International Journal of Applied Home Science
(An International Double Blind Peer Reviewed / Refereed Research Journal of Home Science)
Volume 11 (9 & 10), September & October (2024) : 574-582
Received : 23.08.2024; Revised : 08.09.2024; Accepted : 23.09.2024

REVIEW PAPER
ISSN : 2394-1413 (Print)
DOI: 10.36537/IJAHS/11.9&10/574-582

A Review: Jaggery

VEDANTA MANISH WAGHMARE*[1] AND VIJAY D. KELE[2]
[1]M.Sc. Student and [2]Associate Professor
[1]Department of Food Technology, Parul Institute of Applied Sciences, Parul University, Vadodara (Gujarat) India
[2]Department of Dairy and Food Technology, Parul Institute of Technology, Parul University, Vadodara (Gujarat) India

ABSTRACT

Traditionally made from sugarcane juice or palm sap, jaggery has a rich cultural and nutritional history in many parts of the world. The purpose of this essay is to clarify the complex meaning of jaggery from the standpoints of agriculture, cooking, and nutrition. It begins by exploring the jaggery production process and showcasing its sustainable practices and artisanal methods. Second, it examines the various ways that jaggery is used in traditional cuisines, from salty to sweet, highlighting the spice's adaptability and distinct flavor. This study also looks at the nutritional makeup of jaggery, highlighting how much more antioxidants and important minerals it contains than refined sugar. It also covers the possible health advantages of consuming jaggery, such as how it helps with blood sugar regulation and improves digestion. Finally,the relevance of jaggery in local customs and beliefs is highlighted by elaborating on its socio-cultural role in a variety of ceremonies, festivals, and folk medicinal practices. This study attempts to promote a broader understanding of jaggery as a sustainable, nourishing, and culturally relevant sweetener in the contemporary world through this thorough investigation.

Keywords: Jaggery, Nutrients, Sweetener

INTRODUCTION

Jaggery, also known as Gur, is a substance made by condensing the sweet fluids of sugarcane or palm trees into a solid or semi-solid condition. It is appropriate for a plethora of desserts that are well-known throughout the world. People prefer it over white sugar because of its distinct qualities when making several sweet foods (Hirpara *et al.,* 2020). Gur can be defining as a honey brown colored raw lump of sugar. It contains all the minerals and vitamins present in sugarcane juice and that is why it is known as healthiest sugar in the world (Dwivedi, 2010).

With a long history and cultural significance, jaggery is a traditional sweetener that is utilized in many different cuisines worldwide. The sap of sugarcane or the juice of some palm trees is used to make this natural sweetener. Refining sugarcane juice or palm sap into a thick, unrefined sugar product is the process of boiling it to make jaggery.

With thousands of years of history, jaggery has been a mainstay in various culinary traditions, especially in South and Southeast Asia, as well as some regions of Africa and Latin America. Due to its particular flavor and adaptability in the kitchen, it is a popular component in both savory and sweet dishes.

Beyond its culinary uses, jaggery also holds importance in traditional medicine systems like Ayurveda, where it is believed to have various health benefits. Rich in minerals like iron, magnesium, and potassium, jaggery is often considered a healthier alternative to refined sugar (Nath *et al*., 2015).

The production of jaggery is often carried out using traditional methods, involving small-scale production units or even artisanal practices in some regions. This adds to its charm and authenticity, as it retains the flavors and qualities of its natural source (Singh *et al.,* 2013).

How to cite this Article: Waghmare, Vedanta Manish and Kele, Vijay D. (2024). A Review: Jaggery. *Internat. J. Appl. Home Sci.,* **11** (9 & 10) : 574-582

Because of its popularity as a natural sweetener and its alleged health benefits, jaggery has drawn attention from all over the world in recent years. It is becoming more and more common in modern recipes, both in traditional cuisines and in creative modern dishes, as consumers look for natural and healthier substitutes for refined sugars (Kumbhar, 2016).

In general, jaggery represents more than simply a simple sugar substitute; it also represents a variety of culinary traditions, cultural legacy, and ties to the natural world. Its distinct flavor, high nutritional content, and cultural importance keep it a beloved ingredient in kitchens all around the world (Said and Pradhan, 2013).

Review of Literature:

Rao *et al.* (2007) stated that, jaggery is made from concentrated sugarcane juice, jaggery is a traditional natural sweetener. It is a conventional unrefined non-centrifugal sugar that is eaten throughout the Caribbean, Latin America, Africa, and Asia. It is referred to as the healthiest sugar in the world because it has all the vitamins and minerals found in sugarcane juice. The world's biggest producer and user of jaggery is India. More than 70% of global production is generated in India.

It is used as a sweetener and a source of energy by practically every segment of the population. Mixtures used in animal feed also contain it. It is used as a medication, blood purifier, and foundation for syrups in Ayurvedic medicine. One of India's largest agricultural processing industries is jaggery. The nation produces roughly 7 million tonnes of jaggery, the most nutritious sweetener, using about 20–30% of the sugarcane that is grown there (Singh *et al.,* 2013).

Water from sugarcane juice is evaporated in steel pans placed over pit furnaces to generate jaggery, or raw sugar. Even if it provides a medicinally valuable and health-friendly sweetening ingredient (Sahu and Paul, 1998).

According to a report, the Indian jaggery sector produced 10.3 million tons of jaggery in 2000. Cane is produced in large quantities in Western Maharashtra, particularly in Kolhapur, and jaggery prepared from certain unique cane kinds is in high demand internationally. Traditionally, farmers own and operate small-scale, rural businesses that produce jaggery (Shiralkar *et al.*, 2014)

Jaggery is consumed worldwide and known by different names; Jaggery in most of the Asian and African countries, *Gud* or *Gur* in India, *Kokuto* in Japan, *Naam Taan Oi* in Thailand, *Panela* in Mexico and South America, *Palmzucker* in Germany, *Hukuru* in Sri Lanka, *Muscovado* and *Rapadura* in Brazil and Portugal, etc. (Verma *et al.*, 2019).

Table 1: Sugarcane production, its utilization for jaggery in India

Year	Average Cane Production (Million Tonnes)	% Utilization Of Jaggery
1971-1980	140.09	55.81
1984-1990	185.66	46.31
1991-2000	265.45	37.07
2001-2010	291.37	25.29

Source: - Alternative Sweeteners Production from Sugarcane in India: Lump Sugar (Jaggery)
Singh *et al.* (2011).

Nath *et al.* (2015) reviewed that the production of sugar and other goods from sugarcane is India's second largest industry, behind the textile sector. The manufacturing of sugar (refined sugar) uses between 50 and 55 per cent of sugarcane; jaggery and Khandsari use 30 to 35 per cent; and the remaining portion is used for juice and seeds for the next year. The states of Uttar Pradesh and Maharashtra are where most sugarcane is grown. Approximately 35 per cent of India's sugarcane crop is used to create 8 to 10 million tons of jaggery each year. Uppal and Sharma (1999) reported that the months of November through April are when majority of jaggery is produced in India (Singh *et al.*, 2021).

Gur contains iron (11%), calcium (0.4%), phosphorous (0.045%), glucose and fructose (10-15%), protein (0.25%) and fat (0.05%) (Kumar, 1999).

Jaggery has a rich flavor that is similar to molasses and brown sugar, along with a strong fragrance. Minerals, vitamins, and proteins can all be found in jaggery. In addition, it contains more iron and copper than refined sugar, making it a powerful source of iron. In terms of vitamin content, it is also a better product within the category of natural sweeteners. It is an energy food that is supposed to maintain bodily health, control liver function, and purify blood (Shahi, 1999).

Jaggery of superior grade has a golden yellow color, a firm texture, a crystalline structure, a pleasant taste, and little moisture content (Nath *et al.,* 2015). Jaggery is a good source of energy (383/ kcal/100/ g) and has various medicinal values (Shrivastava *et al.*, 1998).

Uppal and Sharma (1999) concluded that India is the country that produces and uses jaggery the most.

When compared to the world's total production of jaggery, over 70% is produced in India.

Gangwar *et al*. (2015) referred that of all the jaggery produced in India, 65–70% comes from sugarcane, with the remainder coming from other crops that can produce sugar.

Karnataka, Maharashtra, Tamil Nadu, Uttar Pradesh, and Andhra Pradesh are the states that produce the most sugarcane in India, accounting for 80–90% of the country's jaggery production (Gangwar *et al*., 2015).

According to Singh *et al*. (2011) 300 MT of sugarcane are produced in India; of that, 53% is turned into white sugar, 3% is used to make cane juice, 36% is made into khandsari and jaggery, and 8% is used as cane seed.

Because jaggery is made up of longer chains of sucrose, it is far more complicated than sugar. Because of this, it digests more slowly than sugar and releases energy gradually rather than all at once. Long-lasting energy is produced by this, and it poses no risks to health. However, since it contains sugar in the end, this does not ensure that it is safe for people with diabetes to eat. Jaggery is made in iron vessels, which means that during preparation it also collects a significant number of ferrous salts (iron). Additionally, this iron is beneficial to health, especially for individuals who are iron deficient or anemic. You may have noticed that jaggery leaves a sense of salt on your tongue, but jaggery also includes minute amounts of mineral salts, which are extremely healthy for the body. These salts are derived from the juice of sugar cane, which absorbs them from the soil.

Gur is known to produce heat and provide an immediate burst of energy in an individual. The custom of welcoming guests with a glass of water and gur is prevalent in many regions of India. Ayurveda pharmaceuticals, ayurveda sura, ayurvedic health tonics, distilleries, and medicine manufacturing facilities also employ gur (Nath *et al.,* 2015).

Singh and Shahi (2002) reported that jaggery continues to be the main ingredient in many traditional dishes such ramdana, chikki, reori, gazak, and patties. In many areas of Maharashtra, kakavi, or liquid jaggery, is a staple food and has been growing in popularity in India's commercial sector.

Singh and Singh (2008) reviewed that the magnesium found in jaggery supports healthy blood vessels, eases muscle tension, enhances the nervous system, and relieves weariness. It also has the antioxidant ability to scavenge free radicals from our bodies, together with selenium. Its low sodium content and potassium content help to keep our blood pressure under control, fight acetone and acids, and preserve the acid-base balance of our cells.

Within the Poaceae family, sugarcane (*Saccharum officinarum* Linn.) is a widely recognized crop. After Brazil, India is the world's second-largest producer of sugarcane. The Greek term Sakcharon, which meaning sugar, especially sucrose, is the source of the word saccharum. The perennial grass *S. officinarum* Linn is native to tropical and southeast Asia. It has a thick longitudinal stalk that is typically three to five meters tall and roughly five centimeters in diameter (James, 2008). Because of its high sucrose content, the stalk has a sweet taste. It is often referred to as noble cane and chewing. Tropical and subtropical climates are ideal for sugarcane cultivation. It will need hot, humid conditions, well-drained soil with a pH of 7.5 to 8.5 and a high organic matter content (Shah and Tyagi, 2021).

The researcher claims that everything produced with jaggery tastes far better than sugar, as stated by Rahul Verma of The Hindu Times (2019) in their article Sweet January. Gud has been his favorite dessert since he was a young child, as he stated in his article. Only roti and gud make a satisfying dinner for the folks living in the Uttar Pradesh region today. During winter festivals, when people consume jaggery, these delicacies leave a lasting

Table 2 : Approximate Composition of Different Forms of Jaggery and Refined Sugar (Per 100 G) (Rao *et a.*, 2007; Singh *et al*., 2018)

Parameters	Forms of Jaggery			Sugar
	Solid	Liquid	Granular	
Water	3 to 10	30 to 35	1 to 2	0.2 to 0.4
Reducing Sugar	9 to 15	15 to 25	5 to 9	-
Sucrose	65 to 85	40 to 60	80 to 90	99.5
Total Minerals	0.6 to 1.0	0.75	0.6 to 1.0	0.05
Fat	0.1	0.1	0.1	-
Protein	0.4	0.5	0.4	-
Calorific Value	383	300	383	398

impression on tourists. Like liquid gold, this can be compared (Kumar, 2015).

Jaggery: South Asia's sweet, nostalgic panacea was described by Imtiaz (2021). Not only is jaggery a tasty treat or a traditional medicinal food. Millennia have long regarded it as the condensed form of ancient custom. Nutrient-rich jaggery is our traditional treasure trove. Sweet and savory South Asian cuisines benefit from the addition of jaggery's flavor (Shah, and Tyagi, 2021).

Lamdande *et al.* (2018) reviewed those muffins made with eggs and 42, 63, and 84% jaggery instead of 84% sugar can benefit from the use of jaggery, a natural sweetener. The findings demonstrated that the quality attributes of the muffins made with 84% jaggery and eggs were acceptable. The pasting temperature and peak viscosity were raised by the addition of jaggery and sugar; jaggery had a higher aw, a lower pH, and an overall quality score. The muffins were satisfactory and microbiologically safe even though they were less soft and had a lower overall quality score.

Kumar examined the many techniques for producing jaggery, including the traditional method and the contemporary scientific approach (Said and Pradhan, 2013). Jaggery is manufacture in three forms *i.e.,* liquid, solid and powder or granular form (Singh *et al.,* 2011).

Solid jaggery:

The filtered and clarified cane juice is pumped into open pans and cooked in a triple pan furnace, with the leftover bagasse being utilized as fuel. Deola extract (45 g/100 kg juice) is an herbal clarificant that is used to remove particles from suspension, colloidal particles, and coloring chemicals via accumulation, resulting in light-colored jaggery. The liquid is then condensed to create the required shape and size of jaggery mass by boiling it in an open pan while stirring (Nath *et al.,* 2015).

Liquid jaggery:

The semi-liquid, syrup-like intermediate product that is obtained after the concentration of pure sugarcane juice during the jaggery-making process. In most of West Bengal, Maharashtra, liquid jaggery is a staple food and is growing in popularity. Gujarat, Andhra Pradesh, Tamil Nadu, Maharashtra, Kerala, West Bengal, and Gujarat use liquid jaggery as a sweetener in food and beverages (Singh, 2013).

To eliminate the risk of crystallization and to make liquid jaggery more eye-catching in color, 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.

Granular jaggery:

A wooden scraper is used to manipulate the concentrated slurry (TS 58–60%) in order to create grains. After cooling, the granular jaggery is sieved. Less than 3 mm sized crystals are proven to be better for high quality jiggery. An exceptional grade granular jaggery with a high sucrose content of about 88.6% and a low moisture content of about 1.65% may be produced by raising the pH of cane juice with lime solution to 6.0 to 6.2 and reaching a striking point temperature of 120°C. The granular jaggery also has good color, friability, and crystallinity. Granular jaggery (approximately 3 mm), sun-dried to reduce moisture content to 2% or less, and put in polyethylene bottles or bags allows it to be kept in storage for longer periods of time (more than two years) at room temperature, even throughout the monsoon season with few alterations to its physicochemical composition.

Value Addition of Jaggery:

Pradhan *et al* (2015) reported that jaggery can be combined with a variety of natural flavorings (black pepper, cardamom, ginger, lemon, etc.), nutritional ingredients (protein, amino acids, vitamins, and phytochemicals), additives that improve texture, and taste enhancers (nuts, cereal, spices, and pulses).

Anwar *et al*. (2011)created a jaggery powder enhanced with vitamin C. The best results were obtained when he included a natural source, which was tiny bits of dried amla fruit, and dried it to 10% moisture content.

Rao and Singh (2022) reported that warm water infused with jaggery, consumed first thing in the morning on an empty stomach, may aid to balance our metabolism and regulate body temperature. It facilitates faster digestion, increases the body's natural digestive enzymes, and helps treat kidney-related conditions. Warm water

and jaggery are also helpful for body detoxification. Together, these substances facilitate the flow of bile, regulate acidity, and produce the ideal amount of stomach acid secretion, all of which aid in maintaining a healthy weight.

Utilization of Jaggery in Milk Products:

Coffee, khees, bomboyson, poppy seed payasam, bamboo seed payasam, jaggery chocolate, jaggery pedha, ice cream, milk shakes, sapota milk shakes, kulfi, and other products have all been made with jaggery (Hirpara, 2020).

Packaging and Storage Life of Jaggery:

Pandey and Kulshrestha (1999) concluded that the conventional techniques for storing jaggery that are common in the western and eastern parts of India include open storage, matka, gunnysacks, etc.

These techniques don't work in the Tarai regions because of the extremely high humidity there, which makes the climate unsuitable for maintaining the quality of jaggery. The high humidity range during the monsoon season causes jaggery samples to become infected with microbiological activity, which lowers the jaggery's keeping quality. Although jaggery samples can be kept in cold storage, small-scale farmers may find it challenging to store the samples because to the associated costs. There is also a significant energy consumption. Off-season use of cold-stored jaggery results in significant costs (Chand *et al.*, (2012).

Chand *et al.* (2012) analyzed the way that jaggery samples kept in Uttarakhand's mountainous climate behaved while stored. Throughout the course of five months, changes in product parameters such moisture content, sucrose, reducing sugar, and color were measured every 30 days. The samples were stored in polythene bags, IISR containers, and hanging baskets. The findings showed that, in a chilly, hilly region, jaggery's good keeping quality could be preserved with minimal adjustments to its color, sugar concentration, and overall moisture content—all while utilizing an IISR drying and storage bin. When stored in a bin instead of an open basket, jaggery samples preserved in a cold, hilly region showed less decline in quality indices.

Mandal *et al.* (2006) researched how conventional packing materials affected the sugarcane jaggery's ability to retain quality over the monsoon season. According to their research, heat-sealed 150-gauge LDPE (low density polyethylene) packets were the best packing material for preserving Gur throughout the rainy season, followed by glass jars. To the greatest extent possible, LDPE packets stopped moisture intrusion, pH decline, and sucrose inversion in the stored Gur. Gur, however, was darker in color in LDPE packets than it was in glass jars. Glass jars and PET (polyethylene terephthalate) jars performed as well, although the preserved Gur browned more in the PET jars. When it came to painted earthen pots, canisters performed well as long as they had an airtight lid

Process of Making Jaggery:

Unit Operations Involved:

The process of producing jaggery from sugarcane primarily consists of four unit operations: extracting the juice, heating and clarifying the juice, boiling/concentrating the juice, and molding.

The following is a description of these operations:

1. **Extraction of Juice:**
   Sugarcane is often crushed in vertical or horizontal crushers that are powered by an engine or electricity to produce juice. These crushers extract 60–65 per cent juice (based on cane) and contain three to five rollers. Bagasse and juice are produced when cane is crushed. When compared to vertical roller crushers, horizontal roller crushers produce 2-3% more juice. The factors of the crop, the operating environment, and the crusher settings all affect juice extraction.

2. **Heating and Clarification of Juice:**
   To remove trash and bagasse particles, the extracted juice is collected via an underground PVC conduit and placed in a juice settling tank covered with thick muslin fabric. Heavy contaminants can be removed with the aid of settling. After that, the furnace's open pan is pumped with of clean juice to concentrate it. Singh 1998; Banerji (2008) reported that in order to clarify the juice, vegetative clarificants are added after it has been cooked in an open pan furnace. These clarifying agents aid in the production of a dense foam with colloidal particles on the juice surface, which is then strained off. Deola (*Hibiscus ficulneus*), among other vegetative clarificants, was discovered to be the

most efficient.The scum that has been removed is put into a scum settlement tank, which aids in recovering juice that has been wasted along with scum. In addition to its light color and crystalline texture, the addition of this tank to the widely used juice clearing process boosts jaggery recovery by 0.4%.

3. **Boiling/Concentration of Juice:**
Juice is heated vigorously over the furnace after clarity. Use a small amount of coconut or mustard oil to control overflooding. There could be one, two, three, four, or five pans in the furnace, according on the needs of the jaggery production. Bagasse is preserved in the enhanced and effective two-pan and three-pan furnaces created by the Indian Institute of Sugarcane Research (IISR), Lucknow. The two-pan furnace's pans were altered to add fins to their bottoms in order to increase efficiency. This led to a 28% reduction in fuel consumption and a 17% reduction in juice processing time.
In addition, extra pans are supplied in furnaces used to make jaggery in order to increase efficiency even more. These pans are used to pre-heat juice by capturing waste heat that escapes down the chimney with flue gases. With a 34.3% heat consumption efficiency, the triple pan furnace created at IISR Lucknow has these unique characteristics.

4. **Moulding:**
A wooden tray is filled with the concentrated juice that has the right consistency, and a ladle is used to create puddles. After being poured into the moulds, the concentrate (slurry) is dried, boxed, kept, and sold. The IISR created jaggery manufacturing system in the past, jaggery was made in India using a variety of age-old techniques. It was created in bucket shapes weighing 15 to 20 kg as well as irregular shapes that varied depending on the location. Some of these shapes caused issues with distribution, packaging, drying, and moulding, among other things. IISR Lucknow created moulding frames and the methods for shaping jaggery into the following desirable sizes and forms: bricks (500 and 250 g), cubes (25 mm cubes, weighing 20–22 g apiece), and rectangular shapes (25 9 25 9 12.6 mm, each weighing around 10–11 g). Of these, 25 mm jaggery cubes in eye-catching packaging are the most hygienic, practical for distribution, and well-liked by customers (Singh, 2011).

Utilization of Jaggery in Different Foods:

Sivaranjani and Singh (2024) concluded that Ariselu, a traditional deep-fat fried product made of rice flour and jaggery syrup, was studied for its quality attributes under different frying conditions. Results showed that oil content increased with moisture, and the lightness and yellowness decreased. However, redness increased due to browning reactions. Thermal properties were also examined, and the textural attributes showed increased hardness with higher frying temperatures. The overall acceptability was 4.28/5 at 170°C for 150 seconds.

In the current study done by Sonawane and Sonkamble (2020) reported the impact of jaggery powder on the nutritional value and sensory appeal of value-added Shrikhand was examined using both chemical and sensory characteristics. All treatment combinations showed a significant difference in overall acceptance scores ($P<0.05$). Superior acceptability among experimental samples is indicated by a higher acceptability score (7.99). The trend for the mean liking was SO>S2>S1>S3. The current study demonstrated that, out of all the experimental samples, Shrikhand (S2) made with 41% powdered jaggery had higher acceptable quality attributes. All nutritional indicators were substantially different ($P<0.05$) with the exception of protein. It's okay to use equal weight substitutions of jaggery powder for sugar when making shrikhand.

Sree *et al.* (2020) reported that eating little meals in between larger ones is referred to as snacking. There is a growing need for nutrient-dense foods as a result of quick changes in lifestyle. A snack bar is a ready-to-eat, high-protein, high-vitamin, high-mineral food. Fruits and vegetables are foods high in micronutrients that help prevent and control a number of degenerative diseases while also enhancing quality of life. Dates, pineapple, and beetroot were combined with various amounts of jaggery to create bars. Semi-trained panelists used sensory evaluation to determine which combination was the best. The combinations containing the most dates, pineapple, and beetroot had the lowest acceptance, according to the results. The bar's aesthetic value was diminished by

the rise in beets. Dates > pineapple > beet root was the descending order of the list.

A study was conducted by Kumar *et al.* (2021) to develop jaggery-based biscuits using scientific technology to evaluate the quality and acceptance of fresh and stored samples. The study used the Hunter colour lab to determine the colouring properties of fresh and stored samples. The biscuits were prepared using different levels of jaggery, wheat flour, HVO, WMP, baking powder, salt, TBHQ, GMS, and eggs. The biscuits were packed in HDPE and metalized polystyrene pouches for storage studies at ambient conditions.

The colour value of the biscuits was measured after 60 and 120 days. The L value decreased with increasing jaggery levels, indicating a decrease in lightness due to dark jaggery color. The control sample had a L value of 53.32 due to the incorporation of other ingredients and high baking temperature, causing browning and caramelization. However, the effect of ambient temperature storage significantly increased "L", "a", and "b" values. All four samples (control, 40%, 50%, and 60% jaggery biscuits) had positive "a" value.

During ambient temperature storage, the value of "a" increased for all four samples packed in HDPE and CF. However, the effect of ambient temperature storage significantly increased "a" value. The color change observed during 120 days storage was due to additional development of little brown/red color. Different packaging materials did not significantly affect the "L", "a" and "b" values for all samples (Quadri *et al,* 2022).

Manisha *et al.* (2022) reported that jaggery, a natural sweetener, is made by concentrating sugarcane juice and heating it uniformly. However, it is sensitive to various factors, from cultivation practices to processing and storage. This study aims to develop granular jaggery, which can replace sugar granules in daily intake. Granular jaggery was prepared by concentrating sugarcane juice above 20 obrix and uniformly heating up to 120 p C in an open pan. The granular jaggery was sieved and packed in polythene pouches. These jaggery granules were used to create jaggery chocolates, which were compared with sugar-based chocolates. The chocolates were formulated using different proportions of granular jaggery, with the J2 sample being the most acceptable. The study also conducted proximate analysis and sensory evaluation to determine the acceptance level of the jaggery chocolates.

Borale *et al.* (2023) reviewed that the juices from tamarind, beets, aonla, ginger, and lemon were used to make a squash drink with a jaggery base. At room temperature and under refrigeration, the squash was kept in polyethylene terephthalate bottles. A physicochemical examination was performed on the beverage to ascertain its composition, including acidity, pH, TSS, total sugar, reducing sugar, non-reducing sugar, ascorbic acid, and betalain. The levels of pH, TSS, total sugar, and reducing sugar increased whereas those of acidity, non-reducing sugar, ascorbic acid, and betalain decreased, according to the findings. Based on the sensory evaluation, the squash beverage's qualitative qualities remained unaffected even when stored at ambient temperature or under refrigeration.

The goals of this study concluded by Khumgard and Sripa (2018) are to examine three common recipes for coconut milk ice cream and determine the ideal amount of jaggery palm to use while making coconut milk ice cream. wherein jaggery palm was used to partially replace sugar at 50%, 70%, and 100% of the original amount. The experiment was then evaluated using Randomized Complete Block Design (RCBD) with a 95% confidence level. Sixty panels of judges used a 9-point hedonic scale to rate the appearance, color, flavor, texture (smoothness), and overall liking. The Duncan's New Multiple Rang Test (DMRT) in the SPSS software was used to compare the mean score differences and determine the best amount of jaggery palm and standard recipe. Lastly, a test of consumer acceptance for the coconut milk ice cream. 100 consumers used a 5-point hedonic scale to rate an ice cream that had some jaggery palm added in place of some sugar. The outcome demonstrated that the panelists in the sensory evaluation found that the third standard recipe and the 100% jaggery palm were the most favorable. Viscosity climbed to 705.86 cps, with a 21.56 overrun value and an 11.26 melting rate, according to an analysis of the physical parameters that followed. The mean ratings for appearance, color, flavor, taste, texture (smoothness), and overall preference are 4.45, 4.41, 4.33, 4.37, 4.46, and 4.51, respectively, and 98% of customers approved of the use of jaggery palm as a partial sugar substitute in coconut milk ice cream.

Health Benefits:

i. Commonly referred to as "medicinal sugar," jaggery is utilized in pharmaceutical formulations and may lengthen human life expectancy when consumed regularly (Nayaka

et al., 2009).

ii. Jaggery has a high phenol content and is rich in minerals (Shrivastava *et al.*, 2016).
iii. Improves digestion (Singh and Singh, 2008).
iv. Helps in cleansing the liver (Jadhav and Bhutani, 2005).
v. Relieves constipation(Singh and Singh, 2008).
vi. Boosts energy, purifies the blood.
vii. Anti-toxic and anti-carcinogenic properties (Rao *et al*., 2007).
viii. Relives tension (Singh and Singh, 2008).
ix. Treatment of bronchial or lung infections and pre-menstrual syndrome (PMS) (Shah *et al*, 2007).
x. Anti-oxidant activity (Sivaranjani and Singh, 2024).

Conclusion:

In conclusion, the sugarcane juice used for manufacturing jaggery stands as a versatile and valuable sweetener, deeply rooted in various cultures around the world. Its natural sweetness, rich flavor profile, and nutritional benefits make it a preferred alternative to refined sugar in many culinary applications. With its abundance of minerals, antioxidants, and health-promoting properties, jaggery offers not only a delightful taste but also potential health advantages. From traditional recipes to modern culinary innovations, jaggery continues to inspire chefs and consumers alike, embodying a sustainable and wholesome approach to sweetening food and beverages. Embracing jaggery not only adds depth and complexity to dishes but also contributes to a healthier lifestyle and a more sustainable food system.

REFERENCES

Anwar, S.I., Singh, R.D. and Singh, J. (2011). Process development of production of jaggery (gur), with aonla as a natural source of vitamin C. *J. Institution of Engineers India*, **92** : 33-35.

Borale, S.V., Agarkar, B.S., Kshirsagar, P.C., Katakhade, R.P. and Kshirsagar, R.B. (2023). Quality evaluation of liquid jaggery based beverage (Squash) blended with aonla and beetroot juice during storage.

Chand, K., Singh, A. and Kulshrestha, M. (2012). Jaggery quality effected by hilly climatic conditions.

Dwivedi, A.K. (2010). An Empirical Study on Gur (Jaggery) Industry (with special reference to operational efficiency and profitability measurement). *Indian Institute of Management Working Paper*, (2010-12), 03.

Gangwar, L.S., Solomon, S. and Anwar, S.I. (2015). Technological and policy options for modernization of jaggery industry in India. *Energy (kcal)*, **383** : 398.

Hirpara, P., Thakare, N., Kele, V.D. and Patel, D. (2020). Jaggery: A natural sweetener. *J. Pharmacognosy & Phytochemistry*, **9**(5) : 3145-3148.

https://www.thehindu.com/life-and-style/food/sweet January/article2614889

Jadhav, A.N. and Bhutani, K.K. (2005). Ayurveda and gynecological disorders. *J. Ethnopharmacol.*, **97**(1) : 151-159.

James, G. (Ed.). (2008). *Sugarcane*. John Wiley &Sons.Koh, H. L., Chua, T. K., & Tan, C. H. (2009). *Guide to medicinal plants, a: An illustrated scientific and medicinal approach*. World scientific.

Khumgard, P. and Sripa, W. (2018). Use jiggery instead of sugar in the recipe some ice cream.

Kumbhar, Y.S. (2016). Study on Gur (jaggery) industry in Kolhapur. *Internat. Res. J. Engg. & Technol.*, **3**(2) : 590-594.

Kumar, J., Goyal, S.K. and Bunkar, D.S. (2021). Determination of color value of jaggery based biscuits stored under ambient temperature using hunter color lab.

Kumar, K. (1999). Oscillation in jaggery and khandsari industry. In *Proc. National seminar on status, problems and prospects of jaggery and khandsari industry in India, Lucknow* (pp. 60-61).

Kumar, P. (2015). New approaches for jaggery production in Rajasthan. *Ind. J. Sugarcane Technol.*, **30** : 6-11.

Lamdande, A. G., Khabeer, S. T., Kulathooran, R. and Dasappa, I. (2018). Effect of replacement of sugar with jaggery on pasting properties of wheat flour, physicosensory and storage characteristics of muffins. *J. Food Sci. & Technol.*, **55** : 3144-3153.

Mandal, D., Tudu, S., Mitra, S. R. and De, G. C. (2006). Effect of common packing materials on keeping quality of sugarcane jaggery during monsoon season. *Sugar Tech*, **8**(2) : 137-142.

Manisha, J., Roja, T., Saipriya, S., Jayaprakash, R., Rajender, G. and Swamy, R. (2022). Development of palm jaggery and comparison with sugarcane jaggery. *Pharma Innov. J.*, **11**: 812-816.

Nayaka, M.H., Sathisha, U.V., Manohar, M.P., Chandrashekar, K.B. and Dharmesh, S.M. (2009). Cytoprotective and

antioxidant activity studies of jaggery sugar. *Food Chemistry*, **115**(1) : 113-118.

Nath, A., Dutta, D., Kumar, P. and Singh, J. P. (2015). Review on recent advances in value addition of jaggery based products.

Pandey, J. P. and Kulshrestha, M. (1999). Storage characteristics of solid jaggery. In: *Proceedings of the National seminar on Status, Problems and Prospects of Jaggery and Khandsari Industry in India, IISR, Lucknow, India*.

Quadri, H., Madhavi, V., Navya, A., Jayaprakash, R., Rajender, G. and Swamy, R. (2022). Development of granular jaggery and jaggery based chocolates.

Rao, G. P. and Singh, P. (2022). Value addition and fortification in non-centrifugal sugar (jaggery): a potential source of functional and nutraceutical foods. *Sugar Tech*, **24**(2) : 387-396.

Rao, P. V. K., Das, M. and Das, S. K. (2007). Jaggery–a traditional Indian sweetener.

Sahu, A.P. and Paul, B.N. (1998). The role of dietary whole sugar-jaggery in prevention of respiratory toxicity of air toxics and in lung cancer. *Toxicology Letters*, **95**(1001): 154-154.

Said, P. P. and Pradhan, R. C. (2013). Preservation and value addition of jaggery.

Shah, G. and Tyagi, H. (2021). Jaggery a Unique Sweetening Agent Used in Hotel Industry in the Region of Kolhapur. *Atithya: A Journal of Hospitality*, **7**(1).

Shah, S.V., Baliga, R., Rajapurkar, M. and Fonseca, V.A. (2007). Oxidants in chronic kidney disease. *J. American Society Nephrol.*, **18**(1) : 16-28.

Shahi, H.N. (1999). Sustainability of jaggery and khandsari industry in India. *Indian Institute of Sugarcane Research, Lucknow, India*.

Shrivastav, P., Verma, A.K., Walia, R., Parveen, R. and Singh, A.K. (2016). Jaggery: A revolution in the field of natural sweeteners. *European J. Pharmaceutical & Medical Res.*, **3**(3) : 198-202.

Shrivastava, A.K., Agnihotri, V.P., Ajit, K., Ghosh. A.K., Shrivastava, A.K. and Agnihotri, V.P. editors. (1998) Production technology of lump sugar gur. Delhi: Daya Publishing House; p. 271–8.

Shiralkar, K.Y., Kancharla, S.K., Shah, N.G. and Mahajani, S.M. (2014). Energy improvements in jaggery making process. *Energy for Sustainable Development*, **18** : 36-48.

Singh, J. and Shahi, H.N. (2002). Jaggery and khandsari industry in India. *Indian Farming (India)*, **51**(11).

Singh, J. and Singh, R.D. (2008). Nutritive and ecofriendly jaggery. *Processing, handling and storage of jiggery. Lucknow (IN): IISR*, 3-10.

Singh, J., Singh, R.D., Anwar, S.I. and Solomon, S. (2011). Alternative sweeteners production from sugarcane in India: Lump sugar (Jaggery). *Sugar Tech*, **13** : 366-371.

Singh, J., Solomon, S. and Kumar, D. (2013). Manufacturing jaggery, a product of sugarcane, as health food. *Agrotechnol S11*, **7**(2).

Singh, S., Kumar, R. and Kumar, M. (2021). A case study on a traditional jaggery making plant. In *International multidisciplinary conference, Organized by: Universal group of institutes, Lalru, Chandigarh (India), on 31st October-2021* (pp. 92-100).

Sivaranjani, S. and Singh, S.M. (2024). Quality attributes of traditional food from blends of rice flour and jaggery syrup under different frying conditions. *J. Agric. & Food Res.*, **16**, 101074.

Sonwane, R.S. and Sonkamble, S.B. (2020). Effect of replacement of sugar with jaggery powder on sensory and nutritional quality of Shrikhand. *Asian J. Dairy & Food Res.*, **39**(4): 296-299.

Sree, S.R., Jessie Suneetha, W., Anila Kumari, B. and Kavitha Kiran, V. (2020). Development of jaggery based fruit bar using sensory evaluation. *The Pharma Innovation Journal*, **9**(3) : 457-459.

Uppal, S.K. and Sharma, S. (1999). Evaluation of different methods of jaggery (Gur) storage in subtropical region. *Indian J. Sugarcane Technol*, **14**(1) : 17-21.

Uppal, S.K., Sharma, S. and Sharma, K.P. (1999). Post-Harvest Changes in Sugarcane under Varying Weather Conditions. *Plant Physiol. Sustainable Agric.*, **29**.

Verma, P., Shah, N.G. and Mahajani, S.M. (2019). Why jaggery powder is more stable than solid jaggery blocks. *LWT*, **110** : 299-306.

****