



Scientific Correspondence

New dimensions in development of health-based spices and herbs fortified value added jaggery products

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ABSTRACT

This paper discusses about the health benefits of jaggery of which the record is available even in the ancient Indian literature. The difference between jaggery and sugar is their chemical composition. While sugar is the simple form of sucrose, jaggery is made up of predominantly sucrose, mineral salts, iron and some fiber. Jaggery has proven to be superior to white sugar in terms of producing heat and providing immediate energy to the human body. Consumption of jaggery is preferred over white sugar in cases of patients with iron deficiency. It also serves as a cleansing agent by aiding in the cleansing of the lungs and respiratory tract. As a result, it is recommended that we should replace sugar with jaggery in our regular diet. Moreover, jaggery can be combined, both in solid and liquid forms, with different herbs, spices, medicinal plant extracts and oils to amplify its health benefits and taste. The manuscript enumerates some of these value additions in jaggery for improving society health in modern day busy life.

Keywords: Jaggery, herbs, spices, fortification, Ayurvedic, health benefits

INTRODUCTION

Jaggery is a sugar-rich food product prepared by the concentration of sugarcane juice and it is an integral part of the rural diet in many developing countries. It is consumed directly and also used in confectionery products, along with its varied uses in ayurvedic and traditional medicines. In Ayurveda, jaggery is considered to be the best among all sugarcane products, and also the most valuable nutritive sweetener. Extensive research has been done on the beneficial health properties of jaggery that exist because it preserves most of the nutrients present in natural sugarcane juice when compared to white sugar. Jaggery, a

rich source of minerals and vitamins contains calcium, phosphorus, zinc (Nath *et al.*, 2015) and micronutrients which are antitoxic and anti-carcinogenic in properties (Sahu and Paul, 1998). The phosphorus content in jaggery ranged from 18 to 21 mg, potassium ranged from 178.33 to 661.67 mg, sodium 27.73 to 276.00 mg, magnesium ranged from 57.49 to 114.40 mg, and iron ranged from 11.15 to 12.09 mg (Srivastava and Singh, 2020). According to Ayurveda, the properties of jaggery's Rasayana (rejuvenation) and Balya (strength) promote and sustain overall human health. It also stimulates the development of digestive enzymes in the body, which can help with digestion. Additionally, it can assist in the removal of

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general body fatigue and sickness. Due to the presence of vitamins and minerals adding old jaggery in our daily diet can help to minimize the symptoms of weakness in the body (Umate *et al.*, 2020). Processing of jaggery includes extraction of sugarcane juice, filtering, heating and clarification to make thick yellow lump/paste. The concentrated dark yellow lump is finally cooled to make the jaggery crystals. Making jaggery is a simple process that does not involve the use of toxic chemicals. However, mostly due to lack of awareness about the harmful nature of chemicals, jaggery makers, end up employing the use of several toxic chemical clarificants to get attractive colour of jaggery (Verma *et al.*, 2019). While organic and vegetative clarificants like *Deola (Hibiscus ficulneus)* and *Sukhlai (Kydia calycina)* etc. do exist that can give better yield and healthier jaggery products (Singh and Gill, 1954). There are various minerals and nutrients from herbal sources of high medicinal value that can be added to jaggery at different stages of processing to enhance its flavour and nutritional value. This paper primarily focuses on the herbal and spices additives in jaggery and their health benefits.

Health benefits of jaggery

Jaggery is considered medicinal sugar because of its various biological and chemical properties and is used in Ayurvedic formulations. Indian scripts have narrated the nutritive importance and principal mechanism of jaggery in blood purification, rheumatic afflictions prevention and bile related disorders (Sushruta Samhita, Chapter 45, Sloka 146). Hirpara *et al.* (2020) reported that because of the medicinal and nutritional property, jaggery has attained huge scope for application in diversified health products. Jaggery is referred to as a nutraceutical due to the presence of a variety of essential amino acids, minerals, and vitamins. The bioactivity of jaggery is attributed due to the presence of micronutrients and photochemical namely polyphenols (Rao *et al.*, 2021). Jaggery is a rich source of calcium that is essential for bone strength. Anaemia can be prevented due to the presence of iron and it also contains essential nutrients like magnesium and potassium. Magnesium is important for the function of the nervous system and potassium is very crucial in regulating blood pressure and heart functions. Jaggery has been used for different health issues like cooling, diuretic and renders mental refreshment,

besides improving throat conditions (Singh *et al.*, 2015). It is also known to increase sperm count and is proved to be lactogenic (Anonymous, 2019b). Jaggery is used as a remedy for cough and stomach ache, indigestion, gastric acidity, and constipation. It was reported that jaggery was found to be a remedy for our lung (Sahu and Paul, 1998). Refined sugar undergoes huge nutritive losses due to multiple chemical processing whereas jaggery is prepared in a natural way and is a relatively unrefined sugar, hence retains more nutrients and other bioactive components which may be of immense value in supporting a healthier life. The different health benefits of jaggery are listed in Table 1.

Historical mentions in Ayurveda about sugarcane juice and jaggery

Ancient Indian Pharmacology, 'Ayurveda' has used sugarcane molasses for centuries in various diseases and in ancient Indian medicine system for the treatment of various human diseases. According to the *Korampuran*, by consuming sugarcane juice as a staple food, the people of 'Harivarsha' lived a disease-free life for ten thousand years, as well as they had the same color as 'Maharajatasnibha', that is, silver color. Ikshurus (sugarcane juice) is considered to be the 'best rasa' for nourishment of the body. The 'best', sugar and sugar extracted from sugarcane is a sweet, fragrant, and flavored 'jaggery' made in our country for centuries after the heat concentration at a particularly striking point. In the Ayurveda-episode of the ethos of Garuda Purana written about 1000 to 1100 years back, in which about 60 chapters of the teaching of medical science by Lord Dhanvantari to Sushruta are mentioned (Srivastava, 2020). In it, the pharmacological importance of old jaggery, sugarcane, and its juices, and the disorders made from it, jaggery, sugars, and many other uses of sugar (vinegar) are described. Based on this, Sushruta Samhita, an ancient Indian treatise of medicine in ancient India - Ayurveda, and Surgery - is reputed as one of the three fundamental texts of Ayurveda, Brihadtrayi, composed 560 years before Christ. The antecedent of this specific book, divided into two sections, the antipatra, and the Uttaraantra, mentions 13 cane species, sugarcane and its juices, and the pharmacological properties of the disorders created from it, and their many uses in the treatment of various diseases in Uttaraantra (Srivastava and Singh, 2020).

Table 1: Health benefits of jaggery

Diseases	Benefits	References
Anaemia	Jaggery can help with iron intake as it's very rich in iron. Regular consumption of jaggery also facilitates the absorption of iron and it also increases the haemoglobin count.	Rajesh <i>et al.</i> (2016); Resmi <i>et al.</i> (2016)
Blood purification	Jaggery is a good blood purifier. In nature, there are plenty of natural blood purifiers; liquid jaggery is much superior of them all. Jaggery eliminates the clotted blood from the body which is necessary for cleaning the blood. Patients with heart disease are advised to take it to fight tiredness and exhaustion.	Mishra <i>et al.</i> (2010); Sushruta Samhita, Chapter 45, Sloka 146
Rheumatic afflictions	Jaggery makes it easier to breathe and naturally combats pollution. It contains a moderate amount of calcium, phosphorous, and zinc, all of which contribute to good health. It also helps to treat jaundice by preventing rheumatic diseases and bile disorders.	Singh <i>et al.</i> (2012); Sushruta Samhita, Chapter 45, Sloka 146
Bile related disorders	Jaggery aids in digestion by cleaning the extra mucus in the body. When eaten, this sweetener helps to maintain acid balance in the body, which helps to treat bile disorders.	Anonymous (2019a)
Nervous system	The presence of magnesium in jaggery can help control the nervous system. Magnesium helps to calm the muscles and stimulates the nervous system. It also acts as an antioxidant, preventing nerve cell damage and maintaining the integrity of blood vessels.	Rajesh <i>et al.</i> (2016)
Piles	Constipation is the most common cause of piles. Jaggery's <i>Snigdha</i> (oily) property aids in pile management. It aids in the reduction of intestinal dryness and provides oiliness, allowing for quick stool passage and the prevention of piles.	Anonymous (2021)
Heart functions	The antioxidant properties of jaggery can aid in the management of heart function. Jaggery is said to be good for the heart in Ayurveda because of its <i>Hrdya</i> (heart tonic) properties. It aids in the strengthening of heart muscles and the improvement of heart function.	Johari (2000)
Indigestion	Indigestion, according to Ayurveda, is caused by an inadequate digestion of the food consumed. <i>Agnimandya</i> (weak digestive fire) is the principal cause of indigestion. Because of its <i>Ushna</i> (hot) property, jaggery helps to increase <i>Agni</i> (digestive fire) and improve digestion. The magnesium and potassium content in jaggery can aid in indigestion and reduce stomach acidity.	Deotale <i>et al.</i> (2019); Ravisankar <i>et al.</i> (2016)
Cholesterol	According to Ayurveda, cholesterol is caused by inadequate digestion, which results in the development and accumulation of <i>Ama</i> (toxins) in our body. Because of its <i>Ushna</i> (hot) property, jaggery aids in cholesterol management by improving digestion and preventing the formation of toxins.	Anonymous (2021)
Cough and cold	Jaggery serves as a natural lungs cleanser, which can help manage cough and cold symptoms. It aids in the cleansing of the respiratory passages and the facilitation of breathing. Jaggery is used as an immunity booster. When mixed with dry ginger, black pepper, it becomes a powerful medicine to shed away cold.	Shrivastav <i>et al.</i> (2016); Rao <i>et al.</i> (2021)
Blood pressure	Because of its potassium content and low sodium content, jaggery can be beneficial to blood pressure. It aids in the reduction of blood pressure by counteracting the harmful effects of salt.	Deotale <i>et al.</i> (2019)
Bloating	The high potassium and low sodium content of jaggery aids in the reduction of bloating. This helps to keep the acid balance in the body cells in check, which relieves bloating.	Shrivastav <i>et al.</i> (2016); Deotale <i>et al.</i> (2019)
Loss of appetite	Loss of appetite is linked to <i>Agnimandya</i> (weak digestion) in Ayurveda). An increase in <i>Vata</i> (wind), <i>Pitta</i> (fire), and <i>Kapha</i> (cold) doshas, as well as certain psychological factors, may cause a loss of appetite. Because of its <i>Ushna</i> (hot) property, jaggery aids in the enhancement of <i>Agni</i> (digestive fire) and improves appetite. It can also be used as a digestive stimulant and appetiser.	Anonymous (2021)

Table 1 contd..

Diseases	Benefits	References
Obesity	Due to poor digestion formation and accumulation of toxins in the form of fat and <i>Ama</i> (toxic remains in the body) occurs that leads to obesity. Because of its <i>Ushna</i> (hot) property, which aids digestion and prevents the formation of toxins, jaggery aids in the management of obesity.	Anonymous (1986)
Weight loss	The potassium content in jaggery can aid in weight loss. Jaggery's high potassium content prevents water retention in the body, resulting in weight loss. Jaggery also contains moderate amount of B group of vitamins and minerals which is considered as a cleansing agent. It helps in weight reduction.	Shrivastav <i>et al.</i> (2016)
Acidity	Potassium content in jaggery aids in the management of acidity. It helps to control acidity by preventing acids from accumulating in the stomach. Acidity occurs due to weak digestion. Jaggery being <i>Ushan</i> (hot) in nature helps manage acidity by improving digestion, thereby providing relief from acidity.	Ravisankar <i>et al.</i> (2016)
Asthma	Jaggery cleansing properties is beneficial to asthma sufferers. Regular consumption of jaggery keep the air passages healthy especially who come in contact with dust and dirt on a daily basis. Asthma occurs due to an imbalance of <i>Vata</i> (wind) and <i>Kapha</i> (cold) dosha and leads to shortness of breath in Ayurveda. Jaggery helps in balancing <i>Vata</i> and <i>Kapha</i> thereby reducing the symptoms of asthma.	Shrivastav <i>et al.</i> (2016)
Arthritis	Arthritis is a disease that occurs when the <i>Vata</i> (wind) dosha is out of control, resulting in pain and swelling. According to Ayurveda, jaggery's <i>Vata</i> balancing properties can help reduce symptoms such as pain and provide relief.	Anonymous (1986)
Body building	Jaggery is thought to be ideal for bodybuilding because it contains a lot of potassium, which aids in the body's metabolism. However, consumption of old jaggery to our diet will also help in minimizing the symptoms of weakness as it is loaded with vitamins and minerals. Jaggery's <i>Balya</i> (strength provider) nature, according to Ayurveda, may be also helpful in bodybuilding.	Shrivastav <i>et al.</i> (2016); Umate <i>et al.</i> (2020); Anonymous, 2021
Lungs	Minerals in jaggery help clean the lungs, stomach, intestines, oesophagus, and respiratory tracts.	Kumar and Singh (2020)
Boost immunity	Jaggery contains zinc and selenium, which help to avoid free radical damage and increase resistance to infections. Jaggery also aids in the increase of total haemoglobin levels in the blood.	Anonymous (2018a)
Cooling	Jaggery helps to keep our stomach cool by maintaining a normal body temperature.	Anonymous (2018b)
Diuretic	Jaggery aids the liver by helping in detoxing the body and acts as a natural diuretic as well. It soothes bladder inflammation and is helpful in other urinary problems.	Anonymous (2019a)
Throat conditions	Jaggery is a well-documented traditional treatment for respiratory and throat issues. It calms and soothes throat inflammation, as well as the discomfort that comes with it. It also keeps the lungs warm and dilates the respiratory tract.	Anonymous (2019b)
Migraine control	Jaggery mixed with herbs and taken empty stomach in the morning helps in migraine.	Rajesh <i>et al.</i> (2016)
Detoxification	Jaggery is a natural body cleanser. It offloads a lot of stress from our liver.	Ravisankar <i>et al.</i> (2016)
Boosting sperm production	Jaggery improves the quantity and efficiency of sperm production and is great at energizing our body. Eating jaggery, according to Ayurveda, will increase the quality of sperm. Jaggery combined with Indian gooseberry or milk reduces body fatigue and prevents urinary problems in men.	Anonymous (2019b)

Harit Samhita, written about six centuries before Christ, mentions about 150 pharmaceutical preparations made from sugarcane juice and jaggery in the treatment of various diseases, out of which only 74 consist of jaggery, especially old jaggery. The same has been used in the Labh pratistha Ayurvedic text Bhavaprakash Nighantu (circa 1600 CE) acknowledges the importance of jaggery and addresses it with 'Namo Guday' (Srivastava, 2020).

The jaggery contains mineral nutrients, protein, fat, vitamins and 14 antioxidants in addition to sugars for our nutrition while refined sugars (sugar) contain only sucrose (99.7%). All the components of sugarcane juice are present in jaggery. Mineral nutrients include jaggery per 100 grams, 390-400 mg calcium (Ca), 80 mg magnesium (Mg), 340 mg chloride, 500 mg sulfates and 45 mg phosphate and 570 mg contains nitrogen (N). In micro mineral nutrients, respectively, 11.06 mg Iron content (Fe), 0.61 mg 65.51 mg zinc (Zn), 65.51 µg manganese (Mn), 9.90 µg cobalt (Co), 13.95 µg chromium (Cr), 01 µg iodine (I) and nominal selenium (Se) (Srivastava and Singh, 2020). Therefore, for a normal-healthy person, consumption of jaggery is more beneficial than white sugar. Due to the healthy ingredients of jaggery, its consumption will also be beneficial in malnutrition.

Value addition to jaggery

Jaggery is a solid substance having nearly 80% of sugar and many other beneficial components. It may serve as carrier/ scaffold for other herbal medicinal component beneficial to human health like Haritaki (*Terminalia chebula*), Punarnava (*Boerhaavia diffusa*), Turmeric (*Curcuma longa*), Ashwagandha (*Withania somnifera*), Tulsi (*Ocimum tenuiflorum*), Bramhi (*Bacopa monnieri*) and Aonla (*Phyllanthus emblica*), the primary ingredient in Chyawanprash, a celebrated ancient Ayurvedic herbal rasayana (Anonymous, 2012). Besides certain natural

vitamins from plant sources like carrot having ample carotenes (5.3 mg/100g), a precursor of Vitamin A and some other vitamins like thiamine, riboflavin, niacin and vitamin C extracts may be effectively blended with jaggery to fortify it with enhanced health values. Value addition and fortification of vitamins, minerals and nutritionally important components/products in different forms of jaggery could be carried out simply by crushing, mixing or by the co-crystallization technology (Yang *et al.*, 2020). Keeping the importance of jaggery since ancient times, during the lockdown (COVID-19 pandemic), several new fortified jaggery value added products like Dr Jaggery (www.drjaggery.com) has been introduced with major focus on health issues and boosting immunity. Some of these valued added fortified products are discussed herein.

Cardamom with jaggery

Cardamom (*Elettaria cardamomum*) contains phytochemicals and bioactive compounds like α -terpinyl acetate, 4-terpineol and geraniol. Both cardamom and jaggery are antioxidants, detoxifiers, and diuretics. This combination may lower blood pressure and has better cancer-fighting compounds. It may also protect from chronic diseases, comprised of anti-inflammatory properties. It may help with digestive problems, including ulcers. Adding cardamom and jaggery (Figure 1) to our daily life in a cup of tea will help with digestive problems, and treat bad breath and other infections.

Dry ginger with jaggery

Dry ginger (*Zingiber officinale*) are abundant in bioactive components such as phenolic and terpene compounds. The phenolic compounds in ginger mainly 6-gingerol, 8-gingerol, 10-gingerol, 6-shogaol, paradols 6-gingerol, and oleoresin, possess strong antioxidant activity and soothes the stomach, giving relief from inflammation (Mao *et al.*,

Figure 1: Cardamom and holy basil (tulsi) value added products of jaggery



2019). Jaggery is often referred to as nutraceutical due to the presence of a variety of essential amino acids, minerals like calcium, phosphorus, iron, and vitamins. The combination of jaggery and dry ginger that constitutes anti-inflammatory gingerols and shaogals is a great aid against the common cold. Since jaggery is high in iron, it can help with anaemia. Asthma and allergic reactions can be avoided with the use of jaggery as a preventative measure. Dry ginger aids weight loss by increasing digestion, which aids in the burning of stored fat and the absorption of blood glucose. It lowers cholesterol, menstrual pain, nausea and morning sickness. Jaggery helps to relieve joint pain and stiffness. These effects are reported to be enhanced when jaggery is consumed with dry ginger powder (*sonth*). This combination may be used in making sesame laddoo, pudding and cookies etc. for daily use and for several health benefits.

Holy basil or tulsi with jaggery

Holy basil (*Ocimum tenuiflorum*) contains oleanolic acid, ursolic acid, rosmarinic acid, eugenol, carvacrol, linalool, and β -caryophyllene due to which it is loaded with effective antioxidants, antiseptic and antiviral properties (Upadhayay, 2017). It improves immunity and is employed widely in Indian households. Minerals like zinc and selenium are found in jaggery which are known for their antioxidant properties (Srivastava and Singh, 2020). Tulsi, or holy basil, with vitamin C, is loaded with effective antioxidants, antiseptic and antiviral properties (Upadhayay, 2017). To fight through viral infections like cold, flu, and indigestion, tulsi leaves with jaggery can be a perfect combination (Figure 1). It increases immunity and recovery from infections, and known to boost cardiovascular health.

Mint with jaggery

Mint (*Mentha piperita*) also known as 'pudina' is a popular amazing aromatic herb for its freshness with several health benefits contains menthol, menthone, methyl acetate and menthofuran. The active chemical in mint is a terpene alcohol called menthol or peppermint camphor, or 2-isopropyl-5-methylcyclohexanol (Reddy *et al.*, 2019). Antibacterial and antifungal activities of these components are quite significant against human pathogenic microorganisms. Since ancient times, people have used

different types of mint all over the world. Mint plants containing phytonutrients, vitamin A, vitamin C, and B-complex, phosphorous, calcium offers anti-oxidant properties and health benefits. Jaggery contains minerals such as zinc and selenium. These minerals are known for their anti-oxidant properties. Both jaggery and mint are rich source of iron, potassium, and manganese which improve haemoglobin levels and promote brain function. These plant-based vitamins help to protect our cells from damage. Also, the combination is low in calories and contains minimal amount of protein and fat. Mint and jaggery play an essential role in losing weight in a healthy way due to the presence of potassium. Water retention in the body can be prevented by potassium which results in weight loss (Anonymous, 2018c). Mint leaves and jaggery promotes digestion and boost body metabolism to help in losing weight. Mint and jaggery tea is a great refreshing calorie-free beverage to promote weight loss. It induces warmth in the lungs and dilates the respiratory tract, which helps with cough, asthma, and breathing problems, as well as improving immunity, according to Ayurveda. Including mint and jaggery in our diet, on the other hand, would help us remain healthy and happy (Anonymous, 2020).

Giloy with jaggery

Giloy (*Tinospora cordifolia*) is an age-old herb that contains ascorbic acid, lycopene alkaloids, terpenoids, lignans and carotene etc. Giloy helps in actively fighting against various pathogens and boosting immunity (Srivastava, 2020). Giloy literally means 'Amrita', which means the root of immortality. Giloy has been proven to be one of the most popular natural medicines due to its numerous medicinal properties. The compounds in giloy have been reported to have immune modulatory and cytotoxic effects. They function by enhancing the phagocytic activity of macrophages, improvement in nitric oxide production by incentivising of splenocytes and macrophages showing of anti-tumour effects (Saha and Ghosh, 2012). Jaggery is a great immunity-booster, especially during the winter season. Iron, selenium, zinc, magnesium and phosphorus are micronutrients in jaggery that can help in improving immunity. Jaggery not only satiates sugar cravings but also packs excellent health benefits. The immunity-booster retains electrolyte balance

in the body just as it bursts with minerals and antioxidants. It acts as a boon for weight watchers and helps drive away the moody blues by releasing endorphin, the happy hormone. According to Ayurveda consuming giloy with jaggery overcomes most of the diseases and it also increases the life span of a person.

Trifla (Haritaki, Amla, and Bahera) with jaggery

Trifla is a mixture of Amalaki (*Embllica officinalis*), Bibhitaki (*Terminalia bellerica*), and Haritaki (*Terminalia chebula*). Amalaki is rich in vitamin C, tannins, amino acids, minerals, phyllembelic acid, curcuminoids, phenols, emblicol and rutin. Bibhitaki contains ellagic acid, tannins lignans and gallic acid and flavones Haritaki is rich in phytochemicals such as polyphenols, anthocyanins, terpenes and flavonoids that have potent health benefits. Triphala is extensively mentioned in Ayurveda, the age-old Indian system of medicine as a powerful medicinal substance. Conventionally, triphala is made by combining the above-mentioned three ingredients in equal proportion-one part by each of the powders of amla, baheda and yellow hareda. This is the make-up of triphala powders available commercially (Anonymous, 2019c). Jaggery has digestive properties, helping in digestion and increasing appetite. Naturopaths and alternative therapists endorse jaggery consumption with triphala after meals to aid in digestion. It has been recommended in our ancient literature also to consume jaggery along with triphala powder during summers to keep away many ailments. In conditions such as arthritis, triphala's anti-inflammatory action has been clinically proven. Furthermore, it is proven to suppress cyclooxygenase-2 (COX-2) levels (Anonymous, 2017). It is a general practice among people with abdominal heaviness in India. This digestive aid by jaggery happens because of its conversion to acetic acid in the stomach. It aids in the correction of enzymatic activity in the belly, which

increases digestion and appetite. The combination of jaggery and triphala proves to be anti-inflammatory, detoxifier, antibacterial helps with digestive problems, and treats other infections. In summers taking jaggery mixed with Trifla and Ghrít (clarified butter) provides enhanced level of immunity against common diseases (Rao *et al.*, 2021). Consuming jaggery with triphala (Figure 2) is also helpful in weight loss, as a detoxifier, cures digestive issues, helps in fighting infections and enhances immunity. Beside it is also beneficial in maintaining oral hygiene, beneficial for eye health, helpful in treating gastric ulcers and urinary tract infections. As an antioxidant, it also helps in detoxifying the body and support the immune system. It is suggested to take triphala between meals on an empty stomach for maximum absorption.

Turmeric with jaggery

Turmeric (*Curcuma longa*) contains turmerone, and other coloring agents called curcuminoids. Curcuminoids consist of curcumin demethoxycurcumin, 5'-methoxycurcumin, and dihydrocurcumin. These bioactive compounds has powerful medicinal properties. Curcumin is the chief ingredient in turmeric having powerful anti-inflammatory and antioxidant properties. It substantially enhances the antioxidant capacity in the body, lowers the danger of heart ailments, and studies show that curcumin has remarkable benefits against depression, also helping in fighting chronic diseases. Curcumin has many proven health benefits, such as the potential to avert heart ailments, alzheimer's disease and tumor. It also helps with skin conditions and serve as a brain food (Hewlings and Kalman, 2017). Consumption of jaggery with dried ginger and black pepper (Figure 2) was observed to have similar effects as conventional medications have. This combination helps in chronic cough; It reduces throat irritation due to soothing and smoothening effects on soft tissues of throat. This combination is highly recommended

Figure 2: Triphala and different spices (turmeric, black pepper etc) value added products of jaggery for detoxifying and digestive issues



for building body resistance against viral and bacterial infections, improving digestion/appetite and fighting with several pollution containments.

Black pepper with jaggery

Black pepper (*Piper nigrum*) constitutes a compound named piperine, which is very beneficial for people suffering from depression. It enhances brain functioning and improves memory. This compound has anti-inflammatory properties and is also known to be an antioxidant. Studies have suggested that black pepper helps in controlling cholesterol levels, blood sugar, and brain and gut health. Inclusion of black pepper in our diet can also hasten weight loss process (Masood *et al.*, 2013). Piperine enhances curcumin (present in turmeric) absorption in the body by up to 2,000% (Gupta *et al.*, 2012), jointly consuming these spices along with jaggery amplifies their effect. It also helps in losing weight, cleanses body, prevents cancer and purifies intestines and stomach. They also contain vitamin B and potassium which helps in regulating heart rate, blood pressure and helps in production of red blood cells. This combination may be consumed with milk latte, decoction/kadha, etc.

Fennel with jaggery

Fennel (*Foeniculum vulgare*) majorly constitute of a chemical anethole. Other constituents include alpha pinene, beta myrcene, beta pinene, bitter fenchone, camphene, estragole (methyl-chavicol), fenchone, limonene, p-cymen, and safrole. Fennel seeds and misri together make an excellent mouth freshener (Noemí *et al.*, 2000). But mishri is nothing more than cubes of refined sugar. Replace mishri with jaggery granules are having more health benefits. Fennel seeds and jaggery when taken together can help to remove bad breath and reduce plaque formation.

Fennel and jaggery both contains antioxidants that are anti-inflammatory, detoxifier, antibacterial, helps with digestive problems, and treats bad breath and infections (Figure 3). For various digestive disorders such as heartburn, stomach gas, bloating, loss of appetite, and so on, fennel and jaggery may be used as a mouth freshener. It's also good for bone health. Fennel and jaggery contain vitamins and minerals that help to create and sustain bone structure and strength. It is also beneficial for inflammation metabolism and digestion related irregularities.

Cinnamon with jaggery

Cinnamom (*Cinnamomum verum*) contains polyphenols, antioxidants, and some unique chemicals such as cinnamaldehyde, cinnamic acid, cinnamate. The beneficial effects are the result of cinnamaldehyde, a compound found in all cinnamon varieties. Cinnamaldehyde gives cinnamon its flavour and smell. It has antimicrobial and antifungal properties, helping in lowering of blood sugar levels, reduction of heart disease causing factors and has a plethora of other remarkable benefits (Rao *et al.*, 2014). Cinnamon and jaggery both help in cases of the weakness of heart. Together, jaggery and cinnamom forms a powerful combination. They have antimicrobial and antifungal properties that help fighting through cold, flu, and indigestion. It also enhances neurotrophic factors, that keep the existing neurons in our brain active and helps in the growth of new ones, delaying the onset of diseases like Alzheimer's and Parkinson's. This combination may be used in cake, halwa, cookies, puddings, etc for additional health benefits and enhancing the flavor of the cuisine.

Licorice (mulethi) with jaggery

Licorice (*Glycyrrhiza glabra*) contains glycyrrhizin and its compound, carbenoxolone, makes mulethi a good remedy

Figure 3: Giloy (herb) and fennel fortified jaggery products



Figure 4: Liquid formulations of jaggery with value added products



for constipation, acidity, heartburn, stomach discomfort, inflammation of digestive system and gastro oesophageal acid reflux. This rejuvenative herb serves as a key player in treating different skin problems since it is a powerhouse of antioxidants and healthful nutrients. (Pastorino *et al.*, 2018). The consumption of licorice with jaggery efficiently scavenges free oxygen radicals from the body and diminishes oxidative damage. It keeps the respiratory tract healthy. A sore throat can be relieved by chewing on licorice (mulethi) sticks, which has been used for centuries. Jaggery along with licorice boosts immunity, digestion and cures skin ailments. It has anti-inflammatory properties and also eases menopausal symptoms.

Beside, the above mentioned herbs and spices, jaggery could also be consumed with coriander seeds for menstrual related problems. Coriander seeds contain potassium, manganese, choline and beta-carotene consuming it with jaggery reduces period pain. Sesame seeds contain calcium, magnesium, manganese and zinc. These seeds are a powerhouse of energy, and when taken with jaggery they can help to reduce the risk of cold, cough and flu, which is a common health concern in winters. Jaggery when mixed with bael fruit or Bengal quince (*Aegle marmelos*), it prevents diarrhoea (Ullikashi *et al.*, 2017). Pseudo-ginseng or Himalayan ginseng (*Panax pseudoginseng*) and jaggery when consumed together relieve pain and reduces swelling and blood pressure (Yang *et al.*, 2020). Jaggery with some fenugreek (*Trigonella foenum-graecum*) seeds everyday results in long, strong and lustrous hair. The combination of May-tree or whitethorn, or, thorn apple (*Crataegus*) and jaggery is loaded with antioxidants. It has anti-inflammatory properties, helps in reducing blood pressure, prevents hair

loss, reduces anxiety and blood fats. Jaggery combined with Ashvghandha (*Withania somnifera*), musli (*Chlorophytum borivilianum*), Sarla (black basil), drumstick (*Moringa oleifera*), Emblic or Indian gooseberry (amla) (*Phyllanthus emblica* L.) are rich source of vitamins and minerals. They help in regulating blood sugar level, prevent heart related problems, develop strong bones and boosts immunity (Rao *et al.*, 2021). Along with solid forms of jaggery such as cubes or powder, the liquid form of jaggery also exists (Figure 4). The ease of using a liquid sweet substance in so many recipes are available and can be employed in several food recipes which carries better flavour and nutritive contents. The favourable, earthly taste with the modern touch of simple flavors elevates the simple-looking brown liquid to a versatile product for people of different choice. Dr. Jaggery has introduced several liquid fused essential oils jaggery products from different ingredients like cardamom which is a perfectly organic, simple, and healthy product for daily societal use.

CONCLUSION

Different nutritive and health values of jaggery products are discussed which can be adopted in society for better health values of mankind and replacement of sugar. Jaggery value added and fortified products shows multifarious uses as nourishing food, medicinal formulations and alternative diet and drink recipes. Moreover, these new value added and fortified jaggery products being manufactured by Dr. Jaggery and others that are entirely focussed on health related nutritive products by combining all-natural additives should be adopted by majority of people for improving health and boost natural immunity.

DISCLOSURE

The mention of trade names or commercial goods in this article is purely for the purpose of providing specific details & does not mean that the authors recommend or endorse them.

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