

## International Journal of Agriculture Extension and Social Development

Volume 7; Issue 4; April 2024; Page No. 125-130

Received: 06-02-2024  
Accepted: 10-03-2024

Indexed Journal  
Peer Reviewed Journal

### Jaggery (Gur) and khandsari sugar

<sup>1</sup>Venketesa Palanichamy N and <sup>2</sup>Vivek G

<sup>1</sup>Dean (Agri.), Agricultural College and Research Institute, TNAU, Coimbatore, Tamil Nadu, India

<sup>2</sup>Research Scholar, Agricultural College and Research Institute, TNAU, Coimbatore, Tamil Nadu, India

DOI: <https://doi.org/10.33545/26180723.2024.v7.i4b.508>

Corresponding Author: Venketesa Palanichamy

#### Abstract

In India, sugarcane is an important cash crop for sugar and allied industries. Organic gives consumers the option of living a “healthy life” by delivering nutritious food. It guarantees that no hazardous persistent pesticides, synthetic fertilizers or genetically modified organisms (GMO) are used in production and cattle are not administered antibiotics or growth hormones. It could be concluded that one tonne of raw sugarcane averagely yields 105-110 kilograms of khandsari sugar. To get one tonnes of jaggery and khandsari sugar nearly 10 tonnes of raw sugarcane is required. The net return for jaggery and khandsari sugar is producer is Rs. 12017.50 per tonne. Four marketing channels were observed in the study.

**Keywords:** Jaggery, khandsari sugar, genetically modified organisms

#### Introduction

As consumer demand for natural and healthy food grows, major efforts are being made to develop and sell food products that preserve vital nutrients and quality traits after processing and packaging. Chemical preservatives are widely employed in the food business as a means of extending product shelf life and ensuring food safety (Khan *et al.*, 2021) [8]. Organic gives consumers the option of living a “healthy life” by delivering nutritious food. It guarantees that no hazardous persistent pesticides, synthetic fertilizers, or genetically modified organisms (GMOs) are used in production, and that cattle are not administered antibiotics or growth hormones. It also signifies that strict organic farming requirements have been reached in terms of impact on soil, water, and air, which helps to protect the environment. Growing consumer concern for their health and the environment, increased income and lifestyle, and government initiatives all contribute to a growth in demand for organic products. Since ancient times, jaggery has been used as a sweetener in many parts of India, traditionally made in open earth pan furnaces. To make jaggery, sugarcane juice and bagasse, which is extracted after sugarcane is crushed, are utilised as raw ingredients. Sugarcane is a key agro-industrial crop, not only of its economic value, but also for its medical significance. Sugarcane is also used as a single medicine as well as a combination drug with other herbs and plants in ancient Indian ayurveda (Anis & Iqbal, 1986) [1]. Around two-thirds of the sugarcane produced in India is used to make sugar, one-fifth is used to make jaggery, and the rest is utilised for other commercial purposes. (Anwar, 2010) [3]. The production of jaggery is regarded as a small-scale industry that employs a large number of people in rural India.

Jaggery is composed of 65–85 percent sucrose, 10–15 percent reducing sugars, 3–10 percent moisture, and the rest is insoluble debris. (Rao *et al.*, 2007) [20]. To make jaggery in an open earth pan furnace, it will need both mechanical and thermal energy. Crushing sugarcane to generate sugarcane juice necessitates mechanical energy, whereas heating sugarcane juice in the furnace necessitates thermal energy. The moisture percentage of the bagasse is typically 40-50 percent at the time of first crushing (Manohar Rao, 1977) [19]. By drying the bagasse in an open area, the moisture content can be reduced to 8-10%, and the dry bagasse can then be used as a raw material to generate heat in an open earth furnace. It was discovered that around 45 percent of the entire energy produced in the combustion process is used for jaggery processing, with the remainder being lost through flue gases, ash, and furnace walls. Some of the report reveals that areas consuming jaggery and khandsari sugar showing least rate of diabetes when compared with areas consuming refined sugar (Jaswant Singh, 1998; Kumar K, 1999 and Esther *et al.*, 2013) [23, 12, 5]. Solar energy and heat pumps are used in advanced jaggery production procedures. Any increase in the thermal efficiency of a jaggery furnace results in bagasse savings, which generates greater money for the jaggery producer (Jakkampati & Mandapati, 2016) [11]. Sugar and sweet consumption has long been popular around the world; however, the rising trend in per capita sugar consumption is significant in light of the high prevalence of insulin resistance, abdominal adiposity, and hepatic steatosis, as well as the rising prevalence of chronic diseases such as type 2 diabetes and cardiovascular disease. Increased taxation on sugar-sweetened beverages and increased promotion of jaggery and related goods could be used as

part of a variety of prevention initiatives to reduce white sugar consumption among multiple stakeholders (government, industry, and consumers) (Gulati and Misra, 2014) <sup>[22]</sup>. Ayurvedic and nutritional properties of jaggery In comparison to sugar, jaggery has a higher nutritional value in terms of phosphorus, calcium, iron, and vitamin B. Iron-rich jaggery aids in the maintenance of haemoglobin levels

in the blood, preventing anaemia. Small units constructed by local artisans and operated by locals in various parts of India are used to make jaggery. To ensure future profitability in the Gur trade, the development of various value-added products from Gur, as well as their commercial availability, is a must.

Comparison of Typical Composition of Jaggery and White refined Cane sugar

	Jaggery	Cane Sugar
Moisture, g/100 g	3.0–10.0	0.2–0.4
Sucrose, g/100 g	65.0–85.0	99.5
Reducing glucids, g/100 g	10.0–15.0	–
Protein, g/100 g	0.4	–
Fats, g/100 g	0.1	–
Total minerals, g/100 g	0.6–1.0	0.05
Calcium, mg/100 g	8.0	–
Phosphorus, mg/100 g	4.0	–
Iron, mg/100 g	11.0	–
Energy, kcal/100 g	383	398

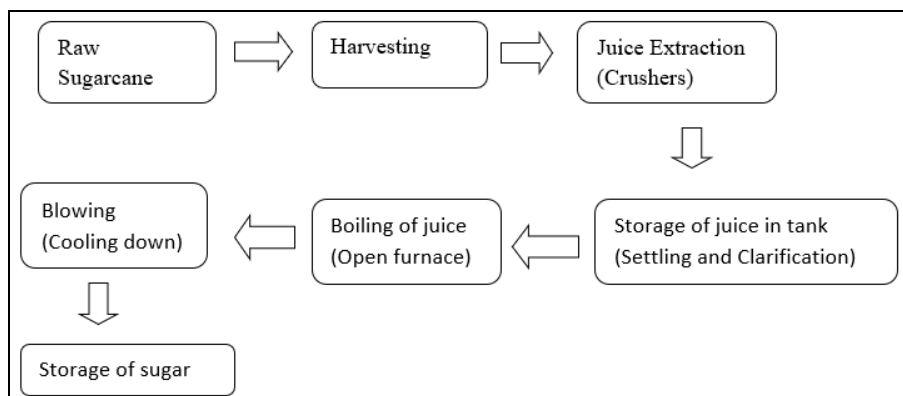
Source: Rao *et al.*, 2007 <sup>[20]</sup>; J.A. Solís-Fuentes, *et al.* (2019) <sup>[24]</sup>

### Jaggery & Khandsari Sugar (Cottage Sugar) – Rural Development

As starting the Jaggery & khandsari unit was cheap comparing the other business and its investment was also very low. In rural areas, starting the unit provides the way for employment opportunities to rural peoples. The skill requirement was very low and it provides the way for rural development. Though this business was seasonal, but it can uplift the farmer's livelihood status and economy. Those

who willing to start can easily get subsidy with the help of bank. Manufacturing high-quality, value-added jaggery with a focus on hygienic processing and packaging will aid in the sugar industry overall integration and transformation of the rural economy into a dynamic and buoyant industrialised sector.

### Processing stage of Jaggery & Khandsari sugar



### Raw Sugarcane and Harvesting

Producers procure sugarcane from the farmers with the nominal price of Rs. 1900 to Rs. 2100 per tonne. The price of sugarcane varies from season to season and also based on cooperative sugar mills price. The producers also bear the transportation charges and harvesting charges. On reaching the unit, crushing of cane started within a day. Here, the farmers also producers, as it was seasonal and very low investment compared to others business in terms of production, they also make minimal production of jaggery and khandsari sugar.

### Juice Extraction

One tonne of crushing cane gives 100 to 110 kilograms of sugar. Nowadays, crushing machines came with many innovations. Also, there is a huge market potential for sugarcane juice and widely consumed by many peoples.

Sugarcane juice is a proven health-promoting beverage that contains a significant quantity of polyphenols, antioxidants, and functional elements that helps to prevent a variety of disorders. Sugarcane juice is generally consumed fresh after extraction due to its perishable nature (Panigrahi *et al.*, 2021) <sup>[15]</sup>. Sugarcane juice has long been utilised as a primary source of medicine in India, according to ayurveda and Unani schools. Hemorrhage, anuria, jaundice, dysuria, cancer, cardiovascular, and urinary illnesses have all been linked to it as a natural cure (Karthikeyan & Samipillai, 2010) <sup>[7]</sup>. Sugarcane juice has a variety of health benefits, including cancer prevention, blood sugar stabilisation, weight loss, relief from fevers, acidity, kidney cleansing, tooth decay management, micturition, burning, gonorrhoea, enlarged prostate, cystitis, and a variety of other ailments (Pathak & Tiwari, 2017) <sup>[16]</sup>. Using of natural preservatives such as lemon extract, ginger extract, and maybe moringa

extract instead of artificial preservatives improves the stability of sugarcane juice. Lemon extract contains citric acid, which functions as an antibacterial agent, while ginger extract contains ascorbic acid, which improves the stability of sugarcane juice. The use of organically derived preservatives increased the stability of sugarcane juice for several days with good quality (Chopade and Mankuskar, 2021) <sup>[25]</sup>. Since, sugarcane juice is widely consuming for various purpose, here getting good quality of juice will lead to good quality of sugar.

### Settling and Clarification

Here, sugar is not processed on industrial scale and it is done by the farmers on a small scale using traditional techniques. Thereby, whole sugarcane stalks is directly crushed on a milling machine, and the impurities will be settled on the juice. Further, clarification process is needed for the juice to remove impurities settled down in the juice and also helps to improve the quality of the juice. Many methods are involved for the clarification process, to eliminate suspended contaminants from raw juice, producers (farmers) often employ traditional filtering and occasionally non-food-safe chemicals. Meerod *et al* (2019) <sup>[14]</sup> revealed about clarifying the juice at pH 8.5 with CaO gave the greatest mud weight (47.52 g) and the lowest sediment value of NCS (0.68%), while clarifying the juice with the maximum studied level (0.1% w/v) of NaHCO<sub>3</sub> gave the mud weight and sediment values of 30.28 g and 0.71%, respectively. The higher the amount of clarifier, the cleaner the juice obtained. Clarifying the juice with CaO or sodium NaHCO<sub>3</sub> caused loss of policosanol and tricin contents. Sugar cane juice must be clarified before being stored since it darkens minutes after extraction due to oxidation of some of its components (particularly chlorophyll and polyphenolic chemicals), which can make it unsafe to consume (Prati and Moretti, 2010) <sup>[17]</sup>. The colloids and pigmented substances in sugar cane juice are clarified by coagulation, flocculation, and precipitation, which are then removed by decanting and filtration, resulting in an insoluble precipitate that absorbs and drags such compounds from the juice. Flocculation can be accomplished by altering the pH, employing chemical reagents, or by boiling the water (Koblitz & Moretti, 1999) <sup>[9]</sup>. Simple defecation with lime and heating to obtain crude sugar, and sulf-defecation, in which sulphur dioxide is added before treating with lime and heating to obtain white crystal sugar, are the two most common procedures for clarifying sugar cane juice in Brazil. Some mills also use phosphate to generate even lighter juices with higher colloidal removal and faster decanting (Koblitz, 1998) <sup>[10]</sup>.

### Concentration of juice in an Open Furnace and Blowing

There are three phases to the sugarcane juice used in the open earth pan to make jaggery and khandsari sugar. The first stage of the process involves providing sensible heat (about 6% of total energy produced during combustion) to raise the temperature of sugarcane juice from ambient to boiling. To maintain the proper pH in this stage, a measured amount of chemicals such as bhendi, calcium carbonate, and phosphoric acid (each at roughly 30-50 g/100 kg of sugarcane) would be added to the sugarcane juice (Ghosh *et al.*, 1998) <sup>[6]</sup>. The second stage includes elimination of water

from the sugarcane juice at its saturation/boiling temperature. The quantity of warmth provided for the duration of this stage (round 39% of the whole strength produced with inside the combustion process) is taken into consideration to be latent of vaporization required to transform water to steam. Floating residue called molasses (round 3-5 kg/390 kg of sugar-cane juice) is shaped at this factor and wishes to be eliminated from the loose floor. At the cease of the second one stage, the sugarcane juice turns into wealthy in focused solids because the water is absolutely eliminated. In the remaining stage of jaggery preparation, the warmth provided (round 0.1% of the whole strength produced) is applied to growth the temperature of the sugarcane juice from its boiling factor to hanging factor. The hanging factor is the temperature at which the sugarcane juice converts to a semisolid paste which slides at the pan floor in preference to sticking to the pan. At this stage the sugarcane juice in semi-strong nation is eliminated from the pan and cooled to room temperature to put together the jaggery. The contents are put to wooden/aluminum moulds or earthenware pots to solidify. This functions as both a cooling and a moulding tool. Solid jaggery can come in a variety of shapes, from small spherical balls to enormous lumps. A significant amount of heat is lost to the environment during cooling. Cooling cum moulding devices that circulate cold water can replace manually pouring viscous jaggery into wooden moulds. The cooling water can be utilised to generate steam for the concentration process in steam jacketed kettles, making the process more efficient and hygienic. This easy solution will help the farmer save even more energy (Esther *et al.*, 2013) <sup>[5]</sup>. The following process is used to determine the right concentration of juice: a small amount of concentrated juice is withdrawn from the pan and poured into cold water. When it takes the shape of a ball and makes a metallic sound, the process of boiling the juice is complete, and the Pan is removed from the furnace and swirled for a while. Gur is poured into a cooling pan after it has been boiled. The Gur begins to crystallise as the temperature drops. The semi-solid mass is then poured into moulds by swirling the juice slowly and intermittently to avoid the loss of granular structure. Gur (Jaggery) solidifies, it is removed by inverting the moulds. These lumps or moulds are designed to resemble a bucket of various weights. These buckets range in weight from 30 kg to 20, 19, 10, 5, or 1 kilogramme. These buckets come in a variety of sizes but all have the same shape and contain different weights of Gur chunks (Rao, 1993; Kumbhar, 2016) <sup>[21, 13]</sup>. For khandsari sugar, the semi solid paste of boiled juice will be poured into the wooden box, while on cooling, clods formation will be breakdown into pieces.

### Storage

Moisture content should not exceed 6% and be kept at a relative humidity of 43-61% for good keeping quality of jaggery (Chockalingam, 1985) <sup>[4]</sup>. The production of jaggery is seasonal, but the demand for it is constant throughout the year. As a result, jaggery must be stored properly throughout the year. Throughout the year, over three million tonnes of jaggery are kept in India for consumption. Two million tonnes of jaggery are kept in domestic storage by large organised agents and traders. According to estimations, the quality and quantity of jaggery drops by

10% during the rainy season. As a result, extreme caution should be exercised in keeping it away from moisture and air, pot jaggery storage proved better for maintaining the sucrose content in storage compared to other shapes of jaggery in the form of bucket shaped rectangular blocks and balls (Pawar, 2012) <sup>[18]</sup>. Due to its nature of the high humidity levels during the monsoon season, jaggery samples become infected with microbial activity leads to

lowering the quality of the product. Although jaggery samples can be stored in cold storage, small-scale farmers may find it difficult to do so due to its high cost. In the off-season, jaggery from cold storage is used at a high cost (Anubha, 2021) <sup>[2]</sup>.

### Marketing Channels of Jaggery and Khandsari sugar



Fig 1: Channel I



Fig 2: Channel II



Fig 3: Channel III

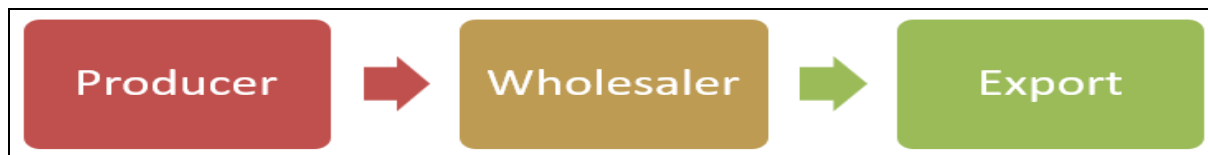


Fig 4: Channel IV

### Identifying marketing channels - Cost and Returns – Jaggery and Khandsari sugar

The cost for initial establishment of the jaggery and khandsari sugar unit was Rs. 7,50,000. One tonne of raw sugarcane yielded on an average of 105-110 kgs of sugar.

To get one tonne of jaggery and khandsari sugar, nearly 10 tonnes of raw sugarcane was required. The net return for jaggery and khandsari sugar producer was Rs. 1164 per tonne.

Marketing Channels involved in marketing of Jaggery and Khandsari sugar	
Channels	Actors involved in the channel
Channel I	Producer – Commission Agent – Wholesaler – Retailer - Consumer
Channel II	Producer – Wholesaler – Retailer - Consumer
Channel III	Producer – Wholesaler – Retailer - Consumer
Channel IV	Producer – Wholesaler – Export

In the channel I, producer sold jaggery and khandsari sugar to wholesalers through commission agent. Then wholesaler sold to retailers of various districts in Tamil Nadu. Retailers were the direct contact with consumers and they knew about the absolute needs of consumers. However, wholesaler regularly sells the sugar to retailer of various cities.

As mentioned in the channel II, producers directly sold the produce to wholesalers at their farm gate, reducing market fee throughout the channel. Producers received their credit from wholesalers, and payment was received once the

ordered quantity reached. Then, the wholesalers supplied to the retailers with a margin.

In the channel III, producers directly sold the produce to the retailers either at Rs. 55 or Rs.50, based on the quantity ordered. Retailers purchased in bulk quantities from the producers, and packed based on consumer required quantities i.e. 1 kg, 2 kgs and 5 kgs. However, the retail price varied from district to district, for example the sugar produced in Erode, was priced at Rs. 60 in Erode surroundings, but in Vellore and Chennai the sugar was



priced at Rs. 75 to Rs. 80, irrespective of the buying price of the retailers.

In the channel IV, producer sold the product to wholesalers in a bulk quantity, either in fully packed or moderately packed conditions. The wholesalers then packed based on the standards given by the export authorities. However, in exports, standard procedures were followed appropriately by the exporter and the price in foreign countries was around Rs. 130 to Rs. 140 per kg.

#### Commission Agent

Jaggery market was a licensed market which was approved by the government and the group of jaggery and khandsari sugar producers. Auction system was followed in the market where the buyers and sellers fixed auction price based on the demand. The buyers bid the price based on the demand and quality of the sugar, and the buyer with the highest quoted price took the product.

#### Wholesaler

Wholesalers were buyers in the market. They bought jaggery and khandsari sugar in 30 kgs bag in a lot of five bags, and sold it to retailers and consumers based on their needs. They purchased jaggery directly from producers or in the markets based on auction price. Later, they sent it to the retailers or transported to other areas. The wholesalers also catered to restaurants and any other events.

#### Retailer

Retailers were the facilitators in catering sugar demand of the final consumer. The retailers packed sugar based on the preference of consumers in sizes like 500 g, 1 kg, 3 kg and 5 kgs packs.

**Channel I:** Channel I revealed that producers sold jaggery and khandsari sugar to wholesalers through commission agent. Then wholesaler sold to retailers of various districts in Tamil Nadu. Retailers were the direct contact with consumers and they knew about the absolute needs of consumers.

**Channel II:** Channel II revealed that producers directly sold the produce to wholesalers at their farm gate, reducing market fee throughout the channel. Producers received their credit from wholesalers, and payment was received once the ordered quantity reached. Then, the wholesalers supplied to the retailers with a margin.

**Channel III:** Channel III depicted that the producers directly sold the produce to the retailers either at Rs. 55 or Rs.50, based on the quantity ordered. Retailers purchased in bulk quantities from the producers, and packed based on consumer required quantities i.e 1 kg, 2 kgs and 5 kgs. However, the retail price varied from district to district, for example the sugar produced in Erode, was priced at Rs. 60 in Erode surroundings, but in Vellore and Chennai the sugar was priced at Rs. 75 to Rs. 80, irrespective of the buying price of the retailers.

**Channel IV:** Channel IV revealed that producer sold the product to wholesalers in a bulk quantity, either in fully packed or moderately packed conditions. The wholesalers

then packed based on the standards given by the export authorities. However, in exports, standard procedures were followed appropriately by the exporter and the price in foreign countries was around Rs. 130 to Rs. 140 per kg.

#### Cost and Returns of Jaggery and Khandsari sugar production (in terms of tonnes)

##### Estimated Turn Over for Jaggery and Khandsari sugar production (in terms of tonnes)

Initial Establishment cost (in Rs.)		
S. No.	Particulars	Value
1.	Land	0.4 HA
2.	Shed and Furnace	Rs. 10,00,000
3.	Pan, Shaping (Aachu) & Ash spade and Drum	Rs. 5,00,000
4.	Total Cost	Rs. 15,00,000

Value addition cost per tonne (in Rs.)			
S. No.	Particulars	Cost (Rs)	Estimated for 10 tonnes
	Purchase of raw sugarcane cost (Per ton of sugarcane)	Rs. 2,700	Rs. 25650
	Processing	Rs.300	Rs. 2850
	Labour cost involved in production	Rs. 200	Rs. 1900
	Caustic soda cost (2 kg), Machinery cost and others	Rs. 260 (60 + 200)	Rs. 2470
	Total Value addition cost	Rs. 3760	Rs. 32870
Marketing cost per tonne (in Rs.)			
	Local transportation cost	Rs. 315	Rs. 2992.50
	Packing and Labour cost	Rs. 315	Rs. 2992.50
	Loading cost	Rs. 315	Rs. 2992.50
	Miscellaneous	Re. 1	Rs. 997.50
	Total cost (Marketing cost + Value addition cost)	Rs. 946	Rs. 9975
Returns (in Rs.)			
	Selling price	Rs. 55	Rs. 54862.5
	Net profit		Rs. 12017.50

It could be observed from the above table that initial establishment cost for starting the jaggery and khandsari sugar unit is Rs. 15,00,000. Here, one tonne of raw sugarcane gives averagely 105-110 kg of sugar. To get one tonne of jaggery and khandsari sugar, nearly 10 tonnes of raw sugarcane is required. The net return for the jaggery and khandsari sugar producer is Rs. 12017.50 per tonne.

#### Conclusion

The present investigation was intended to depict the picture of jiggery production through technical analysis, which the producer will get the fair price for their production to meet out the cost incurred during all stages. Many producers are not able to adopt technical advancements in their unit. Through the establishment of these industries, problems like unemployment, low level of education will be alleviated easily. Further research and development in these aspects helps the manufactures to increase their production and to enhance the shelf life of product for maximum time. Since there is no automation, there will be bright future for these of researches. This will help the young entrepreneurs attract easily by providing various subsidies. By providing various subsidies, it will motivates and attracts easily young entrepreneurs to start these kind of business.

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