CHAPTER 1

Utilization of Plant-derived Wastes For Value Added Product Formation

Ketaki Nalawade[1], Paharika Saikia[1], Sukhendra Singh[1], Shuvashish Behera[1], Kakasaheb Konde[1] and Sanjay Patil[1,*]

[1] *Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Manjari (Bk.), Pune-412307, India*

Abstract: Depletion of fossil fuels and environmental concern has impelled to search for alternative biofuels and biobased chemicals. Biofuels have been considered an alternative clean energy carrier due to their environmentally friendly nature. Recently, research has been focused on finding a readily available, low-cost and renewable lignocellulosic biomass to produce value-added products. In this context, the plant-derived organic wastes can be transformed to produce biofuels (bioethanol, biobutanol, biogas and biohydrogen) and biochemicals (lactic acid, succinic acid, xylose and xylitol). It will be a sustainable effort to reduce the huge amount of plant waste generated. In addition, in the recent decades, several efficient conversion methods have been invented.

During the past few years, a large number of chemical pretreatment methods have also been developed for efficient lignocellulosic conversion. The current chapter discusses the advanced methods for biofuels and biochemicals' production, focusing primarily on different pretreatment methods for effective conversion of plant derived wastes.

Keywords: Anaerobic digestion, Biomass, Biofuels, Bioethanol, Biobutanol, Biogas, Biochemicals, Biohydrogen, Detoxification, Fermentation, Inhibitors, Lignocelluloses, Ligninolytic enzymes, Lactic acid, Plant derived wastes, Pretreatment, Succinic acid, Value added products, Xylitol, Xylose.

INTRODUCTION

Energy plays a crucial role in the socio-economic development of a country. According to the Global Status Report on energy, the major part of energy share of around 78% is obtained from nonrenewable resources (fossil fuels such as petroleum, gases and coal) and only 19% comes from renewable energy resources

* **Corresponding author Sanjay Patil:** Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Manjari (Bk.), Pune-412307, India ; Tel:+91-020-26902341; E-mail: sv.patil@vsisugar.org.in

Vinay Kumar, Sivarama Krishna Lakkaboyana & Neha Sharma (Eds.)

APPLICATIONS OF RADIATION-PROCESSED CHITOSAN IN AGRICULTURE

Ashish Kumar Srivastava[1,2*], Manish Pandey[1] and Sunil Dalvi[3]
[1]Nuclear Agriculture and Biotechnology Division, Bhabha Atomic Research Centre, Mumbai, Maharashtra 400085, India.
[2]Homi Bhabha National Institute, Mumbai-400094, India.
[3]Tissue Culture Section, Vasantdada Sugar Institute, Manjari (Bk.), Pune, 412307, India.

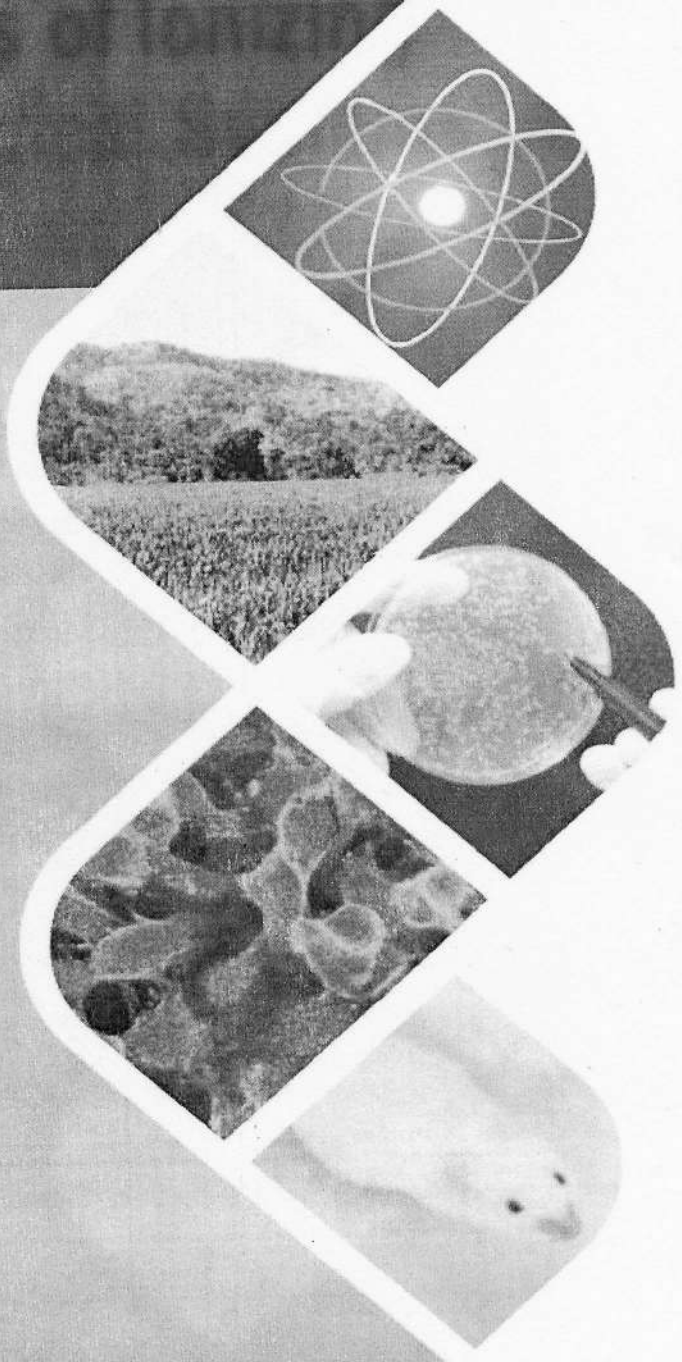
E-mail: ashish@barc.gov.in

Abstract:

Chitosan is a natural biopolymer composed of randomly distributed β-(1,4)-linked D-glucosamine (2-amino-2-deoxy-D-glucopyranose) and N-acetyl-D-glucosamine (2-acetamido-2-deoxyD-glycopyranose) units. In nature, crustacean shell biomass, one of the major waste-product of marine/sea-food industry, is the source of chitosan production. The application of chitosan affects various physiological processes in plants including cell division, cell elongation, nutrient uptake, enzymatic activation and protein synthesis, resulting in improved growth and yield. In addition, chitosan mediated biocontrol properties for crop protection may be attributed to its elicitor response towards various plant pathogens. Apart from agriculture, chitosan also has many diverse applications in the fields of medicine, pharmaceutical, and food; however, its true potential is still limited due to its low-solubility. With this background, the present chapter highlights the potential of gamma-radiation for depolymerizing chitosan, with the aim of being used as a plant-growth bioregulator for ensuring sustainable agriculture. The bio-efficacy of gamma-irradiated chitosan has been demonstrated in multiple crops, including horticultural plants. Considering this, an indigenous technology named "Anu-Chaitanya" has been developed using gamma-irradiated chitosan that can be seen as a typical example of "wealth-from-waste" and "peaceful use of radiation".

Key words: Benefit:cost ratio, chitosan, crop yield, depolymerization, elicitor, plant signalling.

Beneficial Effects of Ionizing Radiation in Biological Systems



Editors
Santosh K. Sandur
Tapan K. Ghanty

A BARC PUBLICATION

Government of India
Department of Atomic Energy
Bhabha Atomic Research Centre

Beneficial Effects of Ionizing Radiation in Biological Systems

E-ISBN : 978-81-967453-6-3

ISBN - 978-81-955713-7-6

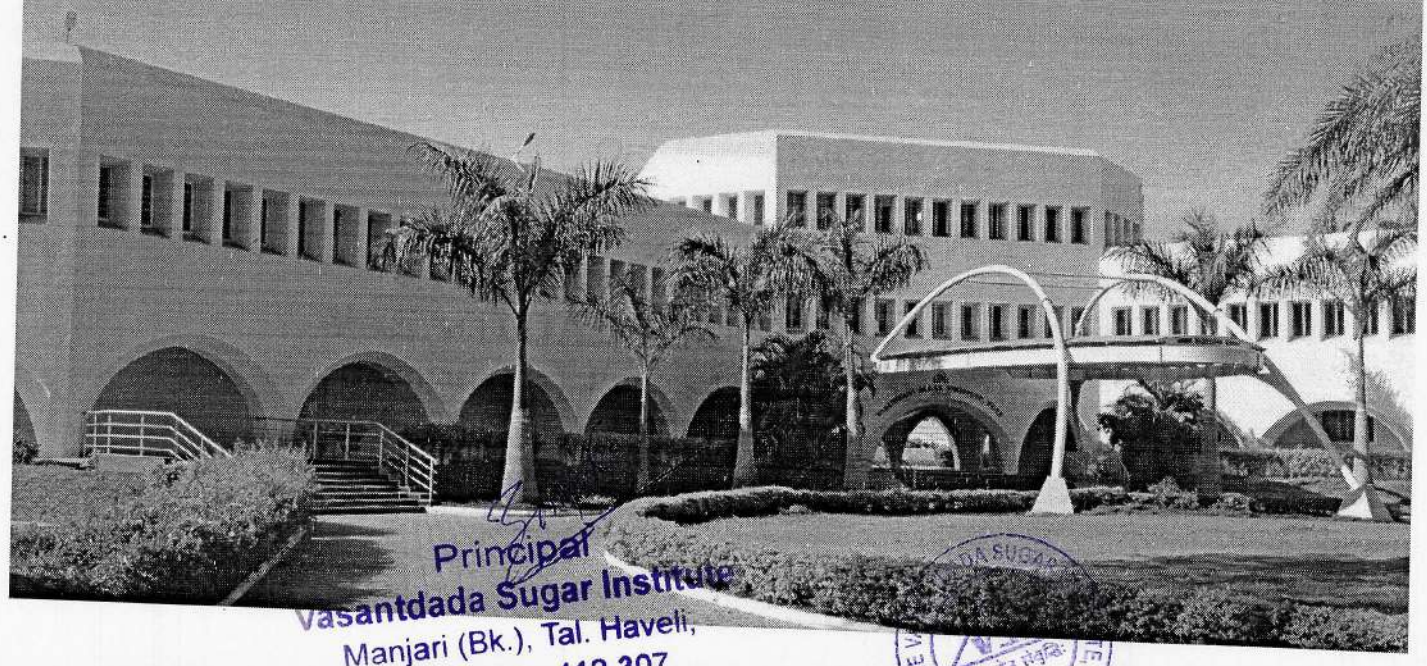
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

TS-GT- 48

Process Development for Second Generation (2G) Ethanol Production Through Enzymatic Route

Somnath Sutar, Snehal Patil, Shuvashish Behera, Kakasaheb Konde and Sanjay Patil
Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Manjari (Bk), Pune-412307, India.
sutarsomnath2@gmail.com

Agro-energy crops and plant residues are promising low-cost, sustainable biomaterials for biofuel and power generation. One of the most commonly examined lignocellulosic materials for second-generation ethanol production is sugarcane bagasse. Sugarcane is a versatile plant grown for sugar production, and its major by-product is bagasse. It is a highly heterogeneous material that consists roughly of 20-30 % lignin, and 40-45 % cellulose and 30-35 % hemicellulose and ash. Its composition makes it a promising feedstock for second-generation biofuel production. Bioethanol production from lignocellulosic biomass requires enzymatic hydrolysis of cellulose to release sugars that can be subsequently fermented by yeasts. For an economically viable ethanol production at the industrial level, the produced ethanol must reach at least 5 % (v/v).

In current study, the shake flask scale experiments were conducted for pre-treatment of bagasse followed by hydrolysis and fermentation. Alkali pre-treated bagasse was used for hydrolysis experiment. A series of batch and fed-batch enzymatic hydrolysis were conducted with different solid loading. The 2 G ethanol concentration of 7 % (v/v) was achieved with alkali treated and enzyme hydrolyzed sugarcane bagasse. The ethanol yield 158 Lit/MT of bagasse was achieved. The process developed for 2 G ethanol production can be retrofitted in the existing 1 G distillery plants.

Keywords: Sugarcane bagasse; Pretreatment; Enzymatic hydrolysis; Cellulose; Hemicellulose

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

THE VASANTDADA SUGAR INSTITUTE, PUNE SEAL OF

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

संशोधनेन संवृद्धिः

VASANTDADA SUGAR INSTITUTE

Manjari (Bk.), Pune - 412 307; Maharashtra.

Phone : (020) 26902100; Fax :(020) 26902244;

E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

ISBN-978-81-955713-7-6

TS-GT- 49

Microbial Process for The Production of Butanol: A Value Addition to The Sugar Industry

Komal Barguje, Shuvashish Behera Jayashri Pawar, Nandita Naik, Kakasaheb Konde
Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Manjari (Bk.), Pune-412307
komalbarguje72@gmail.com

India has been producing an excess quantity of sugar since last 10 years. Diversification of the product portfolio of sugarcane biorefineries by using surplus sugar for the production of valuable products such as butanol will provide significant economic returns to the sugar industry and further promote their economic competitiveness. Butanol has gained attention as a renewable transportation biofuel, less polluting and alternative to gasoline due to its superior fuel properties. This study highlights the efficiency of new isolated VSI strain through bioprospecting of glucose for the production of butanol in synthetic medium. Flask scale batch fermentation of glucose for the production of butanol was carried out using bacterial cells of VSI isolated *Clostridium sp.*

The optimized parameters such as pH and temperature for flask production were found to be 6.5 and 40 oC, respectively. Under optimized conditions, the total solvent titre of 11.03 g L-1 was obtained with 0.19 g g-1 of butanol yield and 0.28 g L-1h-1 of butanol productivity. This study revealed the promising potential of the isolated bacterium for butanol production. The efficacy for butanol production using the newly isolated Clostridium sp. can be further validated on fermenter scale.

Keywords: ABE fermentation; Biobutanol; Bacterial fermentation; Optimization; *Clostridium*

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN - 978-81-955713-7-6

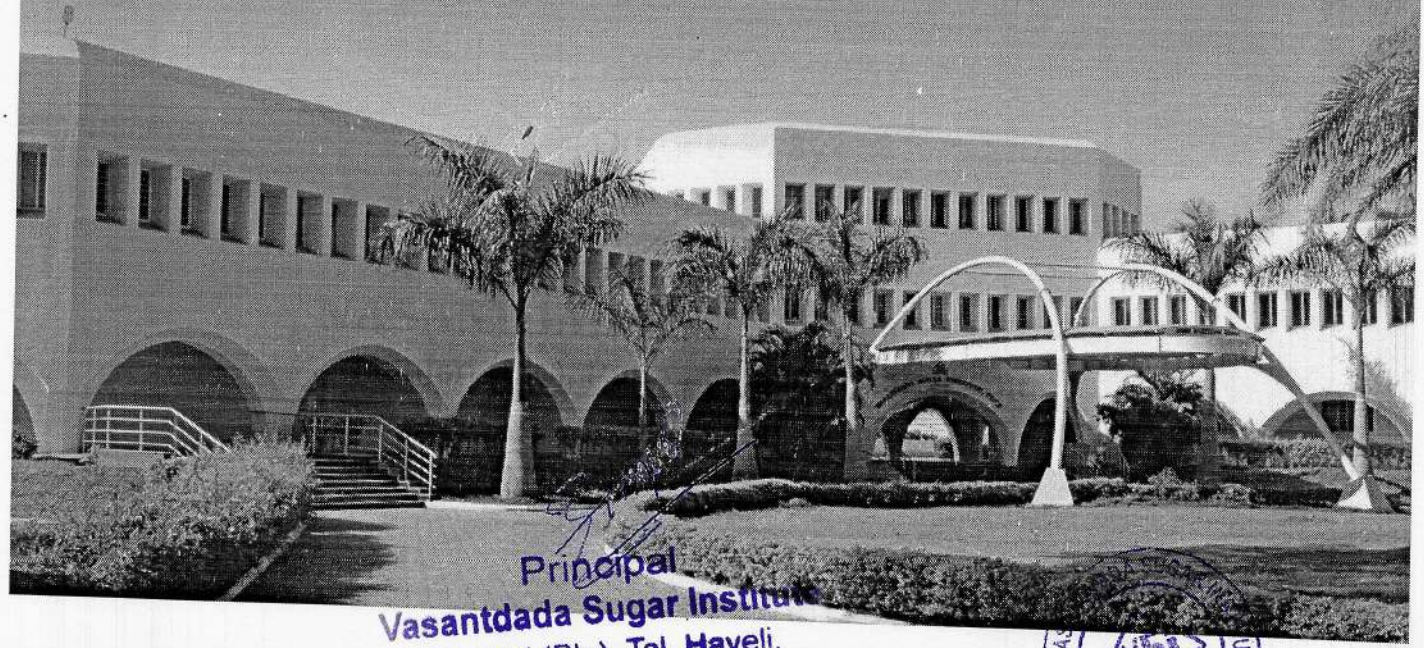
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

TS-GT- 50

CBG Production Opportunities in Sugar & Allied Industry

Pranav Nikam, Shuvashish Behera, Rajendra Godage, Kakasaheb Konde
Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Manjari (Bk.), Pune-412307, India
nikampranav@yahoo.in

CBG can play an important role in diversification of sugar industry product portfolio. It will create additional employment opportunities and pollution free environment for the society. Sugar Industry has plenty of resources which can be exploited to produce CBG. Sugar Industry is looking for economically viable alternatives for disposal of spentwash and utilization of pressmud instead of bio composting. CBG production using biogas generated from spentwash can prove to be a lucrative option for the industry. Also, pressmud which is available with the sugar mills can be used for CBG production through anaerobic digestion process. Sugar industry/Distillery is generating biogas using spent wash through anaerobic digestion. This biogas can be converted into CBG by different purification processes.

Keywords: Biofuels; Green hydrogen; Sugar & allied industry

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

VASANTDADA SUGAR INSTITUTE, PUNE

ISBN - 978-81-955713-7-6

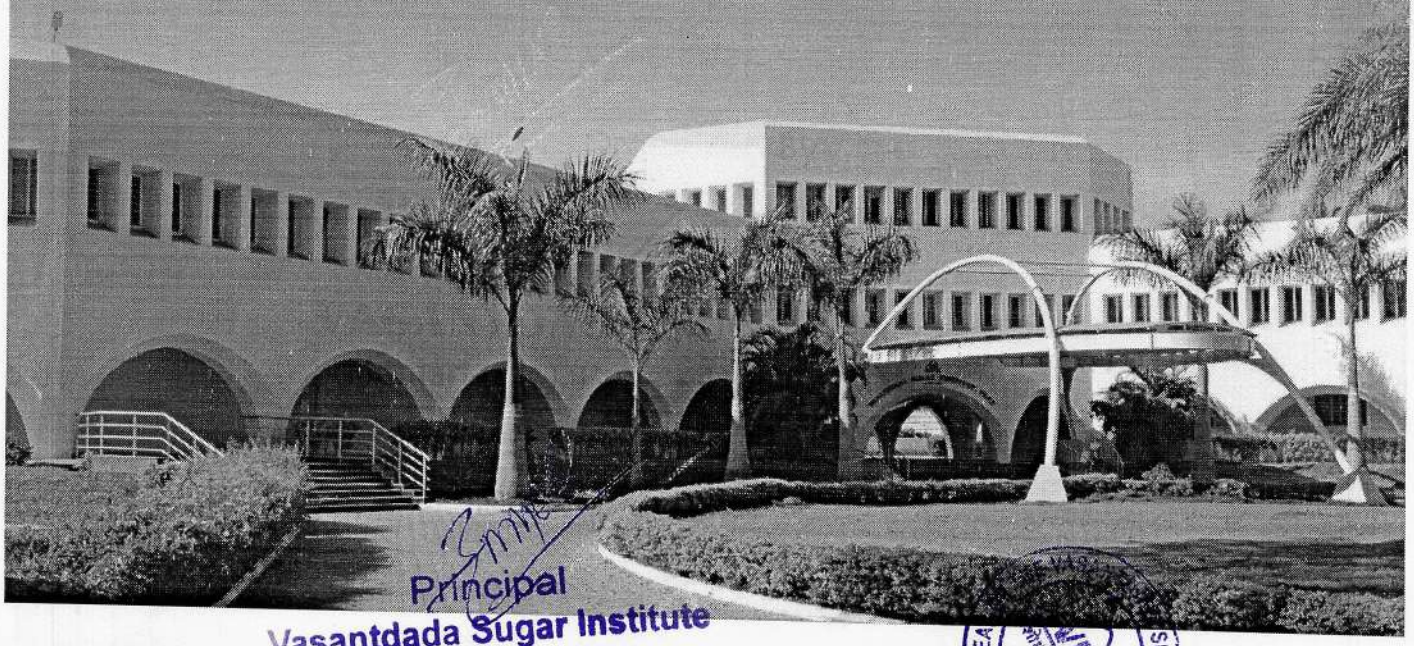
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

TS-GT- 53

Process for Microbial Gluconic Acid Production: A Value Addition to The Sugar Industry

Shuvashish Behera, Somnath Sutar, Shivani Suryawanshi, Jayashri Pawar, Sneha Patil, and Kakasaheb Konde, Sanjay Patil

Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Manjari (Bk.), Pune-412307, India

sutarsomnath2@gmail.com

India has been producing excess quantity of sugar during the last 10 years. Diversification of the product portfolio of sugarcane biorefineries by using surplus sugar for the production of valuable products such as gluconic acid will provide significant economic returns to the sugar industry and further promote their economic competitiveness. This study highlights bioprospecting of glucose for the production of gluconic acid in synthetic medium. Batch fermentation of gluconic acid from glucose was carried out using cells of *Aspergillus niger* NCIM 545. Two methods were followed to maintain the pH of the medium throughout the experiment. Fermentations carried out in a 10 L fermenter resulted in 210 g/L of gluconic acid with a 1.01 g/g glucose yield and a 2.19 g/L/h productivity. This efficacy for gluconic acid production using *Aspergillus niger* NCIM 545 can be commercialised to use surplus sugar of sugar and allied industries. It will allow sugar mills to diversify towards gluconic acid production to improve their profitability.

Keywords: *Aspergillus niger*; Gluconic acid; Calcium gluconate; Batch fermentation; pH control strategies

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN - 978-81-955713-7-6

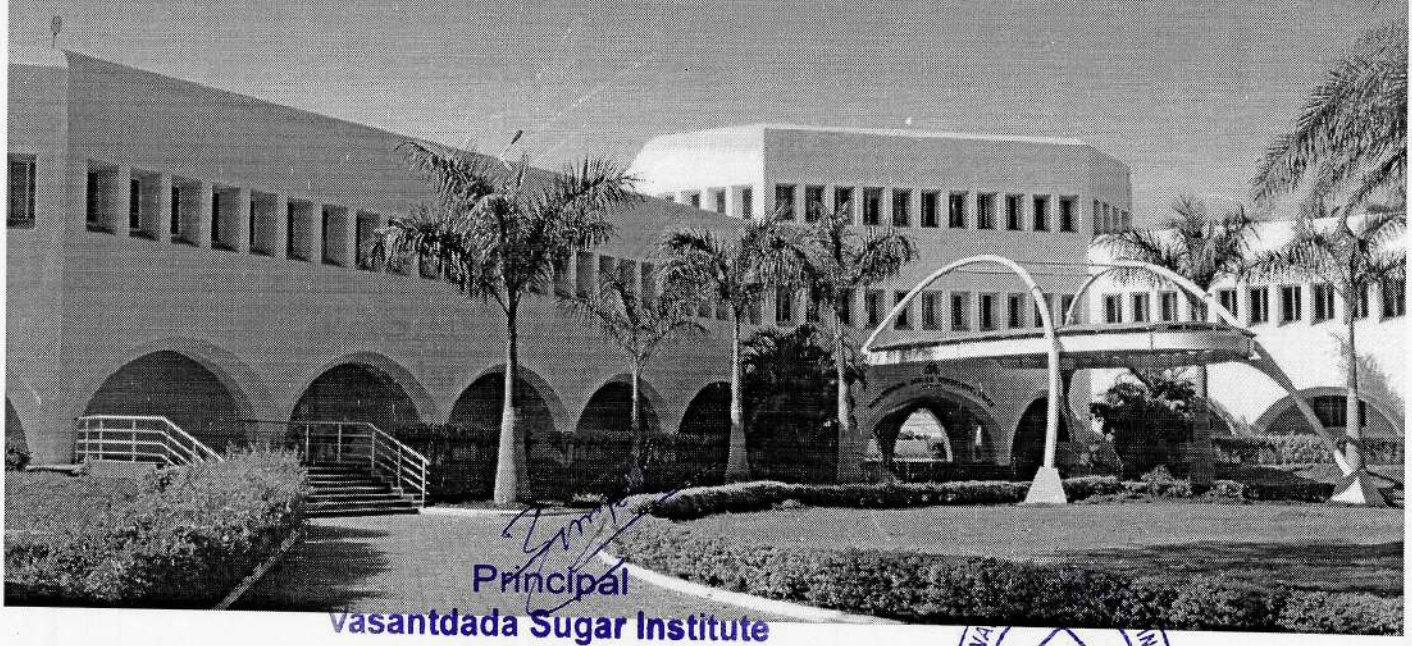
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

TS-GT- 51

Prospects of Hydrogen Production in Sugar & Allied Industry

Sangram Patil, Pranav Nikam, Shuvashish Behera, Pawan Mane, Kakasaheb Konde
Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Pune-412307
sangrampatil579@gmail.com

Green hydrogen can play an important role in diversification of sugar industry product portfolio. It will create additional employment opportunities and pollution free environment for the society. Sugar Industry has plenty of resources which can be exploited to produce green hydrogen. Sugar Industry is looking for economically viable alternatives for utilization of its excess electric power instead of exporting it to the grid. Hydrogen production using water electrolysis with this excess electricity can prove to be a lucrative option for the industry. Also, excess sugarcane bagasse which is available with the sugar mills can be used for hydrogen production through gasification process. Sugar Industry/Distillery is generating biogas using spent wash through anaerobic digestion. This biogas can be converted into hydrogen through Steam Methane Reforming process.

Keywords: Biofuels; Green hydrogen; Sugar & allied industry

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN - 978-81-955713-7-6

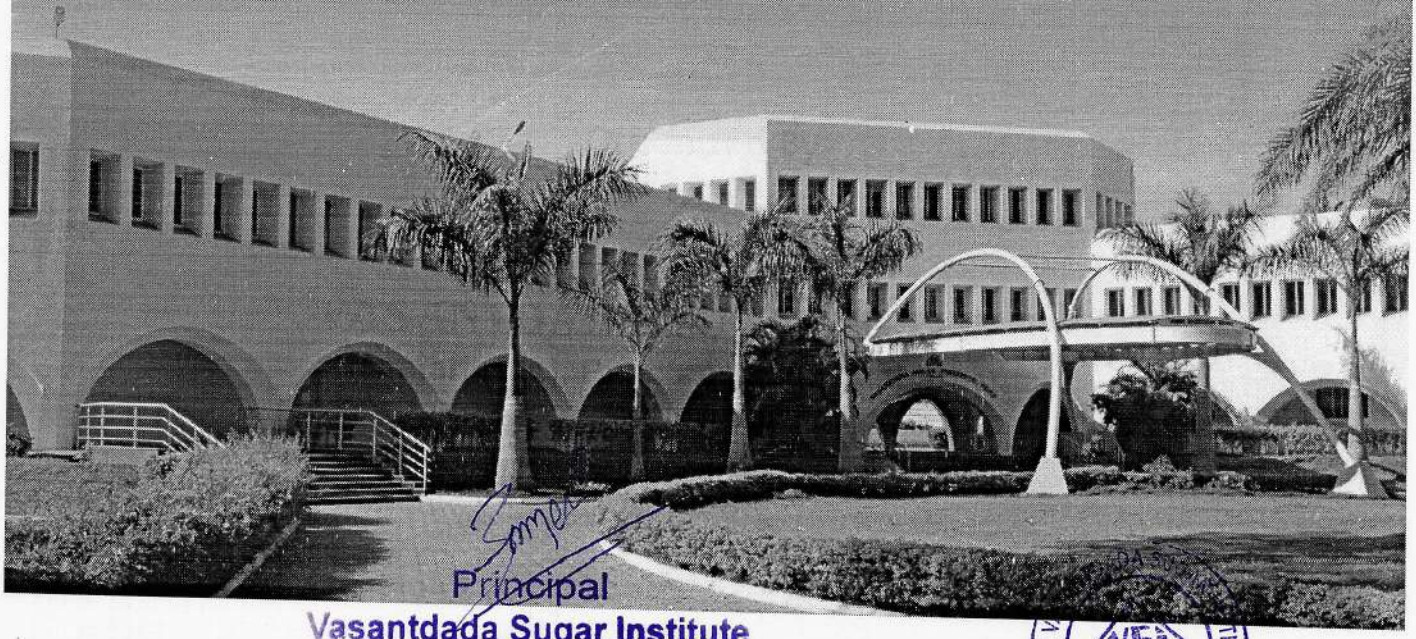
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

TS-GT- 52

Valorisation of Sugarcane Bagasse for L-Lactic Acid Production

Snehal Patil, Ketaki Nalawade, Paharika Saikia, Sneha Patil, Somnath Sutar, Shuvashish Behera, Kakasaheb Konde, Sanjay Patil

Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Manjari (Bk.), Pune-412307, India;

psneha42@gmail.com

The emphasis on high solid loading and concentrated sugar production from lignocellulosic biomass indicates a focus on cost-effectiveness and efficiency, which is crucial for industrial-scale applications. This approach aligns to establish greener and economically viable routes for producing valuable biochemicals like L (+) lactic acid. This study offers a promising avenue for sustainable and economically feasible bio-based LA production. The efficient conversion of sugarcane bagasse into L (+) lactic acid (LA) through a multi-step process involving alkali pretreatment, enzymatic hydrolysis, and fermentation. The present study aimed to hydrolyze alkali pretreated sugarcane bagasse and its successive valorization to L (+) lactic acid (LA). The flask scale optimization was carried out for the hydrolysis of sugarcane bagasse. Lactic acid production was demonstrated from sugarcane bagasse on a shake flask scale. L(+) lactic acid production of 91.9 g L^{-1} with productivity of 2.6 g/L/h was achieved using *Bacillus coagulans*. This study presents a promising pathway for economically feasible and environmentally friendly bio-based LA production from lignocellulosic biomass, specifically sugarcane bagasse. The optimization of enzymatic hydrolysis and fermentation strategies showcases the potential for greener and more sustainable biochemical production processes.

Keywords: Lignocellulosic biomass, Sugarcane bagasse, Lactic acid, Enzymatic hydrolysis

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE
VSI संशोधनेन संवृद्धिः

ISBN - 978-81-955713-7-6

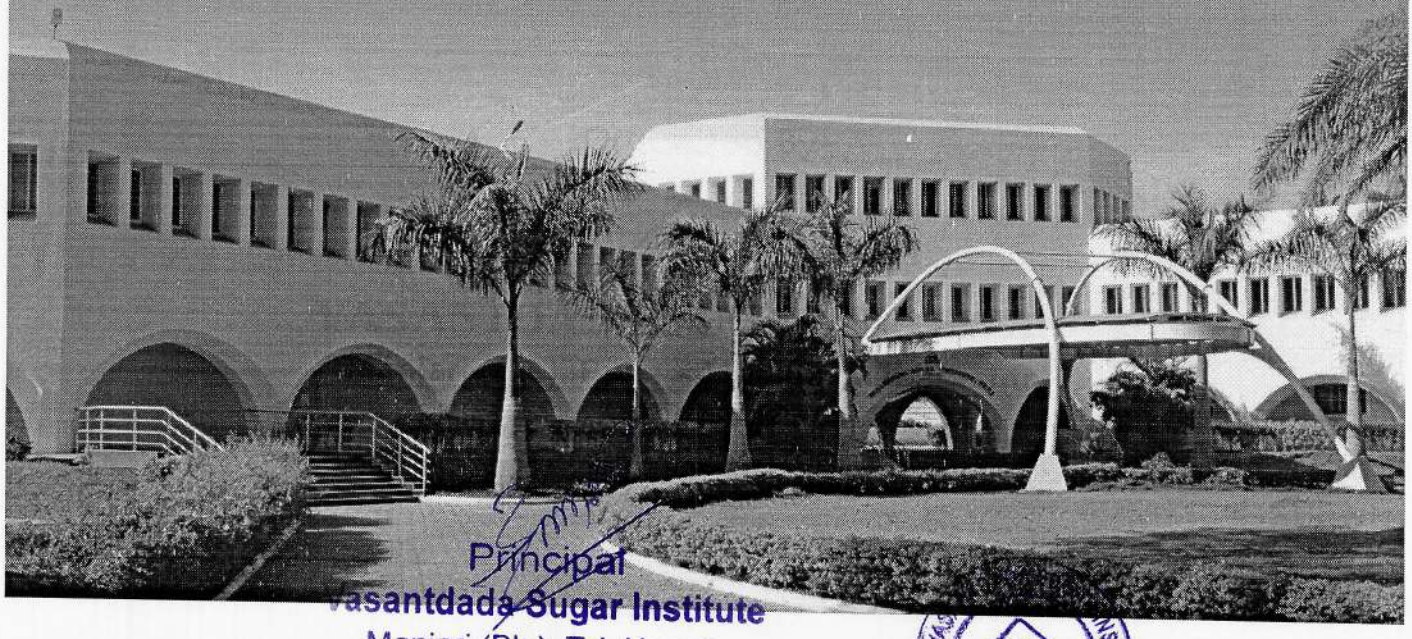
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSi
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

TS-COB- 67

Traditional Vs Scientific Technologies for Mahua Liquor Production

Shuvashish Behera, Pranav Nikam, Harish Pachpute, Santosh Devkar, Vandan Ghule, Dinesh Patil, Kakasaheb Konde and Sanjay Patil

Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Manjari (Bk.), Pune-412307, India

behera.shuvashish@gmail.com

Mahua tree (*Madhuca latifolia* L.), has been domesticated by tribal people in India for use as food (flower), feed (leaf, flowers), wood (timber), oil (seeds) & beverage (flowers) locally called Mahua or Mahuli. However, collection, transportation, storage, fermentation and distillation process by the tribal people involves traditional processes which involve post-harvest losses during transportation from forest to local market and up to storage. Mahua flower has potential as the substrate for making good quality liquor. The flavour of the fresh Mahua flower is due to its sweet taste and good odour.

There is tremendous scope for production of Mahua liquor by performing scientific study for Mahua flower/juice fermentation and distillation. In our current study, batch fermentation & distillation experiments were conducted to develop a process for Mahua liquor production through optimization of different growth and fermentation parameters. Maximum 6.5% (v/v) ethanol concentration could be achieved through fermentation process. After single distillation process, the values of impurities of the Mahua liquor are within the limit of FSSAI for potable alcohol & achieved 36% (v/v) of alcohol concentration was achieved. As per the sensory analysis, the produced Mahua liquor was suitable for potable purposes. Based on VSI lab-scale technology, Govt. of Madhya Pradesh successfully established 2 demo plants at Alirajpur & Dindori District under scientific guidance of VSI.

Keywords: Mahua flowers; Mahua liquor; Batch fermentation; Single distillation

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE
VSI
संशोधनेन संवृद्धिः

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

संशोधनेन संवृद्धिः

VASANTDADA SUGAR INSTITUTE

Manjari (Bk.), Pune - 412 307; Maharashtra.

Phone : (020) 26902100; Fax :(020) 26902244;

E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

TS-COB- 69

Sugarcane Syrup Production Through Inversion: An Alternative Substrate for Ethanol Production in Sugar and Allied Industries

Shuvashish Behera, Tejaswini Patil, Kakasaheb Konde, Sanjay Patil

Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Manjari (Bk.), Pune-412307, India

behera.shuvashish@gmail.com

Diversification of the product portfolio of sugarcane biorefineries through the use of sugarcane syrup for the production of ethanol throughout the year will provide significant economic return to the Sugar and Allied Industries and further promote their economic competitiveness. Therefore, study was carried out to enhance the inversion efficiency (%) through optimizing different parameters like acid concentration, enzyme concentration, temperature and reaction time for sugarcane juice inversion. With the optimized conditions, it was possible to get 100% inversion efficiency at 120 min and 350 min reaction time, respectively for acid and enzyme method. It was also possible to get 93.47% inversion efficiency at 550 min reaction time through invertion of sugarcane syrup containing 60% of sucrose concentration. Further the syrup could be stored up to 10 Months of duration which is a good sign for Industries for its use during off-season for ethanol production.

Keywords: Sugarcane juice; Sugarcane syrup; Inversion; Hydrochloric acid; Invertase; Sucrose; Glucose; Fructose

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

TS-COB- 63

Bioprospecting of Sugarcane Juice for Ethanol Production

Dinesh Patil, Shuvashish Behera, Sangram Patil, Pranav Nikam, Kakasaheb Konde
Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Pune-412307
dineshvsi80@gmail.com

The sugar industry is passing through a very significant transformation in view of increasing sugar stocks and proactive steps have been taken by the Government of India to maximize the production of ethanol. Government of India took a policy decision to continue ethanol blending programme (EBP) and has fixed target of 20% blending of fuel ethanol with petrol by 2025. It is possible to divert substantial quantity of sugar through ethanol production from syrup. Ethanol payment is made by OMCs within 21 days. Due to priority lifting by OMCs and better price for ethanol from sugarcane juice/syrup, it provides golden opportunity for sugar industry to divert sugar to ethanol. Thus, ethanol production will help to reduce the increasing sugar stocks in the country. There are also indirect benefits of ethanol production from sugarcane juice/syrup such as increasing in crushing capacity, reduction in steam consumption (bagasse saving) in sugar mill, higher export of power, saving in handling & bagging charges of sugar and reduction in interest burden on sugar stocks

Keywords: Sugar mills, Sugarcane juice; Ethanol; Sugar stocks

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN-978-81-955713-7-6

TS-COB- 70

Process for The Production of Acetic Acid from Neera and Development of Kit for Detection of Toddy Adulteration

Shuvashish Behera, Vandan Ghule, Digvijay Sangle, Arati Pawase, Pratima Jadhav, Nandita Naik, Somnath Sutar, Dinesh Patil, Kakasaheb Konde, Sanjay Patil

Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Manjari (Bk.), Pune-412307, India

vandanpg@gmail.com

Neera is fresh sap & the main product of mature Wild date palm (*Phoenix sylvestris*), locally known as Khejur. Sap is either consumed as fresh juice or processed into a broad array of products, including syrup, vinegar, organic acids, sugar, wine and distilled liquor due to its high sugar contents. Fresh palm sap is obtained by the process known as tapping, which is clear, sweet in taste, neutral in pH and contains sugar in the form of sucrose. Neera, on the other hand, has a short shelf life and is to be consumed within a time frame. The sap (neera) cannot be stored in room temperature after its harvesting which causes natural fermentation to form sweet, milky white and mild-alcoholic drink called as tari/toddy. Sometime, toddy becomes sour taste which causes postharvest losses. Due to the increase in consumer demand, toddy is diluted & adulterated with chemical substances which are considered to be dangerous & proved to be fatal poisoning. The adulterated toddy is prohibited for consumption under the laws of Excise, which necessitates the development of suitable analytical methods for detection of adulterants. Neera can also be used for the production of some value-added product such as palm vinegar or acetic acid using acetic acid bacteria. Thus, VSI is working in the direction of exploitation of neera which will provide a solution to nutrition, livelihood and economic security of tribals by using available traditional wisdom as well as modern processing technology.

Keywords: Neera; Palm sap; Toddy; Acetic acid

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN - 978-81-955713-7-6

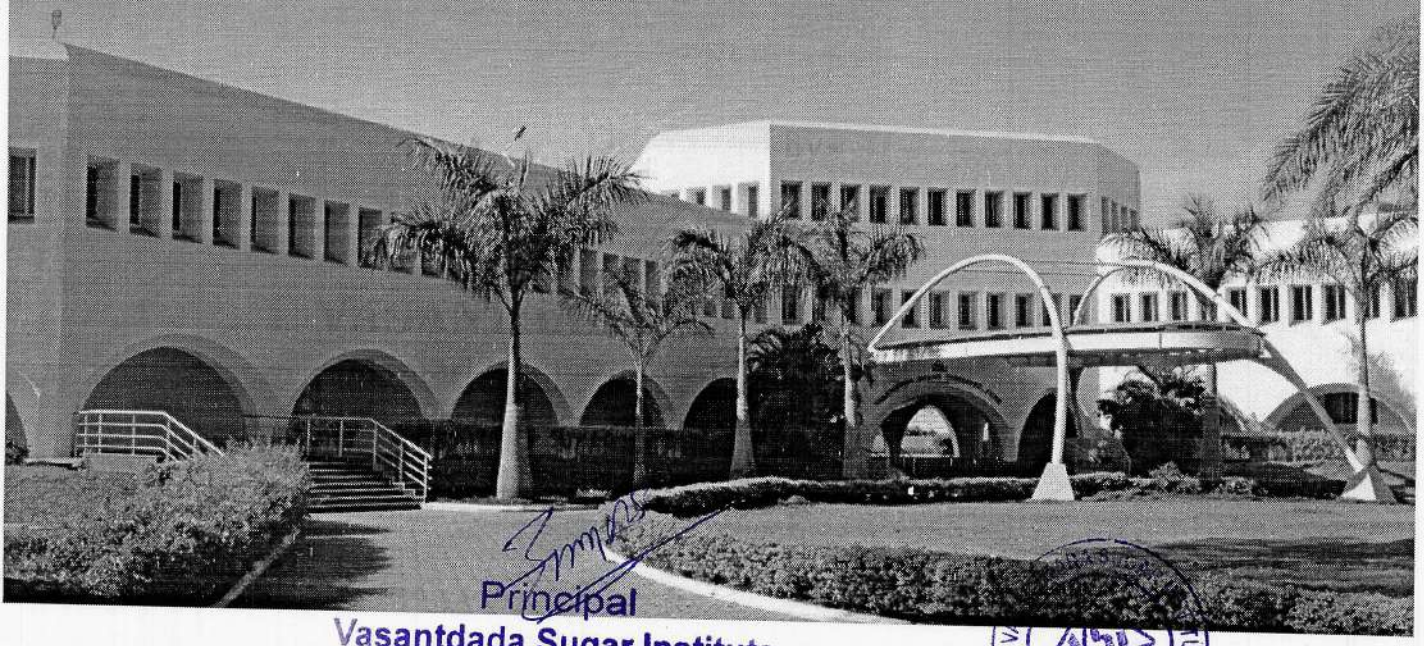
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

3rd International Conference & Exhibition on Sustainability: Challenges & Opportunities in Global Sugar Industry

TS-GT- 44

CBG Opportunity in Sugar Industry: Biomethantion of Press Mud Cake for Biogas Production

Kalyan Gaikwad[1], *R. V. Burase*[2], *Somnath Sutar*[2]

[1]Nira Bhima SSK Ltd, Shahajinagar, Po: Redni, TaL: Indapur, Dist. Pune 413 114

[2]Vasantdada Sugar Institute, Pune, India

nirabhima@rediffmail.com

India imports nearly 50% of natural gas requirement, leading the GoI to set a target of reducing this import by at least 10% by 2022. GoI is promoting Waste / Biomass sources like agricultural residue, cattle dung, PMC, municipal solid waste and sewage treatment plant waste, etc. for production of biogas. Through Sustainable Alternative towards Affordable Transportation, OMCs have invited Expression of Interest from Entrepreneurs/Co-operative societies/ Technology provider for production & supply of compressed biogas (CBG). EoI call is aimed at supporting the phased setup of 5000 biogas plants spanning across India. Ministry of New and Renewable Energy, GoI has notified Central Financial Assistance of Rs. 4.0 crore per 4800 kg of CBG per day with maximum assistance of Rs. 10.0 crore per project for CBG production. GoI has announced the basic price of attractive price for CBG. Recently, the Reserve Bank of India has also included CBG plants under priority sector lending. As per the notification from the Department of Agriculture and Farmers Welfare, GoI, the fermented organic digestate coming out from digester of PMC/SCB/other agro-wastes is now approved as organic manure in Fertilizer Control Order. Considering initiatives taken by GoI, CBG production seems to be next golden opportunity for sugar industry to diversify in value added renewable Bio-fuels. In view of this, VSI has conducted lab scale anaerobic digestion (AD) study on 200 L scale for biomethanation of press-mud cake (PMC) and achieved biogas generation of 120 m^3/MT of PMC. At Nira Bhima SSKL, Pilot scale AD trials was conducted on 50000 L scale for one year. Biogas generation of 100 m^3 per MT of PMC was achieved on pilot scale.

Keywords: PMC; Biogas; CBG; Biomethantion.

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN - 978-81-955713-7-6

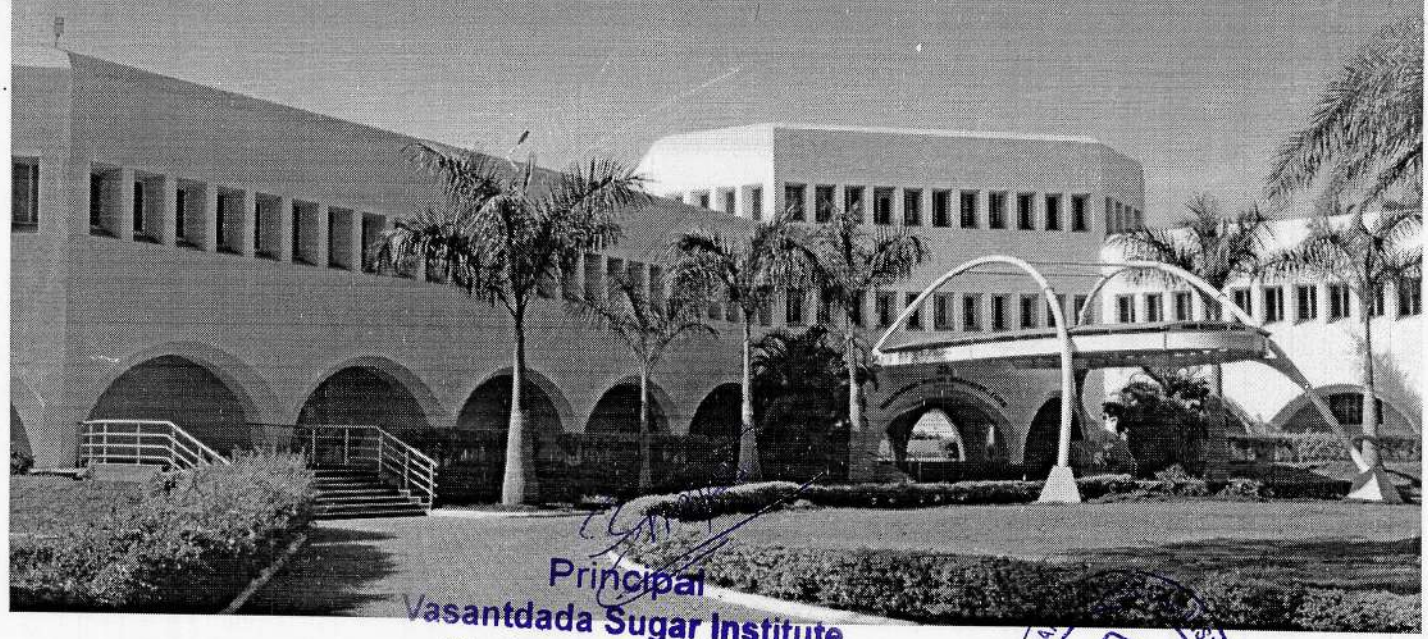
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

ISBN-978-81-955713-7-6

TS-GT- 54

Wax Recovery from Press Mud Cake: Value Addition Product for Sugar Industry

Sangram Patil, Sneha Patil, Rohini Gore, Jaylaxmi Patil, Kakasaheb Konde
Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Pune-412307
sangrampatil579@gmail.com

Presently, the supply of sugar in world market is surplus resulting in depressed international price of sugar. Therefore, there is pressure on the sugarcane industry to diversify in other value-added products from sugarcane for sustainability. There is considerable economic interest in the development of technologies for development of byproducts in sugar mills. The by-products produced during sugar manufacturing are having promising source of compounds, that can be used for their chemical, medicinal and biological potential. Press mud cake (PMC) is a dark fibrous solid residue obtained after removal of clarified juice from the mixed raw juice. Sugar mills generate PMC at the rate of 4% of cane which can be a potent supplier of various high value byproducts. The wax extracted from the press mud cake (PMC) can become a promising candidate of natural wax.

Keywords: Natural wax; Sugar industry; Sustainability; Press mud cake.

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN - 978-81-955713-7-6

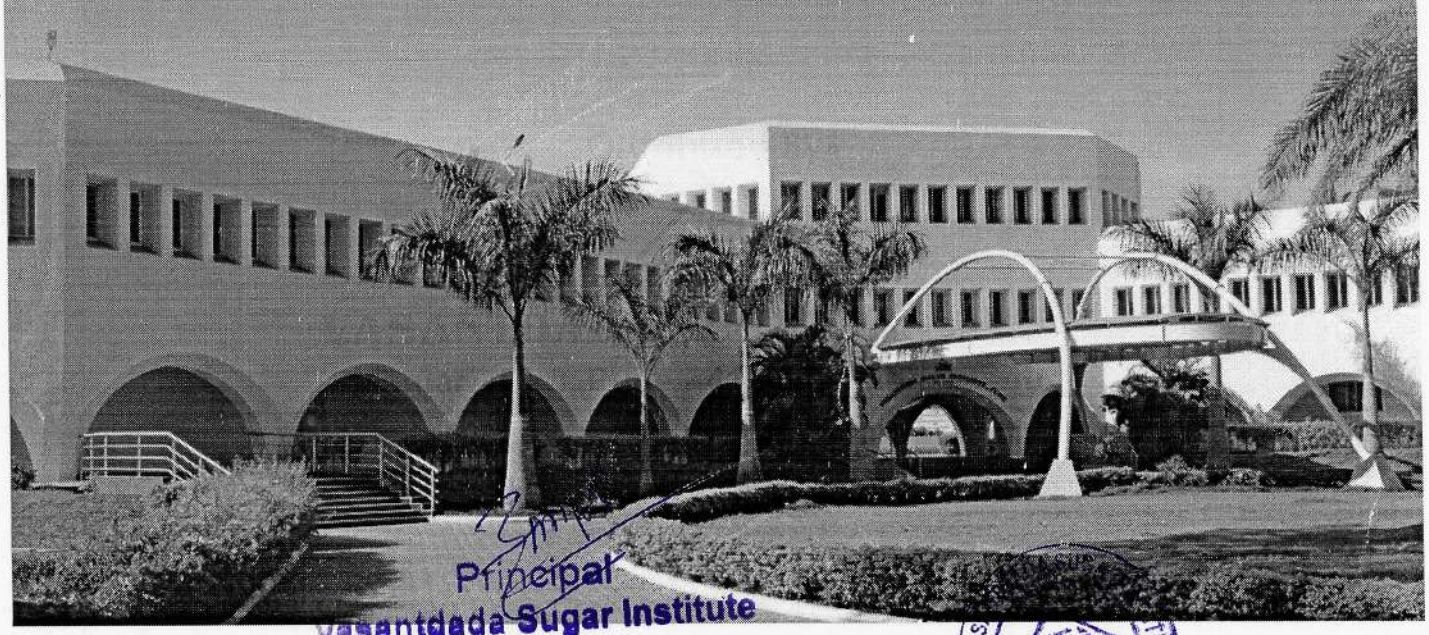
Proceedings of
3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN-978-81-955713-7-6

TS-COB- 64

Cost Benefit Analysis: Production of Ethanol from Grains & Sugarcane-Based Feedstock

Dinesh Patil, Nitesh More, Kakasaheb Konde
Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Pune-412307
dineshvsi80@gmail.com

With cane syrup/molasses as a feedstock, the use of B-heavy molasses/syrup seems to be future options for production of fuel ethanol and for reducing sugar stocks. The dryer route looks to be more attractive as compared to incineration route but the technology is in the phase of maturation. The financial parameters such as payback period, BEP and IRR are way superior in case of dryer route. With grain as a feedstock for ethanol, the financial parameters such as payback period, DSCR, BEP and IRR are lower favorable and higher capex as compared to sugarcane. Grain ethanol is not financially viable in Maharashtra but grain ENA is attractive due to policy of GoM for mandatory mixing of 40 % grain ENA in potable liquors. Profitability of ethanol from grain depends on price of grain, DDGS and boiler fuel. For grain-based distillery, ethanol production not seems to be viable for damaged grain price above Rs. 21,000/MT. When sugar has better export market, grain ethanol can be supplementary to sugar ethanol.

Keywords: B-heavy molasses; Sugarcane syrup; Ethanol; Cost benefit analysis

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE
VSI संशोधनेन संवृद्धिः

ISBN - 978-81-955713-7-6

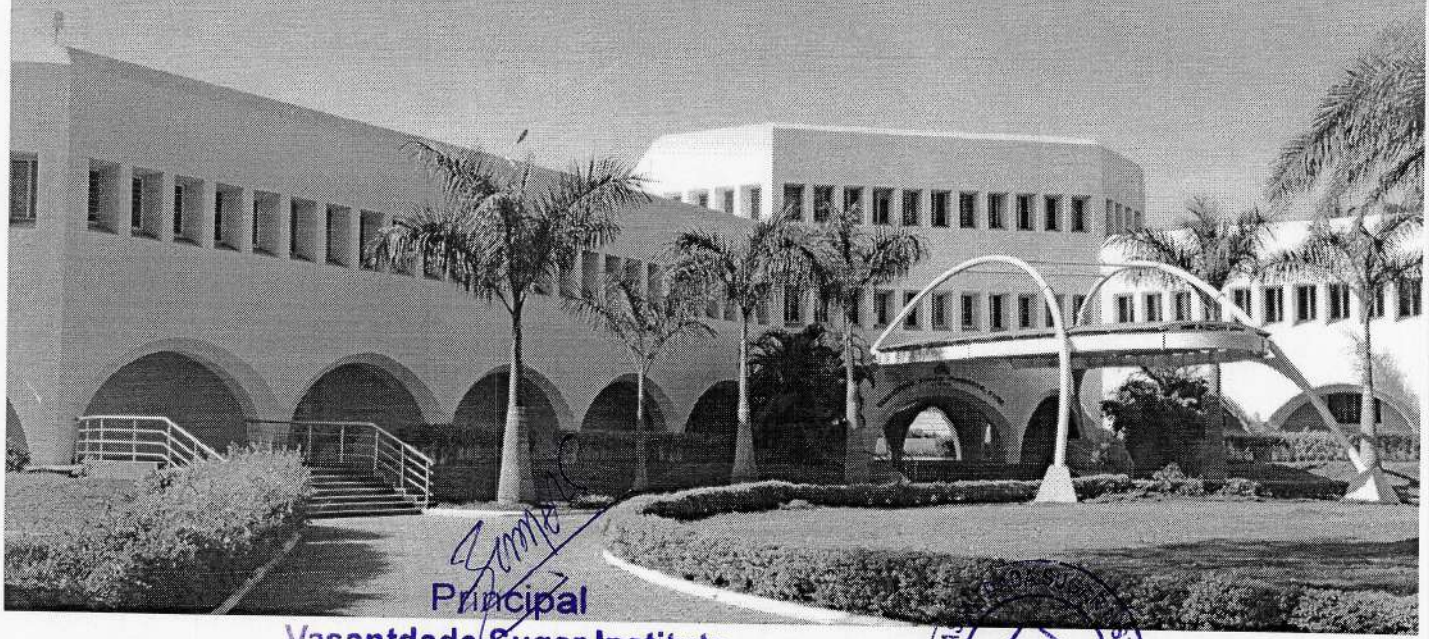
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN-978-81-955713-7-6

TS-COB- 65

Cane Juice/Syrup to Ethanol: Opportunities for Dryer Technology in Distillery

Vishal Deshmukh, Pranav Nikam, Dinesh Patil, Kakasaheb Konde
Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Pune-412307
vishaldeshmukh1111@gmail.com

Spent wash is being generated by distilleries during the distillation and fermented molasses to ethyl alcohol using specific strains of yeast. It is a dark brown coloured liquid containing residual nutrients from cane juice or Syrup or B-Heavy or C-Heavy Molasses and yeast cells does not contain any heavy metals or other toxic residues. In case of sugar cane juice/syrup as a feedstock for production of ethyl alcohol, the quantity of spent wash generated liter per liter of total alcohol production is about 3 L to 5 L and having low organic and inorganic load. Spent wash drying is an alternative option for management of spent wash to achieve Zero Liquid Discharge (ZLD). The zero discharge of spent wash will be achieved and biomethanated spent wash potash powder will be generated. This potash powder is used as fertilizer and result in additional revenue generation.

Keywords: Ethanol; Sugarcane juice; Zero liquid discharge; Drying; Biomethanated spent wash powder (BMSW)

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE
VSI संशोधनेन संवृद्धिः

ISBN - 978-81-955713-7-6

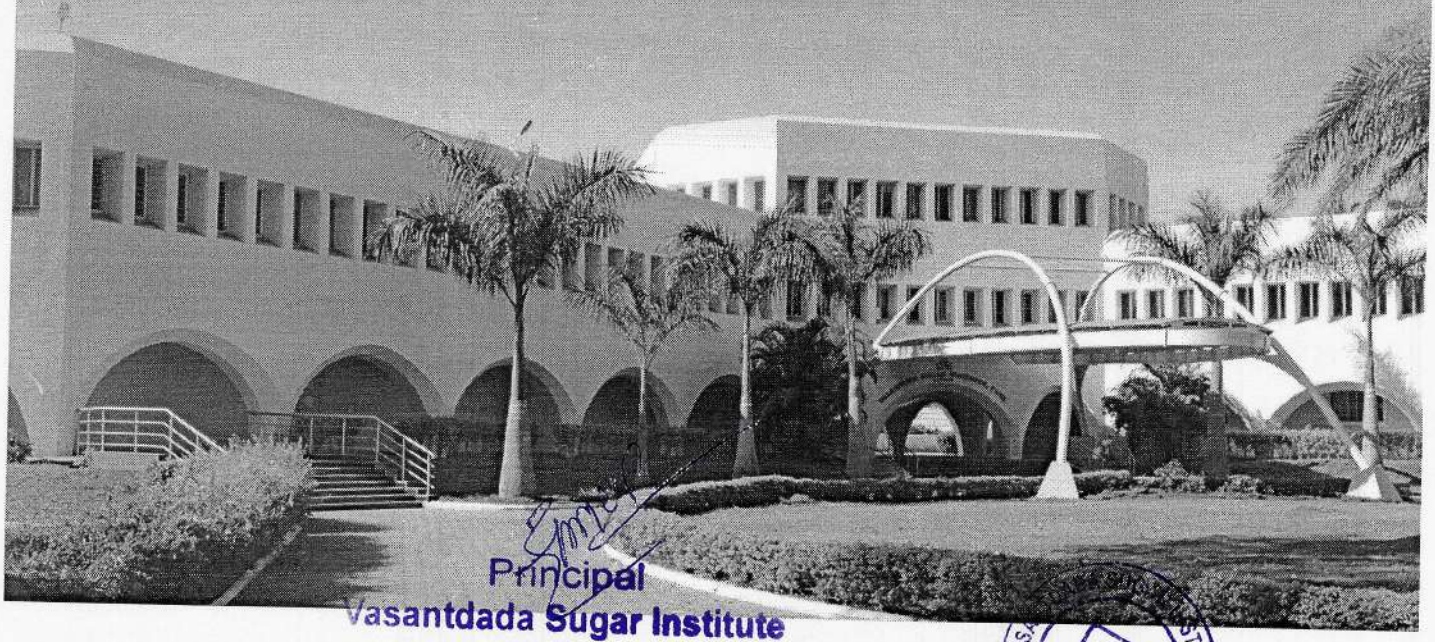
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

ISBN-978-81-955713-7-6

TS-COB- 66

Advanced Technologies for Distillery Plant and Its Downstream Processes

Rajendra Godage, Pranav Nikam, Vishal Deshmukh, Kakasaheb Konde
Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Pune-412307
godagerajendra@gmail.com

The sugar industry is passing through a very significant transformation in view of increasing sugar stocks and proactive steps have been taken by the Government of India to maximize the production of ethanol. This study, conducted by the Department of Alcohol Technology and Biofuels at Vasantdada Sugar Institute, focuses on three advanced technologies—Air Cooled Heat Exchangers (ACHEs), Mechanical Vapour Recompressor (MVR), and Thermal Vapour Recompressor (TVR)—to enhance energy efficiency in distillery plants and downstream processes. Air Cooled Heat Exchangers (ACHEs) are highlighted as a green solution, eliminating water requirements for cooling in draught-prone areas. Mechanical Vapour Recompression (MVR) technology emerges as a pivotal tool for efficient industrial waste effluent treatment. Thermal Vapour Recompression (TVR) technology is introduced as a system utilizing high-pressure steam ejectors to recycle vapor, reducing steam consumption in evaporation. As the industry moves towards compliance with stringent water consumption norms, these technologies offer sustainable and effective solutions.

Keywords: Ethanol blending program; Advanced technologies; Distillery plant

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN - 978-81-955713-7-6

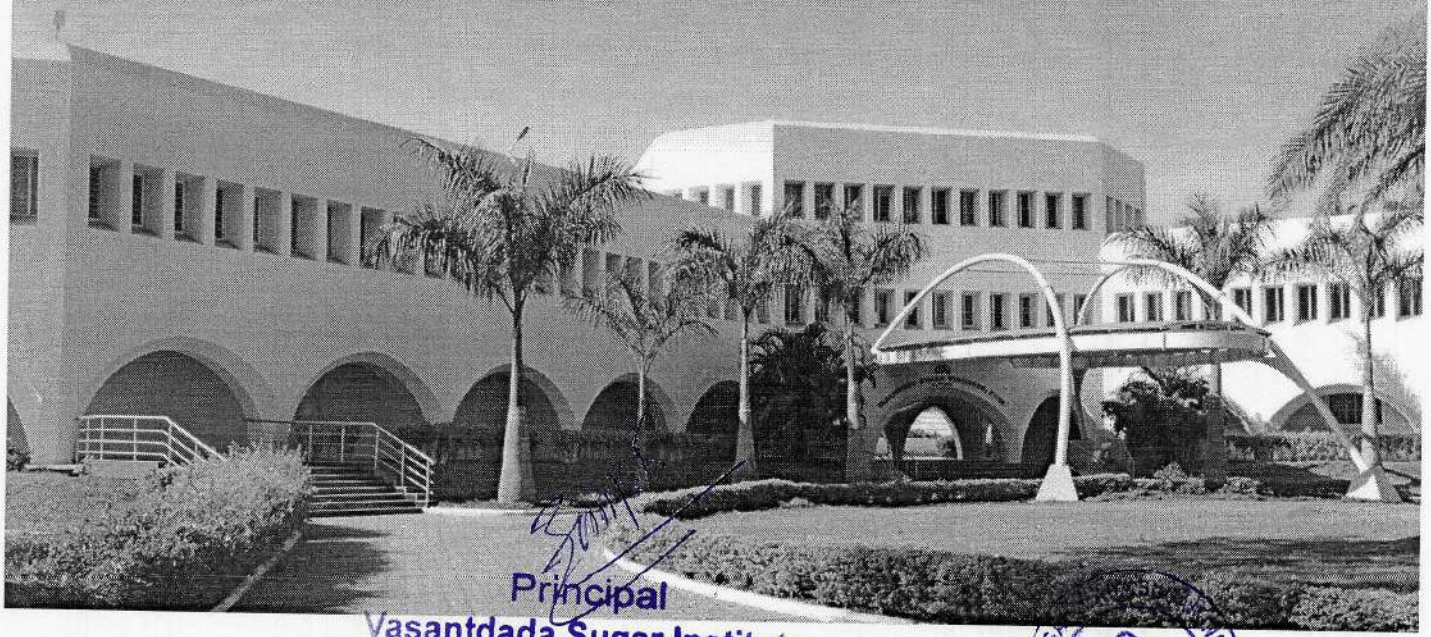
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

ISBN-978-81-955713-7-6

TS-COB- 71

Malt Spirit Maturation Study by Using Advance Analytical Techniques

Nandita Naik, Vandan Ghule, Sukeshani Havale, Suresh N.S.*, Kakasaheb Konde
Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Pune-412307
*United Spirits Ltd., Bangalore-560066
nanditanaik27@gmail.com

Spirit-based beverages are alcoholic drinks; their production processes are dependent on the type and origin of raw materials. Over the last 50 years there has been considerable analytical research on the malt parameters which govern the flavour and aroma. In the production of alcoholic beverages, one of the most important contributors to the final quality of the product is the oak container in which maturation takes place. During the time the spirit spends in oak barrels, major changes occur in its sensory character.

The composition of this complex matrix is difficult to analyze, and scientists commonly prefers gas chromatography and GCMS-HS techniques for this reason. In the present work, the current technical understanding of the maturation process and describes the main variables that influences product quality is overviewed. Current control of the maturation process is achieved by the careful selection and sourcing of casks and their reuse. With a wide selection of methods and detectors it is possible to provide qualitative and quantitative analysis for conclusion of malt spirit maturation by using advance analytical techniques.

Keywords: Spirit-based beverages; Maturation; Flavors and aroma; Gas chromatography, GCMS-HS

संशोधनेन संवृद्धिः

Principal
Vasantdada Sugar Institute
Manjari (Bk.) Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN - 978-81-955713-7-6

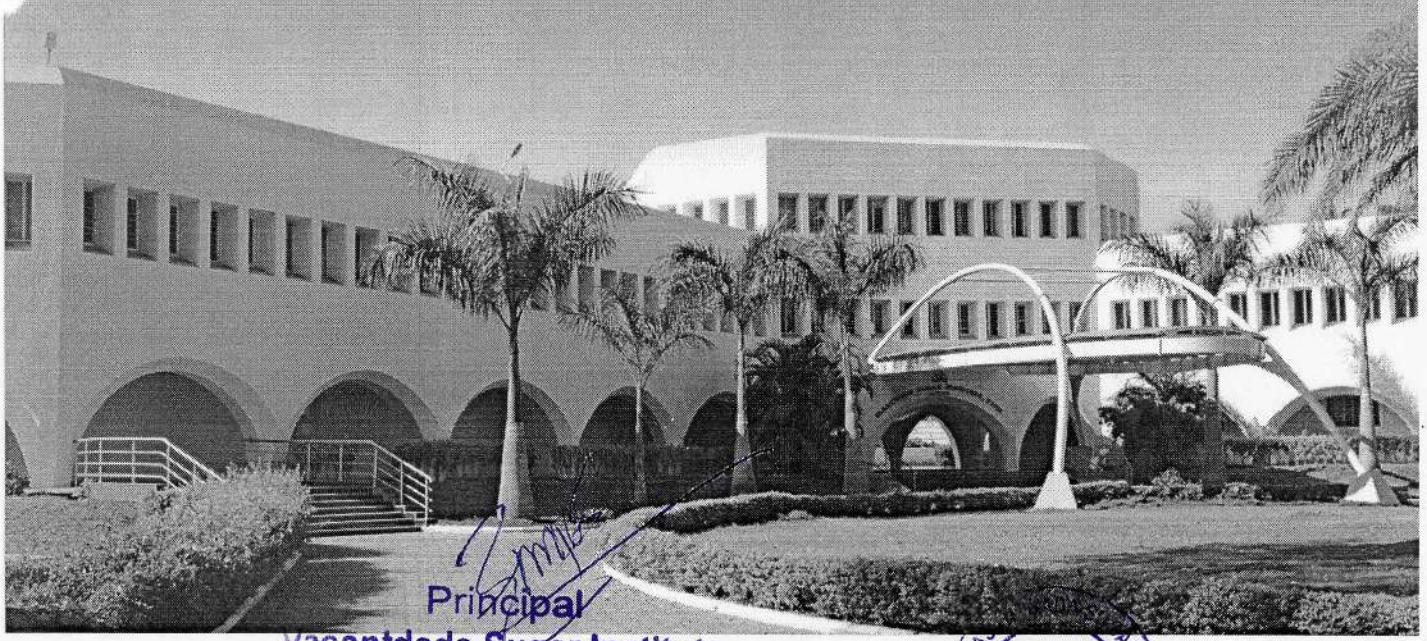
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

ISBN-978-81-955713-7-6

TS-COB- 72

Separation of Cation and Anion by Ion-Chromatography Technique In Cane Molasses

Sukeshani Havale, Nandita Naik, Sonali More, Kakasaheb Konde
Department of Alcohol Technology and Biofuels, Vasantdada Sugar Institute, Manjari (Bk.), Pune-412307, India;
landgesukeshani@gmail.com

A fast method for the determination of anion and cation in cane molasses by the use of suppressed or non-suppressed ion chromatography (IC) with conductometric detection has been developed. The use of ion chromatography is demonstrated to determine anions (Chloride, Phosphate, and Sulphate) and cations, (Sodium, Potassium, Calcium and Magnesium) in cane molasses. IC analysis include clarification, and degradation of molasses.

The technique is based on electrostatic interactions between charged fragments on the surface of molecules and oppositely charged functional groups bound to a stationary phase. It is a surface process that occurs between the contact of an ionic solid and a solution. The method has good validation metrics such as sensitivity, selectivity, precision.

Key words: Ion chromatography, Cane molasses, Anionic and Cationic profile

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE
VSI संशोधनेन संवृद्धिः

ISBN - 978-81-955713-7-6

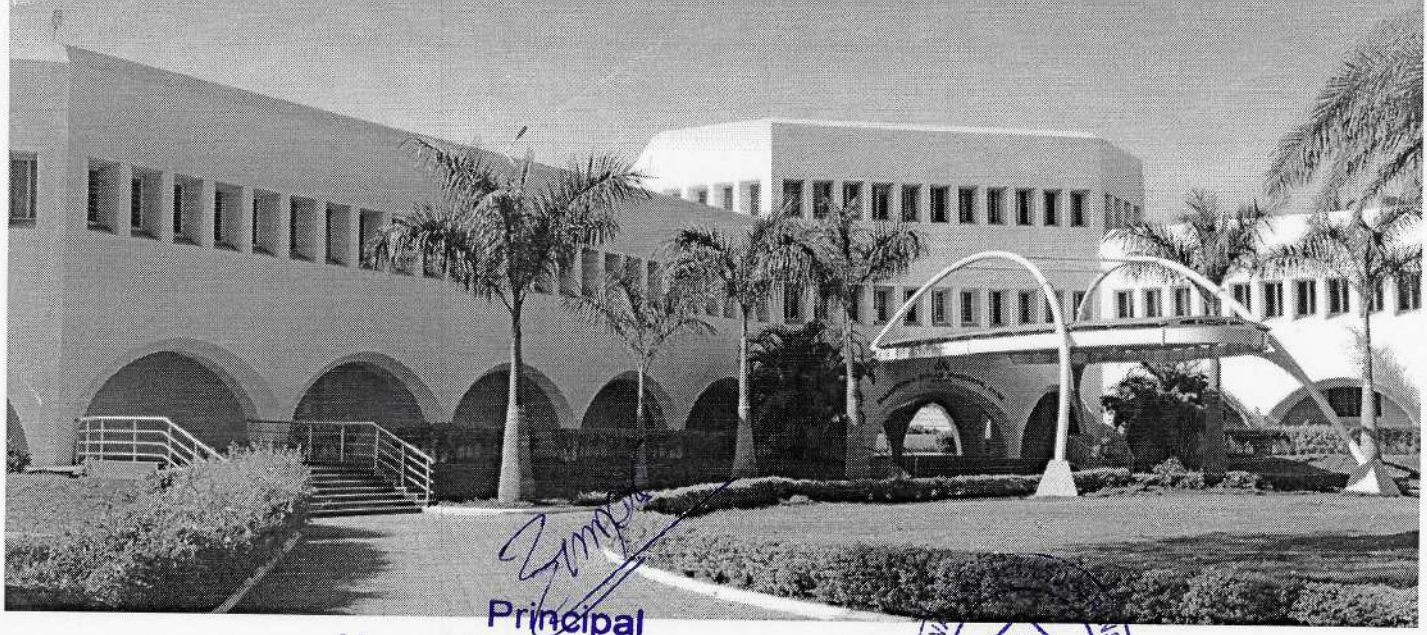
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

TS-ES- 80

Excess Sugar Condensate as an Alternative Source of Fresh Water

Eknath Alhat, Kapil Uphade, Deepali Nimbalkar, Bhushan Madke, Somesh Gaikwad
Department of Environmental Sciences, Vasantdada Sugar Institute, Manjari (Bk), Haveli, Pune 412 307
ealhat1vsi@gmail.com

Sugar cane contains approximately 70% water, which is released as condensate during the sugar cane manufacturing process. This has led to the sugar industry being referred to as a water-generating industry. India stands as the world's second-largest sugar producer, with an annual average of 300 to 350 Lakh Metric Tonnes (MT) of cane crushed during the crushing season. Considering the 70% water content in cane, approximately 210 to 245 Lakh MT of water is available in the form of vapour condensate from the sugar cane. The Central Pollution Control Board (CPCB) of the Government of India has mandated the sugar industry to treat excess condensate using a condensate polishing unit and recycle it back into the manufacturing process. However, it remains impractical to recycle the treated condensate in boilers and other industrial processes. This study involved passing the treated condensate through a 2 m3/hr capacity Ultrafiltration (UF) system followed by a Reverse Osmosis (RO) plant, utilizing two stages to assess its quality. The permeate and reject water were analysed for pH, dissolved solids, hardness, Chemical Oxygen Demand (COD), chlorides, and sulphate content. The findings indicated that the permeate water exhibited a pH range of 8.9 to 7.3, with Total Dissolved Solids (TDS) at 10 mg/l, hardness at 5 mg/l, COD at 4 mg/l, chlorides at 2 mg/l, and sulphate content at 0.2 mg/l. The properties of the permeate water were compared to the standards outlined in IS1050

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

TS-ES- 81

Method to Dispose Dried Spent Wash Through Brick Manufacturing

Kapil Uphade, Eknath Alhat, Deepali Nimbalkar, Somesh Gaikwad
Department of Environmental Sciences, Vasantdada Sugar Institute, Manjari (Bk), Haveli, Pune 412 307
kapilevsvsi@gmail.com

The Indian government introduced the ethanol blending program in 2003 and further amended it in 2018, which significantly accelerated the production of ethanol. This initiative aimed to boost the existing distillery production capacity and establish new distilleries. The distillery industry, affiliated with the sugar industry, benefits from the abundant availability of raw materials such as cane juice, sugar syrup and molasses. During the ethanol manufacturing process, approximately 4 - 8 liters of effluent, known as spent wash, is generated per liter of ethanol produced depending on the feed stock. This spent wash contains notably high concentrations of organic and inorganic pollutants, contributing to adverse environmental effects. In India, the Central Pollution Control Board (CPCB) and the Ministry of Environment, Forest, and Climate Change (MoEFCC) issued guidelines to achieve zero liquid discharge (ZLD) in molasses-based distilleries. To comply, many distilleries are adopting technologies such as evaporation followed by drying of spent wash to attain ZLD. The resultant dried spent wash powder contains a considerable amount of potassium, ranging from 15 to 22%, and serves as a high-quality, high potash manure. However, the market demand for this dried spent wash is not commensurate with its production. This study explores the utilization of dried spent wash powder in the formation of concrete bricks at proportions of 25% and 50% with other material, comparing the resulting bricks with regular concrete bricks. Both types of bricks underwent analysis for parameters including water absorptive test, compressive strength, and characteristics of leached organic and inorganic pollutants in the water.

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

संशोधनेन संवृद्धिः

VASANTDADA SUGAR INSTITUTE

Manjari (Bk.), Pune - 412 307; Maharashtra.

Phone : (020) 26902100; Fax :(020) 26902244;

E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

TS-ES- 85

Green Technology: Hydrogen Generation Through Sugar Mill Effluent Treatment

Amol Deshmane, Ujwala Salunkhe
Department of Environmental Sciences, Vasantdada Sugar Institute, Manjari (Bk), Haveli, Pune 412 307
amoldeshmane.vsi@gmail.com

Effluent treatment, featuring the versatile algal strain *Chlorella vulgaris,* emerges as a beacon for sustainable environmental remediation and renewable resource extraction. This study investigates the symbiosis between *Chlorella vulgaris,* sugar mill effluent (SME), and the nuanced dynamics of biomass-driven hydrogen generation, aiming to contribute substantively to global environmental and energy paradigms.

Initial experiments showcase *Chlorella vulgaris's* transformative impact on SME constituents, achieving remarkable reductions in COD, pH, and EC. A brief 6-day treatment period witnesses a notable 91% COD reduction alongside substantial algal biomass increase, eliminating effluent odors.

This study unveils the transformative potential of *Chlorella vulgaris* in treating sugar mill effluent (SME) and unlocking a cascade of valuable outcomes. Experimental results spotlight a substantial accumulation of carbohydrates, notably observed at 630nm, indicative of an intricate interplay between *Chlorella vulgaris* and the effluent. The high carbohydrate content, as a hallmark of glycolysis, sets the stage for subsequent theoretical calculations, revealing an estimated release of approximately an average 800 joules per ppm of biomass through hydrogen molecules.

To deepen our understanding of the molecular intricacies, we delve into the theoretical framework of glycolysis. Glyceraldehyde-3-phosphate dehydrogenase (GAPDH) and pyruvate kinase, pivotal enzymes in the glycolysis pathway, play a key role in producing NADH and ATP, respectively. Literature survey shows that 4 hydrogen molecules are released per glyceraldehyde-3-phosphate molecule, reinforcing the linkage between effluent treatment and hydrogen generation. For future perspectives, introducing elements that prevent the bond between NAD+ and hydrogen could enhance its release (H+), providing valuable insights into sustainable energy production.

Keywords: Sugar Mill Effluent, Green Hydrogen, *Chlorella*

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

AST-SI-P25

A Prominent Role of the ATL-NCS-TCP Project in Ensuring Testing, Certification, and Micropropagation of Virus-Free Commercial Elite Clones

*Atul Kumar, Madhavi Y. Ghan, and R. M. Devarumath**
Vasantdada Sugar Institute, Manjari (Bk.), Taq. Haveli, Dist. Pune, Maharashtra, India 412 307
rm.devarumath@vsisugar.org.in

Plant tissue culture is revolutionizing agriculture on a large scale for the rapid propagation of elite clones of commercial crops. Recognizing the potential of plant tissue culture (TC) in the green revolution of India, the Ministry of Science and Technology, Government of India, established a National Certification System under the umbrella of the Department of Biotechnology (DBT) and National Institute for Plant Genome Research (NIPGR) called the National Certification Systems for Tissue Culture Raised Plants (NCS-TCP). The primary goal of this project is testing and certification of virus-free quality planting materials through the platforms known as Accredited Test Labs (ATLs). Vasantdada Sugar Institute (VSI), Pune, is one of five national ATLs under NCS-TCP project working effectively for testing and certification of major cash crops, viz., banana, date palm, gerbera, and sugarcane (in-house). Under the ATL-NCS-TCP project, the virus indexing of banana viruses viz., BSV and BBTV, was assessed through duplex PCR. The diagnosis of SCYLV and SCMV of sugarcane was carried out through RT-PCR, and the detection of SCBV was done through PCR. Similarly, phytoplasma detection in date palm and sugarcane was accomplished through nested PCR. Likewise, the DAS-ELISA test was implicated for the diagnosis of BBrMV and CMV in banana and for the detection of CMV in Gerbera. On the other hand, the genetic fidelity testing of banana, date palm, and sugarcane TC plants was performed through PCR using ISSR molecular markers. ATL-VSI, Pune, facilitated the testing of about 22 thousand mother plant samples from various tissue culture production units across India and certification of about 91 thousand plant samples which reflect for nearly 9 crores of actual distributed TC quality plants in the period of 2022-2023, that would ultimately empower the farmers and their livelihoods.

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN - 978-81-955713-7-6

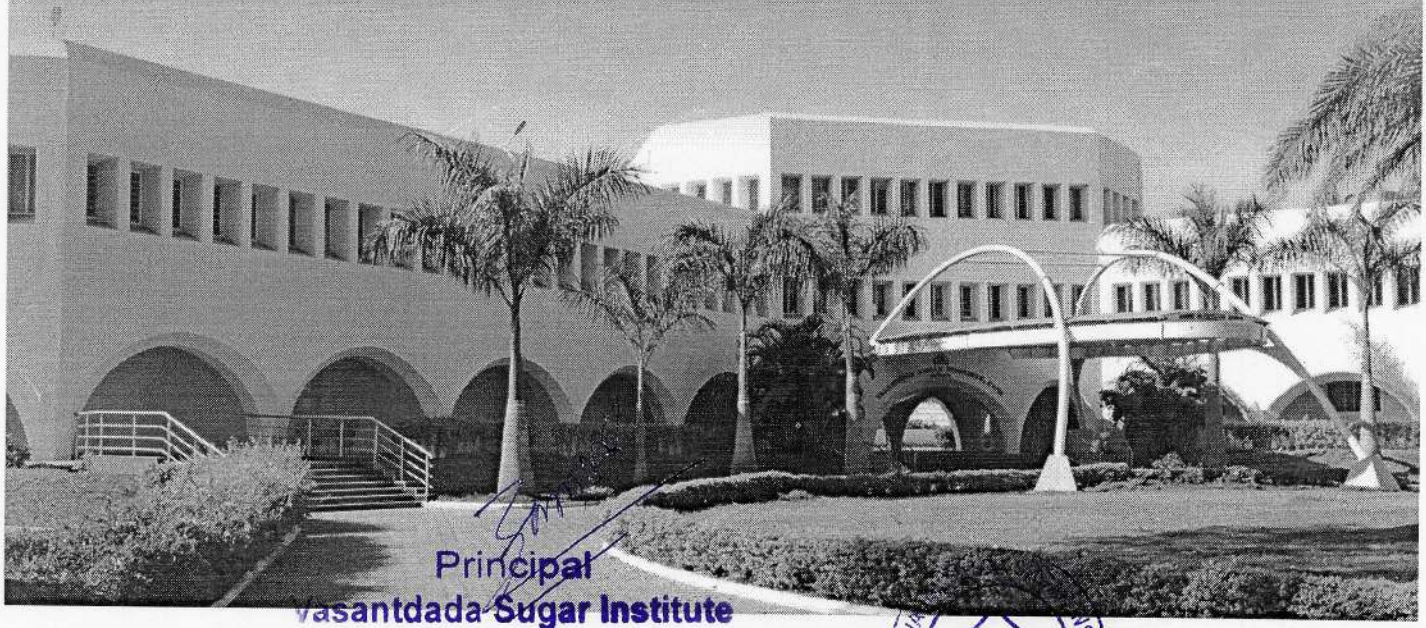
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN-978-81-955713-7-6

AST-SI-P26

Molecular Detection of Sugarcane Bacilliform Virus, Sugarcane Yellow Leaf Virus, and Sugarcane Mosaic Virus in Sugarcane

*Neha A. Warpe[1, 2], Atul Kumar[1], Rohini M Kolekar[2], Seema M. Patil[2] and R. M. Devarumath[1, *]*

[1] Vasantdada Sugar Institute, Manjari (Bk.), Taq. Haveli, Dist. Pune, Maharashtra, India 412 307
[2]Department of Plant Biotechnology, Vidya Pratishthan's Collage of Agicultural Biotechnology, Baramati, Pune
rm.devarumath@vsisugar.org.in

Sugarcane (*Saccharum officinarum*) is a plant that has been commercially used to produce sugar worldwide. Sugarcane is known to be severely affected by many biotic stresses, including infections from viruses and phytoplasma. Among which viruses are known as major constraints reducing sugarcane production worldwide including *Sugarcane bacilliform virus* (SCBV) known to induce leaf fleck disease, *Sugarcane yellow leaf virus* (SCYLV) inducing yellow leaf disease (YLD), and *Sugarcane streak mosaic virus (SCSMV)*, and *Sugarcane mosaic virus* (SCMV) are associated with mosaic disease, *Sugarcane streak virus* (SSV) responsible for causing streak disease, and *Sugarcane Fiji disease virus* (SFDV) causing famous Fiji disease in sugarcane. Among them, SCBV, SCYLV, and SCMV are reported as the major constraints causing a drastic reduction in sugarcane yield contributing parameters. In this regard, symptomatic samples from the major four varieties *viz.,* MS 10001, Co 92005, Co 86032, and CoM 0265 have been collected and subjected to both DNA and RNA isolation using commercial kits (Qiagen). The quantity of DNA and RNA was checked using a nanodrop spectrophotometer (DeNovix). Whereas, the quality was assessed on 0.8% agarose gel electrophoresis with intact bands showing the good quality of DNA and RNA. The cDNA synthesis was carried out followed by Reverse Transcription PCR (RT-PCR) for the detection of SCYLV and SCMV. On the other hand, the diagnosis of SCBV was accomplished using PCR. The results of 1.5% gel electrophoresis showed the amplification of ~610 bp and ~465 bp size of the amplicons of SCYLV and SCMV, respectively, in all four varieties samples. Whereas, SCBV of ~587 bp size of amplicons was detected in only two samples of varieties MS 10001 and Co 92005. The present study has successfully covered the basics of the significance of the major three viruses *i.e.,* SCBV, SCYLV, and SCMV with their distinct characteristic disease symptoms, and their diagnosis. The positive outcome of this study is to provide a better understanding of integrated disease management strategies and crop improvement for sustainable agricultural practices in future research endeavours.

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

AST-SI-P27

Spatio-Temporal Analysis of Sucrose Metabolising Enzymes in Selected Salt Tolerant Mutant Clones of Co 86032 and Com 0265 Varieties Under Control and Saline Conditions

*Madhavi V. Purankar, Madhuri M. Jagdale, and R. M. Devarumath**
Vasantdada Sugar Institute, Manjari (Bk.), Taq. Haveli, Dist. Pune, Maharashtra, India 412 307
rm.devarumath@vsisugar.org.in

Salinity is one of the major stresses affecting directly on the yield contributing parameters of sugarcane. Identification and development of new varieties is important objective in view of catering to increasing demands of sugarcane and allied industries in food, beverages, and also in the fuel. In this regard, clones obtained through gamma radiation induced mutagenesis and salt selection were developed in major sugarcane varieties *viz.*, Co 86032, and CoM 0265 at VSI, Pune. These clones have been checked and selected based on their performance under saline field conditions. In the present research, we have analyzed activity of four different enzymes including sucrose acid invertase (SAI), neutral invertase (NI), sucrose phosphate synthase (SPS), and sucrose synthase (SuSy) in leaf and mature internodes of the selected mutant clones, and their parent varieties grown under control and saline field conditions. We observed that the activity of SAI, NI and SPS was critically decreased under saline conditions in source (leaf) of both in parent and the mutant clones. Whereas, in sink tissue (internodes) some of the mutant clones such as M8457 and M8711 of CoM 0265 were able to maintain lower SAI activities and higher activity of SuSy. Our results suggest differential regulation of these four enzymes under control and saline conditions is important for the growth and sugar accumulation in the mutant clones. Moreover, these mutant clones can be further used for the understanding of molecular mechanisms in sugarcane for growth and sugar accumulation under saline stress conditions.

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN - 978-81-955713-7-6

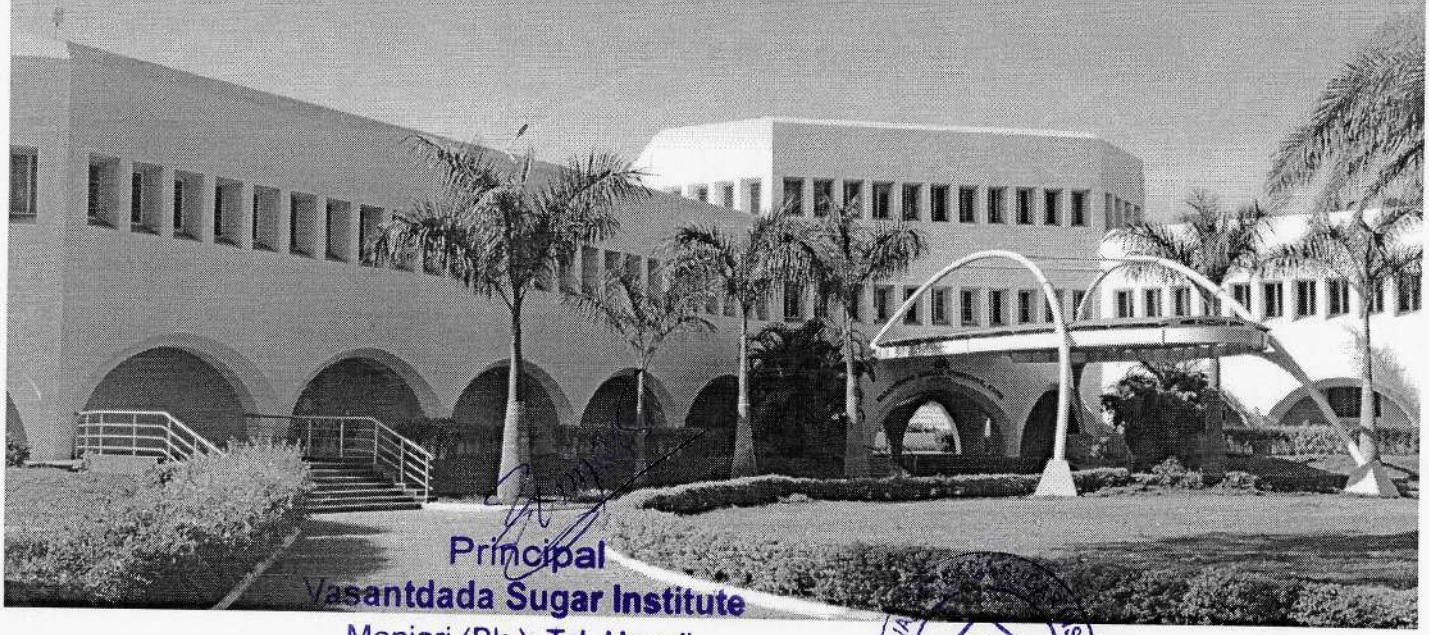
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN-978-81-955713-7-6

AST-SI-P28

Genomic Variation Analysis in Sugarcane Mutant Germplasm by Lignin Pathway Related Target Region Amplification Polymorphism (Trap) Molecular Markers

*Urmila Ghige[1,2], Madhavi V. Purankar[1], Hrushal P. Gawali[2], R. M. Devarumath[1]**
[1]Vasantdada Sugar Institute, Manjari (Bk.), Taq. Haveli, Dist. Pune, Maharashtra, India 412 307
[2]College of Agricultural Biotechnology, Madadgaon, Tal. & Dist. Ahmednagar.
rm.devarumath@vsisugar.org.in

In sugarcane, induced mutagenesis has been successfully implemented for generation of improved germplasm. However, the mutant population is genetically closely related with parent variety and thus analysis of diversity in such population is challenging. In the present study, we have employed 20 primers TRAP molecular marker systems to check extent of variation between selected mutant populations and mutant population of three sugarcane varieties CoM 0265, Co 740, and Co 86032 and also to validate ability of these markers for identifying the differentiation between the parents and mutant population. Collectively, 216 loci were amplified by TRAP primers out of which 93 loci were polymorphic (43.06 %). The TRAP based analysis showed that mutant M8299 and M8711 of variety CoM 0265 (GS-98.6%), M7931 of Co 740 (GS-95.8%), and M8151 of Co 86032 (GS-98.6%) were most diverse to their parent. The polymorphic information content of (PIC) of TRAP analysis for mutagenesis ranged from 0.0-0.078 although PIC for total diversity analysis was higher (0.147). The resolution power (Rp) of TRAP markers ranged from 0.0 to 0.066. In summary, this research suggested for the first time application of lignin pathway TRAP primers for the molecular characterization of germplasm generated through mutagenesis.

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSi
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE INSTITUTE PUNE

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN-978-81-955713-7-6

AST-SI-P19

Nanotechnological advancement in combating *S. rolfsii* causing Disease: Novel Bipolymeric nanocomposite for sustainable management

Somnath N. Chavanke, Sunil G. Dalvi , Ganesh. S. Kotgire and Bharat H. Pawar
Vasantdada Sugar Institute, Manjari (Bk.), Taq. Haveli, Dist. Pune, Maharashtra, India 412 307
sg.dalvi@vsisugar.org.in

In the realm of disease management and immune modulation in plants, the advent of advanced biomaterials has led to a transformative shift. The present research introduces a pioneering methodology for synthesizing novel Chitosan: β-glucan nanocomposites. These nanocomposites are engineered by combining biopolymers extracted from distinct species: chitosan from shrimp, β-glucan from *Sclerotium rolfsii* and yeast. Their nanocomposites were designated as C-SBG and C-YBG respectively. C-YBG and C-SBG nanocomposites have been developed to mimic Microbe/Pathogen Associated Molecular Patterns (MAMPs/PAMPs) as well as to trigger Pattern-Associated Molecular Pathway (PAMP)-induced immunity in sugar beet by activating Pattern Recognition Receptors (PRRs). The ultimate goal was an amplification of Systemic Acquired Resistance to manage Sclerotium rot and alleviate biotic and abiotic stress in response to changing climatic conditions in sugar beet. The synthesized nanocomposites, along with chitosan (CN NPs), and *S. rolfsii* β-glucan (SB NPs) and yeast β-glucan (YB NPs) nanoparticles, were comprehensively characterized using various techniques such as UV spectroscopy, DLS, FE-SEM, TEM, FTIR, and XRD. The characterizations confirmed that the nanocomposites and nanoparticles possess spherical shapes, smooth surfaces and sizes ranging from 60.16 nm to 98.66 nm. The zeta potential analysis indicated their stability ranging from -25mV to +39.1 mV. The chemical fungicides, namely Copper sulfate pentahydrate, Copper oxychloride, and Carbendazim 50% WP, manifested significantly diminished antifungal activity, registering respective efficiencies of 0%, 26.30%, and 13.76% at their maximum concentration of 2000ppm. The synthesized nanocomposites exhibited remarkable antifungal activity against *S. rolfsii* at 220 ppm and 240 ppm, respectively, under *in-vitro* conditions. This efficacy pales in comparison to the superior antifungal performance exhibited by the synthesized nanoparticles and nanocomposites.

Microscopic observations under 100x oil immersion revealed that CN NPs and nanocomposites effectively disrupted the cell membrane, leading to cytoplasmic leakage and subsequent cell death in *S. rolfsii*. This research underscores the promising potential of these innovative nanocomposites in combating *S. rolfsii* disease, offering a sustainable approach for its management.

Keywords- *Sclerotium rolfsii*, Sugarbeet root rot, Chitosan: β-glucan nanocomposite/s, Chitosan nanoparticles, β-glucan nanoparticles, climate change.

ISBN - 978-81-955713-7-6

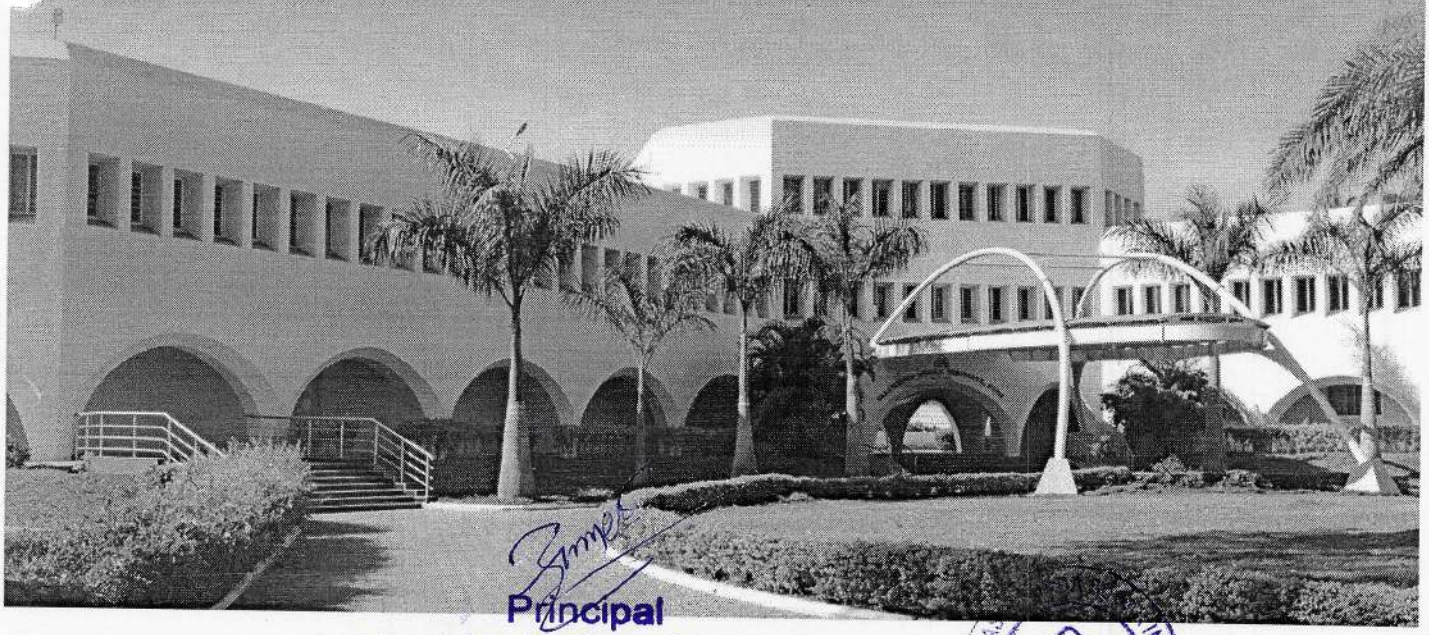
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

AST-SI-P20

Effect of Vasant Urja for Sustainable Groundnut Production

Kovhale Mahesh[1], *Dalvi Sunil*[1*], *Dalvi Vijay*[2], *Bodke Prashant*[3]
[1] Vasantdada Sugar Institute, Manjari (Bk.), Taq. Haveli, Dist. Pune, Maharashtra, India 412 307
[2]Agriculture Research Station, Tal. Shirgaon, Dis. Ratnagiri – 415629, Maharashtra, India
[3]Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Tal. Dapoli, Dist. Ratnagiri– 415712, Maharashtra, India
sg.dalvi@vsisugar.org.in

Groundnut (*Arachis hypogaea* L.) is a major legume crop that provides edible oil (43-55%) and protein (25-28%) for human consumption and animal feed. However, its production and prolificacy are severely affected by various biotic and abiotic stresses. Further, climate change adversities affect the crop productivity and the chemical pesticides applied concerns the environmental issues. For sustainable crop production there is need of biotechnological approach for inducing stress tolerance in the crop. In present study we investigated the foliar application of normal chitosan (50 ppm, 100 ppm) and gamma irradiated chitosan (50 ppm, 100 ppm) at 30, 45, 60, 75 and 90 DAS. The foliar application of gamma irradiated chitosan was found superior than normal chitosan and significantly increased the chitinase activity by 55.07 % as compare to control. The result exhibits increase in superoxide dismutase activity(41.48 %), total phenol content (39.99 %),total carotenoids (18.99 %) at foliar spray of 50 ppm gamma irradiated chitosan at 30 + 45 + 60 DAS as compare to control. The enhanced antioxidant metabolites indicated the induced stress tolerance in groundnut. Overall, the results of this study indicated that application of gamma irradiated chitosan was felicitous technology to cope up these adverse calamities, to achieve the goals of organic farming and ultimately sustainable development.

Keywords- Groundnut, gamma irradiated chitosan, chitinase, sustainable crop production

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

VASANTDADA SUGAR INSTITUTE, PUNE

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

AST-SI-P21

Deciphering the Potential of Gamma-Irradiated-Chitosan in Alleviating the Moisture Stress Tolerance on *In Vitro* Sugarcane Plants

Nalini Arun Shinde[1,3], *Sunil Govind Dalvi*[1,3*] *and Prashant Govindrao Kawar*[2,3]

[1] [1] Vasantdada Sugar Institute, Manjari (Bk.), Taq. Haveli, Dist. Pune, Maharashtra, India 412 307.
[2]ICAR-Directorate of Floricultural Research, Shivaji Nagar, Pune-411 005, Maharashtra, India.
[3] Department of Biotechnology, Savitribai Phule Pune University, Pune 411 007, Maharashtra, India.
sg.dalvi@vsisugar.org.in

Sugarcane (*Saccharum officinarum* L.) is a crucial commercial crop in many countries, playing a key role in sugar production in tropical and sub-tropical climates. Apart from its traditional consumption, sugarcane serves as a significant resource for alcoholic beverages, biofuels, and various bio-based compounds, making it the second-largest energy source. The sugarcane productivity is hampered by water stress. For managing moisture stress in sugarcane different strategies are imposed. Use of chitosan, a good approach for enhancing multiple stress tolerance has been reported in different crops. To address moisture stress in sugarcane, different strategies are employed. The use of chitosan, recognized for its efficacy in enhancing multiple stress tolerances, has been reported in various crops. This study aimed to evaluate the impact of different concentrations of gamma-irradiated chitosan (GIC) on sugarcane to induce tolerance to moisture stress. The study utilized an *in vitro* system for experimentation. The sugarcane cultivar Co 86032 was subjected to varying polyethylene glycol (PEG) concentrations (0, 3, 6, 9, 12, and 15% w/v) in a liquid MS medium to induce moisture stress. This stress led to observable effects such as reduced leaf size, discoloration, leaf rolling and folding, and a decrease in leaf area. Among the different concentrations of GIC applied, 10 ppm GIC demonstrated significantly superior morphological characteristics, including enhanced shoot, root, and leaf growth. Additionally, various biochemical parameters, such as chlorophyll a, chlorophyll b, total carotenoids, malondialdehyde (MDA), proline, total sugars, and enzyme activities (superoxide dismutase (SOD), peroxidase (POD), chitinase, and β-glucanase), were notably impacted under moisture stress conditions. In conclusion, this study suggests that GIC can effectively alleviate the impact of moisture stress on sugarcane. The GIC-based nano-biotech approach emerges as a valuable tool for enhancing sugarcane resilience to moisture stress.

Keywords: Sugarcane, Gamma-irradiated-chitosan, PEG induced moisture stress, chitinase, β-glucanase

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE INSTITUTE PUNE

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN-978-81-955713-7-6

AST-SI-P22

Synergistic Effect of Irradiated Chitosan and Thiourea On The Growth and Biochemical Status of Sugarcane

Dinesh Ithape[1, 2], Sunil Dalvi[1] and Ashish Srivastava[3]*

[1]Vasantdada Sugar Institute, Pune; [2]Savitribai Phule Pune University, Pune; [3] Bhabha atomic research center, Mumbai

sg.dalvi@vsisugar.org.in

Gamma-irradiated chitosan (GIC) and thiourea (TU) are two well-known bioregulators, that enhance plant growth by acting as an elicitor and ROS-scavenger, respectively. Although the individual effects of GIC and TU are well-demonstrated, their combined application has not yet been studied. In view of this, the present study evaluates the growth promotion activity of GIC and/or TU in sugarcane, at physiological and biochemical levels.

The data revealed that the combination of sett treatment flowed by two foliar applications at a 15-day interval of 50 ppm GIC and 250 ppm TU significantly improved several key plant growth parameters which led to enhancement by 32.18% in bud germination percentage, 22.36% in plant height, 45.88% in leaf area index, and 25.92% in biomass accumulation over the control. Additionally, the treatment positively affected the substantial enhancements in chlorophyll content by 197.87%, protein levels by 14.69%, sugar content by 10.00% and total phenols by 10.61%. Notably, Chitinase and β-glucanase activities showed respective rise of 35.67% and 83.49% over the control. The treatments with 100 ppm GIC exhibited the greatest boost in chitinase activity at 51.10%, while the combination of 100 ppm GIC and 500 ppm TU recorded the highest β-glucanase activity, showing an increase of 122.40%.

Thus, the study demonstrated that the combined application of GIC and TU has synergitic effect on overall vigor and health of single eye bud sugarcane settlings. These findings have significant implications for producing healthier settlings in a shorter period, which can contribute to improved crop productivity and increased resilience to abiotic and biotic stress factors during the nursery stage of sugarcane cultivation.

Keywords: Irradiated chitosan, thiourea, sugarcane propagation, plant vigor, bioregulator

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

ISBN - 978-81-955713-7-6

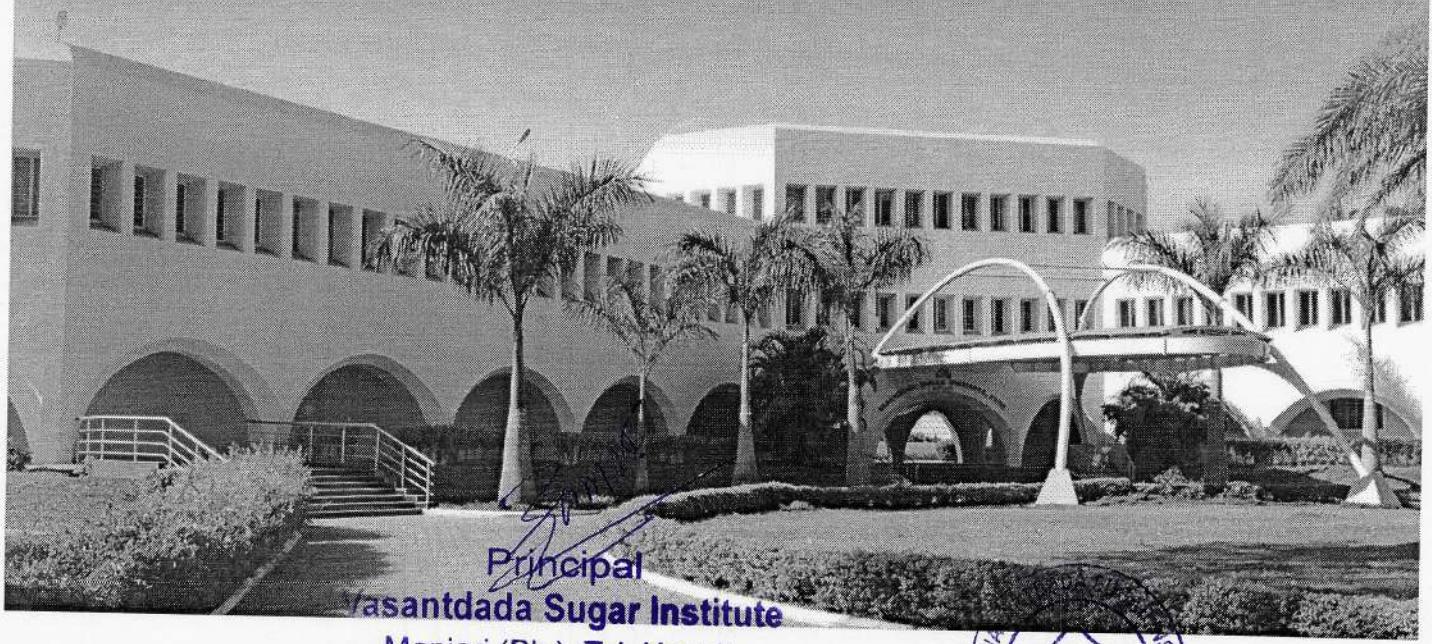
Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com



Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN-978-81-955713-7-6

AST-SI-P24

"Revolutionizing Sugarcane Micropropagation: Vasant Urja as biostimulant for improving the process as well as product with nanobiotech approaches"

*Pratiksha. B. Patil, Shubham. D. Patil, and S. G. Dalvi**
Vasantdada Sugar Institute, Manjari (Bk.), Taq. Haveli, Dist. Pune, Maharashtra, India 412 307
sgdalvi@gmail.com

Globally sugarcane is explored as the most efficient bio energy crop. There is huge demand for higher cane and sugar productivity. Sugarcane micropropagation ensures mass multiplication of disease-free plantlets for cane and sugar yield sustainably. However, several factors affect the micropropagation viz microbial growth, low multiplication rate, uneven plant growth, vitrification and mortality in greenhouse during the production process. These factors have a significant impact on the efficiency of micropropagation process and the economics of technology. Vasant Urja has shown an immense scope in agriculture to boost crop growth and defence response. In present work Vasant Urja has been evaluated for enhancing the micropropgation process as well as quality of micro plants. Result indicated that Vasant Urja at 5 ppm when incorporated in growth medium showed 100% meristem establishment. The shoot multiplication ratio and shoot height increased by 29% and 43% and the rate of contamination was reduced by 50% with 10 ppm Vasant Urja during subculturing stages. It has been observed that Vasant Urja incorporated media saves 5 days incubation period per batch for subculturing. It has been observed that as compared to the control medium, excellent enhancement in all growth parameters such as shoot height, leaf length, root number was observed in media incorporated with 10 ppm Vasant Urja. It was observed 96.36% survival of plants during primary hardening with 10 ppm Vasant Urja spraying as compared to control (67.56%). Thus, the use of Vasant Urja is suggested as beneficial for production quality plantlets, increase survival rate and improve morphology of micropropagated sugarcane plants as well as reducing production cost and time period.

Keywords: Sugarcane, Micropropagation, Vasant Urja, Biostimulant, Plant growth.

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE, PUNE

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN-978-81-955713-7-6

AST-PP-P106

Efficacy of Irradiated Chitosan (Nano Particles) in Combination with Silver Nano- Particles and Fungicide for The Management of Pokkah Boeng Disease in Sugarcane

G. S. Kotgire B. H. Pawar , S. G. Dalvi and J. H. Yadav
Vasantdada Sugar Institute, Manjari (Bk.), Taq. Haveli, Dist. Pune, Maharashtra, India 412 307
ganeshkotgire@gmail.com

India has different agro-climatic zones where sugarcane is cultivated in different seasons throughout the year. Due to vegetative propagation, high sugar accumulation and practice of ratooning, this crop succumb too many diseases in the field during its life cycle. Sugarcane is prone to more than 150 diseases caused by many pathogens *viz.*, fungi, bacteria, viruses, phytoplasma, and nematodes as well as abiotic factors right from planting to harvest. In India, about 100 diseases of sugarcane have been reported so far. Amongst the several diseases pokkah boeng is an important disease of sugarcane caused by *Fusarium moniliforme Sheldon* has been observed in many sugarcane growing states in India and found to cause heavy losses in cane and sugar yield, during favorable condition for disease development. This disease has been noticed in many cultivars of sugarcane commercially cultivated in India. The disease initiation starts after the summer showers and progressed linearly through season and gradually reduced towards the end of the growing season. Owing to the limitations for using pesticides other eco-friendly compounds which may toxic to pathogens needs to be identify. In this context, irradiated chitosan and silver nanoparticles (AgNP's) due to its broad spectrum activities have been tried for its antifungal efficacy at field condition. *In vivo* study results showed that the maximum disease control (72.51%) was obtained by 3 foliar sprays at an interval of 15 days after initiation of disease of silver nano-particles (100 ppm) + mancozeb (0.3%) + irradiated chitosan (50 ppm).

Keywords: Sugarcane, Pokkah Boeng, *F. moniliforme,* chitosan, Silver Nanoparticles (AgNPs),

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN - 978-81-955713-7-6

Proceedings of 3rd International Conference & Exhibition on

Sustainability: Challenges & Opportunities in Global Sugar Industry

12th-14th January 2024

Organized By-

VSI
संशोधनेन संवृद्धिः
VASANTDADA SUGAR INSTITUTE
Manjari (Bk.), Pune - 412 307; Maharashtra.
Phone : (020) 26902100; Fax :(020) 26902244;
E-mail : admin@vsisugar.org.in; Web site : www.vsisugar.com

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE INSTITUTE, PUNE

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

ISBN-978-81-955713-7-6

AST-PP-P109

Chitosan-Enhanced Growth Media for Improved Biocontrol Potential of *Bacillus thuringiensis* subspecies krustaki: A Comprehensive Evaluation

*Bhagyashri Shinde, Tushar Shitole and Sunil Dalvi**
Vasantdada Sugar Institute, Manjari (Bk.), Taq. Haveli, Dist. Pune, Maharashtra, India 412 307
sg.dalvi@vsisugar.org.in

Bacillus thuringiensis stands as a pivotal bio-insecticide globally acknowledged for its diverse insecticidal Cry protein genes, some of which are genetically engineered for expression in transgenic crops. Beyond the conventional insecticidal arsenal, *B. thuringiensis* synthesizes various metabolites, including chitinases, vegetative insecticidal proteins, and proteases, broadening its applicative value. In particular, chitinases of *Bt* are enzymes that hydrolyses chitin. This study develops into the optimization of *Btk* growth on a proteo-chitinaceous substrate—chitosan—leveraging different chitosan derivatives: Normal chitosan, Gamma Irradiated chitosan, Hydrochloride chitosan, Acetate chitosan, and Carboxyl methyl chitosan.

Btk cultivated in Luria broth amended with these chitosan derivatives exhibited distinctive responses. Notably, a 10 ppm dose of normal chitosan manifested superior results, showing an 87% increase in Cry protein secretion, an 89% boost in viable spore production, an 89% elevation in packed cell volume, and a substantial 53% augmentation in β-glucanase activity. Furthermore, irradiated chitosan at 4 ppm concentration demonstrated significant enhancements, with a 59% rise in chitinase activity and a 35% increase in protease activity over the control.

These findings underscore the potential of chitosan derivatives as elicitors, with normal chitosan and irradiated chitosan emerging as particularly promising candidates for augmenting the insecticidal properties of *Bt*. This research contributes valuable insights into optimizing *Btk* cultivation conditions, paving the way for the development of more efficient and sustainable insect pest control strategies.

Keywords: Chitosan, *B. thuringiensis,* Cry-proteins, Elicitor, Insecticidal enzymes, Biological control

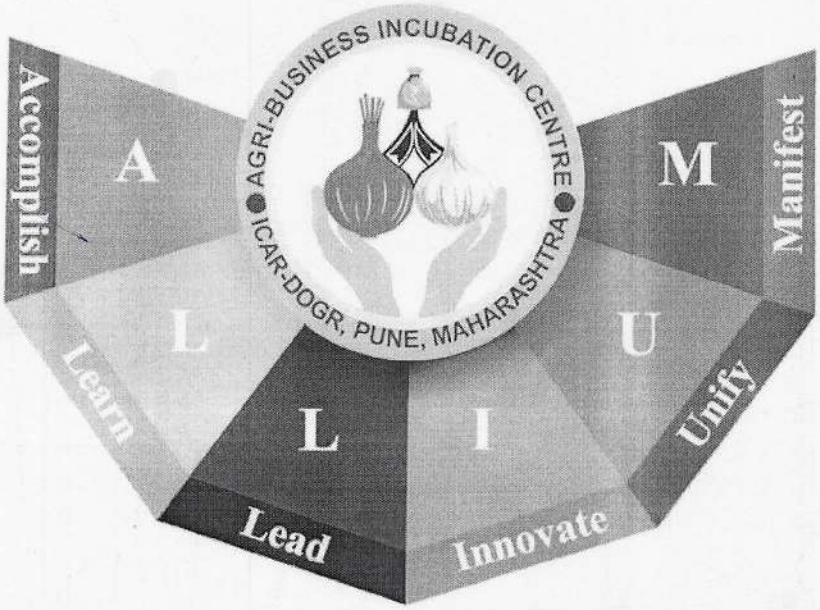
Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

National Symposium cum Industry Meet on "Agri-Business in Alliums: Innovation, Promotion & Sustainability"

20-22 December, 2023

NSIM-2023



Organized By,

Agri-Business Incubation Centre and ITMU

ICAR-Directorate of Onion and Garlic Research, Pune-410505

in association with

Mahratta Chamber of Commerce, Industries and Agriculture, Pune-411016

and

Indian Society of Alliums, Pune-410505

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

INDEX

Theme 1: Seed and Agro-chemical Supply Chain Management

Principal
Vasantdada Sugar Institute
Manjari (Bk.), Tal. Haveli,
Dist. Pune - 412 307

SEAL OF THE VASANTDADA SUGAR INSTITUTE PUNE

the *Technology License Agreement* of *"Controlled Onion Storage Structure Technology"* with Kala Biotech Pvt. Ltd. through Agrinnovate India Ltd., New Delhi.

IP protection of ICAR-DOGR

Patent

1. Patent granted for the invention titled "A STORAGESTRUCTURE FOR STORING ONION BULBS AND A METHOD THEREOF" (Patent No: 469459).

2. Patent application submitted for the invention titled "METHODS ANDSYSTEMS FOR PESTAND DISEASEMANAGEMENT OFONION CROP(S)" (Application No. 202321081043) filed on 29-11-2023.

Trademark

1. ICAR-DOGR logo registered for Trade Mark in year 2014 (application No. 2701085) and protection is valid up to June 2024.
2. Application made for the registration of trademark of logo of ABI of ICAR-DOGR

Varieties

Ten varieties are protected under the Protection of Plant Varieties and Farmers' Rights Authority (PPVFRA).

T1-LD3

SUSTAINABLE CROP PRODUCTION IN ONION USING BIO-STIMULANTS NANO FORMULATION

Sunil Dalvi

Scientist, Tissue Culture Section, Agri. Science & Tech. Dept., VSI, Manjari (BK), Pune 412307, Maharashtra State, India.

Email sg.dalvi@vsisugar.org.in

Climate change has a severe impact on the incidence of erratic, extreme weather events leading to substantial effects on the world's ecosystems. Efforts are therefore required to enhance crop resilience and adaptation to climate change for sustainable Onion and garlic production. Different abiotic and biotic stresses impair the quality of productivity of onion and garlic. Recently strategies of integrating biostimulators have advocated for climate-resilient crop production and increasing farmers' income. Vasant Urja (Gamma Irradiated Chitosan Nano-formulation): the most promising biological macromolecule's role in