T_1-T_3, and T_2-T_3 treatments.

Effect of addition of chicory on microbiological aspects of frozen yoghurt

The highest average *Streptococcus thermophilus* (10^7cfu/g) count in the symbiotic frozen yoghurt sample before freezing was recorded as T3 (46.0) followed by T2 (26.8), T1 (15.8) and T0 (8.8). It is therefore concluded that there was significant difference between the average Streptococcus thermophilus (10^7cfu/g) count of T0-T1, T0-T2, T0-T3, T1-T2, T1-T3, and T2-T3 treatments. The highest average *Lactobacillus bulgaricus* (10^7cfu/g) count was in the symbiotic frozen yoghurt sample before freezing was recorded as T3 (15.0), T2 (12.0), T1 (5.6) and T0 (5.2). It is therefore concluded that there was significant difference b/w the average *Streptococcus thermophilus* (10^7cfu/g) count of T0-T1, T0-T2, T0-T3, T1-T2, T1-T3, and T2-T3 treatments. The highest average sum of yoghurt culture (10^7cfu/g) count before freezing was recorded in the symbiotic frozen yoghurt sample of T_3 (61), T_2 (38.8), T_1 (21.4) and T_0 (14). There was significant difference between the average selective enumeration (10^7cfu/g) of sum of yoghurt culture count of T_0-T_1, T_0-T_2, T_0-T_3, T_1-T_2, T_1-T_3, and T_2-T_3 treatments. The highest average *Streptococcus thermophilus* (10^7cfu/g) count of symbiotic frozen yoghurt culture after freezing was recorded in the sample of T_3 (41.6), T_2 (24.6), T_1 (12.0) and T_0 (7.6). It is therefore concluded that there was significant difference between the average Streptococcus thermophilus (10^7cfu/g) count of T_0-T_1, T_0-T_2, T_0-T_3, T_1-T_2, T_1-T_3, and T_2-T_3 treatments. The highest average *Lactobacillus bulgaricus* (10^7cfu/g) count after freezing was recorded in the symbiotic frozen yoghurt sample of T_3 (14.4), T_2 (11.0), T_1 (5.6) and T_0 (5.0). There was non-significant difference between the average selective enumeration (10^7cfu/g) of Lactobacillus bulgaricus (10^7cfu/g) count of T_0-T_1, T_0-T_2, T_0-T_3, T_1-T_2, T_1-T_3, and T_2-T_3 treatments. The highest average sum of yoghurt culture (10^7cfu/g) count after freezing was recorded in the symbiotic frozen yoghurt sample of T_3 (56.0), T_2 (35.4), T_1 (17.6), T_0 (12.6). There was significant difference between the average selective enumeration (10^7cfu/g) of sum of yoghurt culture count of T_0-T_1, T_0-T_2, T_0-T_3, T_1-T_2, T_1-T_3, and T_2-T_3 treatments.

Conclusion

From the present study it can be inferred that frozen symbiotic yoghurt can be prepared successfully by using chicory as a prebiotic. Frozen yoghurt can serve as an excellent vehicle for dietary incorporation of probiotic bacteria along with prebiotic for maximum health benefit. Chicory a natural source of inulin (prebiotic) can be incorporated in lower level owing, to its strong and intense colour and bitter taste, which to some extent can be balanced by chocolate flavour. Honey as a cryoprotective agent of cell, might have a barrier role or a micro encapsulating agent, in which the cells are protected and cell loss is reduced, the LAB viability was significantly improved by the presence of honey and chicory suggesting it to be a growth improver.

References

1. AOAC, Official Methods of Analysis. 16th edition. Association of Official Analytical Chemists, Washington, D.C, 1996.
2. Arbuckle WS. Ice Cream, 5th ed. Chapman and Hall, New York, 1996.
3. Clark S, Costello M, Drake MA, Bodyfelt F. The Sensory Evaluation of Dairy Products. Second edition. 2009, 200-201.

4. Gilliland SE. Beneficial interrelationships between certain microorganisms and humans: candidate microorganisms for use as dietary adjuncts. Journal of Food Protection, 42:164. Guthrie D., A history of medicine. Thomas Nelson. 1979, 57-8.
5. Marshal RT. Standard Methods for the Examination of Dairy Products. 16th Ed. American Public Health Association, Washington, D.C, 1993.
6. McKinley MC. The nutrition and health benefits of yoghurt. International Journal of Dairy Technology. 2005; 58(1):1-12.
7. Pazola Z. the chemistry of chicory and chicory-product beverages. In: Coffee. Vol. 5: Related Beverages (Clarke, R. J. & Macrae, R., eds.), Elsevier Applied Science Publishers, New York, NY. 1987, 19-57.
8. Schmidt KA, Kim J, Jeon IJ. Composition of carbohydrates and concentration of *β*-galactosidase of commercial frozen yogurt. Journal of Food Quality. 1997; 20:349-358.
9. Tungland BC, Meyer D. Non digestible oligo- and polysaccharides (dietary fibre): their physiology and role in human health and food. Comprehensive Reviews in Food Science and Food Safety. 2002; 1:73-92.