

A Monthly e Magazine

ISSN:2583-2212

February 2024 Vol.4(2), 789-795

Popular Article

Cutting-Edge Jaggery Powder Processing Plant: Revolutionizing the Way of Non-Centrifugal Sugar Production

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<https://doi.org/10.5281/zenodo.10719590>

Abstract

The global sugar industry is witnessing a paradigm shift towards healthier alternatives like jaggery due to increasing health concerns and changing consumer preferences. However, traditional jaggery production faces challenges such as outdated methods and stiff competition. To address these issues, a cutting-edge jaggery powder processing plant has been established, integrating modern technology with traditional practices. This plant promises to revolutionize the jaggery industry by enhancing efficiency, quality, and sustainability, thereby meeting the growing demand for natural sweeteners.

Introduction

Global sugar demand exceeds 180 million tons annually (Anonymous 2019), with developing countries driving 94% of the additional demand, fueled by increased consumption of processed products and sugar-rich beverages (OECD/FAO 2018). By 2027, global sugar consumption is projected to reach 198 million tons, with the jaggery market expected to grow by 6% by 2023 (APEDA 2021). Factors such as reforms in sugar subsidy programs (WHO 2022), implementation of sugar taxes on beverages, and dietary lifestyle changes contribute to the demand for healthier sugar alternatives such as **non-centrifugal sugar**, popularly known as **jaggery**.



Jaggery, a traditional Indian sweetener derived from sugarcane, has gained popularity globally. However, the industry faces challenges including the lack of modernization, stiff competition, and environmental concerns (Gangwar et al. 2015). Efforts to modernize the industry involve adopting efficient machinery, innovative processing techniques, and diversifying jaggery-based products (Tyagi et al. 2022). Promoting awareness about jaggery's nutritional benefits and sustainable aspects is also crucial for its revival in domestic and international markets (Venkatesh et al., 2023). To address these challenges, a cutting-edge jaggery powder processing plant of capacity 10 TCD (tonnes crushing per day) has been established at **Regional Sugarcane & Jaggery Research Station, Kolhapur (Mahatma Phule Krishi Vidyapeeth Rahuri)**, with financial support from **Rajiv Gandhi Science and Technology Commission, Mumbai, Govt. of Maharashtra** and technical support of **Indian Institute of Technology Bombay**. This state-of-the-art facility (Image 1) integrates traditional methods with modern technology, ensuring efficient and high-quality production while preserving jaggery's unique flavour and nutritional value.



Image 1: Modern jaggery powder processing plant established at RS&JRS, Kolhapur

As shown in Image 2, the plant consists of two process streams: batch (Green dotted box) and continuous (Red dotted box). The batch process (each batch of 150 litres of juice) is used for research activities and value-added products, while the continuous process involves minimal human intervention and uses novel machinery for efficient production. Advanced techniques such as clarification, evaporation, and crystallization have been revolutionized to ensure superior quality jaggery powder.



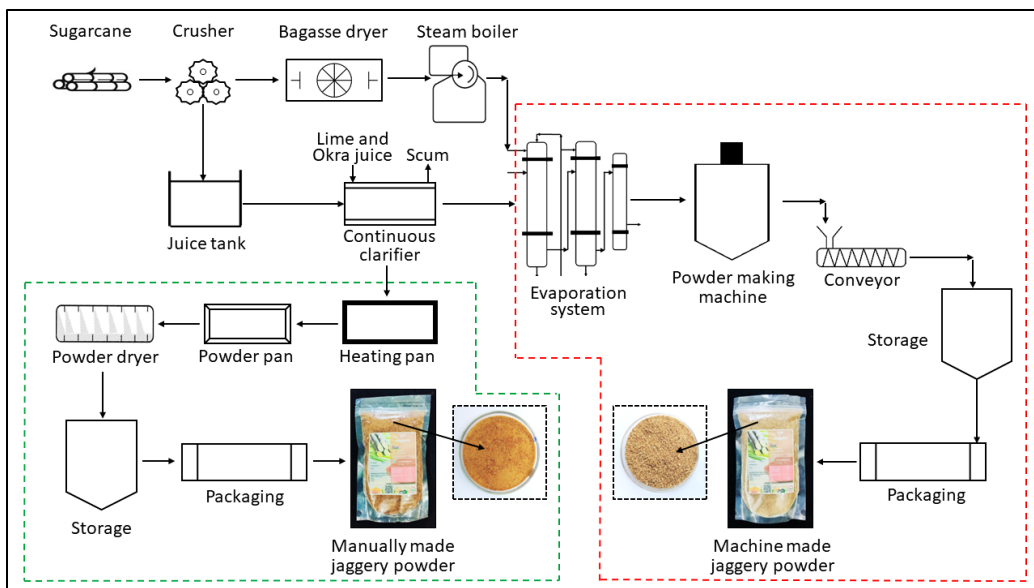


Image 2: Process flow schematics of modern jaggery powder processing plant

Salient Features

The developed modern jaggery processing plant has several salient features (Image 3) as listed below-

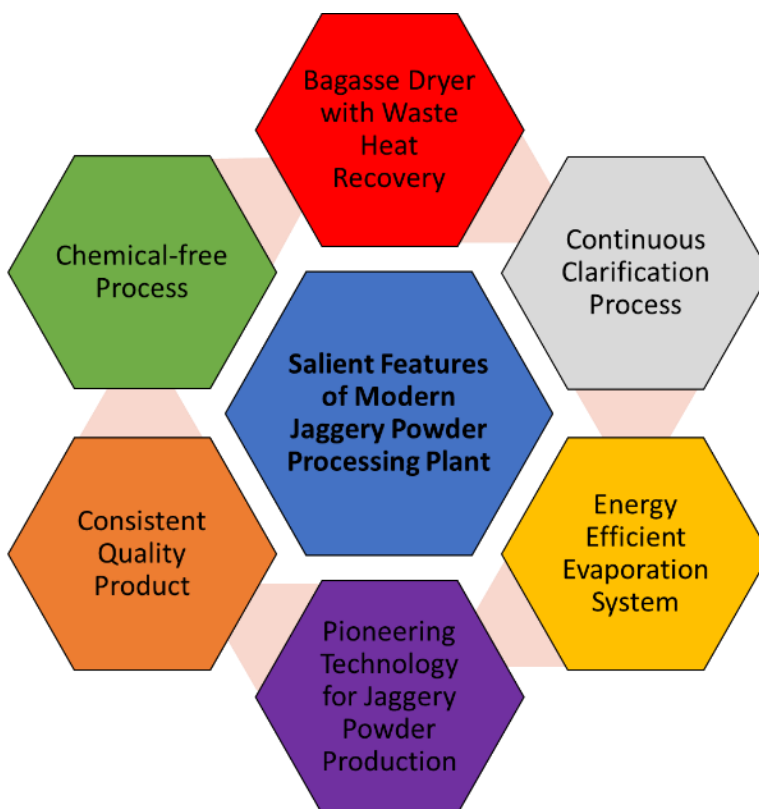


Image 3: Salient Features of modern jaggery powder processing plant



1) Bagasse dryer with waste heat recovery:

The modern bagasse dryer with waste heat recovery improves upon conventional drying methods. Unlike the labour-intensive traditional process, this dryer eliminates the need for manual spreading, turning, and transporting of bagasse to furnaces. Its adoption brings significant advancements, allowing uninterrupted bagasse utilization year-round while reducing space and labour requirements. Additionally, the drying process ensures uniform moisture content, enhancing bagasse's effectiveness as a fuel source.

2) Continuous clarification:

Efficient scum removal is vital for high-quality jaggery. A modern clarification system ensures a consistent supply of clarified juice, enhancing efficiency without skilled labour. This streamlined process improves cost-effectiveness and sustainability.

3) Chemical-free process:

The jaggery powder production process is chemical-free, prioritizing purity and quality. Lime maintains juice pH, while okra stem extract removes scum, ensuring a natural end product. This approach aligns with FSSAI regulations, yielding pure, flavourful, and nutritious jaggery powder.

4) Energy efficient evaporation system:

Utilizing multiple-effect evaporators, the system minimizes energy consumption by increasing evaporation rates and recycling steam. Advanced heat exchangers recover vapour heat for juice preheating, reducing energy and water usage. These measures promote sustainability and eco-friendliness in jaggery powder production.

5) Pioneering technology for jaggery powder production:

A newly developed Jaggery Powder-Making Machine revolutionizes production, eliminating manual labour and additional drying of jaggery powder which is a must practice when prepared manually. This machine utilizes steam to heat, evaporate, and crystallize, yielding a dry powder ready for sale. It increases production rates and reduces labour requirements, enhancing efficiency and reducing costs.

Universal Selling Points

The developed modern jaggery powder processing plant has tremendous potential in the market and food processing industries. The universal selling points (USPs) of this plant (Image 4) are briefly mentioned below-





Image 4: Universal Selling Points (USP) of modern jaggery powder processing plant

1. Streamlining Production:

Modern jaggery powder processing plants use advanced machinery to streamline production, including juice extraction, bagasse utilization, continuous clarification, and drying. This enhances efficiency and hygiene.

2. Enhanced Quality and Consistency:

This plant ensures consistent quality, shape, size, and colour of jaggery powder through strict quality control measures and semi-automated processes, providing consumers with superior products with uniform colour and good flavour characteristics, high dissolvability etc.

3. Improved Shelf Life and Convenience:

Processed jaggery powder from this plant has an extended shelf life (approx. 6-8 months) and is more convenient for storage and use in various recipes, catering to both households and food manufacturers.

4. Economic Benefits:

The plant's mechanization reduces manual labour (40 to 60%), increases productivity (2-3 times more than a most commonly used traditional plant with 400-litre capacity pans), and creates cost efficiencies, contributing to job creation and economic growth in the manufacturing sector.

5. Expanding Market Potential:

The plant opens new opportunities in domestic and export markets with its longer shelf life, convenience (powder form: non-sticky, free flow), and quality, appealing to health-conscious consumers and driving market growth.

6. Less Labour-Intensive Process:

Efficient machinery and advanced techniques minimize manual labour by 40 to 60%, resulting in higher yields and consistent quality, promoting sustainable jaggery production and industry growth.

7. Hygienic Process:

Stringent hygiene protocols, minimal human intervention and stainless-steel equipments (SS 304) minimize contamination risks, ensuring a safer and more reliable product, enhancing market appeal, and addressing health and quality concerns.

8. Energy Efficient Process:

Utilizing innovative technologies like removing scum through scoop mechanization, clarification through sedimentation, efficient multiple-effect evaporators, and optimized heating systems minimizes plant energy consumption and maximizes its resource utilization, enhancing sustainability and cost savings.

Conclusion

The rise of such novel modern jaggery powder processing plants can mark a significant turning point in the jaggery industry. These advanced facilities combine technology, quality control, and sustainability to revolutionize jaggery production, ensuring enhanced quality, convenience, and economic viability. The introduction of jaggery powder as a versatile and consumer-friendly product will open up new avenues for growth and market expansion. With continued innovation and investment in this sector, the jaggery industry is poised to flourish, meeting the evolving demands of consumers while preserving the rich cultural heritage associated with this beloved sweetener.

Acknowledgement

The authors acknowledge the financial support from the Rajiv Gandhi Science and Technology Commission, Mumbai, Govt. of Maharashtra. The authors also acknowledge Shivaji University Kolhapur and Institute of Chemical Technology Mumbai for their scientific and technical support in this project. Additionally, the authors express their kind gratitude towards



Prof. Narendra G. Shah, Ex. Professor, CITARA, IIT Bombay, Mumbai, for shaping the project and providing his technical guidance since the beginning.

References

- Anonymous. 2019. *An Introduction to Global Sugar Markets* (Issue 3) by AB Sugar. International Sugar Organisation, London. Issue 3: 1-32.
<https://www.abfsugar.com/perch/resources/world-sugar-market-booklet-update-march-2019.pdf>
- OECD/FAO. 2018. *OECD-FAO Agricultural Outlook 2018-2027*, OECD Publishing, Paris/Food and Agriculture Organization of the United Nations, Rome. 1-112.
https://doi.org/10.1787/agr_outlook-2018-en
- APEDA. 2021. *Market Intelligence Report for Jaggery*. Agricultural and Processed Food Products Export Development Authority. 1-19.
https://agriexchange.apeda.gov.in/Weekly_eReport/Jaggery_Report.pdf
- WHO. 2022. *WHO manual on sugar-sweetened beverage taxation policies to promote healthy diets*. Fiscal policies for health. World Health Organization. 13 December, 2022. 1-119. (ISBN: 978-92-4-005629-9)
<https://apps.who.int/iris/rest/bitstreams/1485545/retrieve>
- Gangwar, L. S., S. Solomon and S. I. Anwar. 2015. Policy brief on *Technological and Policy Options for Modernization of Jaggery Industry in India*. ICAR-Indian Institute of Sugarcane Research, Raebareli Road, P.O. Dilkusha, Lucknow. India.
https://iisr.icar.gov.in/iisr/download/publications/report/policypaper_gangwar.pdf
- Tyagi S. K., S. Kamboj, Himanshu, N. Tyagi, R. Narayanan, and V. V. Tyagi. 2022. *Technological Advancements in Jaggery-Making Processes and Emission Reduction Potential via Clean Combustion for Sustainable Jaggery Production: An Overview*. J Environ Manage. 301: p.113792. DOI: <https://doi.org/10.1016/j.jenvman.2021.113792>
- Venkatesh, T., A. M. Nandhu Lal, V. Silpa, and et al. 2023. *Current Production Strategies and Sustainable Approaches towards the Resurgence of Non-Centrifugal Cane Sugar Production- A Review*. Sustain. Food Tech. 1: 200-214. DOI: <https://doi.org/10.1039/D2FB00032F>

