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An Overview of the Use of Some Functional Substances in Yogurt Formulation

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Abstract

Functional foods are those foods that have a beneficial effect beyond one of the usual nutritional effects on one or more functional systems of the body and improve health and reduce disease. In recent years, rising medical costs have forced people to find cheaper and more effective ways to stay healthy. Therefore, the tendency towards functional foods has increased. In addition, the increase in the number of older people, as well as the increase in scientific evidence regarding the health effects of functional foods, are among the factors that play an important role in the high sales of these foods. Milk and dairy products are an important part of functional foods, and to prove it, it is enough to mention that people are already familiar with these products and believe that dairy products are healthy and natural. In recent years, with increasing awareness of the benefits of consuming functional compounds and the desire of producers and consumers for natural products, much research has been done in the field of finding sources rich in natural functional compounds. Many of the antioxidant and antimicrobial properties of plant extracts are due to the presence of substances such as phenol and flavonoids and similar compounds. Of all the dairy products, yogurt is the best known and most popular. Also, among fermented products, due to the desired flavor, texture and consistency, it is possible to mix it with other nutrients easily.

Keywords: Plant extracts, Formulation, Yogurt.

1- Introduction

Nowadays, the emergence of drug resistance in various pathogenic microorganisms on the one hand and on the other hand the harmful effects of chemical and synthetic food preservatives and their side effects on the other hand has become an important challenge in both human health and treatment. Therefore, there is a constant need to identify new antimicrobial compounds to minimize the drug resistance of microorganisms and use them as alternatives to chemical preservatives and synthetic antibiotics [1].

Although synthetic antioxidants are widely used in the food industry today, many of these compounds have detrimental effects on human health [2]. The most widely used chemical antioxidants in the food industry include BHT, BHA, TBHQ and propyl gallate. The carcinogenicity and negative effects of these compounds on human health have been identified. In fact, the toxic effects of these synthetic antioxidants on the one hand and the use of natural additives by consumers on the other hand have increased the tendency to use natural antioxidants [3].

Natural compounds are able to extend the shelf life of food by inhibiting the growth of pathogenic and spoilage microorganisms as well as protecting food from damage caused by oxidative stress. In this regard, essential oils and plant extracts are considered as very suitable factors to protect food and also cause fewer side effects than synthetic drugs, lack of drug resistance, health and environmental health are the benefits of using herbal medicines [4].

In general, plants exhibit a wide range of biological activities, including antimicrobial and antioxidant activities, therefore, it is necessary to study the different effects of plants to identify their effective substances if they have positive effects in the later stages, and since the global market for active food is increasing every year, food development is one of the most important priorities and challenges in science and technology, and as life expectancy increases and health care costs grow exponentially, society must overcome new challenges that it can do so through the development of new sciences and knowledge to improve lifestyles, restrictive rules on health issues are also expected to increase the quality of research conducted by food companies [5].

In this regard, dairy products and milk products, especially yogurt, which have bio-active function and health-promoting properties due to the presence of proteins, lipids, carbohydrates, minerals and vitamins are recommended [6]. Yogurt is one of the most widely used fermented products that due to its high nutritional value has a positive effect on human health and has a special importance in the diet of people. Yogurt is one of the most popular dairy products that is widely consumed around the world, which has received much attention due to its high nutritional value and the presence of beneficial bacteria. Yogurts produced in the industry today are very diverse, including low-fat yogurts, probiotic yogurts, beverage yogurts and frozen yogurts [7].

The taste of yogurt is different from other acidified milk products and its volatile and aromatic substances include a small amount of acetic acid and acetaldehyde. General characteristics of yogurt such as acidity, free fatty acid content, aroma composition (diacetyl, acetaldehyde and acetone) along with sensory and nutritional properties are important features in yogurt. These properties are influenced by the chemical composition of the raw milk, the process conditions, the addition of flavorings and the activity of the initiating bacteria during fermentation. Yogurt is made by fermenting milk sugar called lactose. Yogurt-specific bacteria convert lactose into lactic acid and give yogurt a gel-like texture. Due to the presence of lactic acid, yogurt tastes

spicy and sour. Yogurt has three types: low fat, medium fat and high fat. A 240 cc glass of yogurt contains 12 grams of protein, 15 grams of carbohydrates and 300-280 milligrams of calcium. Vitamins B12, B2, potassium and magnesium are abundant in milk [8].

2-A review of the application of plant properties in antioxidant and antimicrobial samples

Li et al. (2013) in a study on essential oils and plant extracts concluded that the yield of the extract depends on the type of solvent, time, extraction temperature and chemical nature of the sample and under the same temperature and time, the solvent used and the chemical properties of the samples are two important factors and also the extraction method used is effective in antioxidant activity [9].

Gamil Shehab et al. (2015) show that high phenolic composition is the main reason for high antioxidant activity of some extracts, including methanolic and ethanolic extracts. Because based on the available evidence, there is a positive relationship between the amount of phenolic compounds and the antioxidant power of plants, and on the other hand, it seems that phenolic compounds that are widely found in plants and have high antioxidant power can be extracted more through plant extracts compared to their essential oils [10].

Ueng et al. (2005) showed the molecular characteristics, amino acid sequence and role of cumin mentone reductase enzyme in the diagnosis of leaf menthol [11].

Al-Temimi et al. (2020) also physiologically determined how to regulate the accumulation of monoterpenes in flax petals and they showed that the amount of monoterpenes in the petals increases with leaf development and also showed that with increasing age of each petal, the general composition of essential oil components changes, which is accompanied by a decrease in the amount of polygon and mentofuran and a simultaneous increase in menthol and the metabolism of monoterpenes and the formation of L-menthol and neomenthol from L-menton by dehydrogenase enzymes in flax were investigated by Preisner et al. (2014) [12,13].

Guzzo et al. (1993) conducted research on the antifungal effect of xanthan and plant pathogenic fungi and concluded that the type of solvent is very important in extracting inhibitors and water is the best solvent for extracting inhibitors from xanthan. The results of this study also indicate the ability of xanthan to control plant pathogenic fungi, especially P. drechsleri and B. sorokiniana [14].

Also, Mohan Nair et al. (2005) in a study on the antioxidant and antibacterial effect of cumin found that cumin oil has a strong antibacterial effect that can be equated with the antibiotic effect of gentamicin [15].

Adlercreutz et al. (2000) in their study on the antimicrobial effect of plant extracts found that this extract on bacteria such as Podomonas aerogenus, Streptococcus mutans, Streptococcus pyogenes, Staphylococcus epidermozeris, Listeria monocytogenes, Salmonella enteritidis, higellasonnei micrococcus flavus, methicillin-resistant Staphylococcus aureus, Methicillin-sensitive Staphylococcus aureus (MSSA) and Saccharomyces cerevisiae have anti-inflammatory properties, Cumin also exhibits bactericidal and bacteriostatic activity against pathogenic bacteria such as Streptococcus mutans, Streptococcus pyogenes and Escherichia coli [16].

Palla et al. (2015) in a study comparing flaxseed essential oil with tetracycline antibiotic (8 mg / ml) on three strains of Pseudomonas aeruginosa, Escherichia coli and Salmonella typhimurium reported that the essential oil of this plant has a remarkable anti-bursal effect comparison with the antibiotic tetracycline, it is on the above two sides, also stated that the

antibacterial effect of the essential oil of this plant can be attributed to the menthol and menthone in the chemical compounds of this plant that the antibacterial effect of this compound has been proven [17].

Gaafar et al. (2013) investigated the antioxidant and antimicrobial activity of essential oils and extracts of some flax species in a study [18]. Karagözlü et al. (2011) investigated the antimicrobial effect of mint on different species of Escherichia coli and concluded that cumin essential oil has significant antimicrobial effects and can be used as a food preservative [19]. Lu et al. (2011) stated that thyme essential oil has a greater effect on gram-positive bacteria than gram-negative bacteria [20].

3- An overview of the use of different parts of plants in our formulation

Sharifi et al. (2016) examined the production of yogurt containing cocoa and concluded that cocoa as a prebiotic can significantly increase the viability of Lactobacillus acidophilus. The highest number of live probiotic bacteria was obtained on the seventh day, and after this period, a decrease in the number of probiotics was observed, but their number never reached less than 10^7 cfu / g [21].

Soybeans contain a variety of phytoestrogens (isoflavones) that are about 50 times more than their peers such as lentils and beans. Due to the role of isoflavones in maintaining human health as well as other nutritional values of soy in preventing many diseases, soy milk consumption is very high in most countries of the world.

For this reason, Mashayekh et al. (2008) added skim cow's milk, skim milk powder, whey protein concentrate and gelatin to soy milk to produce soy yogurt and observed that the viscosity increased with increasing cow's milk ratio and gelatin percentage and synergism decreased significantly but general acceptance did not show a significant increase [22].

In the production of synbiotic yogurt by Aghajani et al. (2012), prebiotic compounds such as lactulose, inulin and oligofructose were used individually and mixtures of two and three with the probiotic bacterium Lactobacillus casei were used. According to the results of this study, after 3 weeks of storage at 4 $^{\circ}C$, the yogurt sample containing lactulose-inulin mixture obtained the best taste and the control sample obtained the lowest taste score. The highest score for tissue evaluation and tissue firmness belonged to the yogurt sample containing lactulose-oligofructose, while the control sample received the lowest taste score [23].

Yared (2012), after examining the different properties of yogurt containing oatmeal and its changes during storage, found that the produced yogurt sample contains beneficial and probiotic compounds and has more antioxidant activity than plain yogurt and they introduced it as a useful product [24].

In the study of agitated yogurt containing allium iranicum powder, it was found that with increasing the concentration of allium iranicum powder, the acidification rate of the samples was slower during storage and the dry matter increased with increasing the concentration of allium iranicum powder. Viscosity, water holding capacity, synergy and sensory properties of colorimetry were more desirable at lower levels. Antioxidant activity increased with increasing concentration of allium iranicum powder and decreased during storage. The highest overall acceptance of yogurt samples to samples containing allium iranicum powder was 1.25% and higher percentages (2%) showed an adverse effect on sensory properties [25].

In the study, inoculation of initiator bacteria and Kombucha extract was used in yogurt production and it was found that during storage, decrease in pH and increase in acidity in the

samples was slight and these changes were observed with increasing concentration of Kombucha extract to a much lesser extent. Watering in the samples increased and viscosity decreased and with increasing the concentration of Kombucha extract, the amount of watering in the samples increased and the viscosity decreased. Also, the amount of vitamin C in the samples decreased and the amount of ethanol increased to a very small extent, and the amounts of vitamin C and ethanol increased with increasing concentration of Kombucha extract [26].

Numerous studies have been performed to improve the physicochemical and rheological properties of yogurt using various additives. The effect of inulin at 4 and 6% and mucilage at 0.2% on the physicochemical properties of yogurt were investigated. The results showed that pH values decreased significantly with increasing storage time in all yogurt treatments. Decreased lactose was also observed with increasing storage time. The reduction of adverse dehydration was 6% more in inulin than in mucilage. However, both were effective in reducing this phenomenon [27].

In the enrichment of yogurt mixed with purslane oil (Portulacaoleracea), the results of statistical analysis showed that the effect of treatment and storage time on physicochemical and sensory properties was significant. The highest and lowest pH belonged to the samples containing 2% and 1% of purslane oil, respectively, and during storage the pH decreased and the water content of all samples increased significantly. On day 0, the highest viscosity was related to the sample containing 1% oil (5706.7 cm) and the viscosity of the other treatments decreased compared to the control sample, but on the seventh to the twenty-first day, the highest viscosity related to yogurt contained 1.5% purslane oil [28].

Bakhtiari celery (Kelussia odoratissma Mozaff) extracted with yogurt produced industrially in the factory at concentrations of 20, 40 and 60 ppm and celery plant powder was added after the starter stage and before packaging and the results showed that mountain celery essential oil affects the physical and chemical properties of yogurt and controls the increase in yogurt acidity, but reduces water holding capacity. It also increases the sensory properties and has the greatest effect on the taste and aroma and increases the shelf life of yogurt [29].

Bayoumi (1992) studied the effect of cloves, cinnamon, cardanom, and peppermint essential oils on the growth of yogurt-initiating bacteria (Streptococcus thermophilus and Lactobacillus bulgaricus), and it was observed that the above essential oils have no effect on the growth retardation phase of yogurt-initiating bacteria, but reduced the final population of Streptococcus thermophilus and Lactobacillus bulgaricus by 1.5-3 logarithmic cycles [30].

A study was conducted to evaluate the effect of mountain Ziziphora Clinopodioides on the activity of yogurt-initiating bacteria. The results showed that the number of initiator bacteria in all yogurt samples was significantly reduced during storage. Survival of primer bacteria in samples containing mountain Ziziphora Clinopodioides essential oil at the level ($P < 0.01$) was not significantly different from control samples. Survival of primer bacteria in the highest concentration of mountain Ziziphora Clinopodioides extract (4000 micrograms per liter) showed a significant decrease from the 17th day onwards [31].

Tarakci and Kucukoner (2003) by examining the physical, chemical, microbiological and sensory properties of several types of flavored yogurts concluded that grape molasses and cherries have more flavor advantages than other flavoring substances [32].

Addition of fruits undergoing dehydration (osmotic-freezing to yogurt) was done only by Torreggiani (1995) who used osmotic dehydrated apricot and peach pieces in the production

of fruit yogurt Until to prevent the separation of milk serum through a controlled amount of moisture absorption by relatively dry pieces of fruit [33].

In optimizing the formulation of fruit yogurt, in the first stage, it was found that adding apples at a rate of 10% and strawberries at a rate of 13% was appropriate, and in the second stage (examining changes during storage), it was found that storage had a significant effect on pH, acidity, synergy, taste and texture of the samples. Samples containing apples were free of mold and yeast and the coliforms in them also reached zero after the seventh day. Yeast growth was observed in strawberry samples and no coliforms appeared in the growth medium after the seventh day [34].

In the production of frozen yogurt, three types of stabilizers, carboxymethylcellulose, panicol ex and stabilizer / emulsifier mixture (including sodium alginate, guar, carrageenan, propylene glycol and polysorbate 80) were used and the results showed that the type and amount of stabilizer had no significant effect on the pH and acidity of the mixture. however, they showed a significant effect on viscosity, increasing volume and melting resistance of samples. The highest increase in volume and melting resistance was observed in samples containing the third level of Panisol ex and the lowest in the samples containing the first level of carboxymethylcellulose. The study of sensory properties showed a significant effect of the type and amount of stabilizers on the texture of the product. So that the samples containing the third level of the stabilizer / emulsifier mixture obtained the highest score in this field [35].

syneresis is a common defect in skim yogurts. In non-fat and low-fat yogurt, due to the lack of solids, the phenomenon of yogurt syneresis is observed. Unless different stabilizers are used to reduce syneresis [36].

Yogurts made from heated milk show a delicate micelle matrix that makes the clot stronger and increases serum retention. Although thermal curing increases clot strength and reduces yoghurt dehydration, stabilizers and thickeners are also added to milk to improve rheological properties and serum retention [37].

Because the total amount of solids in low-fat yogurts is relatively low, their quality is determined by their consistency and texture. Production and formulation of low-fat dairy products with good texture quality is one of the biggest goals of today's manufacturers [38]. In order to improve the properties of these yogurts, substances such as gelatin, pectin, carrageenan, inulin, alginate, fiber, starch, starch derivatives and gums can be used [39].

Another way is to increase the dry matter content of milk, which can be done by adding caseinate, whey protein concentrate, condensing milk by evaporation and membrane filtration of milk. The main determinant of the consistency of yogurt is the method of its production, and too much protein and fat will cause the gel to become too firm. For example, casein makes yogurt very hard and its consistency granular, and the use of evaporation causes the production of a lot of acid, especially during storage. Therefore, it is better to create the desired consistency and properties in yogurt by using additives such as stabilizers [40].

To prepare nonfat yogurt, corn starch and gelatin were used in two different proportions. Non-fat yogurts made with cornstarch and 0.5% gelatin have no better additives than yogurt in terms of consistency and have a better flavor. The chemical properties of these yogurts are also acceptable. But in the case of yogurts prepared with 1% gelatin, no acceptable results were obtained [41].

Other studies have been performed on the effects of stabilizers on the physicochemical properties of dairy products. For example, the effect of hydrocolloids such as guar gum,

xanthan gum and carboxymethylcellulose on the physical and sensory properties of frozen yogurt was studied by Soukoulis et al. (2008). The results of this study showed that the addition of hydrocolloids had no effect on acidity but the viscosity and volume of the product increased significantly [42].

Moeenfard and Mazaheri Tehrani (2008) stated that the type and concentration of stabilizers significantly affect the viscosity, bulking, melting properties and sensory properties of frozen yogurt. In this study, it was found that the type and concentration of stabilizers have no effect on the pH and acidity of the product. They reported that the oral sensation of the product was also not affected by the type and concentration of stabilizers [43].

In the study of the effect of guar and arabic gums on the quality properties of frozen yogurt, it was found that the gums used did not cause a significant change in the pH of the samples but caused a significant increase in volume in the samples, So that the lowest volume increase belongs to the control sample and the highest volume increase was observed in the sample containing Arabic gum with a concentration of 5 g / l. Frozen yogurt containing 3 grams per liter of guar gum had the highest viscosity and the control sample had the lowest viscosity [44].

4- Conclusion

Yogurt is a coagulated product obtained from the fermentation of pasteurized milk acid by the activity of specific lactic acid bacteria, especially Streptococcus salivarius of the thermophilus subspecies and Lactobacillus delbrucci of the Bulgaricus subspecies in a certain amount and at a specific temperature and time. Yogurt is the most well-known product among milk fermentation products and has a higher acceptance among consumers. Yogurt is a good option for the production of useful products, in which a lot of research has been done. Adding fruit and vegetable extracts to yogurt, due to its anti-cancer and medicinal properties, is an effort to prepare useful yogurt.

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