Journal of Agriculture and Veterinary Science
ISSN: 2959-1198 (Print), 2959-1201 (Online)

Review Article

Nutritional Importance of Stirred Yogurt

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Article History
Received: May 15, 2022
Accepted: June 29, 2022
Published: July 14, 2022

Abstract

Yogurt is a nutrient-rich food product obtain by bacterial fermentation of milk. Recently, numerous studies have been reported its tremendous health effects through fortification and addition of different fruits provides several nutrients which may help to upgradation of health of vulnerable groups. Fruits yogurt is excellent source of essential amino acids, calcium, vitamin D, riboflavin, vitamin B6 and vitamin B12. It promotes gut microbial population as carrier of probiotics which control intestinal infections reduce the serum cholesterol levels and lactose intolerance and reduce the chance of cancer. Yogurt is a functional food, preventive medicine, and residence treatment in the new times requires persistent and transparent public education. This review paper highlighted the importance of fortification of indigenous fruits to makes fruits yogurt.

Keywords: Yogurt; Nutrient; Milk; Fermentation.

Introduction

Yogurt with fruits addition has higher potential to boost the nutritional and health promoting effects. Number of research activities and studies have been carried out in order to boost up the properties of yogurt. Addition of fruits basically alters the characteristics/parameters like PH, acidity, Total soluble solids, antioxidant, antimicrobial and phenolic content. These parameters greatly affect the nutritional and physical qualities of yogurt. These studies were based on the use of fruits that were easily available within that specific locality where research studies had been carried out. A brief overview highlighting the key points is presented as under in order to provide a foundation for this research.

Importance of fruits yogurt

Fruit and yogurt have been considered individually as indicators of healthy dietary patterns. Fruits are usually low in energy and are an excellent source of prebiotic fibers antioxidants, and polyphenols which are very helpful for promoting digestive health. Yogurt, is a nutrient-dense food that is a source of dairy protein, calcium, magnesium, vitamin B-12, conjugated linoleic acid, and other key fatty acids. Besides this, it contains beneficial bacterial cultures, making it a potential source of probiotics. Yogurt's unique fermented food matrix provides added health benefits by enhancing nutrient absorption and digestion. Combining the intake of yogurt and fruit could provide probiotics, prebiotics, high-quality protein, important fatty acids, and a mixture of vitamins and minerals that have the potential to exert synergistic effects on health.

Fruits drinking yogurt

According to study, different percentages of sour cherry pulp were introduced in the yoghurt drink and sensory evaluation was performed by a trained panel of judges using 9 points hedonic scale at different interval of storage. It was observed that yoghurt fortified with sweet cherry pulp has high phenolic contents as well as have strong antioxidant activity. A decrease in the dry matter, ash, protein, fat and syneresis and increase in the viscosity of the drink was also observed. Highest score was given by the panelists to the fruit yogurt containing 8% sour cherry pulp which was stored for 1 day. It was suggested that enrichment of the sour cherry in the yoghurt may take place due to its high antioxidant activity on the commercial level. Antioxidant activity also protect against cardiovascular effect. So, it was concluded that 8% (w/w) of cherry pulp may be recommended in the production of sour cherry yoghurt on commercial level (Şengül *et al.*, 2012). Similarly, another research showed that adding Cherry laurel marmalade to yogurt affects overall acceptability and titratable acidity positively but decreased syneresis and flavour. While storage interval showed that syneresis, pH, flavour and overall acceptability scores declined significantly as compared to control, but titratable acidity increased significantly (Temiz, 2013). In the same way mulberry pekmez (concentrated juice) at varying concentration of 2.5, 5, 7.5 and 10 % into milk results in higher pH i.e. 4.65 to 5.57 as compared to plain yogurt that who's PH is 4 (Celik *et al.*, 2013). A mango drinking yoghurt was made and sensory evaluation was performed by the panel of judges using 9 points hedonic scale. Highest score was obtained by the treatment which was manufactured by using 6% mango pulp and 94% drinking yoghurt. Different physicochemical tests were performed and concluded that fat and protein contents decreased while acidity, TS and SNF were increased (Raut *et al.*, 2015). A peach flavored drinking yogurt fortified with fructooligosaccharide (prebiotic) and *Lactobacillus acidophilus* (probiotic) was manufactured and undergone sensory evaluation by using 9 points hedonic scale. Sensory score of the drinks demonstrated that drink containing synbiotic had sourer and yeastier flavor than that of the control as well as prebiotic drink. It was also concluded that the yogurt drinks made by the whole milk were scored high as compared to that of made by the skim milk. Whole milk yoghurt drink containing prebiotic were preferred mostly. Fortification of synbiotic was disliked by consumers (Gonzalez *et al.*, 2011). Adding any of blackberry or blueberry noticeably enhanced total phenolic compound (TPC) and antioxidant activity of drinking yogurt, this rise was declined till the end of storage period either for controlled condition treatments (Balasundram *et al*., 2006). In another research carrot juice was added to fermented milk. Syneresis and pH were found increasing significantly, whereas titratable acidity (TA) decreased. The result tells us that yoghurt with less syneresis and high nutritional and total carotenoids contents can be processed from 10 to 15 percent carrot juice and 0.7 percent stabilizer additions (Emun *et al.*, 2016).

A research highlighted that the effect of hydrocolloids on the sensory characteristics of drinkable yogurt. Yogurt with gelatin (hydrocolloid) had significant positive effect on sensory parameters. This research also shows that there is an increase in acidity and protein content by the addition of hydrocolloid's (Ahmed and Mohamad, 2014). Drinking yoghurt containing different fruit flavours with w/w ratio of 7% was made. It was then stored at 5 ºC for 10 days. These all samples then subjected for sensory, bacterial, chemical and some rheological properties. Coli-form count, total bacterial count, yeast and mold counts were determined in all yoghurt samples at 1, 6 and 10-days intervals. A significant difference in protein, fat, total solids and titrable acidity was observed in all samples at zero day of storage. Difference between protein and dry matter was because of the addition of different dry matters. An increase in titrable acidity and syneresis was observed during storage period. Drinking yoghurt containing Morello and grape

https://doi.org/10.55627/agrivet.01.01.0239

molasses got higher flavor score as compared to other flavors, while high mesophilic bacterial count was observed in grape molasses containing drink. Significant increase in yeast and mold was observed in all drinks during storage at 5 ºC. Cornelian marmalade containing drinking yoghurt was not preferred because of having high level of acidity. This was also observed that body texture and flavor of fruit drinking yoghurt decreased during storage, while addition of fruit level can increase in the flavor score of the product (Sun-Waterhouse *et al.*, 2012).

Stirred yogurt

A study depicts that the use of apple and banana fruits pulp to make stirred yogurt caused significant variation in the parameter such as PH, acidity, protein and carbohydrate (lactose). An increase in protein and carbohydrate content by the addition of fruits pulp was observed. Besides that, physicochemical qualities were found relatively better at two days of storage in banana and apple based stirred yogurt (Mahmood *et al.*, 2008). Similarly, study focused to investigate the impact of loquat fruit (*Eriobotrya japonica*) marmalade at different levels on the physicochemical and sensorial characteristics of yogurts during the storage period were carried out. The increasing of marmalade levels significantly decreased titratable acidity and syneresis, while pH values significantly increased. Yogurts containing loquat marmalade 15 % were acceptable for overall acceptability (Temiz, 2013). Another similar research showed the effect Persimmon marmalade and puree in yogurt. The antioxidant activity, physicochemical and sensory properties remained stable during the storage period. The result showed, by the addition of 12% persimmon marmalade into yogurt increased sensory attributes. The yogurt with persimmon puree showed lower antioxidant activity than the yogurt containing persimmon marmalade (Arslan and Bayrakci, 2016). Similarly, apricot based Yogurt stored at 4 ◦ C for shelf life and were studied over a period of 22 days. The results obtained with the addition of 9% apricot pulp showed the best quality up to 22 days of storage. The lactose, fat contents and pH were decreased over the period of storage, whereas total solids and acidity of fruit yogurt increased in all the samples. However, body texture, physical appearance and flavour of fruit yoghurt were found deteriorating progressively (Kauser *et al.*, 2011). In the same way addition of blueberries into yogurt was also studied, the result of study showed that the addition of blueberries increases syneresis and decrease the pH and whiteness of yogurt, and this study suggested that addition of 5% berries showed the significant effect on physicochemical and sensory characteristics (Cinbas and Yazici, 2008). A research study showed yogurt with pomegranate pulp has been developed. Probiotic Greek Dahi with 20% the pomegranate pulp had significantly decreased pH, but titratable acidity, fat, total solid and carbohydrate and ash percentage were significantly increased compared to the control probiotic Greek Dahi, Probiotic Greek Dahi with 20% pomegranate pulp showed the highest quality acceptance by consumers, Dahi fortified with pomegranate pulp is a nutrition's food with high acceptance by consumers (Reeta *et al.*, 2016). Another study revealed that strawberry based yogurt with the addition of microencapsulated salmon oil (2% wt/vol) and evaluated its properties during one month of storage. Addition of MSO in strawberry based stirred yogurt had no significant effect on pH and syneresis. This study concluded that stirred yogurt could be fortified with microencapsulated salmon oil (Estrada *et al.*, 2011). In the study sensory and textural properties were checked by the addition of whey protein isolate, skim milk powder and sodium caseinate in 12 days of storage. Consumer acceptability also was measured. Result showed addition of whey protein isolate reduced syneresis and highest viscosity but sensory properties were not desirable but on the other hand yogurt fortified with texture improver and sodium caseinate showed better physical and sensory characteristics and preferred by Turkish consumer (Isleten and Karagul-Yuceer, 2006). In a research the effect of green coffee

https://doi.org/10.55627/agrivet.01.01.0239

powder and green tea powder on the syneresis and consistency of stirred yogurt. By the addition of green coffee powder at (1 or 2 percent) decreased syneresis rate but on the other hand green tea powder effect on syneresis was concentration dependent. Green tea powder decreased syneresis when it was added at 0.02% and when it was added at 2% syneresis increased. No significant difference was observed in the syneresis rates when GTP was added at 1 and 0.01%, until 14 and 7 days of storage, respectively (Dönmez *et al.*, 2017). In a similar study the addition of Nano powder chitosan improved the functionality of the yogurt. The result of study showed that NPC at the concentration (0.3 to 0.5% vol/vol) could be used to produced cholesterol free yogurt without significantly adverse effect on sensory and physicochemical properties of yogurt (Seo *et al.*, 2009).

In another research the effect of addition of Osmodehydrofrozen fruit on sensory and quality during the storage. The result showed that addition of 10% apple and 13% strawberry in yogurt had better quality. The syneresis is lower in apple containing yogurt because apple has high osmotic activity. Strawberry yogurt has better taste, texture and mouthfeel was good of yogurt containing higher percentage of fruits. The results also showed that storage intervals had significant effect on pH, acidity, syneresis, taste and texture (Vahedi *et al.*, 2008).

A research highlighted the addition of mango pulp into yogurt and concluded the effect of mango pulp in the physicochemical parameter of yogurt. Increasing the mango pulp increase results the increase total solid, acidity and solid not fat, while fat and protein content decreased. The results also showed that addition of 6% mango pulp into yogurt have highest sensory score (Raut *et al.*, 2015).

A research showed that addition of different fruit flavour into yogurt and their physicochemical and sensory parameter were observed up to 10 days storage. There was great significantly difference in protein, total solids (TS), fat, ash and titratable acidity (TA) for samples amount after one day of storage. Titratable acidity and syneresis were observed increasing over the storage period. Grape molasses and Morello when added to yoghurt won higher flavour scores than using other flavouring (Küçüköner and Tarakçı, 2003).

Hassan and Amjad (2010) studied physiochemical analysis and nutritional evaluation of yogurt, prepared by various starter cultures during storage. This study showed that pH and moisture values degraded gradually while total solid mass and acidity were slightly raised during 12 days storage period. In a research different ratios of cornelian cherry paste and sugar were used to prepared yogurts and the effect of sugar and paste on organoleptic and physicochemical properties of yogurt were studied. pH, titratable acidity and organoleptic properties of experimental yogurts were examined at weekly intervals. The pH of above- mentioned yogurt declined significantly whereas viscosity, whey separation and titrable acidity increased during the storage period. Yogurt with 10 kg/100 kg sugar 10 kg/100 kg fruit paste had high acceptability level and high score in context of overall acceptability value by judges however the result was statistically insignificant (Celik *et al.*, 2013). A research revealed the effect of Mexican caramel jam on pH and acidity of Mexican caramel jam-based yogurt. Acidity increase pH decreased with the addition of Mexican caramel jam (Ramírez-Sucre and Vélez-Ruiz, 2013).

In another study yoghurt with caramel jam flavour was manufactured and its physiochemical and flow properties in terms of caramel jam flavour, gum, fats and storage period of the product were observed. It is observed that acidity, soluble solids, pH, colour and syneresis were affected largely during manufacturing and storage time. Caramel contents, fats and storage time highly affected the flow behavior of the product. Storage time and fat contents both raised the value of yield stress and consistency coefficient while lowered the flow behaviour index. On the other hand, the concentration of caramel jam flavour caused a decrease in yield stress and consistency coefficient while

https://doi.org/10.55627/agrivet.01.01.0239

increasing the behaviour index of flow. It was also noticed that the amount of hydrocolloid individually had no effect on the flow properties of yogurt but combined with storage time (Ramírez-Sucre and Vélez-Ruiz, 2013).

A study was carried out in which yoghurt enriched with strawberry pulp was made and shelf life of prepared yoghurt was estimated. The results concluded that strawberry drinking yoghurt had the shelf life of 30 days at refrigerated temperature but during this time period antioxidant activity, total anthocyanin contents as well as total phenolic contents were decreased. It was also observed that phytochemicals were also affected so their concentration decreased during the shelf life of yoghurt. Strawberry polyphenols and protein were the most affected and reduced during storage of 24 hours due to the complex formation with beta lactoglobulin (Oliveira *et al.*, 2015).

The research was done for the preparation of fruit yoghurt drink with different percentages (5%, 10% and 15%) of fruit juice from different fruits like orange, grape and strawberry. Different microbiological and physicochemical properties were studied to evaluate the excellence of the yoghurts. Of all samples, yoghurts with 10% orange juice was rated as the best quality yogurt. The colour, taste, smell, body texture and consistency of the fruit yoghurts were uniformly satisfactory. Fruit yogurt with 10% and 15% strawberry hold more acid and its texture was broken down in refrigeration temperature. The moisture content and acidity of fruit yoghurts were amplified than plain yoghurt as of high content of these in the fruits. The protein, fat, ash and carbohydrates content of strawberry and orange fruit yoghurt were declined than normal plain yoghurt but for grape yoghurt, carbohydrate content was augmented since there is more sugar in grape as compared to other two fruits and milk itself. Results highlighted that yoghurt having 10 % orange juice was more suitable in all quality characteristics when compared with other samples. The acid content of the fruits and hence the microbiological activity of the fruit yoghurts were also satisfactory. In case of strawberry yoghurt, fruit juice concentration more than 5% was not suitable for fruit yoghurt because that are highly acidic and curd was cracked down at refrigerated condition. Yoghurt prepared with 10% orange juice was the best in all quality point of view among the yoghurts manufactured in this study. Yoghurt having 5% was also acceptable slightly but those having 15% were not liked (Hossain *et al.*, 2012).

A research was carried out on fruit yogurt with various type of fruit pulp (papaya, watermelon and banana) with concentration of 5, 10 and 15 percent and at refrigerated storage for 15 days, to study the physicochemical and sensory during storage phase. The results revealed that physio-chemical and organoleptic characteristics of fresh yogurt samples were greatly influenced by the addition of fruit pulp. Samples of fruit yogurt were found with good textural quality and lesser syneresis value as compared with the control sample stored in refrigerator. Among all treatments, blending of 15% banana pulp led to a lower syneresis in yogurt. With all percentage's papaya yogurt was found most accepted, whereas at the end of storage period watermelon yogurt samples were found not preferred by panelists. Yogurt with 15% fruit pulp, and specially papaya fruit could be recommended (Southgate, 1991). The research study concluded that the addition of fruits into yogurt may increase the therapeutically as well as nutritive value. In this study yogurt was prepared by the addition of 10, 20 and 30 percent white and red dragon fruits and their physicochemical and functional parameter studied. All fruit-based yogurts basically reported lower pH readings (3.95 - 4.03) as compared to those of plain yogurt (pH 4.05). Yogurt in both cases given a higher lactic acid percentage fruit yogurt (1.14-1.23%) and plain yogurt (1.08%). In all fruit-based yogurts a notably higher percentage of syneresis (57.19 - 70.32%) was observed as compared to those of control yogurt (52.93%). The presence of white and red dragon fruit enhanced the antioxidant value from 19.16 % of plain yogurt to a value of 24.97-45.74% for fruit-based yogurt. The

https://doi.org/10.55627/agrivet.01.01.0239

phenolic content of all fruit containing yogurt showed a rise in in values (36.44 - 64.43mg/ml) as compared to plain yogurt (20.25mg/ml). However, the addition of white and red dragon fruit the proteolysis of milk did not enhance during fermentation. Therefore, we can conclude that lactic acid content, milk fermentation rate, antioxidant activity, syneresis percentage, and total phenolic content in yogurt are greatly influenced by the addition of white and red dragon fruit into yogurt (Zainoldin and Baba, 2009).

Nutrient profiles of fruit and yogurt

Fruit excellent source are fiber, antioxidants nutrients as well as potential source of prebiotics. Beside this they are an excellent source of dietary fiber, potassium, antioxidants, phenolic compounds, and carotenoids (b-carotene, lycopene, lutein, and zeaxanthin) and are very low in energy density and high in water content (Chandan, 2017). Most fruits contain negligible amounts of fat and protein and little starch (except for bananas), and have a relatively high percentage of simple sugars, such as fructose and sucrose. Fruits are particularly high in insoluble fiber, which has the digestive benefit of adding bulk to the stool, and high-fiber diets have been linked to lower incidences of gastrointestinal disease, cardiovascular disease (CVD), and certain cancers (WHO, 2016). Recommendations for fiber intake, set by the Institute of Medicine based on CVD risk, are rarely met in the United States. In a standard 2000 kcal/d diet, a single 100-g portion of fruit could provide between 7% and 53% of the recommended daily intake of fiber (28 g /d) (30). High fiber intake protects against DRDs; the prebiotic properties of fruit are thought to contribute to its health-promoting potential. Fruits, vegetables, and grains are good sources of oligosaccharides, a dietary prebiotic fiber that promotes the colonization of lactobacilli and bifidobacterial in the colon (Fernandez and Marette, 2017).

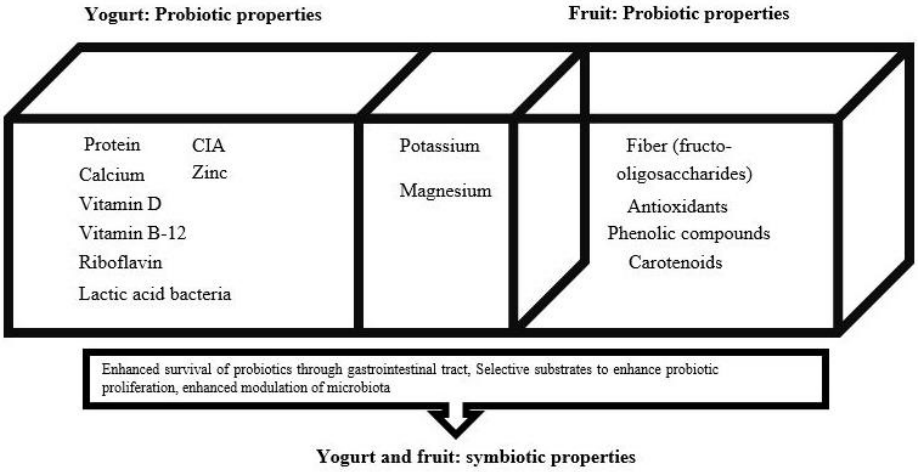

Figure 1. Nutritive elements found in yogurt and fruit.

Conclusion

Stirred yogurt fortified with Mulberry, Apple and Probiotics is nutrient-rich food product obtain by bacterial fermentation of milk. Stirred yogurt is excellent source of essential amino acids, calcium, vitamin D, riboflavin, vitamin B6 and vitamin B12. It promotes gut microbial population as carrier of probiotics which control intestinal infections reduce the serum cholesterol levels and lactose intolerance and reduce the chance of cancer.

Conflict of Interest

The authors have not declared any conflict of interest.

Authors Contributions

All the authors have contributed equally to the research and compiling the data as well as editing the manuscript.

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