



A Case Study

Studies on quality jaggery (gur) production with organic clarificants

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Abstract : The jaggery quality is the most challenging aspect for the jaggery making process. Jaggery provides an alternative market to sugarcane growers. About 26 per cent of the sugarcane produced is diverted for jaggery production. Jaggery production with the use of chemical clarificants is very common and is widely adopted by almost all jaggery manufactures in view of cheapness and ready availability of chemicals in the market. The presence of sulphur as sulphur dioxide in the jaggery beyond 70 ppm is injurious to the health. The technology developed at Sugarcane Research Station, TNAU, Melalathur has established that the use of slaked lime solution along with the mucilaginous extract of wild bhendi / bhendi as clarificant (40 - 45 g / 100 l). The results of the experiments conducted at various research centres also revealed that among the herbal clarificants used for the jaggery making the bhendi mucilage significantly contributed in removing higher amount of scum and highest non reducing sugars (83.56%) and significant decrease in the reducing sugars (4.44%) due to beneficial in reducing the inversion process. Use of bhendi mucilage, soyabean seed meal improved the colour of jaggery.

Key Words : Jaggery, Quality, Herbal clarificants

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The sugar industry in India plays a vital role towards socioeconomic development in the rural areas by mobilizing rural resources and generating higher income and employment opportunities. About 7.5 per cent of the rural population covering about 45 million sugarcane farmers, their dependents and a large number of agricultural labourers are involved in sugarcane cultivation, harvesting and ancillary activities (Murthy, 2010).

Sugarcane is one of the important commercial crops used for the manufacture of sugar, jaggery and other products. Jaggery provides an alternative market to sugarcane growers. About 26 per cent of the sugarcane

produced is diverted for jaggery production. The quality of the jaggery is dependent on the cane juice which in turn is determined by the variety and the environment in which the cane is grown. The adverse conditions *viz.*, salinity, drought etc., affect cane yield and quality (Wandre *et al.*, 1985).

The jaggery manufactured from sugarcane juice and is very widely used not only in individual households but also in many eateries, restaurants, clubs and hostels and it has certain industrial applications as well. Manufacture of sugar involves many technical aspects and the capital investment is also on the higher side. Compared to this, production of jaggery is very simple and the capital cost is also very limited. Due to its wide applications, the market for jaggery is continuously growing. The jaggery contains approximately 60-85 per cent sucrose, 5-15 per cent glucose and fructose. Along with 0.4 per cent of protein, 0.1 g of fat and 0.6 to 1.0 g of minerals (8 mg of calcium, 4 mg of phosphorus, and 11.4 mg of iron). It is also found to contain traces of vitamins and amino acids. 100 g of jaggery gives 383 kcal of energy. In ayurveda, jaggery is considered as the

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best base material for the preparation of medicines. In contrast, the white crystal sugar contains only sucrose to the tune of 99.5 per cent without any minerals. Its production is undertaken at several places but Maharashtra, Uttar Pradesh, Bihar and Tamil Nadu are the leading manufacturers.

In Tamil Nadu, almost all sugarcane cultivating areas/districts about 35-40 per cent of cane production is utilized for the jaggery making. Since, the jaggery plays an important role in all spiritual and religious celebrations of the people. The jaggery quality is the most challenging aspect for the jaggery making process and the colour of the jaggery is the predominant factor taken in to account while deciding the quality of jaggery. The quality aspects especially, colour of the jaggery decides the value and marketability. Colour is one of the important criteria determining the grade of gur/jaggery (Thangavelu, 2005). Normally gur with light colour is preferred for consumption. Sources for development of colour in jaggery can be traced namely (i) inherent sugarcane juice characteristics (ii) machineries used for making jaggery (iii) the processing of juice for jaggery making. As in the case of sugar, jaggery yield too mainly depends upon the cane yield, juice volume and total sugar contents. On the other hand, quality and storability of jaggery depends upon the juice quality, which is determined by the varieties growing conditions, quantity and quality of inputs used and the jaggery preparation techniques.

Clarification process:

An ideal clarification process for jaggery making should control undesirable colour development and inversion of sucrose during boiling and concentration (Baboo and Solomon, 1995). Asokan and Rupa(2007) suggested that an ideal juice clarification process for gur making should necessarily meet the following requirements,

Removal of all constituents of juice other than sucrose, reducing sugars, inorganics(phosphates, iron and calcium) and organics (higher proteins and fats),

- Control of undesirable colour development and inversion of sucrose during boiling and concentration.
- Better crystallization
- Prevention of overheating and charring
- No adverse effect on gur taste and human health
- Longer storage life of the product and
- Easy availability of clarifying agent.

Herbal and chemical clarificants:

Jaggery preparation is broadly divided in to three stages viz, harvesting of sugarcane, extraction of juice and boiling of juice. A clarification technique is adopted for the separation of the non-sugar substances from the juice. Vegetable and chemical clarificants are used for clarification

of juice. Generally, jaggery production with the use of chemical clarificants (hydros - sodium hydro sulphite, lime - calcium oxide, sodium carbonate, etc..) is very common and is widely adopted by almost all jaggery manufactures in view of cheapness and ready availability of chemicals in the market. The chemical clarificants also used as a bleaching agents, electrolytes or pH adjusting agents. The pH of fresh sugarcane juice ranges between 5.5 and 5.4. It is required to be monitored at 6.4 to 6.5. The clarificants are added to monitor the pH and to facilitate the coagulation of suspended impurities in the juice.

Most of the above chemicals affect the taste and storability of jaggery due to the presence of undesirable elements such as sodium, chloride and sulphur left in the jaggery. The colour improvement brought about by use of chemicals such as hydros is temporary. The presence of sulphur as sulphur dioxide in the jaggery beyond 70 ppm is also injurious to the consumers. So, generally it is advisable to avoid chemical clarificants to the extent possible.

The mucilages of bhendi, seed meal of groundnut, soy bean are used as herbal clarificants. Mucilage of wild bhendi is commonly used as a clarificant. The sukhalai extract gives better clarification of juice, resulting in a jaggery having better luster and attractive colour(Singh and Gill, 1954). Vegetable clarificants like deola, bhendi and sukhalai were better than the chemical compounds (Laxmikantham, 1973). The technology developed at Sugarcane Research Station, TNAU, Melalathur has established that the use of slaked lime solution along with the mucilaginous extract of wild bhendi / bhendi as clarificant (40 - 45 g / 100 litres of juice) was found to give jaggery of acceptable good colour and keeping quality. The mucilaginous extract of bhendi can be obtained by pounding the stem and roots of bhendi plant in water. The addition of clarificants varied with the quantity and used as clarificants (Table 1).

Influence of herbal clarificants on the quality of jaggery:

Sugarcane clones containing high sucrose and phosphate and low reducing sugars, ash, non-protein N, total N, colloids, calcium in juice give good quality jaggery with high sucrose, low ash, low reducing sugars and moisture with good quality jaggeries. In addition to sugars, juice contains salts, nitrogenous substances, lipids, gums, wax, pectins, organic acids and phenols. All these need to be removed before sugars are collected for jaggery. Clarificants are added to remove these non-sugars unwanted to purify the juice and get good quality jaggery. Baboo (1993) reported that generally soft, straight, less fibrous canes producing high clarifiable juice were suitable for good quality gur. High quality of claribility and quality of jaggery had low colloids (total colloids as also individual constituents), low ash and

Table 1 : Different herbal clarificants used for jaggery production

Common name	Botanical Name	Part to be used	Method of use	Quantity (g)/100 litres of juice
Bhendi	<i>Abelmoscus esculantus</i>	Stem and root of green plant	Pound and rub in water. Use mucilaginous extract	40 – 45
Deola	<i>Hibiscus ficulneus</i>	Stem and root of green plant	Pound and rub in water. Use mucilaginous extract	40 – 45
Phalsa	<i>Grewia asiatica</i>	Bark of the tree	Pound and rub in water. Use mucilaginous extract	50 – 55
Semal	<i>Bombax malabaricum</i>	Bark of the tree	Pound and rub in water. Use mucilaginous extract	55 – 60
Sukhlal	<i>Kydin calycina</i>	Dry bark of the tree	Soak in water. Pound and rub in water. Use mucilaginous extract.	45 – 60
Castor	<i>Ricinius communis</i>	Seed	Soak in water. Grind decorticated seed with water. Use milky liquid after straining	70 – 75
Groundnut	<i>Arachis hypogea</i>	Seed	Soak in water. Grind decorticated seed with water. Use milky liquid after straining	70 – 75
Soybean	<i>Glycine max</i>	Seed	Soak in water. Grind decorticated seed with water. Use milky liquid after straining	30 - 40

high phosphate (Thangavelu, 2005). Lime and sukhlai combination gave best quality jaggery with both in colour and hardness. Crystalline structure was the poorest when soybean, or groundnut seed extract were used with lime (Anonymous, 1956).

The results of the various experiments on the quality of jaggery conducted in different parts of the country revealed that, among the herbal clarificants used for the jaggery making the bhendi mucilage significantly contributed in removing higher amount of scum and highest non reducing sugars (83.56%) and significant decrease in the reducing sugars (4.44%) due to beneficial in reducing the inversion process (Table 2). Use of bhendi mucilage, soybean seed meal improved the colour of jaggery. Further, it was found

that the pH of the jaggery was not significantly influenced by the use of herbal clarificants rather the moisture content of jaggery was decreased due to use of herbal clarificants especially by bhendi mucilage and soybean seed meal (Mungare *et al.*, 2000).

The *Hibiscus vitifoliosus* extract was used as a clarifying agent during gur manufacturing and the gur obtained was found superior than that obtained using chemicals. So quality gur can be produced using the extract by avoiding the use of harmful chemicals and this will reduce the cost of production of gur. One ppm of chemical agent is equivalent to three ppm plant extract for settling of mud in the juice. *Hibiscus* plant extract has a peculiar bleaching action which helps in removing unwanted colours in the juice and produce

Table 2 : Effect of different herbal clarificants on quality parameters of jaggery

Treatments	Reducing sugars%	Non-reducing sugar %	pH (6.5% soln.)	Colour (6.5% soln.)	Moisture (%)	% scum on cane wt.basis
T ₁ Bhendi (<i>Hibiscus esculantus</i>)	4.44	83.56	6.61	70	5.21	2.70
T ₂ Ambadi (<i>Hibiscus cannabinus</i>)	7.76	79.95	6.64	79	6.59	1.73
T ₃ Phalsa (<i>Grewia asiatica</i>)	5.48	83.23	6.68	74	6.02	2.43
T ₄ Kateshevari (<i>Bombax malabaricum</i>)	6.37	81.75	6.62	80	6.14	2.24
T ₅ Groundnutseedmeal (<i>Arachis hypogea</i>)	5.95	82.59	6.69	73	6.35	2.15
T ₆ Soybean seed meal (<i>Glycine max</i>)	4.62	82.92	6.78	71	5.42	2.21
T ₇ Guar seed meal (<i>Cymopsis tetragonoloba</i>)	6.07	83.10	6.71	71	5.61	2.37
T ₈ Haliv seed (<i>Lepidium sativum</i>)	7.62	79.56	6.63	98	7.41	1.90
T ₉ Tamarind seed meal (<i>Tamarindus indica</i>)	7.20	79.04	6.80	91	7.45	1.84
T ₁₀ French bean seed meal (<i>Phaseolus vulgaris</i>)	7.30	80.02	6.70	93	7.14	2.05
T ₁₁ Control	10.82	73.32	6.67	1.03	7.72	1.43
S.E.±	0.53	1.40	0.24	5.08	0.38	0.07
C.D. (P=0.05)	1.67	4.42	NS	16.02	1.04	0.20

Source: Mungare *et al.* (2000)

NS=Non-significant

golden yellow colour (Thangamuthu, 2009). North Indian Centres point to the need of using a protinacious or muclilaginous plant or seed extract to ensure proper crystallization of sucrose in manufacture of gur (Narasimham,1957). Use of deola extract gave maximum clarifying effect, it reduced colour from its initial value of 98.87 to 18.49 and turbidity from 4.985 to 0.259. Clarification process did not change TSS, sugar content or pH but it reduced tannin content (Prasad *et al.*, 2002)

Conclusion:

From the studies, it was concluded that the use of herbal clarificants like, bhendi mucilage, soyabean seed meal are very effective as clarificants and equally performing with the chemical clarificants in removing higher amount of scum and highest non reducing sugars and decreaseing reducing sugars. Further, the quality jaggery can be produced using the herbal clarificants and thereby we can avoid harmful chemicals as well as reduce the cost of production of jaggery.

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