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Jaggery: A natural sweetener

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Abstract

Jaggery is a natural sweetener obtained by concentrating the juices obtained sugarcane and/or palm trees. Jaggery can be used as a base for number of sweet dishes in different countries because it has sweet winy fragrance and delicious flavor which lies between brown sugar and molasses. It contains nutrients like protein, vitamins and minerals like iron and copper. It is also used as an energy food having therapeutic advantage so, it can be used for blood purification, regular functioning of liver and keeping blood healthy. A good quality jaggery has golden yellow colour, hard texture, crystalline structure, sweeter taste and less moisture content. Jaggery can be in the form of solid, liquid and granuals. In nowadays, manufacturers prepare organic jaggery which is free from chemical like sodium bicarbonate, sulphur dioxide, citric acid, alum, etc. Jaggery is known as 'medicinal sugar' which is used for pharmaceutical formulations. Jaggery improves digestion, helps in cleansing the liver, relieves constipation, boosts energy, purifies the blood, anti-toxic and anti-carcinogenic properties, relives tension, treatment of bronchial or lung infections and pre-menstrual syndrome. Jaggery can be added with some different natural flavour like black pepper, ginger, lemon, cardamom etc. and nutrients like protein, amino acids, peptides, vitamins and phytochemicals (flavonoids, polyphenols, phytosterols, etc.). Jaggery has been used for manufacture of ice cream, milk shake, sapota milk shakes and kulfi, jaggery chocolate etc. Due to number of advantages of jaggery is a better choice as compared to sugar.

Keywords: Jaggery, nutrients, sweetener, pharmaceutical, organic

I. Introduction

Jaggery (Gur) is defined as the product manufactured by concentrating the sweet juices of palm trees, or of sugarcane, to a solid or semi-solid state. It can be used for the countless sweet dishes, which are famous in different countries. It has unique characteristics for which it is preferred by individuals over white sugar for preparation of certain sweet dishes ^[1].

According to FSSAI (2018), "Gur or Jaggery means the product obtained by boiling or processing juice pressed out of sugarcane or extracted from palmyra palm, date palm or coconut palm" ^[2]. It is a natural sweetener and has a sweet, winy fragrance and flavour. It has a heady aroma and a delicious flavour, somewhere between brown sugar and molasses. Jaggery contains proteins, minerals and vitamins. It is also a potent source of iron and has higher iron and copper contents than refined sugar. It is also a superior product in the category of natural sweeteners in terms of the vitamin content. It is an energy food that is said to purify blood, regulate liver function and keep the body healthy. As a form of sugar, it forms an important item of the diet and is either consumed directly or as a sweetening agent for sweet preparations ^[3].

A quality jaggery is golden yellow in colour, hard in texture, crystalline in structure, sweet in taste and low in moisture. A good quality Jaggery/Gur contains over 70% sucrose, below 10% of glucose and fructose, less than 5% minerals and under 3% moisture ^[4]. The quality jaggery is influenced by the variety of cane used, quantity of fertilizers used, quality of irrigation water and method of processing adopted ^[5].

India is the largest producer and consumer of jaggery. If compare with the total jiggery production of the globe, more than 70% Jaggery produced in India. Jaggery is mainly produced in the month of November to April ^[6]. From the total jaggery produced in India, 65-70% is manufactured from sugarcane and the remaining is from other sugar yielding crops. The major sugarcane producing states of India are Karnataka, Maharashtra, Tamil Nadu, Uttar Pradesh and Andhra Pradesh contributing to around 80-90% of jaggery production ^[7]. Out of the 300 MT of sugarcane produced in India, 53% is converted into white sugar, 3% is used for cane juice, 36% is processed into jaggery and khandsari and 8% is used as cane seed ^[8]. By 2020 AD, India would need at least 54 MT of sweeteners, out of this about 40% has to be met by jaggery ^[9]. Table 1 and Table 2 shows the composition and nutrient content in jiggery.

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Table 1: Approximate Composition of Different Forms of Jaggery And Refined Sugar (Per 100 G) [22, 8].

Parameter(s)	Forms of jaggery			Sugar
	Solid	Liquid	Granular	
Water (g)	3 to 10	30 to 35	1 to 2	0.2 to 0.4
Reducing sugar (g)	9 to 15	15 to 25	5 to 9	-
Sucrose (g)	65 to 85	40 to 60	80 to 90	99.5
Total minerals (g)	0.6 to 1.0	0.75	0.6 to 1.0	0.05
Fat (g)	0.1	0.1	0.1	-
Protein (g)	0.4	0.5	0.4	-
Calorific value (Kcal)	383	300	383	398

2. Methods of Manufacturing

Kumar [10] reviewed the different methods for manufacture of jaggery viz., local method and modern scientific method of jaggery production. From 10,000 g of sugar cane around 6500 g cane juice and 3500 g bagasse is obtained [11]. Jaggery is manufacture in three forms i.e., liquid, solid and powder or granular form [12], which is briefly describe under.

Table 2: Nutrients in Jaggery [42, 8].

Particulars	Quantity (mg)	Particulars	Quantity (mg)
<i>Minerals</i>		<i>Vitamins</i>	
Calcium	40-100	Vitamin A	3.8
Magnesium	70-90	Vitamin D ₂	6.5
Potassium	10-56	Vitamin E	111.3
Phosphorus	20-90	Vitamin B ₂	0.06
Sodium	19-30	Vitamin B ₁	0.01
Iron	10-13	Vitamin C	7.000
Manganese	0.2-0.5	Vitamin B ₅	0.01
Zinc	0.2-0.4	Vitamin B ₆	0.01
Copper	0.1-0.9		
Chloride	5.3		

A. Solid Jaggery

The clarified, filtered cane juice is pumped into open pans which is heated using triple pan furnace and the begasse is used as fuel. Herbal clarificant (deola extract @ 45 g/100 kg juice) is used for clarification of juice, to make light coloured jaggery by eliminating impurities in suspension, colloidal and colouring compounds by accumulation. The juice is then boiled in open pan with stirring and concentrated to form jaggery mass in desired shape and size [4].

B. Liquid Jaggery

The intermediate product which can be acquired during concentration of purified sugarcane juice in the course of jaggery making, and is semi-liquid syrup like product. Liquid jaggery is a majorly part of diet in most parts of West Bengal, Maharashtra and is achieving commercial values. The liquid jaggery is being employed as sweetener in foods and drinks in Maharashtra, Kerala, West Bengal, Gujarat, Andhra Pradesh and Tamil Nadu [8].

The chemical and microbial quality of liquid jaggery mostly depends on to the physico-chemical quality of cane juice, striking temperature at which concentrating juice is collected and type of clarificants used. For a good quality liquid jaggery, the concentrated juice is removed from open boiling pan, when it reaches striking point at a temperature of 103-106 °C, which further depend upon the variety and agro-

climatic zone.

To eliminate the risk of crystallization and to make liquid jaggery more eye-catching in colour, citric acid is added at a rate of 0.04% (400 mg/kg of liquid jaggery), however to enhance the storage life of liquid jaggery without deterioration in its any quality parameters, potassium metabisulphite at a rate of 0.1% (1 g/ kg of liquid jaggery), or benzoic acid at a rate of 0.5%, is added. Liquid jaggery is then hold undisturbed for 8-10 days at ambient conditions. Later after filtration, it is properly packaged in sterilized bottles. The chemical composition of typical liquid jaggery has about 30 to 36% moisture, 40 to 60% sucrose, 15 to 25% invert sugar, ~0.30% calcium, 8.5 to 10 mg/100g iron, ~ 5mg/100g phosphorus and ~0.10 mg/100g protein.

C. Granular Jaggery

The concentrated slurry (TS 58-60%) is worked with wooden scrapper, for formation of grains. The granular jaggery is then cooled and sieved. For a good quality of jaggery, less than 3 mm sized crystals are found to be better. Increasing pH of cane juice with lime solution, up to 6.0 to 6.2, and striking point temperature of 120°C produces an excellent quality granular jaggery with high sucrose content of around 88.6% with low moisture content of around 1.65%, with good colour, friability and crystallinity. Jaggery in the granular form (about 3 mm), sun dried and reduced moisture content to about 2% or less, and packed in polyethylene polyester bags or polyethylene bottles, can be stored for longer time (more than two years) at ambient temperatures, even during monsoon period with little changes in its physicochemical quality.

3. Organic Jaggery

Now a day there is a trend to manufacture chemical-free jaggery and organic jaggery [14]. In regular jaggery chemicals such as sodium bicarbonate, ZFS (zinc formaldehyde sulphonylate), sulphur dioxide, calcium carbonate, chemofioc, polyelectrolite, sodium hydrosulphite (hydros), citric acid, hydrogen peroxide, alum, phosphoric acid etc. are used as clarificants. These chemical clarificants should be used within the safe limit. In manufacture of organic jaggery clarificants such as deola, bhendi, semal, castor seed, phalsa, ground nut, soybean, ambadi, tapioca, sukhlai, etc. [13]. In manufacture of chemical-free jaggery specific varieties of sugarcane such as CoJ64, CoJ82, CoJ88, etc. are used [14].

4. Health Benefits

Jaggery is popularly known as 'medicinal sugar' it is being used in pharmaceutical formulations and daily consumption jaggery may associated with elevation in human life span [15]. Jaggery is rich in minerals [16, 17] and contains high amount of phenol [18]. The health benefits of jaggery has been described by various authors in literature viz. improves digestion [19], helps in cleansing the liver [20], relieves constipation [19], boosts energy, purifies the blood [21], anti-toxic and anti-carcinogenic properties [22], relives tension [19], treatment of bronchial or lung infections and pre-menstrual syndrome (PMS) [23], anti-oxidant activity [24].

5. Comparison Between Jaggery & Sugar [20].

Attributes	Comparison
Colour	Commercial sugar (Sucrose) is bright white color, whereas the colour of jaggery varies from dark brown or golden-yellow to golden brown.
Texture	Commercial sugar is in crystals form, which are solid and hard while, jaggery is semi-solid, softer than sugar and also amorphous in

	nature.
Composition	Sugar consist only of sucrose whereas jaggery consist of sucrose, mineral salts, iron and some fiber.
Health	<ul style="list-style-type: none"> ➤ Sugar is readily absorbed in the blood, and high packs of energy is released rapidly. Therefore, it is not recommended for diabetic people. But jaggery is digested slowly and hence, energy release is also slow. ➤ The potassium content in jiggery is high, which assists in weight management, as it prevents water retention in the body. It also increases metabolism of the food. ➤ Addition to decreasing physical activity, sugar consumption assumes importance in terms of the high tendency for Indians to develop insulin resistance (Type II Diabetes), hepatic steatosis, abdominal adiposity, the increasing “epidemic” of type 2 diabetes and cardiovascular diseases.

6. Value addition in jaggery

Jaggery can be added with different natural flavouring components (black pepper, cardamom, ginger, lemon etc.), nutritive ingredient (protein, amino acids, vitamins and phytochemicals), texture improving compounds (additives) and taste enhancers (additives like nuts, cereal, spices and pulses) [25, 4]. Anwar *et al.* [26] developed a vitamin C enriched jaggery powder. He added a natural source *viz.*, small pieces of amla fruits and dried it up to 10% moisture content was found to be the best.

7. Utilization of Jaggery In Dairy and Food Products

Jaggery has been used for manufacture of ice cream [27], milk shake [27, 28], sapota milk shakes and kulfi [29, 30], jaggery chocolate [31], jaggery pedha [32], milk based fortified eggless pudding [33], coffee, khees [34], bomboyson [35], poppy seeds payasam [36], bamboo seeds payasam [37], roat [38], weaning foods [39], etc.

8. Adulteration in Jaggery

To identify the adulterations in jiggery, the ratio of reducing sugar to non-reducing sugars can be used. GC-MS, GC, IR-MS, NMR, HPLC and DNA based techniques used to check adulteration. Sugarcane jaggery is often adulterated with sodium bicarbonate, ZFS (Zinc Formaldehyde Sulphoxylate), sodium hydrophosphide, calcium carbonate, etc. Date palm jaggery is adulterated with sugarcane jaggery and plain sugar. Palmyra jaggery is adulterated with sugar, sodium bicarbonate, yellow colour, etc. A near-infrared (NIR) spectroscopic method to detect adulteration of jaggery with sugar and rice bran [40, 41].

9. Conclusion

Jaggery manufacturing has been one of the most antediluvian practise and significant rural-based cottage industries in our country. It has higher medicinal and nutritional values as compare to other sweeteners, easily available to the rural people and is highly recommendable by health experts. There are number of applications of jaggery in variety of foods and its use in households makes it a better choice as compared to sugar. Also, jiggery is associated with number of health benefits; which makes it a better choice than sugar.

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