

Study on the therapeutic properties of herbs and their utilization in the development of value-added products: A Review

Abstract

India has the largest population of cattle in the world and also ranks first in consumption considering it as having a huge demand for dairy and value-added dairy products. A wide range of dairy products is already available in the market like butter, cheese, labneh, ice cream, buttermilk, custard, etc. Yogurt is one of the oldest consumed dairy products with several benefits as it contains various microorganisms such as Lactic acid bacteria, *Lactobacillus* spp. and *Streptococcus* spp. which ferment the product and it helps in improving the nutritional value of the product. Yogurt contains a rich source of B vitamins, lactose, proteins, and minerals. To enhance its nutritional value herbs and fruits can be added to it. Herbs are a type of plant whose leaves and seeds have a wide range of use in medicines, adding flavor, cooking, etc. Herbs are anti-inflammatory, have antioxidants, boost the immune system, and have several other health benefits. Different types of herbs and their health benefits were studied such as Ashwagandha, Arjuna, Cinnamon, Sage, Aloe vera, Tulsi, and Peppermint. Fruits are added to dairy products to enhance their flavor and nutritional value. Fruits are a good source of vitamins and minerals. In this review paper, we discuss the nutritional prospects of yogurt supplemented with herbs.

Keywords: Fruits, Herb, Microorganisms, Nutritional value, Therapeutic properties, Yogurt.

1. Introduction

Yogurt is a fermented product that is made from the fermentation of lactose in milk by specific microorganisms such as *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. It can be noted that in the majority of countries yogurt a cultured dairy product has seen a popular demand. As fermented dairy products deliver a good nutritional value, they are widely consumed food all over the world. Beneficial microorganisms that help in gut health improvement are present in yogurt [103]. In most countries, a cultured dairy product that has been increasingly getting popular is yogurt. This is because of spreading awareness among

consumers towards the health benefits of yogurt. Yogurt is a rich source of carbohydrates, protein, fat, vitamins, calcium, and phosphorous [86]. To produce fermented food products and milk products lactic acid bacteria have been used for thousands of years [97]. The one which is best-known food that contains probiotics is yogurt. Probiotics are defined as “living microorganisms, which on ingestion in sufficient numbers exert health benefits beyond inherent basic nutrition” [71]. Consumers accept foodstuff based on flavor, hence flavor is the key factor [15]. As fruit makes dishes tasty, the addition of fruit in yogurt will make it more delicious therefore a variety of different fruits has been tested in yogurt manufacturing increasingly [60]. India has a wide range of fruits as it has a vast horticulture base but India is also at the top position in the world because of its post-harvest losses of perishables and semi perishables, this terms for a new approach for utilization of fruits in an efficient manner [103]. Using fruit in yogurt enhances its taste and makes it more delicious. Pectin and sugars that are present in fruit are mixed with the yogurt which helps to increase its consistency and viscosity leading to a good mouth feel. Commonly used fruits in yogurt are raspberry, blueberry, peaches, orange, pineapple, strawberry, cherry, lemon, peach [13], and mango [103]. Other ingredients such as; herbs can be used such as holy basil (tulsi), cardamon, fenugreek, coriander, turmeric, cinnamon, wheat grass, ashwagandha, green tea, and many more. All these herbs have nutritional benefits. The addition of herbs in yogurt can increase its nutritional value and will add health benefits [100]. Tulsi is one of India’s greatest healing herbs that were recognized thousands of years ago by rishi [18].

2. Yogurt

A milk product with coagulation, yogurt. The need for innovative products that can offer greater nutrition has become critical as customer lifestyles have changed in favor of health benefits. About 7 per cent of the milk required to make fermented dairy products is produced in India [87]. Milk is regarded as a nutritious food with numerous health advantages. Proteins, fatty acids, vitamins, and minerals that are abundant in dairy products are needed for maintaining healthy blood, the nervous and immunological systems, eyesight, muscle and nerve function, healthy skin, energy levels, and growth and repair in all areas of the body. Additionally, these items can enhance health or wellbeing, and when taken in the correct amounts, they provide advantages such as boosted immune system performance, lowered cardiovascular risk, lowered possibility of bone mass loss, and defence against free radical damage [42, 61, and 102]. Fruits come in a variety of forms, including fresh, dried, powder, liquids, puree, pulp, fiber, and extract, giving food manufacturers the opportunity to enhance

the nutritional value of their creations [85, 83, 88, and 84]. Studies have been done on adding these products or their by-products to dairy products such as yogurt, ice cream, and cheese. In India, the yogurt market expanded at a CAGR (Compound annual growth rate) of 28.9 per cent between 2011 and 2015. *Lactobacillus delbrueckii* spp., *bulgaricus* and *Streptococcus thermophilus* work together to ferment lactic acid to produce yogurt, a fermented dairy product. Lactic acid produced as a result of this reaction with milk protein enhances the product's distinctive texture and sensory qualities [91]. Yogurt is likewise a good source of protein, fat, calcium, potassium, and vitamins B (B₁, B₂, B₆, nicotinic and pantothenic acids) [45 and 46]. Due to their desired functional qualities, such as their capacity to bind water, gel, and thicken, certain fruits and vegetable powders have been suggested as suitable stabilizers for yogurt. Besides, passion fruit by-products [38], apple pomace [51 and 104], date fiber [47], apple, wheat, bamboo and inulin fibers [99], carrot juice [38], orange fiber [39], and pineapple peel and pomace powders [82] confirmed to improve the structure and decrease the syneresis of yogurts. Fiber-rich fruit powder may have functional qualities in addition to its nutritional value, such as the ability to hydrate after eating, absorb fat, and have viscosity and texture qualities [36 and 84]. Apple fiber was added to yogurt production to enhance the a* and b* values while decreasing the lightness (L*) value [34 and 99]. Orange fiber (0 %, 0.6 %, 0.8 %, and 1 % doses and different fiber sizes) obtained from orange juice by-products was added to yogurt [39].

2.1 Nutritional value of yogurt

Yogurt's nutrient profile is determined by the nutritional makeup of the milk it is made from, which is influenced by a variety of variables, including genetics and the individual mammal's variations in feed, lactation stage, age, and environmental factors things as the time of year and the season.

2.1.1 Vitamin B

Dairy products are typically regarded as a great high-quality protein, calcium, potassium, phosphorus, and other minerals the vitamins B niacin, riboflavin, and vitamin B₃; magnesium; and zinc; B₆ and B₁₂ are vitamins [25]. A considerably higher vitamin loss than of minerals might happen when making yogurt because vitamin sensitivity to changes in environmental circumstances is greater, compared to minerals. The vitamin content of yogurt might vary depending on the bacterial cultures utilized during the fermenting process. Vitamin B are necessary for the development of LAB species; however, some Cultures can

produce vitamin B synthetically [25]. Here's one Vitamin B₁₂ is a kind of vitamin B that LAB uses [79 and 93]. The range of vitamins needed for the development of LAB cultures strains from one. It is possible to restore significant vitamin B₁₂ deficits, by the prudent application of additional LAB cultures that are able to produce vitamin B₁₂ from scratch [56]. Vitamin B folate is the finest illustration that some LAB species produce [57 and 31]. Depending on the types of bacteria Yogurt's folate level might vary significantly depending on how it's consumed, from 4 to 19 g/100 g [93]. The primary folate form found in milk is 5-methyl-tetrahydrofolate [106]. Recent research involved bacterial isolates, from a variety of species used in yogurt and milk fermentation. The ability of production to synthesize or make use of folate [31]. Folate was produced by *S. thermophilus*, *Bifidobacteria*, and *Lactobacilli*, whereas it was depleted from the milk medium by *Lactobacilli*. The final fermented product's ultimate folate content increased thanks to the mixture of folate-producing microorganisms. Further research on the impact of variations in milk's vitamin B level on fermentation would be extremely useful.

2.1.2 Lactose

Dishes cooked using dairy components and dairy products are the only sources of lactose disaccharides in human diets. Lactose is degraded by the digestive tract before being absorbed galactosidase (lactase) into glucose and galactose with a brush. These monosaccharides are ingested and utilized as fuel. Prior to fermentation, the yogurt mixture's lactose concentration typically is 6 per cent [29]. One prominent bacteria-related illness is the fermentation process involves a shift called hydrolysis. To its absorbable monosaccharide, converting 20–30 per cent of the lactose disaccharide galactose and glucose as constituents [23]. Additionally, some lactic acid is produced when glucose is consumed. Contingent upon others this hydrolysis lowers the lactose concentrations after the addition of components. Compared to milk, which partially explains why yogurt is better tolerated than milk by those with lactose intolerance [81 and 58]. However, it also appears that additional elements are involved. For instance, subjects with lactose intolerance showed improved tolerance for yogurt with a disproportionately large quantity of lactose compared to milk with the same volume quantity of lactose [81 and 58]. Another illustration is when bacteria in yogurt, like *L. Bulgaricus* and *S. thermophilus* functional expression of the enzyme that digests lactose is called lactase [43]. This statement may also lead to increased lactose tolerance in yogurt than in milk by those who have lactose maldigestion [58].

2.1.3 Protein

Commercial yogurt often contains more protein than milk because non-fat dry milk is added during processing and concentration, which raises the protein level of the finished product. As bacterial pre-digestion of milk proteins in yogurt may occur [93 and 78], it has been proposed that protein from yogurt is easier to digest than protein from milk. This claim is confirmed by data showing that yogurt contains more free amino acids than milk, particularly proline and glycine. Proteolytic enzymes and peptidases continue to function throughout the yogurt's shelf life. Consequently, the focus of the amount of free amino groups doubles during the first 24 hours, then doubles once again during the next 21 days, preserving at 7 °C [59]. The ability of some bacterial cultures to possess more proteolytic activity than other organisms. For instance, *L. bulgaricus* it was discovered that has significantly greater proteolytic activity. Then *S. thermophilus* during the fermentation and storage of milk was seen by increased levels of peptides and free following milk fermentation, amino acids [17]. Casein coagulates more finely during fermentation as a result of both heat treatment and acid generation, which may also help explain why yogurt has a higher protein digestibility than milk. Due to the fermentation process' remarkable preservation of milk proteins' nutritious content, yogurt's and milk's proteins both have outstanding biological qualities [48]. Yogurt's casein and whey proteins are both abundant suppliers of all nine necessary amino acids, and studies have shown that the intestinal availability of nitrogen is high (93 %) [20 and 41]. In research including human participants, [40] discovered that while both milk and yogurt's proteins were quickly degraded after consumption, the gastroduodenal transfer of dietary nitrogen was slower with yogurt than with milk.

2.1.4 Lipids

Additionally, during the metabolic transformation of milk fat, fermenting procedure. Free fatty acids are released in small quantities, in response to lipase activity [29] due to the fact that most yogurts both low-fat and non-fat products are offered for sale in the United States. Little is added by lipid hydrolysis to the characteristics of most yogurt-related goods. Yogurt, however, has been demonstrated to have greater milk from cows that have higher concentrations of conjugated linoleic acid (CLA), a long-chain biohydrogenated derivative of linoleic acid, which processed the yogurt [95] an item made from fermented milk dahi, an Indian food, has likewise been demonstrated to have greater compared to non-fermented dahi, conjugated linoleic acid content [5]. The principal sources of conjugated linoleic acid in our diets come from ruminant animal products, which bacteria in the rumen produce conjugated

linoleic acid. According to reports, conjugated linoleic acid has immunostimulatory and anticancer properties [111]. In a current breast and colon investigation, [54] showed that the anticarcinogenic characteristics of conjugated linoleic acid may result from some conjugated linoleic acid isomers' capacity to prevent the progression by inhibiting the expression of cyclins G1 to S phase of the cell cycle. Additionally, conjugated linoleic acid caused the expression of the p53 tumor inhibitor.

2.1.5 Minerals

Yogurt is a great source of calcium and phosphorus in addition to being a healthy source of protein. The role calcium plays in the mineralization and development of bones is one of its main functions. During periods of development, pregnancy, and nursing, more calcium is needed. However, women who can have children generally consume less calcium than is advised [21]. Additionally, during the years after menopause, women's calcium consumption typically declines even further [37]. For postmenopausal women, who are more susceptible to osteoporosis and bone loss, this is particularly crucial. In the rat model, calcium retention was higher when rats had a diet where lactose made up half of all the carbs, they consumed than when they consumed a control diet [53]. According to [89], who used rat models to study the impact of dairy products on mineral absorption, lactose improves the absorption of calcium, magnesium, and zinc. The bioavailability of several minerals may be significantly impacted by yogurt's lower lactose level than milk, however, the impact is probably minimal. Yogurt's pH is acidic, which ionizes calcium and makes it easier to absorb intestinal uptake of calcium [24]. Yogurt's low pH might also diminish the inhibition of calcium absorption by dietary phytic acid bioavailability. Intestinal regulation is significantly influenced by vitamin D, taking in calcium. The saturable, active, transcellular the proximal jejunum and the duodenum's pathway of calcium absorption need the vitamin D-dependent calcium-binding protein calbindin-D [69].

3. Fruits

Table 1 reports the impact of fruits on several attributes of specific dairy products. The information in this table displays the physicochemical characteristics of yogurt products that contain fruit and vegetable powder. In conclusion, adding fruits and vegetables to cheeses, ice creams, and yogurts results in functional dairy products with excellent nutritional benefits and acceptance. Dairy products are widely consumed, therefore enriching them will

successfully reduce or prevent illnesses linked to nutrient shortages [42]. Protein, fatty acids, calcium, potassium, and vitamin B are abundant in dairy products, while iron, vitamin C, carotenes, and dietary fibers are lacking [26, 27, and 46]. The nutritional value and functional food qualities of these products will thus be enhanced by the addition of fruits, vegetables, and their by-products to cheeses, ice creams, and yogurts. The antioxidant molecules in fruits and vegetables that are thought to be the most naturally occurring include vitamins, polyphenols, and carotenoids. Compared to the artificial additions in dairy products, these natural chemicals can offer greater sensory, nutritional, and antioxidant qualities [26].

Table 1 Sensory evaluation of apple pomace and date fiber base yogurt

Dairy product	Fruit	Appearance	Color	Flavor	Consistency	Overall acceptability	References
Yogurt	Apple pomace : 2.5%	7.2	6.5	7.4	7.6	7.3	(51)
Yogurt	Date fiber: 1.5%	6.2	6.3	6.1	-	6.8	(47)

3.1 Mango

According to literature, mangoes [*Mangifera Indica Linn* (family Anacardiaceae)], a well-known fruit from the tropics, began on the Indian subcontinent before moving elsewhere and gaining popularity globally. India, China, Thailand, and Mexico are currently the leading mango growers and exporters [8 and 92]. 15 per cent of mango's calories come from carbs, 1 per cent from dietary fiber, 38 per cent from fat, and 82 per cent from protein [70 and 35]. The mango's leaves, fruits, stem bark, heartwoods, and roots are all rich sources of mangiferin [50 and 1]. Mangiferin, a crystalline powder with a light-yellow tint, has a low solubility in ethanol, a moderate solubility in methanol, a negligible solubility in water, and is nearly insoluble in diethyl ether, acetone, and n-hexane [2]. Mango pulp is the primary and most immediately digestible component. Accounts for mango pulp 50 to 60 per cent of the weight of the entire fruit, and is used to make a variety of goods, including jam, puree, juice, and nectar. Numerous beneficial and nutritive substances may be found in pulp. The dairy and beverage industries employ mango pulp as a flavoring additive and in formulas for infant

food. With an annual growth rate of 5 per cent, the market for items connected to mangos is expanding consistently [10 and 11]. The World Health Organization (WHO) advises the 400 g of fruits and vegetables every day is recommended since their nutrients might chronic conditions include diabetes, cancer, heart disease, and obesity [7]. Excellent bioactive substances found in the mango pulp include phenolic acids, polysaccharides, sterols, alkaloids, and carotenoids (provitamin A, 3894 IU/100 g). Mango is a part of the TRAMIL list (a research project on medicinal plant resource in the Caribbean) because it is utilized by the native population to cure ulcers, gastritis, diarrhea, and fever [80].

3.2 Apple pomace

Apple seeds are found in pomace, which most of the fatty acids found in apples, mostly as the (18:2 n-6) linoleic acid and the (18:1 n-9) oleic acid [19]. Studies have shown that linoleic acid is an important fatty acid indicating that it lowers the chance of developing atherosclerosis, lowers body fat, and improves poor glucose tolerance and fat accumulation [68 and 73]. Carbohydrates make up around 14 per cent of the nutritional makeup of apples [9]. The apple pomace consists of more carbohydrates per serving than apples. Because the sucrose level in apple pomace varied greatly apple cultivars differ greatly in terms of sugar content [9 and 75]. Fructose and glucose make up a sizable portion of the total carbohydrates in both apples and apple pomace [19 and 9]. Apple pomace presumably contains more fructose and glucose than apples because of the addition of the seeds that contain sugar (Table 2).

Table 2 Comparison of the nutrient composition of whole apples versus apple pomace

Constituents (fresh weight)	Whole apple ^a	Apple pomace ^b
Fat	0.16-0.18	1.1-3.6
Protein	0.24-0.28	2.7-5.3
Total carbohydrates	13.81	44.5-57.4

Fructose	5.8-6.0	44.7
Glucose	2.4-2.5	18.1-18.3
Total fiber	2.1-2.6	4.4-47.3
Insoluble fiber	1.54	33.8-60.0
Soluble fiber	0.67	13.5-14.6
Pectin	0.71-0.93	3.2-13.3

Source: [9, 19 and 75]

Few researches has looked into the advantages of for one's health despite preclinical research showing positive benefits on lipid metabolism, body weight, gastrointestinal health, glucose management, and antioxidant activity, many still consume apple pomace [19].

4. Herbs

Herbs have been utilized as medicine and preservatives as well as culinary flavorings from the dawn of time. Diet habits and illness prevention are closely related; research has demonstrated how food affects conditions including diabetes, obesity, osteoporosis, hypertension, and cardiovascular disease [6]. With the advent of fortified foods, there is an increase in health awareness and interest in using herbs as valued food additives in dairy and food products around the world [12]. India is the world's greatest supplier of medicinal herbs and is known as the "Botanical Garden of the World" [64]. According to a World Health Organization survey, between 70 and 80 per cent of the world's population rely on complementary and alternative medicine, primarily herbal sources, for their primary healthcare [28]. More than 60 percent of people worldwide and 80 percent in developing nations directly depend on plants for their medical needs [96].

4.1 Ashwagandha (*Withania somnifera*)

Winter cherry or Indian ginseng are other names for ashwagandha. One of the most revered medicinal plants, utilized for ages in Indian Ayurveda. It is a member of the Solanceae family

and is cultivated in India, Africa, and the Mediterranean. Ashwagandha is regarded as a vitalizer, adaptagen, and possesses antioxidant effects in addition to enhancing the capacity to tolerate adversities. Ashwagandha contains antistress compounds called sitoindosides and acylsterylglucosides. Alkaloids, flavonoids, and steroidal lactones are present in ashwagandha, which gives it its unique properties. Most alkaloids—nicotine, sominie, somniferin, somniferinine, withanine, withanonine, withanolides, etc.—are found in their root. The plant's roots have hypotensive, bradycardic, anticancer, respiratory stimulant, and immunostimulant properties [62 and 101].

4.2 Arjuna (*Terminalia arjuna*)

Terminalia arjuna Wight & Arn is an evergreen and deciduous plant, a member of the Combretaceae family of trees. It is widely distributed in South Bihar, including all of Uttar Pradesh's Indo-Sub-Himalayan regions, near ponds and rivers are Madhya Pradesh, Delhi, and the Deccan area. It is also present in the jungles of Mauritius, Myanmar, and Sri Lanka. It has antioxidant and free radical scavenging capability, activity brought on by the presence of higher phenolic and flavonoid compounds content [98]. The plant has a lot of natural antioxidants, so has application in both Yunani and Ayurvedic medical systems. It is claimed to have styptic, anthelmintic, and alexiteric qualities tonic and beneficial for urine discharges, cardiac conditions, fractures, anemia, tumor, asthma, biliousness, ulcers, excessive sweating, etc. Phytochemicals derived from *Terminalia arjuna* are regarded as one of the greatest cardiac supplements for a strong cardiovascular system. This herb's sitosterol decreases blood serum cholesterol levels via preventing the absorption of cholesterol. The participating elements there include tannins, triterpenoid saponin, Flavonoids, Gallic acid, ellagic acid, Calcium, magnesium, zinc, phytosterols, Oligomeric Proantho Cyanidines (OPCs), and copper, too [74 and 94].

4.3 Sage (*Salvia triloba*)

The dried leaf of a mint family plant is sage. The Sage leaves plants are well recognized for their anti-inflammatory and anti-oxidative qualities. The primary anti-oxidants in sage include carnosic acid, rosmadial, rosmanol, and epirosmanol in addition to carnosol as well as methylcarnosate [33].

4.4 Cinnamon (*Cinnamomum verum*, synonym *C. Zeylanicum*)

Many ancient societies have long employed the plant cinnamon. They are tiny evergreen trees from the Lauraceae family native to South India and Sri Lanka. Along with being utilized as a Cinnamon is a spice and flavoring agent that is used in some foods for mouth-freshening outcomes [52]. Cinnamon's essential oils have antifungal, antidiabetic, antibacterial, and antioxidant [55]. Cinnamon demonstrates a full-spectrum antibacterial activity against food-borne microorganisms such as *E. Coli*, *S. Aureus*, *Salmonella typhi*, *Salmonella paratyphi A*, *Bacillus licheniformis*, and *Pseudomonas fluorescens* [4 and 67]. They exert inhibition also toward fungus strains. The Lowest prohibitory for cinnamon essential oil, concentration (minimum inhibitory concentration) readings varied from 1.25 to 5.0 per cent [49].

4.5 Peppermint (*Mentha piperita*)

A peppermint plant may reach a height of 2 to 3 feet. Fragrant dark green on either side of white blooms is leaves. The European native of peppermint a native species from Europe and Asia that thrives in wet, temperate regions various kinds are native to South Africa, South Australia, and America. The menthol-containing leaves and stems a volatile oil, are utilized in food flavoring and medicine [22]. It is soothing and numbing in treating nausea, itchiness on the skin, headaches, digestive issues, menstruation cramps, flatulence, and stress related to depression. The primary ingredients menthol and methyl salicylate in peppermint has relaxing, antispasmodic, and anticonvulsant properties on the stomach and intestines [14].

4.6 Aloe vera (*Aloe barbadensis miller*)

There are two primary parts of aloe vera leaves: the 1,8-dihydroxyanthraquinone-rich green skin derivatives, their glycosides, as well as the more rich pulp that is colorless containing complex carbs. Like parenchyma, mucilaginous jelly is called pulp or gel of aloe vera. This gel contains 95-99 per cent water, along with proteins, lipids, amino acids, and vitamins. In addition to carbohydrates, there are tiny organic molecules, inorganic chemicals, and enzymes. Several biological processes, including an antibacterial diuretic, radiation shielding, antioxidant, anti-inflammatory hypoglycemic as well as anti-tumor, anti-diabetic, and anti-allergic, the following effects: wound healing, immunomodulatory, and gastroprotective this plant gel is responsible [32].

4.7 Tulsi (*Ocimum sanctum Linn*)

Ocimum tenuiflorum, often known as holy basil, tulasi (sometimes written thulasi), or tulsi, is a fragrant perennial plant in the Lamiaceae family. Its synonym is *Ocimum sanctum*. Its original habitat is the Indian subcontinent, and it is widely farmed across the tropical regions of Southeast Asia. Tulasi is grown for its essential oil as well as for use in religion and purported traditional medicine. It has a role in the Vaishnava tradition of Hinduism, where adherents perform worship using holy basil plants or leaves, it is extensively used as herbal tea and frequently utilized in Ayurveda [76]. The plants of the genus *Ocimum* that are members of the family Labiatae are particularly significant because of their therapeutic potential among plants that are known to have medicinal value. Tulsi (*Ocimum sanctum* L), Ram Tulsi (*Ocimum gratissium*), Dulal Tulsi (*Ocimum canum*), Ban Tulsi (*Ocimum basilicum*), *Ocimum kilim* and *scharicum*, *Ocimum ammericanum*, *Ocimum camphora*, and *Ocimum micranthum* are a few examples of well-known major species of the genus *Ocimum* that grow in various locations of the world. The tall, softly hairy, scented plant or undershrub *Ocimum sanctum* L., often known as "Tulsi" in Hindi and "Holy Basil" in English, may be found growing all across India. Tulsi is frequently grown in gardens. Two different kinds of *Ocimum sanctum* L. are grown in cultivation: the Sri Tulsi plant, which has green leaves, and the Krishna Tulsi plant, which has purple leaves. *Ocimum sanctum* L. is revered by Hindus and is regularly used as a medicinal plant in Indian homes to treat a variety of illnesses [72 and 77].

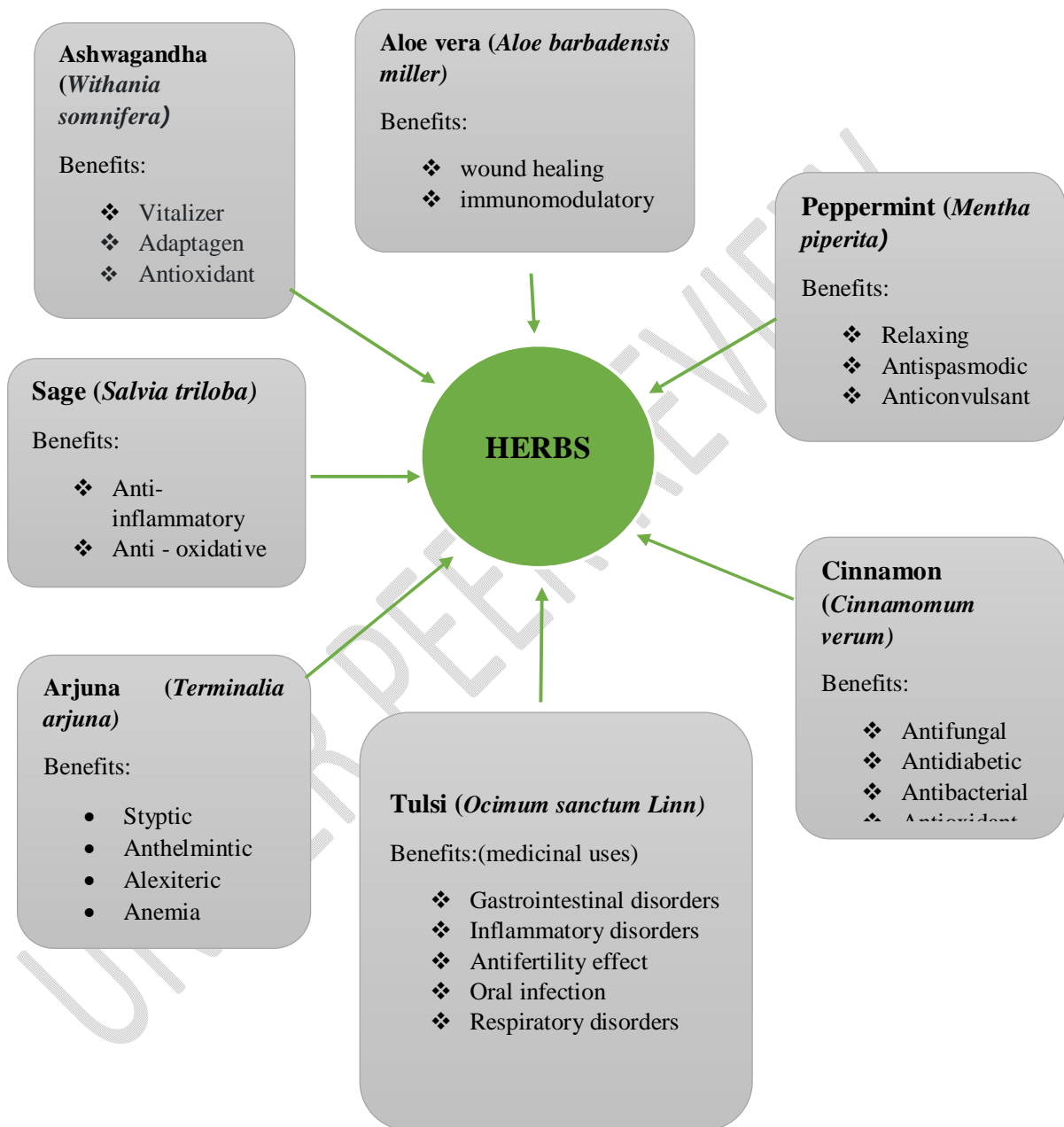


Figure: 1 Benefits of herbs

Source: 4.1 to 4.7 above information

4.7.1 Medicinal uses of tulsi

4.7.1.1 Gastrointestinal disorders

Patients with gastrointestinal and hepatic diseases are administered an aqueous solution of Tulsi leaves [77 and 72]. Herbal formulations comprising *Ocimum sanctum L.* have been put out as potential treatments to reduce the duration of the disease, clinical symptoms, and biochemical markers in viral hepatitis patients. Effective in boosting the GI tract's peristaltic motions. It aids in enhancing appetite. The juice of freshly picked tulsi leaves is often administered to patients to treat persistent fever, diarrhea, bleeding, and dyspepsia [77 and 72]. Tulsi leaves also control vomiting and have been used as an anthelmintic. Tulsi has reportedly been shown to reduce gastric secretion and ulceration in albino rats [90 and 63].

4.7.1.2 Inflammatory disorders

Tulsi blocks the enzymes in our systems that cause inflammation and are responsible for pain and other symptoms of inflammation. Tulsi has similar anti-inflammatory properties as ibuprofen, naproxen, and aspirin. Even better, tulsi improves adrenal function by reducing cortisol levels. As a result, the harmful effects of stress are diminished. Tulsi is very good in preventing any edoema from developing in the body. It helps treat any form of edoema in the body by improving blood circulation throughout the body [44].

4.7.1.3 Antifertility effect

The *Ocimum sanctum L.* leaf, allegedly have an abortifacient effect on females. *Ocimum sanctum L.* has an antifertility impact as well. One of the main components of Tulsi leaves, ursolic acid, is thought to have an antifertility impact on male mice and both sexes of rats. Because of its anti-estrogenic activity, ursolic acid inhibits spermatogenesis and lowers sperm counts [16 and 66].

4.7.1.4 Oral infection

Common mouth infections can be effectively treated with tulsi leaves. Additionally, chewing a few leaves helps keep your mouth healthy. The plant contains the antibacterial compounds carracrol and tetpene. A similar effect is also achieved by the sesquiterpene b-caryophyllene.

Tulsi naturally contains this ingredient, a food additive that has been authorized by the FDA [3].

4.7.1.5 Respiratory disorders

The common cold can be effectively treated with tulsi. Bronchitis, bronchial asthma, influenza, coughing, and colds can all be treated with a decoction of the leaves made with honey and ginger. The combination of leaves, cloves, and common salt in a decoction can also provide quick relief for influenza patients. Tulsi is a key component of several Ayurvedic expectorants and cough syrups. It is quite good for maintaining a highly healthy respiratory passageway since it aids in the mobilization of mucus in bronchitis and asthma. Tulsi leaf chewing improves cold and flu symptoms. When you have a sore throat, you should drink water that has been boiled with Tulsi leaves. Additionally, gargles can be made using this water [90 and 65].

References

1. Acevedo LM, Raya AI and Martinez-Moreno JM. 2017. Mangiferin protects against adverse skeletal muscle changes and enhances muscle oxidative capacity in obese rats. *PLoS One*. 12.
2. Acosta J, Sevilla I, Salomon S, Nuevas L, Romero A and Amaro D. 2016. Determination of magniferin solubility in solvents used in the biopharmaceutical university. *Journal of Pharmacy and Pharmacognosy Research*. 4:49-53.
3. Agarwal P, Nageshl L and Murlikrishnan. 2010. Evaluation of the antimicrobial activity of various concentrations of Tulsi extract against Streptococcus mutants. *Indian Journal of Dental Research*. 21:357-59.
4. Al-Mariri A and Safi M. 2014. In vitro antibacterial activity of several plant extracts and oils against some Gram-negative bacteria. *Iranian Journal of Medical Sciences*. 39:36-43.
5. Aneja RP and Murthi TN. 1990. Conjugated linoleic acid contents of Indian curd and

ghee. *Indian Journal of Dairy Science*. 43:231-8.

6. Anonymous. 2002. World Health Organization. Diet, nutrition and the prevention of chronic diseases.
7. Anonymous. 2003. World Health Organization. In Diet Nutrition and the Prevention of Chronic Diseases: WHO Technical Report Series; WHO: Jeneva, Switzerland.
8. Anonymous. 2016. United Nations Conference of Trade and Development. Mango: An Infocomm Commodity Profile UNCTAD Trust Fund on Market Information on Agricultural Commodities. UNCTAD, New York and Geneva.
9. Anonymous. 2016. United States Department of Agriculture. Food Composition Databases Show Foods—Apples, Raw, with skin.
10. Anonymous. 2020. APEDA-Agricultural and Processed Food Products Export Development Authority. Products-Fresh Fruits and Vegetable: Mango. Ministry of Commerce and Industry, Government of India: New Delhi, India.
11. Anonymous. 2020. National Mango Database. Indian Status of Mango: Area, Production and Productivity-Growth Pattern; National Mango Database.
12. Ansari MM and Kumar DS. 2012. Fortification of food and beverages with phytonutrients. *Food and Public Health*. 2:241-53.
13. Arslan S. and Ozel S. 2012. Some properties of stirred yogurt made with processed grape seed powder, carrot juice, or a mixture of grape seed powder and carrot juice. *Milk science international- Milchwissen schaft*. 67:281-85.
14. Balakrishnan A. 2015. Therapeutic uses of peppermint-A review. *Journal of Pharmaceutical Science and Research*. 7:474-76.

15. Barnes DL, Harper SJ, Bodyfelt FW and McDaniel MR. 1991. *Journal of Dairy Science*. 74. 7:2089-99.
16. Batta SK and Santhakumari G. 1971. The antifertility effect of *Ocimum sanctum* and *Hibiscus Rosa Sinensis*. *Indian Journal of Medical Research*. 59:777-81.
17. Beshkova DM, Simova ED, Frengova GI, Simov ZI and Adilov EF. 1998. Production of amino acids by yogurt bacteria. *Biotechnology Progress*. 14:963-65.
18. Bhateja Sumit and Arora Geetika. 2012. Therapeutic benefits of holy basil (tulsi) in general and oral medicine. *International journal of research in Ayurveda and Pharmacy (IJRAP)*. 3.
19. Bhushan S, Kalia K and Sharma M. 2008. Processing of apple pomace for bioactive molecules. *Critical Reviews in Biotechnology*. 28:285-96.
20. Bissonnette DJ and Jeejeebhoy KN. 1994. Meeting dietary nutrient requirements with cow's milk and milk products. *Rotterdam: Balkema*.
21. Block G and Abrams B. 1993. Vitamin and mineral status of women of childbearing potential. *Annals of the New York Academy of Sciences*. 678:244-54.
22. Blumenthal M, Goldberg A and Brinckmann J. 2000. *Herbal medicine*. Expanded Commission E Monographs. Integrative Medicine Communications, USA:297-03.
23. Bourlioux P and Pochart P. 1988. Nutritional and health properties of yogurt. *World Review of Nutrition and Dietetics*. 56:217-58.
24. Bronner F and Pansu D. 1999. Nutritional aspects of calcium absorption. *The Journal of Nutrition*. 129:9-12.
25. Buttriss J. 1997. Nutritional properties of fermented milk products. *International Journal Dairy Technology*. 50:21-7.

26. Caleja C, Barros L, Antonio AL, Carocho M, Oliveira MBPP and Ferreira ICF R. 2016. Fortification of yogurts with different antioxidant preservatives: A comparative study between natural and synthetic additives. *Food Chemistry*. 210:262-68.
27. Carocho M, Morales P and Ferreira ICFR. 2015. Natural food additives: *Trends in Food Science & Technology*. 45:284-95.
28. Chan K. 2003. Some aspects of toxic contaminants in herbal medicines. *Chemosphere*. 52:1361-71.
29. Chandan RC and Shahani KM. Yogurt. 1993. In: Hui YH, ed. Dairy science and technology handbook. *New York: VCH Publishers*:1-57.
30. Cliff MA, Fan L, Sanford K, Stanich K, Doucette C and Raymond N. 2013. Descriptive analysis and early-stage consumer acceptance of yogurts fermented with carrot juice. *Journal of Dairy Science*. 96:4160-72.
31. Crittenden RG, Martinez NR and Playne MJ. 2003. Synthesis and utilisation of folate by yogurt starter cultures and probiotic bacteria. *International Journal of Food Microbiology*. 80:217-22.
32. Cuvás Limón RB, Julio MS and Carlos CEJ. 2016. Aloe vera and Probiotics: A new alternative to symbiotic functional foods. *Annual Research and Review in Biology*. 9:1-11.
33. Cuvelier M, Berset C and Richard H. 1994. Antioxidant constituents in sage (*Salvia officinalis*). *Journal of Agricultural and Food Chemistry*. 42:665-69.
34. Damian C. 2013. Influence of dietary fiber addition on some properties of yogurt, *Analele Universitatii "Ovidius" Constanta - Seria Chimie*. 17.
35. Dzamic AM, Marin PD, Gbolade AA and Ristic MS. 2010. Chemical composition of *Magnifera indica* essential oil from Nigeria. *Journal of Essential Oil Research*.

22:123-25.

36. Elleuch M, Bedigian D, Roiseux O, Besbes S, Blecker C and Attia H. 2011. Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications: A review. *Food Chemistry*. 124:411-21.
37. Ervin RB and Kennedy-Stephenson J. 2002. Mineral intakes of elderly adult supplement and non-supplement users in the third National Health and Nutrition Examination Survey. *Journal of Nutrition*. 132:3422-7.
38. Espirito-Santo A P, Lagazzo A, Sousa ALOP, Perego P, Converti A, and Oliveira M N. 2013. Rheology, spontaneous whey separation, microstructure and sensorial characteristics of probiotic yogurts enriched with passion fruit fiber. *Food Research International*. 50:224-31.
39. Garcia-Perez FJ, Lario Y, Fernandez-Lopez J, Sayas E, Perez-Alvarez JA and Sendra, E. 2005. Effect of orange fiber addition on yogurt colour during fermentation and cold storage. *Color Research & Application*. 30:457-63.
40. Gaudichon C, Mahe S and Roos N. 1995. Exogenous and endogenous nitrogen flow rates and level of protein hydrolysis in the human jejunum after [15N] milk and [15N] yogurt ingestion. *British Journal of Nutrition*. 74:251-60.
41. Gaudichon C, Roos N, Mahe S, Sick H, Bouley C and Tome D. 1994. Gastric emptying regulates the kinetics of nitrogen absorption from 15Nlabeled milk and 15N-labeled yogurt in miniature pigs. *Journal Nutrition*. 124:1970-7.
42. Gebreyowhans S, Lu J, Zhang S, Pang X and Lv J. 2019. Dietary enrichment of milk and dairy products with n-3 fatty acids: A review. *International Dairy Journal*. 97:158-66.
43. Goodenough ER and Kleyn DH. 1976. Influence of viable yogurt microflora on digestion of lactose by the rat. *Journal Dairy Science*. 59:601-6.

44. Gupta SK, Prakash J and Srivastava S. 2002. Validation of claim of Tulsi, *Ocimum sanctum Linn* as a medicinal plant. *Indian Journal of Experimental Biology*. 40:765-73.
45. Hanson AL and Metzger LE. 2010. Evaluation of increased vitamin D fortification in high-temperature, short-time-processed (2%) milk, UHT-processed (2%) fat chocolate milk, and low-fat strawberry yogurt. *Journal of Dairy Science*. 93:801-07.
46. Hashemi Gahruie H, Eskandari MH, Mesbahi G and Hanifpour MA. 2015. Scientific and technical aspects of yogurt fortification: A review. *Food Science and Human Wellness*. 4:1-8.
47. Hashim I, Khalil A and Afifi H. 2009. Quality characteristics and consumer acceptance of yogurt fortified with date fiber. *Journal of Dairy Science*. 92:5403-07.
48. Hewitt D and Bancroft HJ. 1985. Nutritional value of yogurt. *Journal of Dairy Research*. 52:197-07.
49. Hoquea MM, Barib ML and Juneja VK. 2008. Antimicrobial activity of cloves and cinnamon extracts against foodborne pathogens and spoilage bacteria, and inactivation of *Listeria monocytogenes* in ground chicken meat with their essential oils. Report of National Food Research Institute. 72:9-21.
50. Imran M, Arshad MS and Butt MS. 2017. Mangiferin: a natural miracle bioactive compound against lifestyle related disorders. *Lipids in Health and Disease*. 16:84.
51. Issar K, Sharma PC and Gupta A. 2017. Utilization of apple pomace in the preparation of fiber-enriched acidophilus yogurt. *Journal of Food Processing and Preservation*. 41.
52. Jakheta V, Patel R and Khatri P. 2010. Cinnamon: a pharmacological review. *Journal of Advanced Scientific Research*. 1:1912.
53. Kaup SM, Shahani KM, Amer MA and Peo ER. 1987. (Bioavailability of calcium in

yogurt.) *Milchwissenschaft*. 42:513-6.

54. Kemp MQ, Jeffy BD and Romagnolo DF. 2003. Conjugated linoleic acid inhibits cell proliferation through a p53-dependent mechanism: effects on the expression of G1-restriction points in breast and colon cancer cells. *Journal of Nutrition*. 133:3670–7.
55. Kim SH, Hyun SH and Choung SY. 2006. Anti-diabetic effect of cinnamon extract on blood glucose in db/db mice. *Journal of Ethnopharmacology*. 104:119-23.
56. Kneifel W and Mayer HK. 1991. Vitamin profiles of kefir made from milks of different species. *International Journal of Food Science Technology*. 26:423-8.
57. Kneifel W, Kaufmann M, Fleischer A and Ulberth F. 1992. Screening of commercially available mesophilic dairy starter cultures: biochemical, sensory and morphological properties. *Journal of Dairy Science*. 75:3158-66.
58. Kolars JC, Levitt MD, Aouji M and Savaiano DA. 1984. Yogurt-an autodigesting source of lactose. *New England Journal of Medicine*. 310:1-3.
59. Loones A. 1989. Transformation of milk components during yogurt fermentation. In: Chandan RC, ed. *Yogurt: nutritional and health properties*. McLean, VA: National Yogurt Association. 95-114.
60. Mahmood A, Abbas N and Gilani AH. 2008. *Pakistan Journal of Agricultural Science*. 45:2 275-79.
61. McCain HR, Kaliappan S and Drake MA. 2018. Invited review: Sugar reduction in dairy products. *Journal of Dairy Science*. 101:8619-40.
62. Mishra LC, Singh RRB and Dagenais S. 2000. Scientific basis for the therapeutic use of *Withania somnifera* (Ashwagandha): A Review. *Alternative Medicine Review*. 5:334-46.

63. Mnadal S, Das DN and Dey K. 1993. *Ocimum sanctum* Linn - A study on gastric ulceration and gastric secretion in rats. *Indian Journal Physiology Pharmacology*. 37:91-2.
64. Modak M, Dixit P and Londhe J. 2007. Indian herbs and herbal drugs used for the treatment of diabetes. *Journal of Clinical Biochemistry Nutrition*. 40: 163-73.
65. Nadkararni AK and Nadkarni KM. 1976. *Indian Materia Medica* (Published by Popular Prakashan Pvt. Ltd., Bombay).
66. Nagarajun S, Jain HC and Aulakh GS. 1989. Indigenous plants used in fertility control. In: *Cultivation and utilization of medicinal plants*. Editors: Atal CK and Kapoor BM (Published by PID CSIR):558.
67. Naveed R, Hussain I and Tawab A. 2013. Antimicrobial activity of the bioactive components of essential oils from Pakistani spices against *Salmonella* and other multi-drug resistant bacteria. *BMC Complementary & Alternative Medicine and Therapies*. 13:265.
68. Nicolosi RJ, Rogers EJ and Kritchevsky D. 1997. Dietary conjugated linoleic acid reduces plasma lipoproteins and early aortic atherosclerosis in hypercholesterolemic hamsters. *Artery*. 22:266-77.
69. Norman AW. 1990. Intestinal calcium absorption: a vitamin D-hormone-mediated adaptive response. *The American Journal of Clinical Nutrition*. 51:290-300.
70. Okwu DE and Ezenagu V. 2008. Evaluation of the phytochemical composition of mango (*Mangifera Indica* Linn.) stem, bark and leaves. *International Journal of Chemical Science*. 6:705-16.
71. Oskar Adolfsson, Simin Nikbin Meydani, and Robert M Russell. 2004. Yogurt and gut function. *American Society for clinical nutrition*.
72. Pandey BP and Anita. 1990. In: *Economic Botany* (Published by Chand and

Company Ltd., Ramnagar, New Delhi):294.

73. Park Y, Storkson JM and Albright KJ. 1999. Evidence that the trans-10, cis-12 isomer of conjugated linoleic acid induces body composition changes in mice. *Lipids*. 34:235-41.
74. Parmar P, Khamrui K and Devaraja HC. 2013. The effects of alcoholic extract of Arjuna (*Terminalia arjuna* Wight and Arn.) bark on stability of clarified butterfat. *Journal of Medicinal Plants Research*. 7:2545-50.
75. Queji MD, Wosiacki G and Cordeiro GA. 2010. Determination of simple sugars, malic acid and total phenolic compounds in apple pomace by infrared spectroscopy and PLSR. *International Journal Food Science and Technology*. 45:602-09.
76. Rai Y. 2002. Holy Basil: Tulsi (A Herb). Navneet Publications India Ltd.
77. Rajeshwari S. 1992. *Ocimum sanctum*. The Indian home remedy. In: Current Medical Scene. (Edited and published by S. Rajeshwari, Cipla Ltd., Bombay Central, Bombay).
78. Rasic JL and Kurmann JA. 1978. Yogurt: scientific grounds, technology, manufacture and preparations. 1 of Rasic JL, Kurmann JA, eds. Fermented fresh milk products and their cultures. *Copenhagen: Technical Dairy Publishing House*.
79. Reddy KP, Shahani KM and Kulkarni SM. 1976. B-complex vitamins in cultured and acidified yogurt. *Journal of Dairy Science*. 59:191-5
80. Robineau L and Soejarto DD. 1996. TRAMIL: A research project on the medicinal plant resources of the Caribbean Medical Resource Tropical For Biodiversity Importance Human Health. 1:317-25.
81. Rosado JL, Solomons NW and Allen LH. 1992. Lactose digestion from unmodified, low-fat and lactose-hydrolyzed yogurt in adult lactose maldigesters. *European Journal of Clinical Nutrition*. 46:61-7.

82. Sah BNP, Vasiljevic T, McKechnie S and Donkor ON. 2016. Physicochemical, textural and rheological properties of probiotic yogurt fortified with fibre-rich pineapple peel powder during refrigerated storage. *LWT - Food Science and Technology*. 65:978-86.
83. Salehi F and Aghajanzadeh S. 2020. Effect of dried fruits and vegetables powder on cakes quality: A review. *Trends in Food Science and Technology*. 95:162-72.
84. Salehi F and Satorabi M. 2021. Influence of infrared drying on drying kinetics of apple slices coated with basil seed and xanthan gums. *International Journal of Fruit Science*. 21:519-27.
85. Salehi F. 2020f. Recent applications of powdered fruits and vegetables as novel ingredients in biscuits: A review. *Nutrire*. 45:1-10.
86. Sanchez-Segarra PJ, Garcia-Martinez M, Gordillo- Otero MJ, Diaz-Valverde A, Amaro-Lopez MA and Moreno-Rojas R. 2000. Influence of the addition of fruit on the mineral content of yogurts: nutritional assessment. *Food Chemistry*. 70:85-9.
87. Sarkar S. 2008. Innovations in Indian Fermented Milk Products-A Review, *Food Biotechnology*. 22:78-97.
88. Satorabi M, Salehi F and Rasouli M. 2021. The influence of xanthan and balangu seed gums coats on the kinetics of infrared drying of apricot slices: GA-ANN and ANFIS modeling. *International Journal of Fruit Science*. 21:468-80.
89. Schaafsma GJ, Dekker PR and de Ward H. 1988. Nutritional aspects of yogurt. Bioavailability of essential minerals and trace elements. *Netherlands Milk Dairy Journal*. 42:135-46.
90. Sen P. 1993. Therapeutic potentials of Tulsi: from experience to facts. *Drugs News and Views*. 1:15-21.

91. Serafeimidou A, Zlatanov S, Kritikos G and Tourianis A. 2013. Change of fatty acid profile, including conjugated linoleic acid (CLA) content, during refrigerated storage of yogurt made of cow and sheep milk. *Journal of Food Composition and Analysis*. 31:24-30.
92. Shah KA, Patel MB and Patel RJ. 2010. *Mangifera Indica* (Mango). *Pharmacognosy Review*. 4:42-8.
93. Shahani KM and Chandan RC. 1979. Nutritional and healthful aspects of cultured and culture-containing dairy foods. *Journal Dairy Science*. 62:1685-94.
94. Shahid CSA, Hussain AI and Asad R. 2014. Bioactive components and antioxidant properties of *Terminalia arjuna* L. extracts. *Journal of Food Process Technology*. 5:298.
95. Shantha NC, Ram LN, O'Leary J, Hicks CL, Decker EA. 1995. Conjugated linoleic acid concentrations in dairy products as affected by processing and storage. *Journal of Food Science*. 60:695-8.
96. Shrestha PM and Dhillon SS. 2003. Medicinal plant diversity and use in the highlands of Dolakha district, Nepal. *Journal of Ethnopharmacology*. 86:81-96.
97. Simin Nikbin Meydani and Woel-Kyu Ha. 2018. Immunologic effects of yogurt. *American Society for Clinical Nutrition*.
98. Singh C, Saini NK and Manda H. 2011. Evaluation of antioxidant activity of *Terminalia arjuna* leaves extract. *Pharmacology online*. 1:998-1006.
99. Staffolo MD, Bertola N, Martino M and Bevilacqua YA. 2004. Influence of dietary fiber addition on sensory and rheological properties of yogurt. *International Dairy Journal*. 14:263-68.
100. Supriya Korrapati, Pallavi Kurra and Srinivasababu Puttugunta. 2016. Natural and Herbal Remedies for Cancer Treatment. *Inventi Journals Ltd*.

101. Verma KC. 2010. Ashwagandha (*Withania somnifera dunal*): wonder medicinal plant. *Agricultural Review*. 31:292-97.
102. Verruck S, Balthazar CF, Rocha RS, Silva R, Esmerino EA, Pimentel T C, Freitas MQ, Silva MC, da Cruz AG and Prudencio ES. 2019. Chapter Three - Dairy foods and positive impact on the consumer's health. In F. Toldra (Ed.), *Advances in food and nutrition research*:95-164.
103. Vipul Jaglan, Ankur Ojha, Anurag Singh, Ravinder Singh and Shashank Gaur. 2018. Development of novel herb-supplemented soymilk fortified food-based dairy yogurt. *Journal of pharmacognosy and phytochemistry*.
104. Wang H, Wang CN and Guo MR. 2019. Effects of addition of strawberry juice pre or post fermentation on physiochemical and sensory properties of fermented goat milk. *Journal of Dairy Science*. 102:4978-88.
105. Whigham LD, Cook ME and Atkinson RL. 2000. Conjugated linoleic acid: implications for human health. *Pharmacology Research*. 42:503-10.
106. Wigertz K, Svensson UK and Jagerstad M. 1996. Folate and folate binding protein content in dairy products. *Journal Dairy Research*. 64:239-54.