

# Review on Recent Advances in Value Addition of Jaggery based Products

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## Abstract

Jaggery is sugarcane based natural sweetener made by the concentration of sugarcane juice without any use of chemicals. It is available in the form of solid blocks and in semi-liquid form. Besides this, the sap collected from some palm trees such as palmyra-palm (*Borassus flabellifer* L.), coconut-palm (*Cocos nucifera* L.), wild date-palm (*Phoenix sylvestris* Roxb.) and sago-palm (*Caryota urens* L.) is used for preparation of jaggery. It contains the natural sources of minerals and vitamins inherently present in sugarcane juice and it is one of the most wholesome and healthy sugars in the world. The micro nutrients present in the jaggery possess antitoxic and anti-carcinogenic properties. In India, of the 300 Mt of sugarcane produced, 53% is processed into white sugar, 36% into jaggery and khandsari, 3% for chewing as cane juice and 8% as seed cane. The methods of converting sugarcane and manufacturing sugar, gur and khandsari are different but a great value is added in the manufacturing of these consumable final products. Further it offers employment opportunity to millions of people. Of the total world production, more than 70% of the jaggery is produced in India but most of the jaggery business suffers from losses. The development of different value added products from jaggery and their commercial availability becomes needs of the hour to sustain future profitability in the jaggery trade.

**Keywords:** Jaggery; Sugarcane; Value addition; Packaging; Storage

## Introduction

Gur (Jaggery) is a natural, traditional sweetener made by the concentration of sugarcane juice and is known all over the world [1] in different local names [2]. It is a traditional unrefined non-centrifugal sugar consumed in Asia, Africa, Latin America and the Caribbean. Containing all the minerals and vitamins present in sugarcane juice, it is known as healthiest sugar in the world. India is the largest producer and consumer of jaggery. Out of total world production, more than 70% is produced in India [3].

In India, of the 300 Mt of sugarcane produced, 53% is processed into white sugar, 36% into jaggery and khandsari, 3% for chewing as cane juice, and 8% as seed cane [4]. Jaggery and khandsari have withstood competition protecting farmers' interests besides meeting ethnic demands. Processes and equipments have been developed for quality solid, liquid and powder jaggery. Liquid jaggery has been commercialized. The organic clarificants developed help to retain jaggery as organic food.

Jaggery is prepared by concentrating the sugarcane juice and it is available in the form of solid blocks and in semi-liquid form. Besides this, the sap collected from some palm trees such as palmyra-palm (*Borassus flabellifer* L.), coconut-palm (*Cocos nucifera* L.), wild date-palm (*Phoenix sylvestris* Roxb.) and sago-palm (*Caryota urens* L.) is used for preparation of jaggery [5]. For ease of handling, packaging and storage, jaggery in granular form is becoming popular. The hygroscopic nature of granulated jaggery product lead to stickiness and caking problems.

India is world's largest producer of sugar and sugarcane. Sugarcane in India is processed in to sugar, gur and khandsari and undergoes considerable weight reduction during processing. The methods of converting sugarcane and manufacturing sugar, gur and khandsari are different but a great value is added in the manufacturing of these consumable final products. Further it offers employment opportunity to millions of people. Gur is prepared in all parts of the country. It is also known as Gul, gud, Jaggery, Vellum and Bella.

## Importance of jaggery

Jaggery is far complex than sugar, as it is made up of longer chains

of sucrose. Hence, it is digested slower than sugar and releases energy slowly and not spontaneously. This provides energy for a longer time and is not harmful for the body. But this does not certify it fit for consumption by diabetics, because ultimately it is sugar. Jaggery also gathers a considerable amount of ferrous salts (iron) during its preparation, as it is prepared in iron vessels. This iron is also good for health, particularly for those who are anaemic or lack iron. Again, jaggery also contains of traces of mineral salts (you might have experienced this, that jaggery leaves a hint of salt on tongue) which are very beneficial for the body. These salts come from the sugar cane juice where it is absorbed from the soil. Furthermore, jaggery is very good as a cleansing agent. It cleans lungs, stomach, intestines, oesophagus and respiratory tracts. Those who face dust in their day to day life are highly recommended to take a daily dose of jaggery. This can keep them safe from asthma, cough & cold, congestion in chest etc.

Gur is known to produce heat and give instant energy to a human body. In many parts of India, there is a tradition of serving a glass of water with Gur to welcome the guests. Gur is also used as a cattle feed, in distillery, medicine manufacturing unit, ayurvedic medicines, ayurvedic sura and ayurvedic health tonics. Recently Gur has also found a place in confectionary items. A usage of Gur is also seen in leather and tobacco industries. Besides, in cement industries and coalmines, Gur is supplied to the workers for in order to protect them from dust allergies. And at the time of natural calamities, the district administration purchases Gur and distributes it to the victims for various health benefits.

## Nutritional value and uses of jaggery

It is rich in important minerals (*viz.*, Calcium-40-100 mg,

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Magnesium-70-90 mg, Potassium-1056 mg, Phosphorus-20-90 mg, Sodium-19-30 mg, Iron-10-13 mg, Manganese-0.2-0.5 mg, Zinc-0.2-0.4 mg, Copper-0.1-0.9 mg, and Chloride-5.3 mg per 100 g of jaggery), vitamins (viz., Vitamin A-3.8 mg, Vitamin B1-0.01 mg, Vitamin B2-0.06 mg, Vitamin B5-0.01 mg, Vitamin B6-0.01 mg, Vitamin C-7.00 mg, Vitamin D2-6.50 mg, Vitamin E-111.30 mg, Vitamin PP-7.00 mg), and protein-280 mg per 100 g of jaggery, which can be made available to the masses to mitigate the problems of mal nutrition and under nutrition. The micronutrients present in the jaggery possess antitoxic and anti-carcinogenic properties [6]. It has moderate amount of calcium, phosphorous and zinc, so it helps to optimum health of a person along with all its benefits, purifies the blood and prevents rheumatic afflictions and bile disorders and thus helps to cure jaundice.

Gur is high calorie sweetener and as it contains minerals, protein, glucose and fructose, it is known to be healthier in comparison to white sugar. A good quality Gur contains more than 70% sucrose, less than 10% of glucose and fructose, less than 5% minerals and less than 3% moisture.

In India, it is mainly used as an ingredient in sweet and savoury dishes. Further, its use in many herbal and traditional medicines [5]. In Ayurvedic way of medicine, it is used as medicine, blood purifier and base material for syrups. Jaggery is among major agro processing industries in India. Nearly 20-30% of total sugarcane produced in the country is used for manufacture of about 7 million tonnes jaggery, which is known as most nutritious agent among all sweeteners [7]. This sector provides employment to about 2.5 million people [8]. It is therefore, imperative to expand the sector, as it provides higher food value jaggery at lower cost and boosts-up the rural economic system, involves low transportation cost of raw material, and non requirement of highly technical machinery and labour [9]. Jaggery still dominates in preparation of various products like- reori, gazak, chikki, patti and ramdana, etc. of ancient origin. Kakavi (liquid jaggery) is part of daily diet in most parts of Maharashtra, and has been gaining commercial importance in India [10]. Jaggery is rich in important minerals like salts: 2.8 g/100 grams, whereas only 300 mg/kg is obtained in refined sugar.

Singh et al., [4] mentioned the importance of jaggery in India in their paper entitled 'Alternative sweeteners production from sugarcane in India: Lump Sugar (Jaggery)'. They stated that sugar and jaggery are the main sweetening agents which are added to beverage and foods for increasing palatability. Over the years, food habits of human beings have been greatly influenced by research and developmental activities and also due to their health consciousness. Despite witnessing pressure of industrialization, the jaggery industry has flourished in different states of the country viz., Uttar Pradesh, Tamilnadu, Karnataka, Maharashtra and Andhra Pradesh. The increasing trend of their production is of much significance to learn about peoples' liking towards jaggery in rural areas mainly due to its nutritional and medicinal values. Due to its nutritional and medicinal values, the jaggery has great export potential in the world.

Rama Rao and Babu [11] studied to work-out costs and returns in value added products of sugarcane viz., sugar, jaggery and sugarcane juice, in order to suggest the sugarcane growers the profitable and sustained way to deal with sugarcane. The results revealed that cost of cultivation of sugarcane is the prime factor in the various value added products. Among the value added products, sugarcane juice production was found more profitable, which needs further study of technical and financial feasibility of keeping quality in order to produce on large scale. Lack of infrastructural facilities in jaggery production

and insufficient price dissemination in jaggery marketing were major constraints faced by jaggery manufacturers in India [12].

Dwivedi [13] reported that Kushinagar district of Uttar-Pradesh has large number of gur manufacturing units, mostly located in the rural areas and the manufacturers are following conventional methods for producing this. In the district the major clusters which are having more numbers of manufacturing units are Sukraouli, Kasia, Hata and Padarauna. Around half of the rural population is employed in gur making industry in this region. Although, there is no R & D assistance and marketing institutions for support. It is found that the manufacturers are producing majorly for distilleries and local licker producers, not for the food plate or common man's consumption. The study revealed that units of medium and large sizes were able to cover their operating expenses with significant level of profit but small size units were earning marginal profit. The profit earned by this category was very low as compared to other two sizes. The manufacturers are not interested in any new product of gur, they just want to earn more profit through gur only. This research will urged that the policymakers to streamline strategies that promote stabilization of sugarcane economy and make the nation credible supplier of gur in the International market, benefiting gur makers, sugarcane growers and related stakeholders.

Nain et al., [14] reported that jaggery production was a major traditional enterprise in sugar cane producing areas. At times, jaggery making was profitable to cane producers, than supply to sugar factory. The cost of sugarcane was the major cost item in jaggery production. The investment in jaggery processing units was found to be profitable.

Ramaswamy et al., [15] stated that jaggery making is a traditional enterprise in Tamil Nadu and is more profitable to cane producers than supply to the factory. But, higher profitability is counter veiled by price risk in jaggery. Traditionally, jaggery making is under taken by cane growers in their own farm. The trend has changed with the entry of new enterprisers who venture jaggery manufacturing as a pure enterprise by procuring cane from the cane growers. The substantially higher price, immediate disbursements for the sale of cane, missing the registration in time with factory, delays in cutting order and complex procedure of transactions with the factory make the cane growers favour cane supply to jaggery making. Absence of price risk, labour shortage in the case of own jaggery making, financial and technical assistance extended by the factory are the major factors attracting supply of cane to factory.

Jaggery is produced in different forms viz., solid, liquid and powder or granular forms, which are described as:

### **Solid jaggery (Cube shape)**

The filtered cane juice was pumped into open pans kept on triple pan furnace, and heated with the begasse as fuel. The juice was clarified with herbal clarificant (deola extract @ 45 g/100 kg juice), to make light coloured jaggery by eliminating impurities in suspension, colloidal and colouring compounds by accumulation. The juice was then boiled and concentrated to make jaggery in desired shape and size.

### **Liquid jaggery**

It is an intermediate product obtained during concentration of purified sugarcane juice during jaggery making, and is semi liquid syrup like product. The quality of liquid jaggery largely depends upon quality and composition of cane juice, type of clarificants used, and striking temperature at which concentrating juice is collected. For quality liquid jaggery, the juice concentrate is removed from boiling pan, when it reaches striking point temperature of 103-106°C, depending upon the

variety and agro-climatic zone. To avoid crystallization and to make liquid jaggery attractive in colour, citric acid is added @ 0.04% (400 mg/kg of liquid jaggery), whereas to improve shelf life of liquid jaggery without deterioration in quality, potassium metabisulphite @ 0.1% (1 g/ kg of liquid jaggery), or Benzoic acid @ 0.5% (5 g/kg of liquid jaggery), is added. Liquid jaggery is then allowed to settle for period of 8-10 days at ambient conditions. Later after filtration, it is properly packaged in sterilized bottles. Chemical composition of typical liquid jaggery could be: water 30-36%, sucrose 40-60%, invert sugar 15-25%, calcium 0.30%, iron 8.5-10 mg/100 mg, phosphorus 05/100 mg, protein 0.10/100 mg, and vitamin B 14/100 mg [16].

### Granular or Powder Jaggery

The process of making granular jaggery is similar up to concentration. The concentrating slurry is rubbed with wooden scrapper, for formation of grains. The granular jaggery is then cooled and sieved. Less than 3 mm sized crystals are found to be better for quality granular jaggery. Raising of pH of cane juice with lime, up to 6.0-6.2, and striking point temperature of 120°C was found to yield quality granular jaggery with high sucrose content of 88.6%, low moisture of 1.65%, with good colour, friability and crystallinity. Jaggery in the form of granules (sieved to about 3 mm), sun dried and moisture content reduced to less than 2%, and packed in polyethylene polyester bags or polyethylene bottles, can be stored for longer time (more than two years), even during monsoon period with little changes in quality.

Colour of jaggery powder can range from golden yellow to golden brown dark brown like dark chocolate. The colour is often dependent on base ingredient used to make jaggery powder. It is softer than sugar and also amorphous. This is because vitamins proteins and in gradient of cane are not removed. It is made up of predominantly sucrose mineral salts iron. Hence consumption of jaggery is recommended in case of iron deficiency anaemia. It contains longer chains of sucrose therefore it is digested slowly and energy release is also slow. Hence energy is provided for a longer period of time and it not harmful for the body. Different benefits of jaggery powder are listed as:

- Rich in mineral salts
- Easy to digest
- Develops unique taste as sweetener
- Treats throat and lung infections
- Easily dissolved and balances the deficiency of sugar level
- Sulphur less Organic Composition, a best to suite as preferred health alternative.

Process flow chart for jaggery powder preparation is shown below [17] (Figure 1).

### Value addition in jaggery

Jaggery may be value added with different natural flavour (ginger, black pepper, cardamom, lemon etc.), nutrition (protein, vitamins and phytochemicals), texture (additives) and taste (additives like nuts, spices, cereal and pulses). Moreover, different value added products are prepared traditionally using jaggery instead of sugar viz., rosagolla, peda, curd, laddu (puffed cereal, nuts and sesame etc.) but no scientific literatures as well as process technologies are available for commercial exploitation. Anwar et al., [18] developed a vitamin C enriched jaggery powder by adding through a natural source viz., cut pieces of amla fruits and dried up to 10% moisture content was found

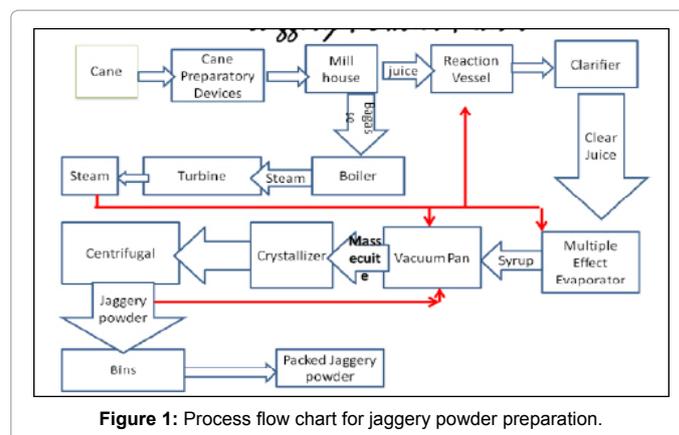


Figure 1: Process flow chart for jaggery powder preparation.

to be the best, followed by samples with grated and fine powder form of amla, as indicated through sensory evaluation. Replacement of sugar in the product formulation of “Bomboysan” by jaggery was studied by Gartaula and Bhattarai, [19] and they reported that replacing the sugar content by jaggery did not alter the overall acceptability (OA) of the product and there is increase in the mineral content of the product. The product could be stored safely up to 28 days at 5°C and 21 days at 25°C. Other uses include jaggery toffees and jaggery cake made with pumpkin preserve, cashew nuts, pea nuts and spices. Jaggery may also be used in the creation of alcoholic beverages like palm wine.

### Packaging and storage life of jaggery

In India, the traditional methods of jaggery storage prevalent in western and eastern regions like open storage, *matka*, gunny bags etc. These methods don't work in Tarai regions because climatic conditions are not favourable for keeping quality of jaggery as there is very high humidity in these areas. During monsoon period, due to high humidity range, jaggery samples get infected with microbial activity and thus keeping quality of jaggery goes down. Jaggery samples could be stored in cold storage but sometimes it is difficult to store the samples for small scale farmers as cost involved is the main constraint for that. Also the energy consumption is very high. Jaggery from cold storage is used in off-season at high cost [20].

Chand et al., [21] studied the storage behaviour of jaggery samples stored under hilly climatic conditions of Uttarakhand. Samples were packed in polythene bags, IISR bins and hanging baskets and stored for a period of five months during which changes in product parameters such as moisture content, sucrose, reducing sugar and colour were determined at an interval of 30 days. The result revealed that good keeping quality of jaggery could be maintained with little changes in sucrose content, colour, total moisture content and reducing sugar under cool hilly climate with IISR drying cum storage bin. Jaggery kept in bin recorded less reduction in quality parameters under cold hilly climate compared to jaggery samples kept in open baskets.

Mandal et al., [22] studied the effect of common packing materials on keeping quality of sugarcane Jaggery during monsoon season. In their studies, it was revealed that the best packing material for storing Gur during monsoon season was heat sealed LDPE (Low Density Polyethylene) packet of 150 gauge followed by glass jars. LDPE packets prevented moisture ingress, fall in pH and inversion of sucrose in the stored Gur to the maximum extent. However, colour of Gur in LDPE packets was darker as compared to Gur stored in glass jars. PET (Poly Ethylene Terephthalate) jars were as good as glass jars but the stored

Gur darkened more in PET jars. Canisters were better in comparison to painted earthen pots provided those were with airtight lid.

## Conclusion

Indian jaggery industry is the largest unorganized sector which has been one of the most ancient and important rural-based cottage industries in the country. The majority of the sugarcane growers are manufacturing jaggery with minimum capital investment which provides jobs to the unemployed rural people. The jaggery manufacturers are mostly small and marginal farmers relying on quick returns from jaggery. It is, therefore, essential to safeguard the sugarcane growers to earn more profit from their jaggery manufacturing unit by improving its qualities through value addition and packaging of jaggery and jaggery based products with modern technologies.

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