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Influence of spices and herbs incorporation on popular Indian dairy products: A review

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Abstract

Spices and Herbs have created a lot of awareness in today's culture, leading people to turn to nature for safer herbal remedies due to their various well-proven therapeutic benefits and absence of adverse effects. Furthermore, herbs are also well-known for their capacity to serve as natural preservatives, antioxidants, and flavor enhancers. Spices and Herbs include not just herbaceous plants, but also the bark, roots, leaves, seeds, flowers, and fruit of trees, shrubs, and woody vines, and have been used for millennia as both food and medicine. Spices and Herbs have been used as an extract, juices, or in dried forms in various Indian dairy products which have resulted in the enhancement of flavor, appearance, quality and overall health benefits. This review paper summarizes the effects of numerous Spices and Herbs used in sandesh, lassi, paneer, ghee and Ice cream.

Keywords: Herbs, spices, dairy products, antioxidants, preservatives

Introduction

Herbs are derived from plant leaves, whilst spices are derived from plant components other than the leaves. Herbs, herbal preparations, and finished herbal product, comprise portions of plants that are thought to provide therapeutic advantages as active substances (Ramesh *et al.*, 2016) [70]. Spices and Herbs are known to have bioactive chemicals that have a variety of functions, including insect repellent, antibacterial, and antifungal activity, as well as beneficial effects on animals and humans (Embuscado, 2015) [20]. In addition to this, herb and spices extracts have also been demonstrated to have health-promoting qualities. The most prevalent bioactive compounds discovered in medicinal and culinary plants are polyphenols (especially phenolic acids and flavonoids) (Paswan *et al.*, 2021) [62]. These substances are widely recognized for their biological action, which includes anticancer, antioxidant, antidiabetic, cardioprotective, and other health benefits (El-Sayed *et al.*, 2019) [19].

Antioxidants are essential for maintaining a healthy lifestyle. They're made up of several plant-based chemicals that protect cells from harm (Gupta and Sharma, 2006) [26]. Spices and Herbs function as an antioxidant when used in the proper proportions which further enhances a product's nutritional quality and shelf life. Furthermore, in today's quest for much more inventive functional foods, herbal extracts in all their forms may offer so much potential for food producers (Rowan, 2000) [71].

Food degradation can be triggered by temperature, oxygen and light variations, whereas enzymatic activity and microbial colonization can also be the reasons for the spoilage of food commodities. It is impossible to eliminate the risk of food degradation given ongoing manufacturing techniques such as preservatives, drying, and pasteurization (Pop *et al.*, 2019). Furthermore, butyl hydroxy anisole (BHA) or butyl hydroxytoluene (BHT), are repeatedly added to food items to suppress the processes that contribute to the lipid, carbohydrates, and protein degradation (Badola *et al.*, 2018) [3]. As a result, in recent years, customer's interest in healthy products supplemented with herbal extracts and plant-derived food additives has surged considerably (Leja and Czaczyk, 2016) [45]. Spices and Herbs have risen to popularity as viable natural food preservatives in recent years because of growing interest in developing safe and efficacious natural food preservation methods. (Martinez *et al.*, 2015).

Consumers have found milk and other dairy products to be effective carriers for imparting the therapeutic, nutritive, and other health advantages of phytochemicals found in Spices and Herbs. In India, traditional milk products account for 50-55 per cent of total milk output. It symbolizes the noteworthiness of customary milk commodities in our country's economy

(Ammu *et al.*, 2020) [1]. Milk is an excellent source of antioxidants in and of itself. Compounds including, vitamins, carotenoids, urate, and proteins like whey and casein protein have been linked to milk's antioxidant activity (Bandyopadhyay *et al.*, 2007) [5].

Since Vedic antiquity, dairy products have been nutritionally significant components of India's cuisine (Singh *et al.*, 2021). Because of the growing popularity of functional foods, dairy products are now being fortified with natural Spices and Herbs that possess therapeutic characteristics, promoting immunity and nutrition in the body and in potential health benefits with minimal side effects.

Spices and Herbs incorporated as an extract, powder or as an essential oil in dairy products serve as a useful food as well as an organic preservative which can substitute artificial preservatives associated with detrimental human health consequences. Several factors have drawn attention to the utilization of edible plant resources as a safer alternative, including consumer desire for natural food components (Jeong *et al.*, 2004) [32]. Indian dairy products such as lassi, sandesh, paneer, ghee and ice cream are consumed on a regular basis and thus, various research has been done to enhance the quality of these products and make them healthier.

Spices and Herbs and presence of bioactive compounds

Spices are derived from seeds, roots, berries, bark, and fruits. Ginger is a rhizome, cinnamon is formed from tree bark, nutmeg is a seed, and cloves are flower buds, to name a few examples. Spices were originally esteemed for their medicinal properties, and their usage in culinary only became prominent relatively later (Ravindran, 2017) [71]. Herbs, on the other hand, are plant components that are not woody, such as stalks

and/or lush green leaves. Herbs have also been utilised for therapeutic purposes, as well as for nutritional value, culinary flavouring, and so on, for a long time. Few species, however, such as fennel and coriander, may be used as both Spices and Herbs since their leaves and seeds are edible (Lust, 2014) [46].

Spices and Herbs have historically been consumed for its fragrant characteristics, flavouring, and as colouring agent without being deemed nutritionally important. Moreover, Spices and Herbs have lately been found as sources of a variety of phytochemicals, which can be used for medicinal causes (Guldiken *et al.*, 2018; Paur *et al.*, 2011) [25, 66]. These phytochemical are known to provide health benefits such as antioxidant, anticancer, anti-inflammatory, anti-viral, and anti-bacterial effects (Vallverdú-Queralt *et al.*, 2014) [89].

Spices and Herbs are well known to possess biologically active compounds or bioactive compounds which are produced as secondary metabolites having pharmacological or toxicological effects (Bernhoft, 2010) [8]. Over the last decade, plethora of research has found that the bioactive molecules present in Spices and Herbs, including as, flavonoids, alkaloids, phenolic, tannins, vitamins and sulfur-containing compounds, have a wide range of health-promoting properties on humans (Jiang, 2019) [3]. Moreover, Spices and Herbs including clove, turmeric, cinnamon, mint, ginger, coriander, curry leaves, oregano, ashwagandha and giloy have gained popularity in recent years as organic food preservatives and for their functional potency, which comprises antibacterial and antioxidant properties (Idowu *et al.*, 2021). These Spices and Herbs have bioactive compound that elicit pharmacological functions. The following Table 1 depicts the presence of bioactive compounds in the most commonly utilized Spices and Herbs.

Table 1: Presence of Bioactive compounds in selected Spices and Herbs

Spices and Herbs	Bioactive compounds	References
Ginger	Gingerol, shogaols, paradols, quercetin	(Stoner, 2013) [81]; (Mao <i>et al.</i> , 2019); (Nile <i>et al.</i> , 2015) [59]; (Zhang <i>et al.</i> , 2016) [94]; (Ho <i>et al.</i> , 2013)
Turmeric	Curcuminoids (curcumin, desmethoxycurcumin, bismethoxycurcumin)	(Komonsing <i>et al.</i> , 2021) [42]; (Zhang <i>et al.</i> , 2015) [94]; (Mathew and Hsu, 2018) [52]; (Yadav <i>et al.</i> , 2013) [93]; (Syed <i>et al.</i> , 2015) [82]; (Sahne <i>et al.</i> , 2016) [72]
Curry leaves	Carbazole alkaloids	(Ganesan <i>et al.</i> , 2013) [22]; (Khedkar, 2015) [41]; (Ghasemzadeh <i>et al.</i> , 2014) [23]
Coriander	Linalool	(Begnami <i>et al.</i> , 2016) [7]; (Kansal <i>et al.</i> , 2011) [36]; (Lodi <i>et al.</i> , 2012) [46]
Clove	Eugenol	(Nagababu <i>et al.</i> , 2010) [56]; (Shukri <i>et al.</i> , 2010) [77]; (Devi <i>et al.</i> , 2010) [16]
Mint	Rosmarinic acid, caffeic acid, ferulic acid	Mimica-Dukic and Bozin, 2008 [54]; (Tahira <i>et al.</i> , 2011) [83]; (Lee, 2010) [44]; (Brown <i>et al.</i> , 2019) [10]
Giloy	Tinosporide, tinosporine, giloisterol, giloin	(Choudhary <i>et al.</i> , 2013) [14]; (Sharma <i>et al.</i> , 2019) [73]; (Murugesan <i>et al.</i> , 2021) [55]
Ashwagandha	Withanolide A and Withaferin A	(Namdeo and ingawale, 2021) [57]; (Pandey <i>et al.</i> , 2017) [60]; (Thirugnanasambantham and Senthil, 2016) [85]; (Shasmita <i>et al.</i> , 2017) [75]; (Singh <i>et al.</i> , 2017)

Effects of Spices and Herbs in Sandesh

Sandesh is a traditional heat-desiccated congealed milk protein mass from West Bengal, India, known as chhana (a heat and acid-coagulated milk delicacy like cottage cheese) (Husain *et al.*, 2017) [30]. Sandesh has a marble white appearance, a spongy texture, and a moderate acidic flavor. It is extremely beneficial to the human health since it has relatively high protein and fat content, minerals (notably calcium and phosphorus) and vitamins (fat-soluble), including vitamin D and

A. In addition to this, sandesh has been incorporated with different plant-based herbs which includes wide range of plant-derived chemicals that protect cells from harm. Spices

and Herbs are potent sources of antioxidants and are also imperative for maintaining healthy health (Kapadiya *et al.*, 2016) [36]. Table 2 illustrates the effect of Spices and Herbs in sandesh.

Sandesh being a dairy product is susceptible to oxidation (Poonia, 2015) [68]. As has been reported, herbal juices of *Ocimum sanctum*, *Coriandrum sativum*, and *Mentha arvensis* at 4%, 5%, and 5% (w/v) concentrations were incorporated in sandesh. It was observed that, pudina (*Mentha arvensis*) at 5% showed greater values of phenolic content and scavenging activity which was followed by basil (*Ocimum sanctum*), coriander (*Coriandrum sativum*) and control sandesh (Chakraborty *et al.*, 2017) [12].

Similarly, it was shown by (Husain and David, 2018a)^[29] that the inclusion of two prominent medicinal plants, ashwagandha and tulsi, can enhance the microbiological quality of sandesh. They incorporated sandesh with ashwagandha and tulsi at different concentrations (1-6%). They observed that when sandesh was integrated with ashwagandha at the rate of 6%, it gave better results with regards to the microbial characteristics of buffalo milk Sandesh. In their subsequent study, (Husain and David, 2018b)^[29] showed that ashwagandha (3%), tulsi (3%) and a mixture of ashwagandha and tulsi in sandesh at 4% gave better results and proved to be highly acceptable in terms of sensory attributes.

A different study done by (Bandyopadhyay *et al.*, 2007a)^[5] turmeric, coriander and curry leaves were added individually as a paste in sandesh at a concentration of 10%. It was concluded that herbal sandesh had lower total antioxidative status than TBHQ samples but was comparable to BHA and BHT samples of 200 mg/kg. In addition to this, turmeric and curry leaves exhibited greater antioxidant levels than 100 mg/kg sample of BHA and BHT. Moreover, the protein content of sandesh mixed with turmeric and curry leaves was comparable with that of the control sandesh. In terms of organoleptic features, when sandesh was fortified with coriander, the degree of acceptability enhanced. Therefore, this study shows that sandesh with herbs has a higher nutritional value than the control sandesh.

Similarly, in a different study (Bandyopadhyay *et al.*, 2007b) utilized natural antioxidants such as *Zingiber officinale* L., *Beta vulgaris*, and *Mentha spicata* L. in sandesh individually or in conjunction to enhance the antioxidant activity of the sandesh, with ginger showing the greatest antioxidant level, which was comparable to BHA: BHT and TBHQ. In an oven procedure, however, mint showed more effectiveness against lipid degradation than ginger, and beet together with ginger

had the greatest antioxidant activity among the organic sources, with a result that is approximately identical to TBHQ (200mg/kg). The study found that using herbs at the latter of the sandesh preparation process had considerably better results than using them at the start. Also, that herbal sandesh has a higher nutritional value than control sandesh.

The usage of extracts from the Lamiaceae family, which includes plants like oregano, is significant for antioxidant applications due to its naturally high concentration in phenolic compounds (Babili *et al.*, 2011)^[2]. Oregano extract as a natural antioxidant and bran (rice and oats) was used to reconstruct sandesh for nutritional fibre. They discovered that the protein content of the oat bran and oregano extract mixture was higher. Whereas, the fat content was higher in case of sandesh having rice bran only. In addition to this, sandesh, which had 1% oregano extract, has the highest scavenging activity which was found to be 71%. The study also showed that the sample containing oregano extract and rice bran received the maximum overall score and was accepted the most, whereas samples containing oat bran received the minimum overall score and were rejected the most. (Paul and Riar, 2016)^[65] came to a conclusion that sandesh incorporated with rice bran and oregano extract, which has a good therapeutic potential and improved antioxidant activity, might be commercialised.

According to a research conducted by (Singh *et al.*, 2021) discovered that the ethanolic extract and the extract containing same proportion of ethanol: water of licorice root showed similar antibacterial efficacy against a fungal isolate and Gram-positive bacteria. The antioxidant efficacy of the ethanol fraction was likewise strong. They suggested that, licorice extract might be employed as a organic antioxidant and antibacterial supplement to preserve the quality of food goods.

Table 2: Application of Spices and Herbs in Sandesh

Product	Spices and Herbs	Remarks	References
Sandesh	Beet, ginger, and mint	10 of beet herbal paste gave higher values of overall acceptability. Antioxidant activity was higher in ginger paste.	Bandyopadhyay <i>et al.</i> , 2006 ^[5]
	Coriander, turmeric, curry leaf Basil, Pudina, coriander juice Tulsi, ashwagandha Bran (rice, oat) and oregano.	10% level of turmeric and curry leaves paste had higher antioxidant values. Pudina at 5% showed greater values of phenolic content and DPPH scavenging ability. Basil, coriander and control sandesh follows. Ashwagandha at 6% gave better results with regards to microbial characteristics. 2% of tulsi and ashwagandha were most acceptable from 0-15 days.	Bandyopadhyay <i>et al.</i> , 2007 ^[6] Chakraborty <i>et al.</i> , 2017 ^[12]
		Rice bran and oregano extract at 1% had higher antioxidant activity and was accepted the most.	Husain and David, 2018 ^[29] Paul and Riar, 2016 ^[65]

Effect of Spices and Herbs in Paneer

Paneer is a soft cheese created by coagulating milk in an acidic solution, retaining all or most of the fat as well as casein conjugated with whey protein (denatured), and a minor number of lactose and salts. It is a non-melting, non-fermentative, unripened and non-renneted type of cheese (Khan and Pal, 2011)^[39]. When compared to other functional goods, the shelf life and nutritional content of these milk products are quite low. Table 3 outlines the influence of Spices and Herbs in paneer.

Herbed and spiced paneer was developed in an experiment employing various medicinal plants like sage (*Salvia officinalis*), oregano (*Origanum vulgare*), and Indian borage (*Coleus aromaticus*), as well as three different classic spices including garlic, ginger, and chilli flakes. It was discovered that taking 2.5 grams of sage, oregano, and Indian borage

leaves and mixing them with coagulum (1% malic acid) yielded better results in terms of coagulation, paneer texture, yield, color, flavor, taste, and longer shelf life as compared to other coagulating substances such as citric acid, acetic acid, and lactic acid. In addition to this, it was shown that oregano-spiced paneer with malic acid as coagulum had the highest nutritional value and the best microbiological and physico-chemical results (Neethu and Nair, 2020)^[58].

According to the study carried out by (Joseph and Rao, 2019)^[34], lemongrass leaves and oil can be used to supplement paneer. They discovered that cutting lemongrass leaves and adding them to milk at a rate of 4% by weight of milk had the highest scores for the overall attributes. Because of its high moisture content and nutritional value, paneer has a short shelf-life, lasting just a day or two at room temperature whereas it extends to 6-8 days when refrigerated

(Thippeswamy *et al.*, 2011) [84]. To enhance the mean life of paneer, turmeric has been incorporated at a rate of 0.1% - 0.6% into paneer coagulum. It was reported that when paneer was refrigerated at 7 °C, paneer sample mixed with 0.6 per cent turmeric before heat treatment were edible for 12 days, contrasted to 7 days for control paneer. Moreover, when turmeric was added at greater concentrations other than 0.6%, the overall acceptability score dropped significantly (Buch *et al.*, 2014) [11].

In addition to this, the utilization of 0.25 per cent black pepper and 0.50 per cent cardamom powder resulted in enhancement of phenolic content (0.472 mgGAE/gram) which was slightly higher than the control paneer (0.459 mgGAE/gram). Moreover, protein content and fat content of paneer was also increased after the addition of black pepper and cardamom powder. It was concluded that utilising cardamom and black pepper to make paneer is a viable option, as it allows for the use of herb as a organic preservative to strengthen the mean life of the product, thanks to antioxidant and antibacterial properties of the herb (Badola *et al.*, 2018) [3].

Inclusion of 0.4% essential oil of clove in paneer led in the increased storage time. During the storage the standard plate count of the control sample rose dramatically. But, there was a drop in case of clove-treated paneer samples. Moreover, the mean life of control paneer was found as being 5 days and that of clove-treated sample was 10 days when stored at 8±1°C. Therefore, it may be inferred that clove essential oil is an effective natural antibacterial agent, particularly for paneer, and it may even be useful in overcoming the problem of paneer's short shelf life (Khatkar *et al.*, 2017) [40].

(Singh and Immanuel, 2014) [79] incorporated lemon, pomegranate and orange peel in paneer at 1% - 3% each. It was reported that the yield, phenolic content and the antioxidant ability was higher when pomegranate peel was used followed by lemon and orange peel. Moreover, because of the increased concentration of antioxidant extracts at 2%, the capacity to inhibit peroxide generation was better. In addition to this, pomegranate peel was the most effective in preventing peroxide generation in the paneer sample, followed by lemon peel and then orange peel.

Table 3: Application of Spices and Herbs in Paneer

Product	Spices and Herbs	Remarks	References
Paneer	Turmeric (0.1-0.6%)	Paneer samples mixed with 0.6% turmeric before heat treatment were edible for 12 days when refrigerated at 7±1 °C.	Buch <i>et al.</i> , 2012 [11]
	Lemongrass (1 - 6%) Cloves	Sensory Attributes was highest at the rate of 4% level. 0.4% clove essential oil had shelf life of 10 days where control paneer had 5 days.	Joseph and Rao, 2019 [34] Khatkar <i>et al.</i> , 2017 [40]
	0.50% Cardamom and 0.25% Black pepper	Phenolic content of herbal and control paneer was 0.472 mg GAE/gram and 0.459 mg GAE/gram severely.	Badola <i>et al.</i> , 2018 [3]
	Indian borage, sage, oregano, ginger, garlic, chilli flakes (2.5 grams dry leaves in 2.5L milk)	Combination of 1% malic acid (coagulant) and oregano spice had maximum overall acceptability followed by 1% acetic acid and oregano spiced paneer.	Neethu and Nair, 2020 [58]

Effect of Spices and Herbs in Lassi

Fermented milk products account for around 9% of total milk output in India. Lassi, made by churning curd, is among India's leading dairy beverages. Lassi has proven to be an effective source of all non-essential and necessary amino acids (Maji *et al.*, 2020) [47]. Lassi is a popular native fermented milk-based beverage that is often made by blending equal parts water and dahi (Dhumal *et al.*, 2018) [17]. Table 4 illustrates the effect of Spices and Herbs addition in lassi. Carrot, turmeric and ginger have proven to be high in antioxidants and have been widely employed in our everyday diets (Bandyopadhyay *et al.*, 2006) [5]. Infusion of 15% carrot extract, 2% ginger extract, and 1% turmeric extract in lassi gave higher values when it comes to overall attributes. In addition to this, turmeric extract (0.226±0.001 mg GAE/gm) had higher values in terms of the antioxidant activity followed by ginger and carrot whereas, the control was 0.124±0.001 mg GAE/gram. Moreover, lassi made with turmeric was consumable up to 9 days (Maji *et al.*, 2020) [47].

In a separate experiment (Maji *et al.*, 2018) [48] employed turmeric and integrated it into lassi at a rate of 1% to 4% (v/v). They found that when lassi was fortified with a 1% concentration, the total phenolic content and overall acceptance increased. Similarly, pudina was added in lassi at 2.5%, 5%, and 7.5% and it was observed that the sensory quality of lassi was increased when the pudina extract was added at the rate of 2.5% (2.5 parts *Mentha arvensis* extract +

97.5 parts curd) with 15% sugar level. Moreover, the same concentration of pudina extract resulted in improved physico-chemical properties of lassi (Dhumal *et al.*, 2018) [17].

Wheatgrass was integrated at 5, 10, and 15% in lassi. The range for coliform was revealed to be between 1 and 5 cfu/g. Furthermore, the coliform count in lassi infused with 15% wheatgrass (85 parts curd + 15 parts wheatgrass extract) was minimum (0.00 cfu/gm), compared to 0.25 cfu/gm in the control lassi. The yeast and mould count, on the other hand, was 0.00 cfu/gm, while the control lassi had a count of 1.00 cfu/gm. Therefore, it was determined that there was no aberrant increase of total bacterial count, yeast, or mould count in wheatgrass (Kakde *et al.*, 2019) [35].

Giloy (*Tinospora cordifolia*) is a significant and widely utilised plant in different unani and Ayurveda medicinal systems. Moreover, giloy contains phytochemical substances, and all sections of the plant are utilised for medicinal purposes (Choudhary *et al.*, 2013) [14]. Giloy has been infused in lassi at varying concentrations of giloy juice (3%, 6%, and 9%). It was observed that giloy juice with a concentration of 9% had a greater percentage of antioxidants, whereas giloy juice with a concentration of 6% was optimum for the formulation of herbal lassi since the overall acceptability and antioxidant percentage was maximum. Furthermore, in all treatments, the coliform count was zero, although the yeast and mould counts were comparable. As a result, Giloy may be successfully included into herbal lassi without compromising

the lassi's sensory quality. The lassi made was also confirmed to be safe in terms of microbiological criteria (Tripathi and

Rani, 2021)^[88]

Table 4: Application of Spices and Herbs in Lassi

Product	Spices and Herbs	Remarks	References
Lassi	15% Carrot, 2% ginger, Pudina extract (2.5, 5.0 and 7.0%)	2% ginger had highest antioxidant activity of 0.216±0.001mg GAE/gm) 2.5% (2.5 parts <i>Mentha arvensis</i> extract + 97.5 parts curd) was most acceptable.	Maji <i>et al.</i> , 2020 ^[47] Dhumal <i>et al.</i> , 2018 ^[17]
	Wheatgrass (5, 10, 15%)	15% wheatgrass (85 parts curd + 15 parts wheatgrass extract) had minimum (0.00 cfu/gm) coliform, yeast and mould count.	Kakde <i>et al.</i> , 2019 ^[35]
	Turmeric (1 - 4%)	1% turmeric lassi had higher values of antioxidant activity (0.226±0.001).	Maji <i>et al.</i> , 2018 ^[48]
	Giloy (3%, 6%, and 9%).	6% herbal lassi was optimum since the overall acceptability and antioxidant percentage was maximum.	Tripathi and Rani, 2021 ^[88]

Effects of Spices and Herbs in Ghee

Ghee is a kind of clarified butter native to South Asia, typically made from the milk of cows or buffalos. It is dehydrated milk fat that plays significant role in cuisine of India. The preparation is done by directly heating fresh or ripened cream, or curd made from milk fermentation (Kapadiya and Aparnathi, 2018)^[37]. Ghee, also known as clarified butterfat, is made from buffalo and cow milk, or the blend of the two, and has a soothing and appetizing aroma. Ghee comes second following fluid milk in India's milk utilization pattern due to its superior cooking and frying qualities (Patel *et al.*, 2013)^[63].

For ghee preparation, buffalo and cow milk is procured and pre-heated to 45 °C. Cream is separated and then the cream is standardized to 40% fat. After that, the pasteurization of cream at 90 °C for 15 sec was carried out, followed by chilling to 4 °C. The cream then aged at same temperature overnight and was then churned into butter. The butter thus produced was melted properly at 65 °C. After melting, it was clarified at 113 °C – 115 °C followed by filtering through muslin cloth (Parmar and Khamrui, 2017)^[61]. Table 5 represents the influence of Spices and Herbs in ghee.

During storage, ghee suffers oxidative deterioration, resulting in changes in main quality criteria such as color, flavor, aroma, and nutritional content, all of which have an impact on its acceptability for eating (Gandhi *et al.*, 2013)^[21]. As has been reported, herbs such as ajwain, curry leaves, and betel leaves were added in ghee in dried form at the rate of 5% (w/w) to observe the total cholesterol lowering effect. It was observed that, ghee treated with betel leaves had the total cholesterol concentration of 187.78mg/100gm, which was 10.53% lesser than the control ghee sample (209.07 mg/100gm). Whereas, it was 4.63% and 4.50% reduction in case of ajwain leaves and curry leaves respectively (Shingala *et al.*, 2019)^[76].

The development of rancidity in ghee produces an off-flavor, which the customer will not accept (Mehta *et al.*, 2015)^[53]. The incorporation of Spices and Herbs in ghee during production provides customers with health advantages as well as increased ghee stability against oxidative degradation. Therefore, to assess the compatibility of 14 different herbs, 0.5 grams each of them were incorporated in ghee in powdered form. It was observed that, ghee having curry leaves and betel leaves have higher values in terms of total

phenolic content followed by tulsi and jequirity leaves. In addition to this, betel leaves had lowest value of peroxide by the conclusion of 12th day during storage. It was inferred that, during an accelerated storage research at 80±2 °C betel leaves were shown to be the most effective in avoiding peroxide development, taste degradation, and colour changes in ghee (Kapadiya and Aparnathi, 2018)^[37]. Shatavari, or *A. racemosus*, is a plant that promotes longevity, enhances brain performance, and gives the body more vigour and vitality (Veena *et al.*, 2014)^[90]. Ethanolic and aqueous extract of shatavari at 0.5% and 1% were incorporated in ghee to assess the effect on the phenolic content and the oxidative stability of the ghee. It was found that, the ethanolic extract of shatavari contained considerably more phenolic components than the aqueous extract. In addition to this, the ethanolic extract had higher antioxidant potential, scavenging capacity, peroxide value and conjugated dienes. According to the study, the addition at the rate of 0.5% - 1% of several herb extracts protected ghee from oxidative degradation (Pawar *et al.*, 2012)^[67]. Similarly, in a different study, two coriander extracts (oleoresin and steam-distilled) were prepared to assess the accelerated storage at 80±1°C and deep frying at 180±5°C. These extracts were incorporated in cream at 0.5%, accompanied by ghee preparation. It was observed that, the total phenolic compounds and the TBA value was more in case of steam distilled extract than in oleoresin extract. However, the antioxidant potential was stronger in BHA, and it was followed by steam-distilled extract and oleoresin extract. The study came to conclusion that, the efficacy of extracts at delaying the oxidation in ghee was higher. Nonetheless, the effectiveness of artificial antioxidants was more than the coriander extracts (Patel *et al.*, 2013)^[63].

Vidarikand (*Pueraria tuberosa*) is widely utilized in the treatment of cancer, diabetes and restoring bodily functions (Sharma *et al.*, 2018)^[74]. Aqueous vidarikand extract and ethanolic vidarikand extract at 1% and 0.5% were prepared respectively. It was found that, the antioxidant activity and scavenging activity of the ethanol extract of vidarikand was determined to be greater than that of the aqueous extract. In addition, vidarikand extracts suppressed oxidation in ghee for 21 days at 80±1°C, according to the accelerated storage test. They were, however, ineffective when compared to synthetic antioxidants (BHA and TBHQ), rosemary, and green tea (Gandhi *et al.*, 2013)^[21].

Table 5: Application of Spices and Herbs in Ghee

Product	Spices and Herbs	Remarks	References
Ghee	Ajwain, curry leaves, betel leaves	5% betel leaves had 10.53% less cholesterol concentration than the control.	Shingala <i>et al.</i> , 2019 [76]
	Shatavari (0.5% ethanolic and 1% aqueous extract)	0.5% ethanolic extract had higher values with regards to phenolics, antioxidant potential and scavenging activity.	Pawar <i>et al.</i> , 2012 [67]
	Coriander	0.5% steam-distilled coriander extract had more phenolics compounds as compared to the 0.5% oleoresin extract.	Patel <i>et al.</i> , 2012 [63]
	Vidarikand (0.5% ethanolic and 1% aqueous extract)	0.5% ethanolic was more effective with regards to the antioxidant potential and scavenging activity.	Gandhi <i>et al.</i> , 2013 [21]
	Curry leaves, betel leaves, tulsi, jequirity leaves and 10 other herbs	0.5 grams of betel leaves had lowest value of peroxide at the conclusion of 12th day of storage at 80±2°C.	Kapadiya and Aparnathi, 2018

Effects of Spices and Herbs in Ice cream

Ice cream being a high-calorie frozen dairy dish is both tasty and healthful. The whipping and freezing procedures are crucial activities for forming the proper palatability, structure, and texture of ice cream, which being a frozen dairy product consumed in its frozen condition (Bahramparvar and Tehrani, 2011) [4]. Moreover, the commercial ice cream is often heavy in sugar and fat, but low in organic antioxidants. Table 6 depicts the influence of Spices and Herbs in Ice cream.

Basil (*Ocimum sanctum*), commonly called tulsi, has lipid-lowering, antimicrobial, anti-inflammatory, antioxidant, and hypoglycemic properties (Bhadra, 2020) [9]. Basil was infused as juice (2%, 4%, 6%, 8%) and as freeze dried powder (0.5%, 1%, 1.5%, 2%) in ice cream to enhance the flavor. According to the study, ice cream taste was enhanced by basil juice when added at 6% by weight of mix, whereas dried basil was more effective at 1%. In addition to this, when compared with the control, the bacterial, mould and yeast count was shown to be lower in basil flavoured ice cream samples (Trivedi *et al.*, 2014) [81].

By adding herbs and other protein-rich substances to ice cream, it will be much more nutritious and good to one's health. Mint and *Aloe vera* were added in ice cream at different concentrations. It was found that 5% *Aloe vera* and 0.5% mint were found to be more acceptable when combined with 95% ice cream mix. In addition to this, the standard plate count and coliform count were significantly lower than the control. Nonetheless, the results of proximate composition were comparable with those of other treatments (Verma *et al.*, 2018) [91].

Ginger (*Zingiber officinale*) and lemongrass (*Cymbopogon citratus* Stapf.) contain bioactive components that can be used

as natural additives (Tovar *et al.*, 2010; Nile *et al.*, 2015) [59]. Ginger and lemongrass at 10%, 15% and 20% were added in ice cream to develop healthy and herbal ice cream. Moreover, sugar was replaced by 80%, 90%, and 100% xylitol. It was determined that 15% ginger extract or lemon grass extract infused with 90% xylitol was the most acceptable in terms of microbiological, chemical and physical properties (Chamchan *et al.*, 2017) [13].

In a separate experiment, ginger juice at 2% - 6% was mixed into ice cream to determine standard plate count and coliform count. It was discovered that, ice cream incorporated with 4% ginger juice was the most acceptable in terms of sensory and microbiological analysis (David, 2014) [15]. Correspondingly, curcumin was utilised as a natural colouring ingredient in ice cream and the sensory qualities of final product were analysed. It was discovered that the optimal amount of curcumin powder to use in ice cream manufacturing was 0.5 percent (Manoharan *et al.*, 2012) [49].

Indian gooseberry (*Phyllanthus emblica*) or amla being rich in vitamin C and its use as an antioxidant is widely known (Verma *et al.*, 2018) [91]. Amla was processed into preserve, candy, pulp and shreds and incorporated in ice cream at varied concentration (5% - 20%). Moreover, amla powder was also utilized at 0.5% - 2% concentration. It was considered that, the melting resistance was increased with the reduction in overrun. Furthermore, the antioxidant potential and the phenolic content increased with the growing concentration of amla. Additionally, it was also discovered that the values for overall acceptability of amla as powder (0.5%), shreds and pulp (5%), preserve and candy (10%) were higher than other concentrations (Goraya and Bajwa, 2015) [24].

Table 6: Application of Spices and Herbs in Ice cream

Product	Spices and Herbs	Remarks	References
Ice cream	Basil Juice (2% - 8%) and Powder (0.5% - 2%)	6% basil juice and 1% dried powder enhanced the overall acceptability of ice cream.	Trivedi <i>et al.</i> , 2014
	Mint and <i>Aloe vera</i>	0.5% mint and 5% <i>Aloe vera</i> mixed with 95% ice cream mix was highly acceptable.	Verma <i>et al.</i> , 2018 [91]
	Ginger or lemongrass (10%, 15% and 20%)	15% ginger or lemongrass mixed with 90% xylitol was more acceptable in terms of microbiological, chemical and physical properties.	Chamchan <i>et al.</i> , 2017 [13]
	Ginger juice (2% - 6%)	4% ginger juice was the most acceptable in terms of sensory and microbiological analysis.	David, 2014 [15]
	Curcumin	0.5% curcumin powder was highly acceptable.	Manoharan <i>et al.</i> , 2012 [49]
	Amla (Indian Gooseberry)	Amla powder (0.5%), shreds and pulp (5%), preserve and candy (10%) had greater values for overall acceptability.	Goraya and Bajwa, 2015 [24]

Conclusion

A natural preservative derived from herbs can serve as both a

beneficial food source and a substitute for synthetic preservatives that are associated with adverse health effects.

Spices and Herbs are a sources of variety of phytochemicals which are known to have health benefits. Aside from this, it is also imperative for spices and herbs to meet food standards in terms of quality, preservation, and potency. As we discussed in this article, different herbs had various effects when incorporated into sandesh, lassi, ice cream, ghee, and paneer. As a result, we learned how herbs were able to improve several dairy product properties, including total phenolic content, antioxidant activity, shelf life, mouthfeel, and overall acceptance. Thus, it is plausible that the inclusion of herbs in Indian dairy products has shown to be of utmost importance and has the potential to improve their efficacy and efficiency.

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