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Review Article

Potential application of herbs and spices and their effects in functional dairy products

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ABSTRACT

Herbs and spices come from different parts of the plant are used to impart an aroma and taste to food. Several herbs have therapeutic properties such as antioxidative, anti-inflammatory, antidiabetic, antihypertensive and antimicrobial activities. Therefore, fortification of dairy foods with herbs and spices could help to provide functional dairy products with nutritional and medicinal values. Also, herbs and spices are used to improve the appearance and attractiveness of fortified foods for consumers and to increase the sale of those herbs. Therefore, only the highest quality herbs or spices can be added to dairy products to combat contaminating microorganisms. In this review the latest progresses in the dairy sector concerning the addition of numerous herbs and spices in different forms (i.e. powder, fresh, extract, essential oils) to dairy food has been conversed. Also, the effects of those herbs and spices on the quality of dairy products such as yoghurts, cheeses, butter, gee and ice creams have been presented.

1. Introduction

Herbs and spices have been used to fortify foods throughout history as preservatives, flavor and therapeutic agents. Although herbs and spices are low-cost commodities, they are nowadays valued as gold or jewels for many centuries. Herbs and spices were used by the ancient Egyptians and have been used for Centuries in India and China. Today, herbs and spices can be used to increase the acceptability of foodstuffs and improve their health. World Health Organization survey pointed that 70–80% of the world population depends on modern medicine mainly on herbal sources in their major healthcare (Chan, 2003). Moreover, 80% of population in developing Countries and up to 60% of the world's population depends directly on herbs and plants for their medical benefits (Shrestha and Dhillon, 2003). The first scientific research on the influence of spices as preservative was presented in the 1880s and displayed the antimicrobial properties of cinnamon oil against *Bacillus anthracis*spores (Tajkarimi et al., 2010).

Also, herbs and spices have been utilized as food additives all over the world, not only to enhance the organoleptic properties of food, but also to increase the shelf life by decreasing or eliminating the foodborne pathogens (Lai and Roy, 2004). Several studies have recommended the use of dietary herbs and spices for their beneficial effects on human health through their antimutagenic, anti-inflammatory, antioxidative, and immune modulatory properties (Conn, 1995). A dietary guideline refers to the utility of herbs as excellent sources of antioxidants and as salt alternatives (Tapsell et al., 2006). Nowadays, dairy products are unique carrier that has been successfully used to deliver phytochemicals and other nutrients for health benefits in our nutrition food system (El-Sayed et al., 2015). Furthermore, addition of herbs and spices or its extracts to different dairy products make these products act as carrier for nutraceuticals. So that dairy industry should discover innovative ways to improve the functionality of traditional dairy products which might deliver important value and potential effects for consumers.

2. Main text

2.1. Herbs and spices

Herbs and spices are harvested from different parts of the plant. Herbs are usually obtained from leaves of the plant while spices come from different seeds, root, bark, fruit berries, aril, pods and flowers of the plant (Herman, 2015). Table 1 summarizes the common sources of herbs or spices.

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Table 1
Sources of herbs or spices (Herman, 2015).

Part of the plant	Herbs and spices
Leaves	Basil, oregano, bay leaf, thyme, tarragon, mint, marjoram, sage, curry leaf
Bark	Cinnamon, cassia
Flower/bud, pistil	Clove, saffron
Fruits/berries	Clove, chilli, black pepper, allspice
Bulbs	Onion, garlic, leek
Root	Ginger, turmeric
Aril	Mace
Seed	Ajowan, aniseed, caraway, celery, coriander, dill, fennel, fenugreek, mustard

2.1.1. Classification of herbs and spices

Spices and herbs can be categorized into several groups based on their flavor & colour i.e., hot (Cayenne pepper, black & white peppers, mustard, chilies) slight flavor (coriander, paprika), aromatic spices (clove, cumin, dill fennel, nutmeg, mace, cinnamon) and aromatic herbs (thyme, marjoram, shallot, basil, bay leaf, onion, garlic). Based on colour (turmeric) and herbaceous (sage, rosemary) or based on their taste such as sweet, bitter, spicy, sour, and sharp (Embuscado, 2015; Bhattacharyya et al., 2017).

2.1.2. Functional role of herbs and spices

Spices and herbs have been used as flavor, colour, aroma, enhancing agents and for preservation of foods. There has been increasing studies on the role of spices and herbs as natural preservatives and for medicinal purposes. The influence of bioactive effects on health from selected spices and herbs are displayed in Table 2.

The bioactive compounds from spices and herbs have the potential to decrease or inhibit the risk of degenerative diseases such as diabetes, obesity, cancer and cardiovascular diseases (Anderson et al., 1999).

Antimicrobial properties of herbs and spices can be successfully used to control the growth of spoilage and pathogenic bacteria in dairy products as shown in Table 3.

Phenolic compounds of herbs and spices are good substitutes for the artificial antimicrobial agents used in food manufacturing. Phenolic compounds such as tea catechins, oleuropein, ferulic acid, ellagic acid and coumaric acid have been found to prevent the growth of some pathogenic bacteria (*Staphylococcus aureus, Salmonella enteritidis and Listeria monocytogenes*) and fungi (Bin et al., 2011).

2.1.3. Processing of herbs and spices

Developments in processing technologies have been applied to ensure that raw herb and spices are free of microbial and other contamination and to extend their shelf-life. At the present time, radiation treatment is acceptable for numerous categories of food and their ingredients. Irradiation aids to prolong the shelf life of herbs and to decrease the food-related health hazards produced by pathogenic microorganisms (Bortolin et al., 2007). Also, Supercritical Fluid Extraction (SFE) has gained acceptance to replace conservative solvent extraction for separation of organic compounds from herbs and spices. It can be professionally used to counter insect, pesticides and microbial contamination (Lang and Wai, 2001).

Fortification of dairy products with herbs and spices need some requirements based on the following properties as shown in (Fig. 1).

Table 2
Bioactive functions of selected spices and herbs (Anderson et al., 1999).

Spice& Herb	Effect& function
Cayenne pepper	Capsaicin in cayenne pepper has been shown to reduce appetite and increase fat burning (weight management).Help combat lung, liver and prostate cancer
Cinnamon	Potent antioxidant activity, Help fight inflammation, Lower cholesterol and triglycerides in the blood
Fenugreek	Improve function of insulin, Lower blood sugar levels
Garlic	Help combat sickness and cold, Reduce cholesterol and LDL. Improve heart health, Reduce blood pressure in hypertensive people
Ginger	Treat nausea caused by morning and sea sickness, and chemotherapy, Strong anti-inflammatory, Help pain management
Rosemary	Prevent allergies and nasal congestion Strong antioxidant
Sage	Improve brain function and memory, Inhibits breakdown of acetylcholine, a chemical messenger in the brain
Turmeric	Powerful antioxidant and help fight antioxidant damage in the body Strong anti-inflammatory, Fight Alzheimer's
Vanilla	Antioxidant activity, Anti-inflammation, Potential for lowering blood cholesterol

Table 3
Antimicrobial properties of some herbs and spices (Bhattacharyya et al., 2017).

Spices& Herbs	Microorganisms
Garlic	*Salmonella typhymurium, Escherichia coli, Staphylococcus aureus, Bacillus cereus, Bacillus subtilis,* mycotoxigenic*Aspergillus, Candida albicans*
Onion	*Aspergillusflavis, Aspergillusparasiticus*
Cinnamon	Mycotoxigenic*Aspergillus, Aspergillusparasiticus*
Cloves	Mycotoxigenic*Aspergillus*
Mustard	Mycotoxigenic*Aspergillus*
Oregano	Mycotoxigenic*Aspergillus, Salmonella* spp.,
Rosemary	*Bacillus cereus, Staphylococcus aureus, Vibrio parahaemolyticus*
Bay leaf	*Clostridium botulinum*
Sage	*Bacillus cereus, Staphylococcus aureus, Vibrio parahaemolyticus*
Thyme	*Vibrio parahaemolyticus*

2.2. Application of herbs and spices in dairy products

Functional application of numerous herbs and spices in several forms (i.e. powder, fresh, extract, essential oils, etc.) in some dairy products has been successfully described. Application of herbs and spices in different dairy products can be summarized in the following:

2.2.1. Effect of using herbs and spices in yoghurt

The health benefits of yoghurts are well-known and several yoghurt based products are consumed by people all over the world (El-Shibiny et al., 2018). Among these products herbal and spiced flavored yoghurt have been developed. Behrad et al. (2009) concluded that adding of cinnamon did not modify the yoghurt fermentation but allowed for the growth of *Lactobacillus spp* during refrigerated storage. Cinnamon-yoghurt containing probiotic bacteria prevented the growth of *Helicobacer pylori* in vitro. The efficiency of these herbal-yoghurts to stop the growth of *H. pylori* needs to be more investigated under extremely acidic environment of the stomach.

Also, Bakrm and Salihin (2013) reported that addition of *Cinnamom umverum* and *Allium sativum* water extract in goat, cow and camel milk had no important effect on the acidification through fermentation. Furthermore, the presence of these two herbs in milk improved the proteolytic activity of the used cultures with the highest proteolytic activity was gotten in cow milk yoghurt. *A. sativum* and *C. verum* encouraged lactic acid bacteria (LAB) growth in three types of yoghurt through fermentation. So, *A. sativum* and *C. verum* can be used to support the development of LAB in yoghurt during fermentation. Moreover, Helal and Tagliazucchi (2018) found that adding cinnamon powder into yoghurt increased the total phenolic content and radical scavenging activity when compared to natural yoghurt. They showed that 34.7% of the total phenolic compounds present in the cinnamon water extract was established in the cinnamon-fortified yoghurt indicating that the remaining compounds actuality bound to milk proteins. Furthermore, in-vitro digestion of yoghurt fortified with cinnamon resulted in the release of the interacted phenolic compounds with milk proteins. The recovered compounds in yoghurt fortified with cinnamon were greater than that present in the digested cinnamon water extract. These results displayed that yoghurt matrix improved the bioaccessibility and

Fig. 1. Requirements for herbs and spices in dairy products.

gastro-intestinal stability of cinnamon polyphenols. Cinnamon-fortified yoghurt can be regarded as a significant source of nutritional bio-accessible polyphenols.

Srivastava et al. (2015) used different ratios of beet root and ginger extracts in the manufacture of herbal yoghurt from buffalo, cow and goat milks. They showed that the maximum antioxidant activities measured by DPPH method were establish in goat milk yoghurt fortified with 2% beet root and 2% level of ginger extracts followed by 2% ginger extract in cow milk yoghurt. Furthermore, Park et al. (2018) found that the fortification of milk and yoghurt with 2% red ginseng extract raised the oxygen radical absorbance capacity values and (DPPH) radical-scavenging activity. Also, the H_2O_2-induced DNA damage was less in yoghurt fortified with red ginseng extract than the destruction in normal yoghurt. However, no important differences were found in DNA damage between normal milk and milk supplemented with red ginseng extract. Therefore, this study shows that fortification with red ginseng can support the antioxidant and antigenotoxic effects of dairy products proficiently.

Amirdivani and Baba (2011) displayed that herbal extracts improved the yoghurt bacteria fermentation of milk and enhanced the acidification of yoghurts. The proteolytic activity of yoghurt bacteria reached a maximum during fermentation and refrigerated storage in the presence of peppermint followed by dill and basil. These herbal yoghurts were characterized by high contents of bioactive peptides, and improved antioxidant activities which may offer novel range of yoghurts with potential multifunctional health properties to consumers. Hanifah et al. (2016) added *L. acidophilus* and roselle extract in the manufacture of goat milk based-yoghurt. These yoghurt were characterized by increased antimicrobial activity and extensive selectivity for Gram positive and Gram negative bacteria (*Bacillus cereus, Escherichia coli, Staphylococcus aureus and Salmonella Typhi*), which might be attributed to the production of higher antimicrobial compounds, including antimicrobial peptides and organic acid. Moreover, Liu (2018) established that Fuzhuan brick-tea (FZT) was compatible with yoghurt and enhanced its proteolytic and B-galactosidase activities. FZT also, reduced syneresis, improved viscosity and total counts of *Lactobacillus acidophilus* and *Streptococcus thermophilus*. The antioxidant activity of the prepared yoghurt was increased and comparatively stable in refrigeration.

Kumar et al. (2013) prepared yoghurt concentrate supplemented with crushed leaves mint at ratios 2, 4 and 6%. They found that the addition of 2% mint level to yoghurt was established to be optimal in all the sensory qualities. Also, the yoghurt spread shelf life was 10 days at 5 °C. The mint flavored yoghurt was suggested for use in burgers, sandwiches and any other bakery stuffs. Also, Ghalem and Zouaoui (2013) supplemented yoghurt with *Rosmarinus officinalis* oil at ratio of 0.14, 0.21, 0.29, and 0.36 g/L and kept it up to 21 days. Panelists gave the maximum score for taste, flavor, and texture, to the herbal yoghurt supplemented with 0.14 g/L of essential oil. Also, addition of *R. officinalis* essential oil improved the qualities of yoghurt by decreasing pH& lactose values and dry matter but raised the titratable acidity, proteins, ash, and fat contents. In general, storage time had no effect on the physico-chemical properties of prepared yoghurts.

2.2.2. *Influence of adding herbs and spices in labneh (concentrated yoghurt)*

Otaibi and Demerdash (2008) added three essential oils, namely thyme, marjoram and sage to labneh at concentrations of 0.2, 0.5 and 1.0 (ppm). They found that Yeasts and moulds, spore-forming bacteria and coliform bacteria were not detected in all treatments. Addition of 0.2 ppm of thyme, sage or marjoram oils can be used to extend its shelf life

for up to 21 days at 5 °C with acceptable flavor and good appearance without detection of any spoilage organisms. Moreover, Zaky et al. (2013) showed that addition of 2μL/100ml milk of dill as well as caraway essential oils to labneh prepared from buffalo's milk increased the total volatile fatty acids of labneh during storage. Also, it enhanced the antioxidant activity and sensory properties of labneh compared with control. Essential oils enhanced the taste and odor of labneh and extended its shelf life up to 28 days. Hence, caraway or dill as essential oils might be suggested for utilizing to improve the quality of the prepared labneh as they are natural, economic, medicinal ingredients in addition to healthy. Correspondingly, Thabet et al. (2014) displayed that addition of cinnamon oil at 0.3% extended the shelf life of labneh up to 24 day at 6 °C with suitable taste, flavor and deprived of any microbial spoilage. Also, El-Sayed et al. (2017) reported that fortify Labneh with different ratios (100, 150 and 200 mg/ml) of *Moringa oleifera oil* increased the total solid, fat, total volatile fatty acid, DPPH scavenging activity, tocopherols and total lactic acid bacterial counts content of labneh. The *M. oleifera* oil displayed well effect against Gram-positive, Gram-negative, Yeast and fungal strains with the increase of the ratios of *M. oleifera oil.* Moreover, enhanced the sensory properties of this labneh compared with control samples. So that, fortified labneh with *M. oleifera oil* can be considered as novel product with functional properties and prolonged the shelf life of this product.

2.2.3. Impact of using herbs and spices in cheeses

Herbs and spices are added to cheeses to impart unique flavors. These cheeses regularly considered as specialty cheeses. Most spices impart specific flavors to cheeses, and some may affect the microbiological quality of cheeses. Common herbs &spices added to cheeses are presented in Table 4.

Hamid and Abdel rahman (2012) investigated the effect of adding 0.02% Cinnamon, Cardamom & Fenugreek powder to goat's milk curd after coagulation on the quality of the obtained white soft cheese. The additions of these spices enhanced the flavor and odor of goat's milk cheese. Protein, fat and ash contents of these cheeses were significantly affected by storage period and added spices, but the total solids and acidity values were not affected by spices types. Josipović et al. (2015) developed successfully novel cottage cheese with appropriate sensory properties, improved biological value and prolonged shelf life by adding spices to cottage cheese. Thirty types of cheeses were manufactured by adding dried or fresh pepper, parsley, garlic, dill and rosemary. Fortify of cheese with fresh pepper and fresh & dried herbs presented excellent sensory properties, particularly with fresh sweet red pepper. Furthermore, dry rosemary had the maximum antibacterial and antioxidant activities due to its high contents of rosmarinic and caffeic acids as well as phenolic and flavones. In vitro studies showed that the plant extracts observed effectively decreased the numbers of foodborne pathogens like *Salmonella typhimurium*, *Listeria monocytogenes*, *Staphylococcus aureus* and *Escherichia coli*, and therefore have potential as good natural preservatives and antioxidants (Youssef and El-Sayed, 2018).

Bakheit and Foda (2012) determined the antioxidant activity of individual spices as black pepper, black cumin, and clove using (DPPH) free radical scavenging assay. These spices were used to produce novel Mudaffara cheese. The antioxidant activity of the spicy cheeses was lower than the spices in the powder form and it was not affected by storage at different temperatures. Spicy Mudaffara cheeses stored at room temperature exhibited excellent taste after 4 or 6 weeks according to the spices used. Also, Mahgoub et al. (2013) studied the effect of adding 0.1% and 0.2% (w/w) of *Nigella sativa* oil to Domiati cheese on the inhibition of food-borne pathogens (*Staphylococcus aureus, Salmonella enteritidis, Escherichia coli in addition to Listeria monocytogenes*) inoculated in cheese during storage. Addition of 0.2% oil showed the maximum effective antimicrobial potential on pathogens and improved the physicochemical and sensory properties of the cheese.

Coskun and Tuncturk (2000) determined the influence of herb (*Allium sp.*) on biochemical changes of herby cheese containing 0, 0.5, 1, 2, and 3% herb made in Turkey. Raw cows' milk was used for cheese making, all cheese groups were matured for 90 days. Addition of herb to cheese enhanced lipolysis and proteolysis which accelerated the ripening of herby cheese. But, the herb level should not exceed 2 % of the cheese milk which resulted in the maximum acceptable sensory level. Furthermore, Tarakci and Temiz (2009) described that Turkish otlu-herby cheese manufactured with the herbal species (*Allium sp., Thymus sp., Mentha sp. Ferula sp*. and *Pranges sp*.) used separately or as appropriate mixtures enhanced cheese flavour and shelf life of the final product. Moreover, the ginger extract was established to be the most active agent to reduce the microbial load and prolong the shelf life of West African soft cheese stored for 15 days (Belewu et al., 2005).

Table 4
Common herbs and spices used in cheeses (Hayaloglu and Fox, 2008).

Herbs/spices	Botanical name	Examples of cheese with herb/spice
Spices		
Chili	*Capsicum frutescens var. chili*	Cheddar, Monterey Jack
Red pepper	*Capsicum frutescens var. faseiculatum*	Cheddar, Monterey Jack
Green pepper	*Capsicum frutescens var. grosum*	Monterey Jack, processed cheese
Paprika	*Capsicum frutescens var. tetragonium*	Bouletted'Avesnes
Jalapeño	*Capsicum annuum*	Monterey Jack, processed cheese
Chipotle (smoke-dried jalapeñ o)	*Capsicum annuum*	Monterey Jack, processed cheese
Habanero	*Capsicum chinense*	Jack, processed cheese
Black pepper	*Piper nigrum*	Gouda
Cayenne	*Capsicum frutescens*	Monterey Jack
Mustard seeds	*Brassica sinapis alba*	Moutardier
Caraway seeds	*Carumcarvi*	Gouda, Liptauer
Cloves	*Eugenia aromatic*	Gouda
Cumin	*Cuminun cyminum*	Gouda, Leidsekaas
Garlic	*Allium sativum*	Cheddar, Monterey Jack
Horseradish	*Armoraci arusticana*	Processed cheese products
Herbs		
Dill	*Anethum graveolens*	Processed cheese products
Basil	*Ocimum basilicum*	Feta, Cheddar, Monterey Jack
Fenugreek	*Trigonella foenum graecum*	Gouda
Tarragon	*Artemisia dracunculus*	Bouletted'Avesnes
Sage	*Salvia officinalis*	Cheddar
Chives	*Allium schoenoprasum*	Cheddar
Rosemary	*Rosmarinus officinalis*	Raclette

Addition of clove oil at concentrations of 0.5 and 1% decreased significantly the growth rate of *Listeria monocytogenes* in cheese at 30 °C and 7 °C. High concentrations of clove oil may adversely affect the sensory properties of food. Small concentrations of clove oil may be enough to ensure food safety where bacterial load is low (Vrinda-menon and Garg, 2001). Moreover, Bin et al. (2011) studied the antibacterial effectiveness of five spices and herb extracts (cinnamon stick, pomegranate peel, grape seed, oregano and clove) contrary to *Staphylococcus aureus*, *Listeria monocytogenes* and *Salmonella enterica* in cheese at room temperature. They displayed that all five plant extracts inhibited the growth of the three foodborne pathogens in cheese. Treatments with those spices and herbs extracts improved the stability of cheese against lipid oxidation. Clove exhibited the highest antibacterial and antioxidant activity. So that these extracts (especially clove) have potential use as natural food preservatives.

Mohamed et al. (2018) reported that adding of *Moringa oleifera* extract to cream cheese at different ratios 2.00, 3.00 and 4.00 g/100 g extend the shelf life of it up to four week and increased the probiotic counts, total phenol content and antioxidant activity of finale products.

Marinho et al. (2015) provided evidence that coating of cheese with dehydrated rosemary leaves improved the physical and physicochemical properties of cheese made from raw or pasteurized milk as compared to

cheese made without coating. They found that the semi hard cheese made with raw milk showed the best sensory acceptance. The coating allowed the final products to retain higher moisture content and preferred texture, appearances and colour. Furthermore, the rosemary gave the cheeses a slight aroma besides spicy flavor. Coating with rosemary leaves can improve the value and to develop a novel of semi hard cheeses.

2.2.4. Effect of addition herbs and spices in butter

Najgebauer et al. (2009) evaluated the storage stability of butter prepared from sour cream with 2% addition of dried herbs (sage or rosemary). They concluded that the addition of rosemary herb was more effective in delaying lipolysis in butter than sage, but both supplemented products had increased oxidative stability through storage than the control. TBA analyses test exposed that the sage and rosemary butters contained significantly smaller concentration of secondary oxidative products like malonoaldehyde and ketones than the butter without herbs. Moreover, Farag et al. (1990) stated that the addition of thyme and cumin essential oils in butter prevented deterioration of butter stored at room temperature and were more effective than butylated hydroxy toluene.

2.2.5. Influence of using herbs and spices in ghee (clarified butterfat)

Ghee is an Indian name for clarified butterfat prepared by the boiling off method. It is usually prepared from buffalo or cow milk or combination of them and has an agreeable and delicious aroma. Approximately 30–35 % of the milk produced in India is converted into ghee (Varkey, 2010). Currently, the herbal ghee marketed in India is generally sold as medicine for cure of certain illnesses and it is therefore classified as 'medicinal ghee'.

Parmar et al. (2013) reported that ethanol extract of Arjuna bark improved the shelf life of ghee as compared to control sample through storage at 8 °C. Also, freshly prepared ghee from cow milk with added Arjuna bark had excellent potentiality to perform as free radical scavenger. Parmar and Khamrui (2017) found that the ghee manufactured by creamery buffalo butter supplemented with 7% arjuna alcoholic extract had maximum phytosterol content with suitable sensorial characteristics.

Merai et al. (2003) added 0.6 % of Tulsi (*Ocimum sanctum*) leaf powder at creamery butter ghee. They found that the obtained gee had similar stability to gee containing 0.02 % butylated hydroxyl anisole for 8 days at high temperature of storing. Also, they consider that Tulsi leaves were the main factor in prolonging the oxidative stability of ghee. Furthermore, Pawar et al. (2012) improved successfully the oxidative stability of ghee by adding combination of the alcoholic and aqueous extracts of Satavari herb. Moreover, Patel et al. (2013) evaluated the antioxidant activity of coriander extract in ghee. They considered that coriander extract provided better oxidative stability for ghee through storage compared to control sample.

2.2.6. Impact of addition herbs and spices to ice cream

Ice cream is one of the best consumed dairy products in the world but it is generally poor in natural polyphenols, antioxidants and colours. Therefore, it is of interest to discover the possibility of enhancing the nutritional values of ice cream using health benefits ingredients like herbs and spices (Gidley, 2004).

Pinto et al. (2009) used ginger (juice and pieces) as a flavoring component in ice cream. Ginger ice cream was manufactured by adding ginger juice in ratios of 3, 4 and 5 % and pieces at 4, 6 and 8% levels of ice cream mix and compared with control flavored with vanilla. Addition of 4% ginger shreds and 4% ginger juice was found optimum for preparing Ginger ice cream. Correspondingly, Gabbi et al. (2017) processed ginger rhizomes into pulp, juice, candy & powder and added them in ice cream mix during the freezing step. They established that addition of ginger juice and paste decreased the total solids, while candy and powder increased them. Addition of different forms of ginger decreased the fat and protein contents (excluding powder) and increased ash and fiber contents (excluding juice) of the resultant ice cream. The antioxidant activity and total phenols increased significantly on addition of ginger in different forms. Furthermore, the overrun of ice cream was decreased and melting resistance increased with addition of ginger preparations. Overall acceptability scores were the highest with 10% candy 6% juice, 4% pulp, & 1.0% powder combination.

Manoharan et al. (2012) studied the acceptable ratio of curcumin to be added in ice cream as natural coloring agent and evaluated the sensory properties of the resultant product. They found that 0.5% was the best level of curcumin powder to be added in the ice cream preparation.

A research was carried out by Trivedi (2014) who evaluated basil in selected forms (juice & dried powder) as a flavoring component in ice cream. Ice-cream was prepared using (0.0, 2, 4, 6, and 8 %) basil juice and (0.0, 0.5, 1.0, 1.5, and 2.0 %) basil powder. They found that the addition of basil juice reduced protein, fat, total solids, ash, total carbohydrate contents, melting resistance and increased the pH content compared to the control. Moreover, there was no effect on overrun and acidity of the ice cream treatments. Adding of basil juice decreased the body &texture and melting resistance scores compared to the control. Addition of basil juice up to 6% improved the flavor and total score compared to all experimental ice cream samples.

2.3. Essential oils of herbs and spices and their effects in dairy products

Essential oils from several herbs and spices have recognized to prevent microbial growth as well as at the same time respectable antioxidant activity, being good candidates for dairy products particularly in cheese preservation. Essential oils have a broad spectrum contrary to diverse pathogenic and spoilage microorganisms. Furthermore, the essential oils have the benefit of having the GRAS (generally recognized as safe) for being approved to use in EU (European Parliament and Council, 2008). They similar linalool, carvacrol and thymol were combined with Kuorwel et al. (2013) in a starch-based coating and then applied on cheddar cheese surface display antifungal properties against *Aspergillus niger*. The film of coating having thymol at 2.38% exhibited the highest reduction in the microbiological development (≈2.55 log CFU/g) after 35 days of storage at 15 °C whereas in the coating without essential oils, the decline was lower (4.25 log CFU/g) throughout the same period when compared to control (≈4.75 log CFU/g). The nanoemulsions of other essential oils (i.e. oregano essential oils (OEO)) were combined with sodium alginate, tween 80 and mandarin fiber and then tested in low-fat cut cheese (10 g). The usage of a loading of 2.0% of OEO decreased the growth of *S. aureus* depressed to 4.6 log (CFU/g) when compared with control (6 log CFU/g) after 15 days of storage at 4 °C. However, and regardless of demonstrating a worthy potential as antimicrobials agent, the utilizing of essential oils is limited because of their influence on organoleptic properties of cheese formerly their flavoring and high odor at high concentrations may change cheese's flavor. Yangilar (2016) demonstrated that the incorporation of a fish essential oil (1%) in chitosan-based coatings targeting to prolong the shelf-life of Göbek Kashar Cheese. Even if a reduction in molds progress arisen when using chitosan-based on fish oil (1.15 log CFU/g) related to control (3.89 log CFU/g) after 3 month of ripening, the sensorial evaluation of cheese coated chitosan-based on fish oil received the lowest scores. Utilization of essential oils could be a good choice with the aim of rise the quality and safety of cheese, conversely the sensorial evaluation would always be taken into account when considering their industrial applications.

3. Conclusions

Herbs and spices are natural ingredients that have been widely used not just as food flavoring but also for its health attributes. The antioxidant, antimicrobial and anticancer components present in herbs could enable them to enhance the health and medical status of human being. Dairy products have always been a choice for food investigators to test the consumer's preferences for novelty in the products. Combination of

herbs or spices in dairy products with gifted health benefit should conform to the requirements to avoid any side effects with respect to quality testing, safety, efficiency, price and marketing approval procedures. However, there are numerous technological challenges that have to be carried out to develop dairy products enriched with herbs and spices like using Nano-form to increase their availability and efficiency. Moreover, more research is needed to improve the existing method and to develop new procedures for optimized extraction and refining separation methods of active components from herbs and spices.

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Author contribution statement

All authors listed have significantly contributed to the development and the writing of this article.

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