Biological Forum – An International Journal 14(4a): 499-504(2022)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Studies on Preparation of Frozen Yogurt Smoothie using Non-Nutritive Sweetener

Raksha G.P.[1*], Deshpande H.W.[2], Monishdeep V.[1], Wanole P.D.[1] and Poshadri A.[3]
[1]M. Tech. Scholar, College of Food Technology, VNMKV, Parbhani (Maharashtra), India.
[2]HOD and Associate Professor, Department of Food Microbiology and Safety, College of Food Technology, VNMKV, Parbhani (Maharashtra), India.
[3]Ph.D. Scholar, College of Food Technology, VNMKV, Parbhani (Maharashtra), India.

(Corresponding author: Raksha G.P.)*
(Received 27 September 2022, Accepted 17 November, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Low calorie and fiber rich synobiotic frozen yogurt smoothies have been identified individually as indicators of healthy dietary patterns. Synobiotic frozen yogurt smoothies have gained popularity as healthy foods since they are low in calories and high in fibre. They stand out for their sour yogurt flavour and ice cream's cooling characteristics. In the present study efforts were made to prepare frozen yogurt smoothie using non-nutritive sweetener such as Fructooligosaccharides (FOS), Stevia, liquid jaggery. The frozen yogurt smoothie samples were analyzed for physico-chemical, nutrition and microbial load. The frozen yogurt smoothie was prepared using mango fruit pulp and yogurt in 1:2 ratio along with 1% of psyllium husk to which different non-nutritive sweeteners were added then standardized the process and product taste through sensory analysis by using commercial sample as control. The sample T-1 (Frozen yogurt smoothie containing FOS as sweetener) was rated as liked extremely than other samples of smooothies such as T-2 (Frozen yogurt smoothie containing Stevia as sweetener) and T-3 (Frozen yogurt smoothie containing liquid jaggery as sweetener). The smoothie with fructooligosaccharides as sweetener was found to have better organoleptic properties.

Keywords: Smoothie, Probioic, Yogurt, Synbiotics, Stevia, Fructooligosaccharides, Psyllium husk.

INTRODUCTION

Yogurt can be prepared by fermenting whole, skimmed, or standardized milk, by using strains like *Lactobacillus delbrueckii* ssp *bulgaricus* and *Streptococcus thermophilus*, which can be accompanied by other lactic acid bacteria that helps bring specific characteristics in the final product (Brasil, 2000). Yogurt is recognized as a healthy product which has growing consumer demand because of healthy eating trends. In addition, the yogurt market is characterized by innovations that have attracted new consumers (Macbean, 2010).

Yogurt is a food manufactured by bacterial fermentation of milk. Frozen yogurt is a frozen dish made with yogurt and occasionally other dairy items. It may or may not contain live bacteria cultures, as in yogurt, and its tartness differs when compared to ice cream. Ice cream is a frozen delicacy that is often produced from milk and cream (Ruopeng & Jiang 2017). Food and Agriculture Organization of the United Nations/World Health Organization (FAO/WHO) has given a solid definition of probiotics as "live microorganisms, which, when administered in adequate amounts, confer a health benefit on the host" in 2001.

Smoothie is a consistent soft drink prepared with fresh fruit puree and milk, yogurt, or ice cream. The combination of fruit beverages and dairy products is gaining a lot of interest among the consumers as juiceceuticals, like fruit-yogurt beverages that are typical examples of dairy products offering health, flavor, and convenience. The fruits can be added to yogurt alone as such or in the form of blends, chilled or frozen, and as juice or syrups, (Rani *et al.*, 2016). Smoothies can be defined as the non-alcoholic liquid refreshment which can be prepared from fresh or frozen fruits and vegetables. They are blended and consumed without straining and frequently served over crushed ice. The other components that can be added to smoothies are yogurt, milk, tea, lemonade, spices, ice cream and sauces. Smoothies have slightly thicker consistency than slushie (Castillejo *et al.,* 2015). Gibson and Roberfroid defined prebiotics as "non-digestible food elements that benefit the host by selectively encouraging the growth and/or activity of one or a restricted number of bacteria in the colon, and thereby enhances host health" in the 1990s (Roberfroid *et al.,* 1993).

Fruit yogurt by heating whole milk in a pre-washed pan on the heater to lower around one-third of its original volume. Following boiling, 12% sugar was added to the milk. To avoid the production of a cream layer, the milk was constantly swirled with a stirrer while heating. After reaching the desired temperature, the milk pan was removed from the heater and left to cool. When the milk reached about 40°C, yogurt were separated into different portions and fruit juices of pineapple, apple, and sweet lemon were blended. 2% starter culture was added to milk and allowed to incubate at 37° until coagulation was complete (8-12 h). The yogurt samples were stored at refrigeration temperature of 4°C (Gangwar *et al.*, 2016).

Recipe of smoothie often contains a variety of different fruits and vegetables in homogenized form. Notable differance between fruit and smoothies are the higher soluble fiber content in the later (4.g per serving on average). Major fiber content in smoothies are pectin which will increase the short time satiety. Diets rich in fruits and vegetables are gaining interest because of its health benefits like reducing the risk of cancers, chronic disease and cardiovascular diseases. Smoothies are ideally suited for a markets in which consumers prefers the highest quality products that are convenient, minimally processed, clean label, with fresh like flavor and has good taste and appearance (Tiwary *et al.,* 1997).

The synergistic combination of probiotics and prebiotics is called as synbiotics. Regular diet containing synbiotics is known to impart health benefits such as improved immune response, decrease intestinal infections, maintain intestinal integrity and reduces the allergic response, influences gastric and digestion motility. Lifestyle changes due to unhealthy diets, exposure to tobacco smoke, use of alcohol, globalization and non communicable diseases are affecting around 80% of low and middle income groups. Use of probiotics as an alternative source of therapy in fighting against many diseases can be achieved along with balanced diet, healthy life style and clean environment (Pande *et al*., 2012).

Mango contains adequate amounts of fiber which is beneficial for numerous gastrointestinal diseases. The communities among many developing countries that do consume more amounts of fiber have been shown to have lower percentage of GI diseases. Dietary fiber has many healthy effects on the gut and overall health of human beings and other body functions because dietary fiber is also associated with decreased incidences of diseases and including obesity, cancer, diabetes, chronic bowel disorder and cardiovascular diseases (Fizza Mubarik *et al.,* 2020).

MATERIAL AND METHODS

A. Raw material preparation

The experiment was conducted in Department of Food Microbiology and Safety, College of Food Technology, VNMKV, Parbhani, Maharashtra. In this study sugar and other non-nutritive sweeteners such as Stevia, Fructooligosaccharides and Liquid jaggery were used. Milk, sugar, mango and liquid jaggery were purchased in local market and fructooligosaccharides, stevia and yogurt starter was obtained through online.

B. Sub-culturing of stock culture

The freeze-dried yogurt culture containing Streptococcus thermophiles and *Lactobacillus bulgaricus* is obtained online. This culture was kept as a stock culture. To increase the biomass of the culture, it is allowed to grow on Lactobacillus MRS broth. After 72 hours broth along with culture is transferred to test tubes with screw caps and is centrifuged at 4000 rpm for 7 minutes.

Preparation of lactobacillus MRS broth
↓
Addition of stock culture
↓
Incubate at 37 °C for 72 hours
↓
Centrifuge at 4000 rpm for 7 mins
↓
Discard supernatant
↓
Store subculture in the freezer

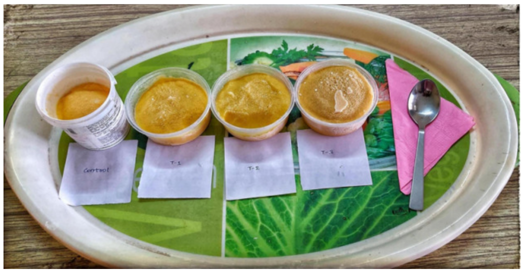
Flow sheet 1: Procedure for Subculturing.

C. Preparation of sweetened yogurt

Sweetened yogurt was prepared using buffalo milk along with 5% Skimmed milk powder. Obtained buffalo milk was pasteurized at 72ºC for 15 sec to kill pathogens and skimmed milk powder was added while pasteurizing. After pasteurization, milk was homogenized to prevent fat separation. Sugar, Stevia, Fructooligosaccharides and Liquid jaggery were added to four different portions of sweetened milk and was allowed to incubate after inoculation of 1% yogurt culture @ 38 ºC for 8 hours or till curd formation and the obtained yogurt was stored in refrigerator till further use.

D. Preparation of Frozen yogurt smoothie

Frozen yogurt smoothie is prepared with the reference of Terpou *et al.* (2019) with slight modification by blending sweetened yogurt, mango pulp and psyllium husk. For the preparation of yogurt whole milk of buffalo is collected from local market skimmed milk powder is added and pasteurized at 72 ºC for 15 secs. After pasteurization, homogenization is carried out then the milk is taken in 4 containers. Sugar is added in the first container and is kept as control. For the remaining 3 containers non-nutritive sweeteners such as Fructooligosaccharides, Stevia and Liquid jaggery is added. Sweetening agents are dissolved in milk. After cooling the milk to room temperature, 1% of culture is added and kept to incubate at 38ºC for 8 hours. After 8 hours, prepared set yogurt is transferred to refrigerator and is stored in there till further use. Mango is used for the preparation of smoothie. Mangoes of Dasheri variety were purchased from local market. Fruits were washed under water and then the peel and stone is removed using clean knife. Collected fruit pulp is stored in deep freezer at -18ºC for 4 hours, after freezing, the pulp and psyllium husk is added to mixer and blended till uniform mixture is obtained and then yogurt is added into the same blender and blended along with the previous mixture till smooth and uniform consistency. After that yogurt smoothie is transferred into polypropylene container and stored in deep freezer at -18 ºC.



Collection of buffalo milk
↓
Addition of 5% SMP
↓
Pasteurization
↓
Homogenization
↓
Addition of sweetener
↓
Inoculation of culture @1%
↓
Incubate @ 38° for 8 hrs
↓
Store in refrigerator

Ripened mango
↓
Cleaning
↓
Removal of peel
↓
Destoning
↓
Freeze the pulp
↓
Blend the pulp with psyllium husk till soft and uniform

Blend till uniform mixture
↓
Transfer into Polypropylene container
↓
Store at -18°

Flow sheet 2. Preparation of Frozen Yogurt Smoothie.

E. Sensory evaluation

Color, texture, sweetness, flavor, sweetness, appearance, after taste and overall acceptability of four frozen yogurt smoothies containing sugar, stevia, fructooligosaccharides and liquid jaggery were evaluated organoleptically using semi-trained panel on a 9 point hedonic scale ranging from 9 being Like extremely and 1 being dislike extremely.

F. Proximate analysis

Frozen yogurt smoothie containing various non-nutritive sweeteners were subjected to proximate analysis in order to determine the components such as moisture, fat, crude protein, ash and crude fiber according to AOAC, 2000 and carbohydrate by difference method.

G. Microbial analysis

Microbial analysis as recorded by Harrigan and Mccance (1996) was conducted to determine the Total plate count of the frozen yogurt smoothie. Nutrient agar plates incubated at 37°C for 48 h was used for Total plate count. Microbiological count data are expressed as Colony Forming Units (CFU) per gram of yogurt. 12 dilutions were carried out to determine the number of microbes present throughout the storage.

H. Physico-chemical properties of smoothies

The physicochemical parameters such as TSS, pH and acidity content of the samples was analyzed as per AOAC (2000) methods. The pH was measured using a pH meter. Acidity was measured by titrating the sample against 0.1 N NaOH solution and expressed in terms of % lactic acid. Refractometer was used to find TSS of the sample.

RESULTS AND DISCUSSION

The organoleptic characteristics of prepared frozen yogurt smoothies play major role in attracting customers to go for the product. Based on sensory properties of product like, color, texture, flavor, appearance etc. Consumer judges the product quality and weather to buy it or not. Organoleptic evaluation was conducted using nine point hedonic scale with 1 being dislike extremely and 9 being like extremely.16 semi-trained panel were involved in sensory analysis.

Frozen yogurt smoothie was evaluated based on characteristics such as color, texture, flavor, sweetness, appearance, after taste and overall acceptability. The obtained results were shown in the Table 1.

A. Sensory analysis of frozen yogurt smoothies

According to the the results shown in Table 1 the product containing T-2 had the highest score of 8.1 as the quantity of stevia used to sweeten the product was very less it had barely any effect on the original color of the smoothie (yellow/orange), followed by fructooligosaccharides and control and the one that scored least was smoothie containing liquid jaggery. Liquid jaggery was brownish golden in color which had imparted its color to the final product making it slightly brown. Sample T-2 had better texture with the highest score of 8.0. It is because of the tiny granular structure of the fructooligosaccharides, on addition, it gave smooth consistency to the product.

Table 1: Sensory analysis of frozen yogurt smoothies containing various non-nutritive sweetener.

Sample	Control	T-1	T-2	T-3	SE±	CD@5%
Color	8.0	8.0	8.1	7.2	0.042	0.052
Texture	7.8	8.0	7.9	7.8	0.035	0.063
Flavor	7.8	7.9	8.2	7.3	0.065	0.135
Sweetness	7.5	8.2	8.2	7.4	0.023	0.096
Appearance	7.8	8.0	7.9	7.3	0.089	0.116
After taste	7.9	7.8	7.7	7.3	0.073	0.158
Overall acceptability	7.9	8.2	8.1	7.5	0.054	0.183

***Each value is average of sixteen determinants**

Control - Frozen Yogurt smoothie containing Sugar as sweetener

T-1 - Frozen Yogurt smoothie containing FOS as sweetener

T-2 - Frozen Yogurt smoothie containing Stevia as sweetener

T-3 - Frozen Yogurt smoothie containing liquid jaggery as sweetener

The smoothie containing stevia was rated highest followed by T-1 and control and T-3 being the least. All the samples had good aftertaste after having the product among which control has stood first with score of 7.9 followed by T-1, and T-3 being the least scored. Sample T-2 which had stevia in it contains a glycoside molecule, rebaudioside A that gives it slightly bitter aftertaste hence it has scored 7.7.

Overall acceptability is a measure which is influenced by various things sensory properties like color, flavor, texture, taste etc. The maximum overall acceptability score (*i.e.* 8.2) was found in sample T-1 containing fructooligosaccharides as non-nutritive sweetener. Followed by sample T-2 containing stevia and then control and lastly sample T-3 containing liquid jaggery.

B. Proximate analysis of frozen yogurt smoothies

The proximate composition of frozen yogurt smoothies containing different non nutritive sweeteners is depicted in the Table 2 and it is revealed that the sample T-1 contains highest carbohydrate content (31.1%) followed by control (20.24%) and T-3 (16.19%). Sample T-2 contains highest protein content (9.62%) followed by T-1 (7.8%) both control and sample T-3 had same amount of protein (7%). Fat content of sample T-3 is found to be 4.17% which is the highest among 4 samples followed by T-2 (3.52%) and control (3.35%). Crude fiber content is highest in control sample (6.7%) followed by T-3(5.6).

Mineral composition of frozen yogurt smoothie with the parameters like calcium, potassium and iron are revealed in Table 3. The results from the Table 3 shows that the potassium content was the highest followed by calcium and iron. Calcium content of control was found to be 242 mg/100 g and that of T-1 was 256mg/ 100 g, T-2 had 262 mg/ 100 g and T-3 had 248 mg/ 100 g. Potassium content of Control, T-1, T-2 and T-3 was 453 mg/ 100 g, 448 mg/ 100 g, 464 mg/ 100 g and 436 mg/ 100 g respectively, iron was present in minor quantity when compared to calcium and potassium. Iron content in Control, T-1, T-2 and T-3 was 3.2 mg/ 100 g, 3.4 mg/ 100 g, 3.1 mg/ 100 g and 4.3 mg/ 100 g respectively.

Table 2: Proximate analysis of frozen yogurt smoothies.

Sample	Control	T-1	T-2	T-3
Moisture content (%)	67.19	55.73	72.4	69.75
Carbohydrate (%)	20.24	31.1	11.9	16.19
Protein (%)	7.0	7.8	9.62	7.0
Fat (%)	3.35	2.87	3.52	4.17
Ash (%)	2.21	2.67	2.51	2.67
Crude fibre (%)	6.7	4.58	4.6	5.6

C. Mineral composition of frozen yogurt smoothies

Table 3: Mineral composition of frozen yogurt smoothies.

Mineral	Control	T-1	T-2	T-3
Calcium (mg/ 100 g)	242	256	262	248
Potassium (mg/ 100 g)	453	448	464	436
Iron (mg/ 100 g)	3.2	3.4	3.1	4.3

D. Total plate count of frozen yogurt smoothies

Table 4: Total plate count of frozen yogurt smoothies.

Time in days	Control	T-1	T-2	T-3
0	3.2×10^8	2.3×10^8	2.9×10^8	4.0×10^8
15	3.6×10^8	3.5×10^8	4.1×10^8	4.3×10^8
30	5.1×10^8	6.9×10^8	4.7×10^8	5.9×10^8
45	5.7×10^8	7.1×10^8	6.8×10^8	7.6×10^8

The results from the Table 4 shows that the TPC of control sample was found to be 3.2×10^8, 3.6×10^8, 5.1×10^8 and 5.7×10^8 on the 0^{th}, 15^{th}, 30^{th} and 45^{th} day of the storage. The TPC of sample T-1 was found to be 2.3×10^8, 3.5×10^8, 6.9×10^8 and 7.1×10^8 on the 0^{th}, 15^{th}, 30^{th} and 45^{th} day of the storage. The TPC of sample T-2 was found to be 2.9×10^8, 4.1×10^8, 4.7×10^8 and 6.8×10^8 on the 0^{th}, 15^{th}, 30^{th} and 45^{th} day of the storage. The TPC of sample T-3 was found to be 4.0×10^8, 4.3×10^8, 5.9×10^8 and 7.6×10^8 on the 0^{th}, 15^{th}, 30^{th} and 45^{th} day of the storage. On observing the Table 4, it can be concluded that the total plate count of the frozen yogurt smoothie increases with increase in storage periods.

E. Change in Physico-chemical properties of yogurt during storage

Physico chemical properties such as Acidity, pH and TSS were measured during 0^{th}, 15^{th}, 30^{th} and 45^{th} day of storage period. Results of acidity change during storage is shown in Table 5 where acidity of the samples increased during its storage period. pH change during storage is shown in Table 6. It can be seen that the pH decreases as the product becomes old. Change in TSS during storage is shown in Table 7 and TSS of the product decreased on storage. The obtained results were similar to the results obtained by Meenakshi *et al.* (2018).

Table 5: Change in acidity during storage.

No. of Days	Control	T-1	T-2	T-3
0	0.82	0.84	0.83	0.91
15	0.86	1.16	0.87	1.13
30	0.92	1.18	0.93	1.16
45	0.98	1.19	1.05	1.17

Table 6: Change in pH during storage.

No. of Days	Control	T-1	T-2	T-3
0	4.4	4.6	4.3	4.5
15	4.2	4.4	4.1	4.2
30	4.0	4.1	4.0	4.0
45	3.7	3.9	3.8	3.8

Table 7: Change in TSS during storage.

No. of Days	Control	T-1	T-2	T-3
0	17	18	16	17
15	15.5	17	15.5	16
30	14	15.5	15	15
45	13	14	14	14.5

CONCLUSION

The present study focuses on standardization and quality evaluation of frozen yogurt smoothie containing non-nutritive sweeteners and development of minimally processed, convenient, protein rich and low calorie functional food. Proximate analysis table shows that the protein and dietary fibre of the smoothies ranges from7-9.62 % and 4.58- 6.7%, thus it can be concluded that the yogurt combined with fruits like mango has good nutritional profile when it is combined with non-nutritive sweetener it enhances the health benefits. The process of frozen yogurt smoothie preparation was standardized by varying the Skimmed milk powder content in the yogurt and quantity of non-nutritive sweeteners. On evaluation among 4 frozen yogurt smoothies containing sugar, FOS, stevia and liquid jaggery, the smoothie containing FOS had highest overall acceptance score followed by T-2 and control.

The obtained results revealed that the formulated frozen yogurt smoothie was good source of protein, carbohydrates, crude fiber and minerals and is low in calorie. Hence it is concluded that developed method of preparation of frozen yogurt smoothie with non nutritive sweetener have good nutritional and health benefits with easy method of preparation. Incorporation of non-nutritive sweeteners into food products which can be consumed as breakfast and snacks provide rich nutrients without side effects like cardiovascular diseases, diabetes etc. Therefore, development of different functional foods incorporated with non-nutritive sweeteners will provide new opportunities for the entrepreneurs to strengthen their economy and food processing sector.

Conflict of Interest. None.

REFERENCES

AOAC (2000). Methods of analysis, 17th ed. Association of official Analytical Chemists, Washington, DC.

Brasil, (2000). Ministério da Agricultura, Pecuária e Abastecimento. Instrução Normativa nº 1, de 7 de janeiro de 2000. Regulamento técnico geral para fixação dos padrões de identidade e qualidade para polpa de fruta. Diário Oficial[da] República Federativa do Brasil, Brasília, DF.

Castillejo, N., Martínez-Hernández, G. B., Gómez, P. A., Artés, F., & Artés-Hernández, F. (2016). Red fresh vegetables smoothies with extended shelf life as an innovative source of health-promoting compounds. *Journal of food science and technology*, *53*(3), 1475-1486.

Fizza Mubarik, Sana a Nore en, Fatima Farooq, Ayesha Siddiqa and Muddassir Khan (2020). A Review on Pharmacological and Nutritional Benefits of Mango (*Mangifera indica* Linn): A remedy for cancer, diabetes, and gastrointestinal infections. *American Journal of life Sciences*, *3*(2), 82-92.

Harrigan, W. F and McCance (1966). Laboratory methods in food and dairy microbiology, Academic press, London.

Macbean, R. D. (2010). Packaging and the shelf life of yogurt. In: ROBERTSON, G. L. (Ed.). Food packaging and shelf life: a practical guide. Boca Raton: CRC Press, 143-156.

Meenakshi, Suganya and Umamaheswari, T. (2018) Formulation of Value Enriched Probiotic Fruit Yoghurt, Community Science College and Research Institute, Madurai, Tamil Nadu Agricultural University, Tamil Nadu, India. *International Journal of Current Microbiology and Applied Sciences*, *7*, 1440-1450.

Pande, S., Aparna, V. S., Chauhan, A. K. & Singh, M. (2020). Development of phytonutrient enriched avocado milkshake powder and its quality evaluation. *Indian. Journal of Dairy science*, *73*(6), 1-7.

Rani, R., Kumar, M. H. S. and Sabikh, L. (2016). Process optimisation for a ready-to-serve breakfast smoothie from a composite milk-sorghum base. *International Journal of Dairy Technology.*

Gangwar, R., Hai, H., Sharma, N., & Kumar, P. (2016). Development and quality evaluation of yoghurt fortified with pineapple, apple and sweet lemon juice (fruit yoghurt). *International Journal of Engineering Research*, *5*(3), 621-629.

Roberfroid, M., Gibson, G.R & Delzenne, N., (1993). The biochemistry of oligofructose, a nondigestible fiber: an approach to calculate its caloric value. *Nutritional Review*, *51*, 137–146.

Ruopeng & Jiang Ning (2017). Frozen yogurt and ice cream were less healthy than yogurt, and adding toppings reduced their nutrition value: Evidence from1999–2014NHANES, *Nutrition Research*, doi: 10.1016/j.nutres.04.013

Terpou, A., Papadaki, A., Bosnea, L., Kanellaki, M., & Kopsahelis, N. (2019). Novel frozen yogurt production fortified with sea buckthorn berries and probiotics. *LWT*, *105*, 242-249.

Tiwary, C. M., Ward, J. A. & Jackson, B. A. (1997). Effect of Pectin on satiety in healthy US army adults. *Journal of the American College of Nutrition*, *16*(5), 423-448.

How to cite this article: Raksha G.P., Deshpande H.W., Monishdeep V., Wanole P.D. and Poshadri A. (2022). Studies on Preparation of Frozen Yogurt Smoothie using Non-Nutritive Sweetener. *Biological Forum – An International Journal, 14*(4a): 499-504.