

New Ventures of Value-Addition in Jaggery Processing for a Dynamic Sugar Industry

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Abstract— Traditionally India has been a hub for producing jaggery which is also known as “Gur”, “Gula”, “Panela”, “Rapadura”, “Raspadura” in various countries and has been termed as “Non-centrifuged dehydrated sugarcane juice” by Codex Alimentarius. In spite of jaggery scoring many points over the other sweeteners, the sector has remained hugely unorganized and the potential has not been harnessed to the extent possible. It offers enormous possibilities of technological up-gradation, product innovation and value addition. The paper discusses many such options available for adoption so as to provide superior quality jaggery with enhanced shelf life.

Keywords— Jaggery, value-addition, innovation, panela

I. INTRODUCTION

Agriculture is the backbone of Indian economy accounting for about 18% of India's gross domestic product (GDP) and also supporting livelihood of more than 50% of the country's workforce. Among the major agro-processing industries in India such as dairy, meat & poultry, food grains etc., sweeteners are known to be the oldest, one of the largest and most valued industry. India has now become the largest producer and consumer of sugar with its production reaching up to 33 MMT for marketing year (MY) 2018-19. Uttar Pradesh & Maharashtra are the major sugar producing states and as far as Uttar Pradesh is concerned, it is said to be the largest state in sugarcane production in the country. Uttar Pradesh alone contributes to 42-44% of the country's total sugarcane production and also occupies the top of the list in being the largest sugar producing state with around 107.19 Lk ton during the marketing year (MY) 2018-19.

Sugar and jaggery (also known as ‘gur’) are known as the most valued, traditional sweetening agent primarily obtained from sugarcane. Nearly 70% of the global production of jaggery is done in India and this sector supports huge rural economic system providing employment to millions of people [1]. The never ending demand of high quality, green & clean labelled, organic, nutritious food products amongst the diet conscious people has influenced the food processing sector to innovate and add value to the existing product line with a view to provide health and wellness to its consumers. Being the major agro-processing industry in the rural sector, there is a greater need to uplift the jaggery processing sector which would thus provide higher value jaggery and jaggery based products at reasonable cost and would in turn help the rural economic system to prosper.

II. JAGGERY PRODUCTION & CONSUMPTION SCENARIO IN INDIA

India during the last couple of years has produced more than 300 MMT of sugarcane out of which, about 79.91 % is utilized in producing white sugar, 11.29% in producing jaggery and khandsari, 8.80 % as cane juice, seed cane for the next harvest etc. Sugar recovery for different states in India lies in the range of 8.89 to 11.26% on cane (MY 2018-19), whereas, recovery of jaggery (gur) ranges from 10 – 13% depending upon the variety of sugarcane, sugarcane quality, soil texture, irrigation facilities, time of cane crushing etc., [2]. Still by and large jaggery is produced in a conventional manner carrying out boiling in bells heated by naked fire and under rather unhygienic conditions. The quality and also the keeping quality is always wanting. Hence, the untapped potential of this jaggery sector should be given a food for thought towards value addition and innovation. Out of the total world production, more than 70% jaggery is produced in India [3]. Jaggery, an unrefined, natural, non-centrifuged sugar is produced using natural clarificants of vegetable origin and at times use of objectionable chemicals are also made in order to produce better quality jaggery. Looking to its present nutritional status and mind-set of people for natural products, jaggery has immense growth potential market both in national & international market due to its high nutritional & medicinal value.

It is pertinent to mention that being the lead producer of jaggery, India is said to be the leading traders & exporters of jaggery to the world. Around 3,13,826.00 MT of jaggery worth Rs. 606.8 crores/230.03 million USD is reported to be exported by India in the year 2018-19. According to a report provided by ISMA & GAIN report for the marketing year (MY) 2018, the average production of jaggery is expected to reach to 6.6 MMT [4].

Jaggery is known as a healthier sweetener and a good replacer of sugar and other artificial sweeteners in many applications. It is also known as ‘medicinal sugar’ rich in vitamins and minerals, finding its use in Ayurvedic medicine as a blood purifier and also used for curing infections [3][5]. Traditionally jaggery is used in sweets and savory food products, now-a-days with the advancement in processing, storage & packaging technologies of jaggery, it may be used as sweetening agent in manufacturing various beverages, as base material for various syrups. Jaggery may also find its application in confectionery products such as hard boiled sweets, biscuits, breads, pastries etc., besides using jaggery for direct consumption [6]. Apart from India, jaggery has seen its application in many other parts of the world. For

instance, the world jaggery consumption could be divided into four distinct market [7].

1. The largest market constitutes the rural, small town and large city rural population. The main jaggery producing countries, principally India, Colombia, Pakistan, China, Brazil, Bangladesh, Myanmar and Philippines. Colombia has the largest yearly per capita consumption of jaggery with around 10 Kg for 2009, followed by Myanmar with around 7 Kg/year/capita. India's yearly per capita consumption is less than 4.0 Kg/year/capita. The consumption of jaggery of the other listed countries lies in the range of 2-4 Kg/year/capita.

2. The second largest market for jaggery is its application for the production of alcoholic beverages and in other fermentation industries, both in the producing countries and also for export markets. One of the greatest examples are rum worldwide, "Shochu" in Japan and "Cachaza" in Brazil.

3. The third market is the household consumption by middle and high income consumers, both in jaggery producing countries and export markets. This market is growing, mainly because of organic jaggery in export markets (International Sugar Organization 2013).

4. Finally, a small, still incipient, market of jaggery is its use as a food industry. Main industries using jaggery as an ingredient are the beverage, confectionery, bakeries and sauces industries.

The development of the jaggery world consumption depends then on increasing its competitiveness as a sweetener and ingredient vis-à-vis its competitors, that is, in the direct household markets, the food-ingredient markets and in other industrial markets. This competitiveness will be accessed by the diversity and convenience of its presentations, its safety and quality, and cost.

III. NUTRITIONAL STATUS AND IMPORTANCE OF JAGGERY

With the passage of time, due importance is being given to the quality of food product available in the Indian market. Awareness among the consumers is increasing, food safety laws are becoming more stringent. As per recent Food Safety & Standards (Food Products Standards and Food Additives Amendment Regulations, 2017), a good quality 'cane jaggery' or 'cane gur' must confer to the following analytical standards as given in table 1 [8].

Table 1: Quality standards for 'cane jaggery' or 'cane gur' on dry weight basis

Sr. No.	Characteristics	Permissible limit
1.	Moisture, percent by weight, Max	7.0
2.	Sucrose, percent by weight, Min	70.0
3.	Total Sugars expressed as invert sugar, Min	90.0
4.	Reducing sugars, percent by weight, Max	20.0
5.	Sulphate ash, percent by weight, Max	4.0
6.	Ash insoluble in dilute hydrochloric acid, percent by weight, Max	0.5
7.	Extraneous matter & water insoluble matter, percent by weight, Max	1.5

Jaggery is known as a natural, high calorie traditional sweetener, which contains minerals, proteins, glucose and fructose that are naturally present in the sugarcane crop as a result of which it is considered to be healthier as compared to

white sugar [9] [10]. The iron content in jaggery that is carried along during its processing in iron vessels helps preventing anaemia. Trace amount of mineral salts i.e. 2.8g/100g present in jaggery as compared to that of sugar which contains only 300mg/kg, helps strengthening the nervous system of the body and also helps take care of the blood vessels. To further add to the list, jaggery is said to be an excellent cleansing agent. Hence, people working in industries like wooden, textile, woollen industries are advised to incorporate jaggery in their daily life regime. This will prevent them from cough, cold & congestion and therefore helps them maintain the quality of life [9] [11].

Jaggery being highly rich in important minerals like Calcium- 40-100 mg, 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, may prove to be beneficial source of food in order to mitigate problems of malnutrition and could also be used to provide instant care to the victims of natural calamities as a result of its various health benefits. Also micronutrients present in jaggery such as Zn, Ca, P may help providing people healthy life along with other benefits such as acting as a blood purifier and curing jaundice and other bile disorders [12].

Such promising and attractive benefits of this great product jaggery should attract various stake holders of the sugar sector to exploit the potential of this product to the fullest for a better quality of life to their consumers and a better market status for themselves.

IV. EXPLORATION OF NEW AVENUES IN JAGGERY PROCESSING

With the advent of modernization and introduction of new technologies while quality of sugar has improved to a greater extend in order to cater to the sector specific requirements of the market, jaggery production is still confined to small scale cottage industry usually for local consumption, using traditional technologies necessitating measures to be taken for quality improvement [13]. With the passage of time although the jaggery industry has witnessed growth in many folds, but sadly there isn't any significant improvement in its performance, technical efficiency and recovery. Few reasons as to why old technologies are still in practice for jaggery manufacturing are:

- Lack of government policy support
- Dis-organized micro and small scale sector
- Lack of will & financial constrains to adopt new technologies
- Poor education of craftsmen involved in jaggery processing

There are several jaggery units which are on the verge of closure as a result of traditional technologies, low market price for jaggery in comparison to Fair Remunerative Price (FRP) /State Advised Price (SAP) for sugarcane. The figure 1 shows a graph which gives an idea that with the passage of

time, on one hand, sugarcane utilization for production of white sugar has increased from 33.47% (1980-81) to 79.91% (2017-18) while that for gur (i.e. jaggery) and khandsari has decreased from 54.73% (1980-81) to 11.29% (2017-18). Figure 2 shows that while the per capita consumption of sugar increased from 7.3 kg per annum (1980-81) to 19.3 kg per annum (2017-18), for jaggery (gur) and khandsari, the per capita consumption decreased from 12.5 kg per annum (1980-81) to 4.1 kg per annum (2017-18) [14].

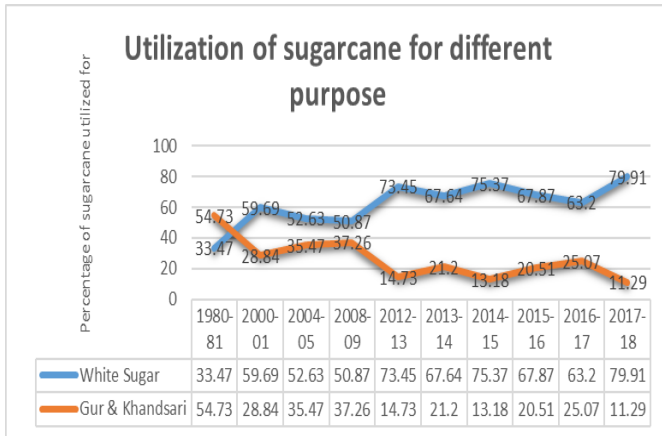


Fig 1: Percentage of sugarcane production utilised for production of white sugar, Gur & khandsari

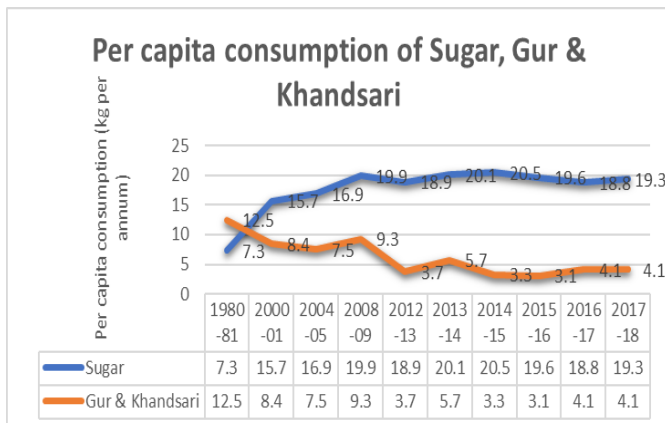


Fig 2: Per capita consumption of sugar, Gur & khandsari

Apart from technological and policy barriers, obstacles such as unawareness amongst both food industry personnel's and common public concerning the health benefits associated with jaggery prevents this sector to flourish. As mentioned earlier, more than 70% of jaggery is produced in India, the time is not far when this jaggery sector may create a huge revolution better than sugar.

A. Technological advancements in jaggery processing

Jaggery is mostly available in large moulds and also as cube, powdered/granulated jaggery. Among all the forms of jaggery, liquid jaggery is attracting the minds of manufacturers and consumers. Studies show the production of liquid jaggery by means of different clarification methods was adopted. In the study, 4 different treatments for sugarcane juice clarification was adopted:

- (1) Sugarcane juice was normally filtered through a muslin cloth to remove dirt and dust impurities.
- (2) Lime was added to sugarcane juice at the time of boiling, which enhanced the scum formation and thereby facilitated clarification process.
- (3) Sugarcane juice was centrifuged @ 4000 rpm for 10 min
- (4) Sugarcane juice was clarified using micro-filters.

The studies concluded that liquid jaggery processed using membrane filtration during the juice clarification process, consisting of multi-channel ceramic membrane of pore size 0.2 μ resulted in superior quality of the final product and therefore the process can be commercialized by the use of micro-filters for clarification of sugarcane juice for better quality of liquid jaggery or even the solid one [15].

Another research study elaborated on the upgradation of process technology for jaggery making. The study throws light on the facts that since the traditional jaggery manufacturing plants were designed by local artisans without proper design consideration as a result of which large portion of energy is wasted thereby reducing the thermal efficiency of the plant. This problem was overcome by the use of two-pan; three or four-pan could be used so as to consume maximum thermal energy of the hot flue gasses. Several research is being carried out to enhance the performance of jaggery plant. The research study includes the use of juice pre-heaters, energy boosters, economizers, heat pump based freeze concentration system of sugarcane juice etc. Among all the above mentioned suggestions, the use of multiple pan plant with heat pump based freeze concentration system of sugarcane juice seems to be a promising approach for efficient jaggery production [16].

Yet in another research study, several innovation towards value-addition with jaggery are carried out. The research shows that with the use of materials like anola pulp, whey, cashew, almonds, cocoa powder, wheat powder etc., the quality of jaggery could be increased. The studies suggest that a good quality jaggery could be prepared from neutralized paneer whey and it is said that whey jaggery contains more proteins as compared to pure sugarcane jaggery. Addition of wheat flour in jaggery would help in increasing the protein content and texture of jaggery. Addition of anola increases vitamin C content of jaggery and thus gives rise to a much more value-added product [1].

B. Shelf life enhancement of jaggery

Storage and quality maintenance of jaggery is a big problem. Traditionally, jaggery was stored in earthen pots or wooden boxes or metal drums which could not sustain the quality of jaggery for a longer period of time. PET film, edible film coating, drying cum storage bins, low temperature storage, PET with 100% nitrogen are some examples of packaging materials and techniques that can be used for enhancing the keeping quality of jaggery [1].

Literature shows that storing jaggery in drying cum storage bin coated with a layer of whey is an effective way for extending the shelf life of jaggery [17]. Green house

drying of jaggery before storing it is also an effective way to increase the life of jaggery at a fairly lower cost [1].

Another study was conducted for assessing the storage of jaggery under low temperatures. Different storage period was adopted at low temperature (7-9°C) for assessing the shelf life of the product [18]. It was observed that with increase in storage time, the quality of jaggery decreased but there was complete check on the microbial growth. The studies concluded that up to 2 years 8 months the quality of jaggery decreased like changes in physiochemical characteristics and some visual observations such as the smell of the product was not pleasing, but there was a complete check on the microbial growth up to the storage period of 2 years 8 months. Storage of jaggery for 1 year 8 months at low temperature (7-9°C) was found safe with no significant change in the quality of the final product [19].

In another research study, quality parameters of jaggery during storage were accessed using edible coating. The study concluded that edible coating improved the shelf life of jaggery and retained its properties up to 4 months of storage. From a sensory point of view, a thick coating of 8% whey protein concentrate (WPC) was said to be in unison with other quality parameters. Hence, edible coating could be one such possible approach in achieving enhanced shelf life of jaggery [17].

Therefore, jaggery, one of the natural products of sugar industry has immense potential and therefore jaggery manufacturing should be taken up on a larger scale with advance technologies as mentioned above so as to obtain improved quality of the final product. Also value-addition and packaging of jaggery and jaggery based products with the use of modern technology is a direction the industry may work so as to have assured market for their products and a stable consumer base for such value-added products.

V. CONCLUSION

Sugarcane based industry plays a vital role in strengthening the agricultural sector. Manufacturing of high quality, value-added jaggery with a sense of hygienic processing & packaging would help in providing an excellent integrated development of the sugar industry and would also help in transforming the rural economy into a dynamic and buoyant industrialized economy. Initiatives like the ones mentioned in the paper would help the industry to venture into a new market thereby creating job opportunities to a major class of group and would also give the market and its customers a quality product.

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