SHARKARA

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OCTOBER - DECEMBER, 2020

It contains……

From Director's Desk...

Crushing operations in sugar factories are now in full swing as 481 sugar mills which were in operation in the country as on 31st December 2020 have produced 110.22 lac tons of sugar, as compared to 77.63 lac tons produced by 437 sugar mills as on 31st December 2019. This is 32.59 lac tons higher as compared to last season's production for the corresponding period. Indian sugar industry is although again all set to produce sugar more than domestic consumption but the silver lining is greater diversion of B Heavy molasses and cane juice expected for ethanol production. This with stable sugar prices and targeted 6.0 million tonnes of sugar export with financial support from government is expected to bring relief to the sugar industry.

However with Brazilian sugar production estimated to be over a record high of 38 million tons, the sugar prices are to be looked from April 2021 onwards. Sugar production in the second largest sugar exporting nation i.e. Thailand, is almost 80-90 lac ton less than what they usually produce. Therefore, India has an opportunity to export its sugar to the Asian importing countries, especially Indonesia and Malaysia, in addition to its own traditional markets in Middle East, Sri Lanka, Bangladesh, East Africa etc.

Diversion of excess sugarcane & sugar to ethanol is a correct way forward to deal with surplus stocks. Diversion of excess sugar would help in stabilizing the domestic ex-mill sugar prices and will also help sugar mills to get relieved from storage problems. Government has fixed target of 10% blending of fuel grade ethanol with petrol by 2022, 15% blending by 2026 & 20% blending by 2030. With a view to support sugar sector and in the interest of sugarcane farmers, the Government has also allowed production of ethanol from B-Heavy Molasses, sugarcane juice, sugar syrup and sugar; and has now revised the ex-mill price of ethanol derived from various feed stocks. To increase production of fuel grade ethanol, Govt. is also encouraging distilleries to produce ethanol from maize; & rice available with FCI. Government has fixed remunerative price of ethanol from maize & rice.

Further the blending targets cannot be achieved only by diverting sugarcane / sugar to ethanol; & 1st Generation (1G) ethanol is required to be produced from other feed stocks like grains, sugar beet etc. for which the present distillation capacity is also not sufficient. Therefore, it is an imperative need to enhance ethanol distillation capacity in the country for producing 1st Generation (1G) ethanol from feed stocks such as cereals (rice, wheat, barley, corn & sorghum), sugarcane, sugar beet etc. Government of India has announced recently a modified scheme for extending interest subvention to augment ethanol production capacity for various categories out of which following are prominent:

Setting up grain based distilleries / expansion of existing grain based distilleries to produce ethanol. However, benefits of interest subvention scheme to be extended to only those stand-alone distilleries which are using dry milling process.

Setting up new molasses based distilleries / expansion of existing distilleries (whether attached to sugar mills or standalone distilleries) to produce ethanol and for installing any method approved by Central Pollution Control Board for achieving Zero Liquid Discharge (ZLD).

To set up new dual feed distilleries or to expand existing capacities of dual feed distilleries.

To convert existing molasses based distilleries (whether attached to sugar mills or standalone distilleries) to dual feed (molasses and grain/ or any other feed stock producing 1G Ethanol); and also to convert grain based distilleries to dual feed.

To set up new distilleries / expansion of existing distilleries to produce ethanol from other feed stocks producing 1G ethanol such as sugar beet, sweet sorghum, cereals etc.

I reiterate that the sugar industry is required to be competitive exploiting unharnessed potential of by-products and through production of special sugars. The distilleries to look for alternate potential techniques of spent wash treatment which besides ensuring ZLD may also yield value added products. For the molasses based distilleries use of carbon di-oxide, bio-gas and potash recovery should be high on agenda.

Wish you all a very happy and prosperous New Year 2021.

(Narendra Mohan)
Director

OUR PROVISIONS:

WEBINARS:

1. Asian Sugar Conference 2020 was organized by the Institute on 8th October, 2020 on virtual platform. More than 250 delegates from Indonesia, Iran, Sri Lanka, Thailand, Nepal, Nigeria, Uganda, Kenya, UAE and Vietnam participated. The conference was inaugurated by Secretary (Food & Public Distribution), Government of India who stressed upon the need for producing sugar as per market requirements and to make sugar industry competitive.

2. राष्ट्रीय शर्करा संस्थान, कानपुर ने भारतीय चीनी मिल्स एसोसिएशन के साथ मिलकर 15 अक्टूबर को एक अत्यंत महत्वपूर्ण विषय **"भविष्य के ईंधन की ओर एक कदम (A step Ahead Toward a Future fuel)"** पर ऑनलाइन वेबिनार आयोजित किया। कार्यक्रम का प्रारम्भ करते हुये श्री सुधांशु पाण्डेय, सचिव (खाद्य एवं सार्वजनिक वितरण), भारत सरकार ने इस बात पर बल दिया कि भारत में कच्चे तेल की आयात को कम करने के लिए हमे चरणबद्ध तरीके से पेट्रोल मे ईथनोल मिश्रण कार्यक्रम को विस्तारित करना होगा। इसके लिए हमे 2022 तक के लिए निर्धारित 10% मिश्रण के लक्ष्य को 2030 तक बढ़ाकर 20% करना होगा।

ONLINE SESSION ORGANIZED:

Institute organized online session jointly with ISMA and NFCSF on two important topics, **"Production of Bio-CNG from Filter Cake**" and **"Production of Potash Rich Fertilizer using Incineration Boiler Ash".** Secretary (Food & Public Distribution), Joint Secretary (Sugar), President, ISMA, Director-General,

ISMA and Managing Director, NFCSF graced the occasion. Very informative presentations on the subject matter were made to boost up production of bio-energy in the sugar industry.

INAUGURATION OF NANO GRAIN BASED ETHANOL UNIT:

Commissioning of Nano Grain Based Ethanol has completed during the period and Inauguration of unit was done on 5th November, 2020 at the Institute. The same has been integrated with Nano Molasses Based Ethanol Unit and this is the first **"Multi Feed Stock Based Ethanol Unit"** of its kind in India.

ONLINE TRAINING PROGRAMME:

Online training programme on "**Sugar Recovery Improvement**" organized for technical personnel of Haryana Sugar Federation on 4th December, 2020.

TECHNOLOGY DEVELOPMENT/TRANSFER:

1. Technology developed by the institute for production of Fortified Jaggery. It has been produced without use of any chemicals but blended with various immunity boosters and processed under hygienic conditions.


Technology developed has been provided to an entrepreneur by NSI, Kanpur through National Research Development Corporation.

2. To showcase ways and means for value addition, nutritious baked cookies filled with richness of liquid jaggery and goodness of dietary fibre were made from bagasse for healthier life. The institute has taken up the activity to promote “Start Ups” and setting up of mini to medium scale units.


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OUR RESEARCH AREAS:

RESEARCH

1. Studies on isolation of Lignin from sugar industry based biomass and development of the process for the conversion of derived lignin and fermentable sugar to value-added product. Sugarcane bagasse (SB) derived lignin has broad scope for valorization to aromatics, phenolic polymers, and other value-added materials. Vanillin is the major flavour constituent of vanilla. It has a wide range of applications in food industry, in the synthesis of several pharmaceutical chemicals and in perfumery. Vanillin can be obtained from SB derived Lignin. The study has been taken up with a view to implement an efficient strategy to depolymerised the SB derived Lignin to access vanillin along with the other fermentable sugars. The experiments related to synthesis of Vanillin from bagasse have been performed by implanting a new catalytic system based on $CuSO_4$/Nitrobenzene. The related TLC was developed. The isolation and characterization of the reaction products are in progress.

2. Studies on access of bio-plastic as polyethylene substitute from sugarcane bagasse. Volatility in sugar prices is leading sugarcane industries worldwide to broaden their revenue base by moving from a single commodity manufacturer to one of renewable biomass for production of a broad range of value-added products. Of the numerous potential pathways for producing biofuels and biochemicals based on the sugarcane crop, the bioplastics such as poly-(3-hydroxyalkanoate) (PHA), poly lactic acid (PLA) or cellulose based bioplastic have attracted great interest due to its intrinsic biodegradability and biocompatibility.

Although industrial scale production of some of these macromolecules is beginning in some countries, they still currently remain niche materials within certain high value markets, due mainly to the high cost of production, particularly the high cost of feedstock that constitutes 50% of the total production cost. The objective of this research is to use low cost biomass such as sugarcane trash or bagasse that have low value as feedstock for synthesis of such type of bioplastics with a view to reduce production cost. The experimental work related to this topic is being taken up as the preliminary work pertaining to data collection and literature survey has been completed.

3. Studies on the feasibility of utilization of sugarcane bagasse as a potential feedstock to access cosmetic ingredients. With aim to convert sugarcane bagasse to value added platform molecule implementing biorefinery concept, we have been devoted to develop a method for the conversions of bagasse based xylose to C-glycosides. C-glycosides are sugar derived compounds and have gained a huge interest in recent years due to their application as anti-tumor agents, surfactants, antibiotics, anti-aging molecules, anti-diabetics and anti-inflammatory compounds. In this line, we have recently developed a chemical method for producing β-C-xylosylic ketones, a class of C-glycosides, using sugarcane bagasse as starting material at 10 g batch reaction. The laboratory scale experiments have

been successfully conducted. Studies indicate economics been in favor, raw material being a cheap source. Draft application for filing patent has been submitted.

4. Studies on pot-efficient synthesis of alkyl levulinates (Als) using sugarcane bagasse derived cellulose. Alkyl levulinates are biobased chemicals having a strong potential to be used in various applications, substituting current chemicals produced from Petro-chemical routes and are obtained in high yields and selectivities from simple biomass-derived products like Levulinic acid, hydroxymethyl furfural or furfuryl alcohol. They can also be obtained directly from real biomass such as sugarcane bagasse (SB). The SB cellulose is majorly used in paper and pulp industries and the development of viable biorefinery routes for its valorization into usable products & platform chemicals remains a challenge. The experiments related to synthesized the methyl-levulinate at 10 g batch scale in triplicate have been carried out. The isolation of the crude product has been completed. The purification by column chromatography and characterization by FT IR is in progress.

5. Studies on Production/isolation of C5 –Sugar Alcohol/Sugar using by-product resources of sugar industry. Dilute base pre-treatment strategy to fractionate xylan, cellulose and lignin components from sugarcane bagasse was carried out. In this line, the experimental works have been carried out at 10 g batch scale in duplicate. The experimental work related to isolation/extraction, purification and characterization of cellulose and lignin from sugarcane bagasse is in progress.

6. Standardization of method for determination Preparatory Index. Study is being taken to assess the role of fibre% and its quality on preparatory index of sugarcane and thus to factorize it while deducing PI. At present, the same preparatory devices installed in a sugar factory yield different values of preparatory index with the variations in fibre loading and changes in the quality of the fibre. Lab trials of different methods to standardize the preparatory index is being carried out during the crushing season. The study is for standardization of method among the available various methods.

7. Production of Liquid Sugar from Sweet Sorghum Juice: Studies have been taken up for production of liquid sugar directly from two different varieties of sweet sorghum juice.

Initial laboratory trials have been conducted using clarifying agents of vegetable origin and aslo using ion-exchange resins and active carbon as secondary de-colorizing agents. Analysis is in progress for ascertaining availability and quantity of various sugars, sweetness index and energy profile. Side by side, studies shall also be taken up to assess the shelf life of such liquid sugar produced by adopting different process techniques and at different concentrations.

8. To study the impact on performance of mechanically coupled twin induction motor drives for Shredder/ Fibrizer having unequal sharing of load and to design & develop dedicated drive for the application. The prime mover for shredder/fibriser (and also for chopper/leveler)) is invariably a slip ring induction motor (SRIM). The conventional system is appreciably inefficient as a lot of electrical power is dissipated and wasted (to the tune of 8-10% of the actual load) in slip resistance, the rpm also varies to a large range affecting the consistency of PI and it is rare that both the mechanically coupled motors share the equal load. But this set-up is running in the industry due to its simplicity and as the other better alternatives were not in practice when the arrangement was introduced in the industry. Recently, in few factories, VFD based induction motor drives have been installed on each of the mechanically coupled motors of shredder/fibriser. The problems associated with the conventional system such as issues of inefficient use of drives, the problem of load balancing and lowering of the speed of the motor during peak load conditions have been addressed. But this newly introduced system is associated with the injection of harmonics in the input current and there is a potential of rise of problems such as “motor bearing failure” and “motor winding insulation breakdown” because of circulating currents and dielectric stresses. In the present study the problem was studied in detail and verified to the extent possible in the commercial factories. A new topology has been proposed which is expected to address the existing problems and the design and development of a prototype is in progress to validate the study practically.

9. Studies on deterioration patterns on different sugars. Sugar samples of plantation white, raw and refined sugars collected from different sugar factories situated in different agroclimatic zones were analyzed for parameters such as colour, ash, pol, pH, RS, SO_2, turbidity as per plan of work. The study is aimed to assess deterioration patterns in different sugars so as to estimate their shelf life which sometimes is debatable. The study is to be concluded and a paper is planned to be published in some reputed journal.

10. Utilization of Potash Rich ash for production of valuable bio fertilizer. A study was earlier carried out on “Utilization of ashes of sugar factory and distillery incineration boiler as carriers for production of valuable bio fertilizer and their assessment on *Urad crop*. The field trials on urad crop were done consecutively for two years using 8 different treatments. The datas were recorded on various growth and yield attributing parameters. Data indicated that the process of bio-fertilizers may be better option for seed growers and also for utilizing waste ashes for biofertilizers to achieve better seed yield and yield components in urad. Now, experiment lay out along with sowing of sugarcane crop at NSI farm got completed. At places of poor germination, gap filling is being done. Prepared bio-fertilizers (*azatobacter* and *PSB)* will be added to assess effect on productivity of sugarcane.

11. Comparative study of Nine varieties of sweet sorghum for production of ethanol yield. Nine Varieties of Sweet Sorghum cultivated at the institute farm were harvested during the period. Their quality is being evaluated for various biochemical parameters like TRS, RS, ethanol yield, FE etc. The work is also aimed at standardizing the process of fermentation keeping in view the composition of the Sweet Sorghum juice from different varities. The most suited variety for ethanol production under sub-tropical conditions thus shall be identified. The work has been taken up jointly with Indian Institute of Millets Research, Hyderabad.

RESEARCH PAPERS:

Following research papers were published /sent for publication during the period:

1. A research paper on "Sustainable & Healthier product profile from Indian Sugar Industry-From Commitment to Action" by Narendra Mohan and Anushka Agarwal sent for publication in proceeding of online conference– 2020 held on 26th October, 2020 on Modernization in Agriculture, Food System & Aqua word organized by Inovine Conferences, Mississippi, Untied States of America.

2. A paper on "Indian Sugar Scenario" by Dr. Ashutosh Bajpai was presented in Asian Sugar Conference 2020 organized by the Institute on 8th October, 2020.

3. A paper entitled "Middle East Sugar Scenario" by E. Berenjian and Narendra Mohan was presented in Asian Sugar Conference 2020 organized by the Institute on 8th October, 2020.

4. A paper entitled "Bio-ethanol from Sugar Industry- Issues & Remedies" was presented by Prof. Narendra Mohan during the Webinar organized by NSI-ASSCT on 7th November 2020.

5. Dr. (Mrs.) Seema Paroha made a presentation on "Alternate Bio-sources for E-20 Blending & their Economic Viability" during the Webinar "A Step Ahead Towards Future Fuel" organized by NSI-ISMA-NFCSF on 15th October 2020.

6. A research paper entitled "Removal of Suspended Impurities From Mixed Juice by Centrifuge Technique" by Mohit Kumar, Subhash Chandra, A.K. Garg & Narendra Mohan sent for publication in the proceedings of 50th Golden Jubilee Annual Convention of SISSTA.

7. A research paper entitled "Vitman – A, Fortification of Sugar – A Novel Approach" by Narendra Mohan & Anushka Agarwal sent for publication in the proceedings of 50th Golden Jubilee Annual Convention of SISSTA.

8. A research paper entitled " Bio-energy for Economic & Environmental Sustainability of Sugar Industry" sent for presentation in International Conference on Recycling and Waste Management from 29-31 March 2021.

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BUREAU OF SUGAR STANDARDS:

The Institute, on behalf of Bureau of Indian Standards, prepares and issues Sugar Standard Grades to the entire Sugar Industry of the country for every sugar season. These Sugar Standard Grades are issued to facilitate quality control and to protect the interest of the common consumers. On the basis of these grades, sugar factories mark their produce accordingly. Meeting of the Expert Committee on sugar standards was held at IISR, Lucknow on 25th September 2020, wherein seven grades and their sale price were approved for the sugar season 2020-21.

On the basis of the approved Standards, Bureau of Sugar Standards Grades distribution commenced from 1st October, 2020.

Price schedule for the sugar season 2020-21:

1	Sugar Standard Grades to be issued	L-31, L-30, M31, M-30, S-31,S-30 & SS-31
2	Set of New Sugar Standard Grades containing 7 grades +3 empty glass bottles + 2 Velvet Cork in packing case	Rs.20,000/= each set
3	Single Sugar Standard Grade	Rs.2550/= each
4	Empty Sugar Standard Glass Bottle	Rs.450/= each
5	Packing case	Rs.600/= each
6	Velvet Cork	Rs.100/= each
7	Postal expenses, forwarding charges, if any	Extra as applicable
8	Payment	For Indian Sugar Standards 2020-21, payment shall be acceptable only through **BHARAT KOSH.** In any circumstances, **no Demand Draft / Cheque / Cash amount shall be accepted.**
9	Delivery of Sugar Standard Grades	Monday to Friday (10.00 AM to 5.00 PM)
10	Taxes	GST extra as applicable @18%.

The institute has taken up revision of various existing BIS standards viz. molasses tanks, raw, plantation white, refined and icing sugar etc. on behalf of Bureau of Indian Standards. BIS standards for some other sugars viz. organic sugar, brown sugar & low sulphur sugar are being drafted in consultation with various stake holders.

OUR ADVISORY:

Besides conducting teaching and training programmes, carrying out research in relevant field, another main functions of the institute are:

1. To function as a "Think-tank" to sugar and allied industry for proposing modernization and trouble free functioning of the process on advisory basis / through Extension Services.

2. To formulate strategies and promotes measures for expansion of capacities, energy conservation, co-product utilization etc. for sugar and allied industries.

3. To assist Govt. of India through technical contribution in policy formulation and control of Sugar Industry.

4. To render assistance to various government organizations in implementation of policies, validations and on associated matters.

5. To extend human resource management services to various government and private organizations.

CONSULTANCY SERVICES:

During October - December, 2020 consultancy services were provided to the following:

1	M/s Haryana State Federation of Co-operative Mills Ltd., Panchkula, Haryana.
2	M/s The Batala Co-op Sugar Mills Ltd., Distt - Gurdaspur, Punjab.
3	M/s Bajaj Hindusthan Ltd., Unit Khambharkhera, Distt- Lakhimpur Kheri, U.P.
4	M/s M/s Panipat Co-op Sugar Mills Ltd., Distt- Panipat, Haryana.
5	M/s Someshwar SSK, Distt- Belgaum, Karnataka.
6	M/s Magadh Sugar & Energy Ltd., Distt- West Champaran, Bihar.
7	M/s L.H. Sugar Factories Ltd., Distt- Pilibhit, U.P.
8	M/s Uttam sugar Mills Ltd., Unit Khaikheri Distt Muzaffarnagar, U.P.
9	M/s Bajaj Hindusthan Sugar Ltd., Unit – Thana Bhawan, Distt – Shamli, U.P.
10	M/s Bajaj Hindusthan Sugar Ltd., Unit – Gagnauli, Distt – Deoband, U.P.
11	M/s Dhanashree Agro Products Pvt. Ltd., Unit – Iqbalpur, Distt – Haridwar, U.K.

12	M/s Parle Biscuits Pvt. Ltd., Distt - Bahraich, U.P.
13	M/s Uttam Sugar Mills Ltd., Distt - Bijnor, U.P.
14	M/s Wave Sugar & Industries Pvt., Ltd., Unit - Dhanaura Distt - Amroha, U.P.
15	M/s Sasa Musa Sugar Works Pvt. Ltd., Distt - Gopalganj, Bihar
16	M/s Balrampur Chini Mills Ltd., Unit – Balrampur, Distt - Balrampur, U.P.
17	M/s Dalmia Bharat Sugar & Ind. Ltd., Unit – Jawaharpur, Distt – Sitapur, U.P.
18	M/s Uttam Sugar Mills Ltd., Unit- Barkatpur, Distt – Bijnor, U.P.
19	M/s Rai Bahadur Narain Singh Mills Ltd., Distt – Haridwar, Uttarakhand.
20	M/s Bajaj Hindusthan Sugar Ltd., Distillery Unit Golagokharnath, Distt – Lakhimpur, U.P.
21	M/s Bajaj Hindusthan Sugar Ltd., Distillery Unit Kinauni, Distt – Meerut, U.P.
22	M/s Bajaj Hindusthan Sugar Ltd., Distillery Unit Rudauli, Distt – Basti, U.P.
23	M/s Triveni Engineering & Ind. Ltd., Unit – Milak Narayanpur, Distt – Rampur, U.P.
24	M/s The Batala Cooperative Sugar Mills Ltd., Batala, Distt – Gurdaspur, Punjab.
25	M/s Bajaj Hindusthan Sugar Ltd., Utraula, Distt – Balrampur, U.P.
26	M/s Bajaj Hindusthan Sugar Ltd., Rudhauli, Distt – Basti, U.P.
27	M/s Bajaj Hindusthan Sugar Ltd., Kundarkhi, Distt – Gonda, U.P.
28	U.P. State Sugar & Cane Development Corporation Ltd., Pipraich, Distt – Gorakhpur, U.P.
29	M/s Dalmia Bharat Sugar & Industries Ltd., Nigohi, Distt – Shahjahanpur, U.P.
30	M/s Majhaulia Sugar Industries Pvt. Ltd., Distt – West Champaran, Bihar.
31	M/s Dwarikesh Sugar Industries Ltd., Dwarikesh Puram, Distt – Bijnor, U.P.
32	M/s Balrampur Chini Mills Ltd., Balrampur, Distt – Balrampur, U.P.
33	M/s Triveni Engineering & Industries Ltd., Distt – Muzaffarnagar, U.P.

34	M/s Balrampur Chini Mills Ltd., Unit - Babhnan, Distt – Balrampur, U.P.
35	M/s Rai Bahadur Narain Singh Sugar Mills Ltd., Laksar, Distt – Haridwar, Uttarakhand.
36	M/s Avadh Sugar & Energy Ltd., Hargaon, Distt – Sitapur, U.P.
37	M/s Haryana State Federation of Cooperative Sugar Mills Ltd., Distt – Panchkula, Haryana.
38	M/s Daurala Sugar Works, Daurala, Distt – Meerut, U.P.
39	M/s Govind Sugar Mills Ltd., Aira, Distt – Lakhimpur Kheri, U.P.
40	M/s Triveni Engineering & Industries Ltd., Unit – Sabitgarh, Distt – Bulandshahr, U.P.
41	M/s Dwarikesh Sugar Industries Ltd., Unit – Dwarikesh Nagar, Distt – Bijnor, U.P.
42	M/s The Kaithal Cooperative Sugar Mills Ltd., Kaithal, Distt – Kaithal, Haryana.

ANALYTICAL SERVICES:

The institute now has a Centralized NABL Accredited Analytical Laboratory to carryout analysis of sugar, molasses, alcohol and other related products as ICUMSA and other standards protocol. During the period, analytical services were rendered to following:

1	M/s Bajaj Hindusthan Sugar Ltd., Unit Rudauli Distt - Basti, U.P.
2	M/s A. B. Sugars Ltd., Distt – Hoshiarpur, Punjab.
3	M/s Triveni Enginnering & Ind. Ltd., Unit - Khatauli Distt - Muzaffarnagar, U.P.
4	M/s SBI General Insurance Company Ltd., GP Road Indore West, Madhya Pradesh.
5	M/s Balrampur Chini Mills Ltd., Unit – Balrampur, Distt - Balrampur, Uttar Pradesh.
6	M/s Balrampur Chini Mills Ltd., Unit – Tulsipur, Distt – Balrampur, U.P.
7	M/s Balrampur Chini Mills Ltd., Unit – Babhnan, Distt – Balrampur, U.P.

The samples of sugar, molasses, ethanol, hand sanitizer waste waters & condensates etc. were analyzed for the desired parameters in the NSI-Analytical Laboratory (NABL Accredited).

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OUR OTHER ACTIVITIES:

1. Director, NSI acted as expert for selection of General Manager & Deputy General Manager etc. in the sugar units and distilleries of M/s HPCL Biofuels Ltd.

2. संस्थान में दिनांक 27.10.2010 से 02.11.2020 तक "**सतर्कता जागरूकता सप्ताह-2019**" का आयोजन किया गया तथा दिनांक 27.10.2020 को संस्थानकर्मियों को जागरुकता की शपथ दिलाई गई।

इस सप्ताह के दौरान संस्थानकर्मियों एवं छात्रों के लिये निबंध एवं व्याख्यान प्रतियोगितायें आयोजित की गईं।

3. Director, NSI attended the 78th STAI convention 2020 as Guest of Honour and Chaired the session for "Dr. Gundu Rao Memorial Lecture". He also presented two papers on important topics related to natural sugar production and measures required to be taken for pushing the ethanol blending programme. He stressed upon change in conventional process of clarification to produce plantation white sugar so as to produce raw/natural cane sugar and refined sugar. While the natural cane sugar produced with minimum use of chemicals can be marketed as healthier sugar, the refined sugar may cope up with the requirement of bulk consumers, the beverage and pharmaceutical industry in particular.

As regards ethanol production, he presented different models of diversion of molasses, juice or syrup giving details of revenue generation. Diversion of B Heavy molasses or diversion of partial quantities of syrup and B Heavy were considered to be the better models.

4. A book entitled **"Evaporators & Evaporation Techniques"** written by Prof. Narendra Mohan, Director, NSI, Kanpur was released during the 78th Annual Convention of STAI by Shri Suresh Rana, Hon'ble Minister of Sugarcane Industries, Government of Uttar Pradesh during the convention.

5. Indonesia seeks NSI support for skill development and sugar productivity enhancement. Preliminary discussions held with their sugar institute for future collaboration on 18th November, 2020.

6. Director, NSI, addressed "National Sugar Summit 2020" organized by Indonesia Sugar Organization, Indonesian Sugarcane Technologist Association, PTT LPP Agro Nusantara, Indonesian Sugar Research Institute and Plantation Polytechnic of LPP. He highlighted role of National Sugar Institute in growth & development of sugar industry in India on 25th November, 2020.

7. A Hindi dictionary comprising technical terms generally used in the sugar industry was published for the benefit of all the stakeholders and to promote Rajbhasha on 31st December, 2020. The dictionary was released by Prof. Neelima Gupta, Vice-Chancellor, CSJM University, Kanpur. She lauded the institute effort and desired that the dictionary should be enriched by adding more words after taking up the matter with all stakeholders of sugar industry.

8. 150 KLD "Sewage Treatment Plant" based on MBBR Technology commissioned at the institute. The resultant water to be used for horticulture and irrigation purposes. This will lower the utilization of borewells and thus helping in conserving natural resource.

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HAPPENING IN THE SUGAR INDUSTRY:

Uttar Pradesh CM Yogi Adityanath to inaugurate two sulphur-less sugar mills.

Uttar Pradesh Chief Minister Yogi Adityanath will inaugurate two sulphur-less sugar mills plants in Basti and Gorakhpur districts . As per an official statement, the sugar mills will be the first-of-its-kind facility in the state and the production will facilitate timely payments to sugarcane farmers.

Sugar mills in Maharashtra warn of delayed payment to farmers due to bank policies.

At the start of the 2020-21 sugarcane crushing season, cooperative sugar mills in Maharashtra have warned of delayed payment to farmers for cane procured due to the lending policy of the Maharashtra State Cooperative (MSC) Bank. A letter written by Jaiprakash Dandegoankar, chairman of the Maharashtra State Cooperative Sugar Factories Federation.

Ministers and stakeholders sign sugar industry master plan.

Trade, Industry and Competition Minister Ebrahim Patel and Minister of Agriculture, Land Reform and Rural Development, Thoko Didiza, alongside industry stakeholders, have signed the Sugar Industry Master Plan. The sugar master plan seeks to take urgent action to protect thousands of jobs, rural livelihoods and businesses, and at the same time create a bold new ambition.

Liquidity for mills: OMCs, sugar mills, banks get into tripartite pacts.

Cash-starved sugar mills that produce ethanol are getting into tripartite agreements with oil-marketing companies (OMCs) and banks, which will allow them to get loans on the basis of committed purchases of the bio-fuel by OMCs. This will ease the mills' liquidity crunch, while boosting ethanol supplies.

ISMA Says Sugar Production Jumps Three Times To 14.10 Lakh Tonnes.

Sugar production in India soared nearly three-folds to 14.10 lakh tonnes in the 2020-21 season so far due to better crop output and timely commencement of the crushing operation, industry body Indian Sugar Mills Association (ISMA) said on Tuesday. Sugar production was at 4.84 lakh tonne in the same period of the 2019-20 season.

Govt incentives across sectors but bitter reality check for sugar.

Even as the Centre has announced production-linked incentives worth some Rs 2 lakh crore for a host of sectors to boost manufacturing investments, the sugar industry is complaining of huge non-payments against schemes notified more than a year ago.

Shetti demands addl Rs 200/tonne for sugar farmers.

Farmers will not allow factories to sell sugar unless they pay fair and remunerative price (FRP) and additional Rs 200 per tonne to compensate for the losses incurred due to increase in harvesting charges of sugar cane cutters, Swabhimani Shetkari Sanghatana (SSS) leader Raju Shetti said on Monday.

Karnataka: Centre's price for our crop unfair, say cane growers.
Sugarcane growers under the banner of Karnataka State Sugarcane Growers Association staged a protest on Monday urging the government to provide higher price for sugar cane. They shouted slogans against sugar minister Shivaram Hebbar, the district minister and the state and Union governments for turning a deaf ear to their demands.

Four days to go for crushing season, Pilibhit sugar mills owe Rs 136 cr as cane dues.
Three of the four sugar mills in Pilibhit owe farmers Rs 136.19 crore as cane dues from the previous year even as current year's crushing season is to begin here from November.

Maharashtra sugarcane workers call off stir post 14 per cent wage hike assurance.
New Indian Express - 28 October 2020: A strike called by sugarcane labourers in Maharashtra was withdrawn after they were assured a 14 per cent wage hike in a meeting.

UP sugar mills' dues to farmers rise to ₹8,447 cr in FY20 on lockdown effect, subsidy delay.
UP's sugar mills, still recovering from the lockdown impact and owed subsidy payments from the government, are yet to pay ₹8,447 crore to farmers for the previous sugar season ended September 30. This is nearly 80 per cent more than the ₹4,942- crore owed in the 2018-19 season.

No tariffs nor quotas for sugar in the Brexit deal between EU and UK.
European Union (EU) and the United Kingdom negotiators finally agreed on a deal on 24th December after Brexit. The Economic and Trade Partnership Agreement guarantees trade without tariffs or quotas for "all goods which comply with the appropriate rules of origin". This includes sugar and several processed food products.

Brazil reverts to applying 20% tariff for ethanol imports from USA.
On 14th December, Brazil reinstituted 20% tariff on imports of ethanol from the USA as talks between the two countries on opening up their ethanol and sugar markets have simply not progressed, according to Brazilian government source speaking to Reuters.

Brazil – Albioma commissions US$23 million cane bagasse cogen plant.
Renewable energy producer Albioma successfully completed on 25 December 2020 industrial commissioning of cane bagasse cogen unit Vale do Paraná Albioma plant in Suzanápolis in São Paulo state, according to the company's press release.

Belgium – Plans to build Seneffe beet sugar factory shelved – banks won't finance the venture.
The plan to build an ultramodern beet sugar factory in Seneffe was abandoned after the project backers Cooperative des beetraviers transformateurs (CoBT) failed to raise necessary funds from banks.

Light-dependent enzyme promotes drop-in fuels production from cellulosic feedstock.
Using an unusual, light-dependent enzyme and a newly discovered enzymatic mechanism, researchers from Aarhus University, Denmark and Massachusetts Institute of Technology have succeeded in producing drop-in fuel from lignocellulosic feedstock.

Boardroom coup at Tereos.
At an extraordinary board meeting of French sugar group Tereos on 18th December, the Chief Executive Alexis Duval was ousted and replaced by Philippe de Raynal, and Gerard Clay was appointed as chairman, according to local press reports.

UK to allow imports of 260,000 t raw sugar duty-free.
The government announced on 16th December that it is to allow 260,000 tonnes of raw sugar to be imported tariff-free in 2021, as it develops an independent trade policy for the first time in 50 years.

Commercial-scale biobutanol production in sight with new membrane.
Researchers at Imperial College London in collaboration with BP have developed a membrane-based extraction system which uses less than 25% of the energy of current processes and produces ten times more butanol with over 99.5% purity.

Uganda – Sugar industry struggles with cheap imports in the local market originally destined for re-export.
Uganda's sugar producers are in dire straits as the sector is currently facing an accumulation of its stocks with the sluggish sale linked to competition from imported sugar free of duty which should be re-exported, according to an industry lobby group.

Pakistan – Surveillance of sugar production in real-time at Sindh's 29 sugar mills by the tax department in advance stage.
The tax department Federal Board of Revenue (FBR) has deputed its officials at sugar mills as a stopgap measure until it develops real-time access to video monitoring of crushing and other production processes. This is to stem tax evasion, according to local press reports.

UK – 2020/21 sugar output down by over 24% from virus yellow-hit beet crop.
With 2020/21 campaign in full swing, the sugar beet output is set to decline by 25%, mirroring similar fall in sugar production. The fall in output is largely due to the severe effect on yields from aphid-spread virus yellows disease, reported Farmers Weekly.

Vietnam – Sugar industry in crisis amidst alleged dumping from Thailand.
Thai companies are allegedly dumping sugar in Vietnam and hurting farmers, say Vietnamese sugar producers, according to local press reports.

Bangladesh – Closure of six-state owned sugar mills announced as losses mount.
The government has decided to suspend productions at six state-run sugar mills in the current financial year 2020-2021 to minimise the accumulated losses of the Bangladesh Sugar and Food Industries Corporation (BSFIC), according to local press reports.

Cambodia – Sugar production increases to 102,000 tonnes.
During this year's campaign the country's Phnom Penh Sugar Co (PPSC), boasting a modern sugar factory amidst the cane plantation in its southwestern provinces (Kampong Speu, Koh Kong), produced 102,000 tonnes sugar, according to Khmer times.

Bangladesh – BMA secures €62 million contract for new sugar refinery.
BMA, one of the leading suppliers of sugar technology, sealed in October 2020 a €62 million contract to fit the new sugar refinery in Bangladesh with a wide range of machinery and equipment, according to the company's press release.

Honduras – Cane production losses estimated at 13% from hurricanes Eta and Iota.
Hurricanes Eta and Iota have estimated to cause losses, to date, of HNL230 million (US$9.5 million) for the sugar agribusiness, according to the Association of Sugar Producers of Honduras (Apah).

Senegal – Sugar industry crippled by smuggled sugar.
The Senegalese Sugar Company (SSC) has raised an alarm that it is not able to sell locally produced sugar due to illegal imports, threatening both the industry and livelihoods of the employees of the factories, according to local press reports.

Braskem and Haldor Topsoe produce biobased MEG from sugar with new technology.
The chemical giants Braskem and Haldor Topsoe have announced that they have achieved their first-ever demo-scale production of biobased monoethylene glycol (MEG).

South Africa – Master plan to support the local sugar industry signed by all the stakeholders.
South Africa's struggling sugar industry has received a major boost after the signing of a master plan by the Trade, Industry and Competition Minister Ebrahim Patel and Minister of Agriculture, Land Reform and Rural Development, Thoko Didiza, alongside stakeholders farmers, industrial users and retailers.

Brazil – Grupo Integra buys Renuka's sugar mill Usina Revati.
The investment firm Grupo Integra acquired Renuka do Brasil's sugar mill Usina Revati for BRL263.5 million (US$48.3 million) in an auction on 11th November.

Guatemala – Cogen output from sugar mills forecast to rise by 37% during the 2020/21 campaign.
With the 2020-2021 campaign (November-May) commenced, the sugar mills are set to cogenerate 2,600-gigawatt hours (GWh) – some 37% more than during the previous campaign, according to local press reports.

China – Imports of sugar syrup from Thailand increases 12-fold in 2020.
Thailand saw a 12-fold jump in its sugar syrup exports to China in 2020, according to a recent USDA attaché report.

Belize suing St Kitts and Trinidad & Tobago over sugar imports from non-CARICOM member states.
The government of Belize is suing St Kitts and Nevis, and Trinidad and Tobago (T&T) over alleged sugar imports from non-CARICOM member states (Guatemala and Honduras) without application of the necessary the Common External Tariff (CET) of 40%, according to local press reports.

Australian sugar exports to China likely to be hit in the current trade war.
The deterioration of Sino-Australian relations ignited by Prime Minister Scott Morrison's call for an inquiry into the origins of coronavirus, which was identified in the Chinese city of Wuhan, has disrupted exports worth up to US$19 billion on a range of goods to date, according to various press reports.

Canada – Rogers Sugar partners with DouxMatok for the latter's sugar-based sugar reduction solution.
Rogers Sugar, the parent of Lantic Inc, is collaborating with the Israeli start-up DouxMatok (DM) to exploit DM's novel proprietary platform, a sugar-based sugar reduction process that is now ripe for commercialization for the US and Canadian markets.

Speculative bet on raw sugar spurring production may backfire.
A huge bullish position held by hedge funds and money managers in raw sugar futures in New York is convincing global producers to boost production, a move that could backfire as an increase in output is likely to mismatch persistently weak demand, reported Reuters.

Australia – Bundaberg Sugar closes down its Bingera Mill.
After 135 years, one of Bundaberg oldest mills is closing down. Bingera Mill is closing down after its owner Bundaberg Sugar Limited (BSL) announced on 24th October that it is rationalizing its operations due to significant drop in cane supply.

El Salvador – Sugar consumption fell by 7% during the Covid-19 pandemic lockdown.
Sugar consumption in El Salvador dropped by 7% during the pandemic lockdown. The total closure ordered by President Nayib Bukele contributed to sugar industry losses of US$ 12 million, according to Julio Arroyo, executive director of the Sugar Association of El Salvador.

Paraguay – Sugar smuggling hits the local sugar industry threatening livelihoods.
Local sugar producers are having a hard time selling their output due to smuggling from a couple of Latin American countries, said the head of the Paraguayan Sugar Center, Eduardo Felippo on October 21st, according to local press reports.

USA – Four new silos for Domino Sugar's refinery costing US$21 million.
The American Sugar Refining is to spend US$21 million to construct four new silos at Domino Sugar's Baltimore refinery. Each silo will have storage capacity for up to 3.5 million pounds (1587.6 tonnes) of finished or refined sugar ready to be packaged or shipped out on railcars or trucks.

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➢ **RESEARCH ARTICLE:**

"ADVANCES IN SUGARCANE INDUSTRY: IMPORTANCE OF BY-PRODUCT VALORIZATION"

by
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ABSTRACT

Agro-industrial production and processing generate huge amount of by-product and waste resulting in significant environmental impact and a great deal of investment being incurred during its storage and disposal. Therefore, proper management and efficient waste utilization is essential for environmental sustainability and human health. Sugar industry is said to be the second largest agro-processing industry next to cotton textiles, playing significant role in the growth and development of India's economy. During the processing of sugar, sugar mills generate several waste such as molasses, bagasse, filter cake, waste water and boiler ash. Utilization of these waste generated from the sugar industry and converting them into value-added by-products is of paramount importance. Since the market price of sugar remains volatile and at times fall below the production cost, innovations and diversification to produce more value-added products i.e. converting "waste to resource" may help the sugar industry to have a better economic sustainability as compared to being a stand-alone sugar factory. The paper elaborates on innovative ways to utilize the by-products and waste of the sugar industry thereby adding value to the existing product line and lowering dependency on revenues from sugar. Improvement in product quality and such innovative management of waste may accelerate the growth of the sugar industry as well as help in maintaining clean and healthy surroundings and providing quality product as per consumer need.

Keywords: Agro-industry, value-addition, by-product, diversification, sugar industry.

INTRODUCTION

The advent of modernization along with technological innovation and advancement in the field of agriculture has significantly increased the agricultural produce. The effect of reformation in the agriculture sector has indeed resulted in quick and swift development of various food processing industries all across globe in order to cater to the needs of the growing population. While on one hand revolution in the food sector resulted in generation of huge quantities of food product as desired by its consumer base, employment opportunities to a large number of people, boosting the economic status, on the other hand, it also resulted in generation of large amount of waste causing sustainability and environmental issues.

Agriculture forms the backbone of the Indian economy supporting more than 2/3rd of the total population of the country and also contributing to the GDP of the country. Therefore, agriculture holds a significant stature in social, political and economic affairs. Sugarcane is one of the major cash crop in India where more than 50 million farmers are directly or indirectly dependent on the sugar or sugar based industries. India in amongst the top ranked country for production and consumption sugar of around 33 MMT (crushing season 2018-19) (Indian Sugar 2020) next to brazil. In spite of many bigs, this industry often encounters issues of economic sustainability to the extent that the issues of pending cane prices arreas become a burning issue attracting the government. As it is rightly said, 'experience is the mother of all', sugar industry too, through its tireless experience have learnt a lesson and is therefore in the process of transformation from being a standalone sugar factory into being an integrated complex having facilities for power export and ethanol production.

The importance of by-product utilization has been realized by the industry as merely depending upon revenues from sugar alone to a greater extend does not sound as a profitable venture in times to come and hence better management of by-products could be a promising asset to the sugar industry as a whole. The by-products of the sugar industry whose potential have not been explored to its maximum, have huge scope to be converted in to value-added products through innovative approach and thereby would yield more income to the industry through sale and marketing of such innovative and attractive products rather than sugar. There is a long way to go as it is well said that Rome was not built in a day similarly changes don't just happen overnight, but a thought process is required to be initiated so as to see a self-sustainable sugar industry in times to come. The potential of revenue generation through utilization of various by-products viz. bagasse, filter cake and molasses is to be taken up in an innovative manner besides developing technologies for converting huge amount of surplus water into good quality water to meet human needs and earn revenue. In fact, sugar industry is to be converted from a single product factory to multiproduct factory.

PRODUCTS AND BY-PRODUCTS OF SUGAR INDUSTRY – EXISTING SCENARIO AND WAY FORWARD

As evident from past 2-3 years, India has grown to be the highest sugar producing geography with sugar production of around 33 MMT (Indian Sugar 2020). Sugar is highly fungible with comparatively small portion of production being amenable to special sugar market. Several policy interventions in regard to facilitating sugar export, and fixation of 'Minimum Selling Price' of sugar by the government has helped the sugar industry to be economically viable but still there is a long way to go for achieving economic stability & sustainability in times to come. The need of the hour is for better allocation of the present resources in making assorted product line that provides the industry as a cushion for its better survival. Figure 1 gives a brief idea of how the by-products of the sugar industry are being utilized in traditional manner.

Primarily sugarcane is processed to obtain sugar, the fibrous residue known as bagasse is majorly used for cogeneration, molasses is mainly diverted for animal feed or used by distilling industry and filter cake being utilized for production of cane wax or are being used as fertilizers.

Indian sugar industry is an industry with immense potential. It is an industry where every product and by-product can serve as a potential and economic raw materials for other manufacturers for production of numerous value-added, bio-based products that may have great market prospect and acceptability amongst consumers as well. There are some countries who have maintain competitiveness through diversification for instance, Mitr Phol's total revenue generation from sugar alone stands for around 42% only, while remaining 58% revenue generation is through by-product diversification. In a similar manner, Kaset Thai International Sugar Corporation (KTIS) aims high in reducing its revenues from sugar to 50 % from 80 % by investing into co-products. Therefore, Indian sugar industry too should start thinking outside of the box, bringing a change in the way the industry looks at the market as well as at its customer is necessary for its survival in present times.

There is plethora of possibilities and challenges for sustainable innovations that the sugar industry can look upon in times to come whose potentials are yet to be harnessed to the maximum possible extent (R. PJ Manohar 1997). Keeping this in view figure 2 illustrates the possibilities and futuristic approach for better utilization of product and by-product that the sugar industry may think upon for better survival in the market. The model as given in figure 2 gives an idea about the bio-refinery concept the industry must adopt. Such model would help the industry to explore food sector, as well as healthcare sector and also the nutraceutical market as well.

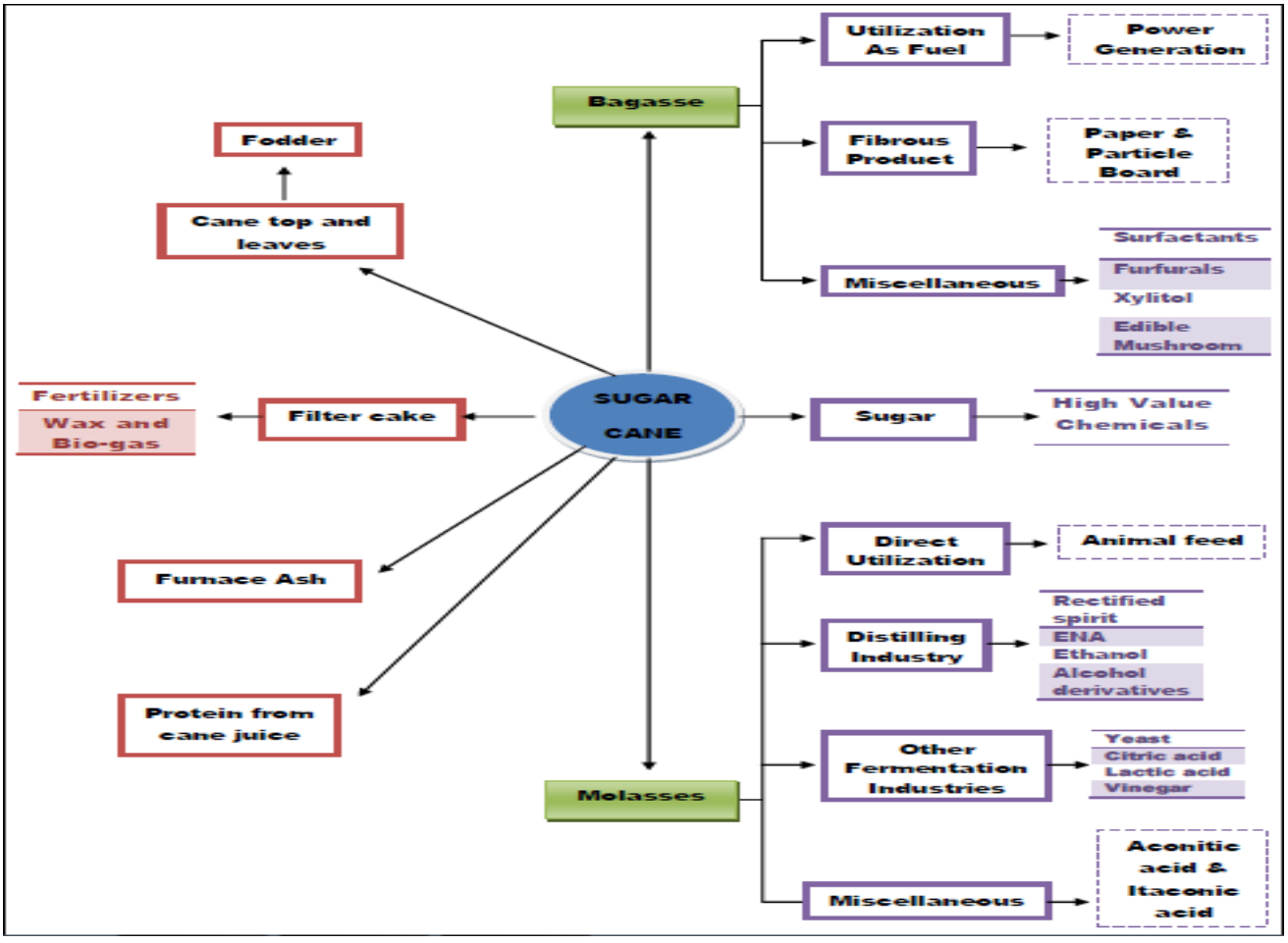

Fig 1 Utilization of products & by-products of sugar industry (existing scenario)

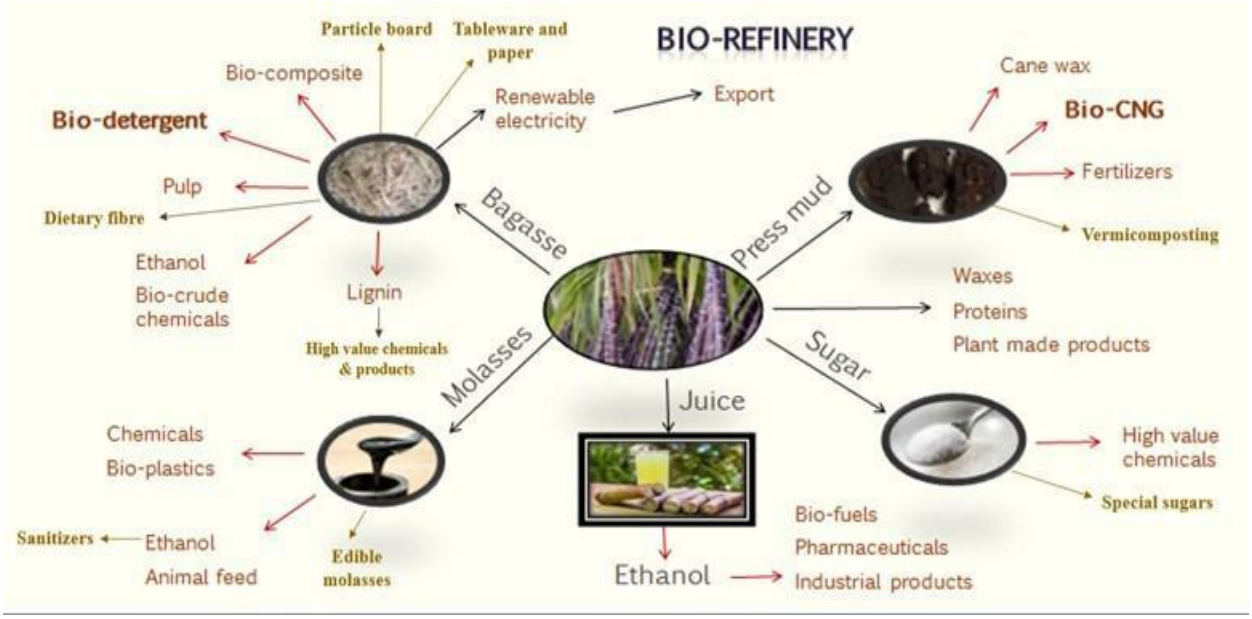

Fig 2 -Bio-refinery concept for sustainable sugar sector

INNOVATIVE AND SUSTAINABLE APPROACH TOWARDS BY-PRODUCT UTILIZATION OF SUGAR INDUSTRY

BAGASSE

During the processing of sugarcane for manufacture of sugar, the fibrous biomass left after the extraction of cane juice is termed as bagasse. This fibrous biomass is considered as one of the most important by-product of the sugar industry in terms of volume (28 – 32 % on cane). Usually sugarcane bagasse is used as a fuel for production of steam and electricity which is further utilized by the sugar factories itself and to some extend even exported to the grid. With the passage of time, the charm of bagasse based co-generation and export of power to grid was fading away as result of reduced power tariffs due to competition with tariffs offered by power generated through non-conventional energy resources and therefore a more comprehensive attitude was required for proper disposal of such huge voluminous by-product. Bagasse, a lignocellulosic biomass is generally composed of cellulose 23 %, hemicellulose 12.3 %, lignin 9.9 %, fat and wax 1.8 % and many other elements such as carbon 48.7 %, hydrogen 4.9 %, nitrogen 1.3 %, phosphorus 1.1 %, ash 2.4 % (P. Ashok 2000).

This by-product being widely available, cheap and also being environment friendly can be a potential source to a huge number of products and therefore its potential is to be fully harnessed by the industry in order to add benefits to the present system. As bagasse is primarily used for fuel, it also finds its application for several other purposes likewise paper and pulp making or it is also seen to be used in cattle feed as well (M. Narendra & K.K. Anoop 2019). With great concerns of consumers

towards environment, there has been a shift in the use of disposables and non-plastic materials for packaging that are bio-degradable, low cost incurred for their manufacturing. This trend has led an altogether different sector for efficient utilization of bagasse. Present times have shown various manufacturers jumping into the production of disposables, tableware's, bottling, packaging materials, particle board etc. that are processed using bagasse (Poopak, S. & Reza, A. R. 2012). The illustrations as given under figure 3(a) to 3(h) given a broad perspective of attractive use of bagasse for various consumer friendly products.

Fig 3 (a) Multiple bagasse products: - tableware, paper, packaging, bottles, MDF board, plastic composite resins

Fig 3 (b) bagasse tableware/dinnerware- disposable plate, bowl, tray, cutlery

Fig 3 (c) Bagasse paper: - A4 copier paper, Kraft, printing, tissue, toilet, wall paper, bags, cardboard

Fig 3 (d) Bagasse packaging: - food, fruits, eggs, beer, perfume, deo, cosmetics

Fig 3 (e) Bagasse bottles: - mineral water, milk

Fig 3 (f) Bagasse bottles: - milk, water, wine, oil, medicine

Sugarcane bagasse contains complex lignocellulosic material which can be used as low cost energy and carbon source for fungal cultures. Generally, fungi are grown on potato dextrose agar (PDA), Sabouraud dextrose agar (SDA), or Cornmeal agar (CMA) which is very expensive. Basically every fungus requires carbon, nitrogen, and energy source to grow and survive. Studies have shown that sugarcane bagasse may meet these requirements and work as a fungal growth medium and can replace expensive media in the market. One quintal of bagasse could yield 87 kg of oyster mushroom (Pleaurotus sajorcaju) and 79.6 kg of white button mushrooms (Agaricus bisporus). To add to the shelf, sugarcane bagasse may be seen as a rich source of dietary fibre but its major limitation is its low digestibility which is due to association of lignin with cellulose and hemicellulose. Lignin is said to reduces the digestibility of cellulose and hemicellulose by physically protecting them against enzyme degradation. Efforts are being made to overcome this difficulty by using number of chemical and biological treatments towards delignification. Therefore, in times to come, sugarcane bagasse fiber may serve as one of the most popular nutrients in the nutraceuticals industry.

Bagasse being a lignocellulosic material comprises of cellulose, hemicellulose and lignin. While on one hand the cellulose and hemicellulose component of this by-product is being exploited for value-addition and is being utilized to its maximum extent possible for production of products viz-a-viz cogeneration, production of dietary fiber, paper and particle board, paper etc. the lignin portion is often left unexplored and untouched. Several literatures have shown that while cellulose and hemicellulose portion of bagasse are of great use for making different value-added products, the lignin portion of bagasse also serves as a base for various high value chemicals as shown in figure 4. Studies and market survey have shown that lignin is the upcoming name which has huge potential for manufacture of numerous aromatics and different kind of polymers (Gourav Dhiman 2019). The market for lignin based high-value products is expected to grow at the rate of

3.42% during the period 2018-2023 from current 974.6 million, where it may form a major share in the cement industry as a cement additive. From a global perspective, Europe is expected to be the major market player for lignin-based products which at present accounts for about 34 % of the total market share. In a nutshell, innovation and advance research in the field of lignin bio-refinery holds immense potential in near future.

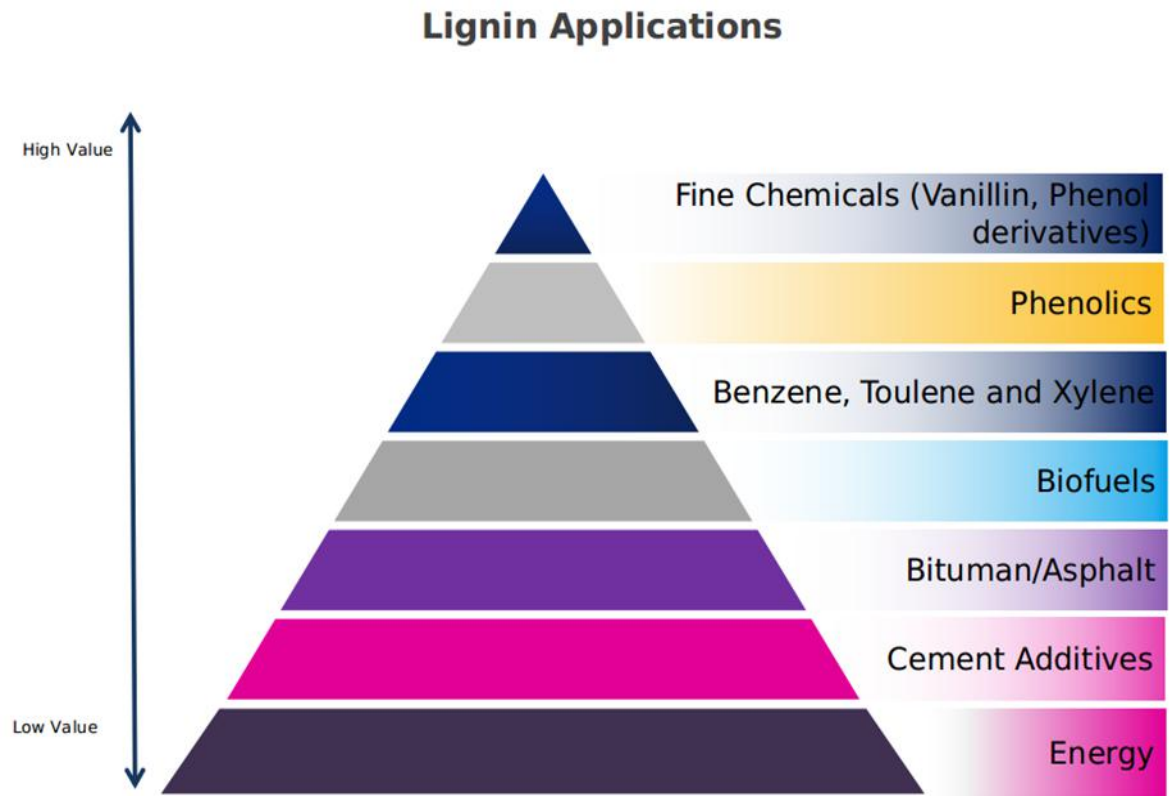

Fig 4 Utilization of lignin for high value chemicals

MOLASSES

Molasses is one of the most valued by-products of the sugar industry. Several value-added products like organic acids, enzymes etc. can be produced by utilizing molasses in a better and efficient way (R. PJ Manohar 1997). In present times molasses is used primarily by the distillation industry. Although due to the recent pricing policy announced by the government of India, production of ethanol has gained momentum, but a part of the molasses can still be used for converting it to a value added product earning higher revenues as compared to those with ethanol production (Gopal, A. R., & Kammen, D. M. (2009). Wide range of molasses as obtained from different sources exists in the market such as cane molasses, beet molasses and refinery molasses. Various MNC's are branding and selling edible molasses @ Rs. 1000/kg or so which is much higher than the normal price of molasses sold by the sugar factories. This edible molasses has wide application ranging from bakery product to enhancing flavouring properties in meat, herbs, chocolate, spices etc. also help in fortifying sweets, savoury or spice flavours. Many innovative technologies and ideas can be explored to make this

product more nutritious and more easily available in the market which therefore opens a new field for the sugar industry to prosper.

Increasing energy demand, depleting natural resources and the need to reduce carbon dioxide emission has greatly increased interest for the use of biomass as alternative energy source. Bio-ethanol is most abundant bio-fuel for automobile transportation. The table no. 1 given below speaks for growing population of vehicles been added in the country over the years and hence the possible increase in emission.

Table 1 Automobile Domestic Sales Trends

Category	**2013-14**	**2014-15**	**2015-16**	**2016-17**	**2017-18**	**2018-19**
Passenger Vehicles	25,03,509	26,01,236	27,89,208	30,47,582	32,88,581	33,77,436
Commercial Vehicles	6,32,851	6,14,948	6,85,704	7,14,082	8,56,916	10,07,319
Three Wheelers	4,80,085	5,32,626	5,38,208	5,11,879	6,35,698	7,01,011
Two Wheelers	1,48,06,778	1,59,75,561	1,64,55,851	1,75,89,738	2,02,00,117	2,11,81,390
Quadri-cycle#			0	0	0	627
Grand Total	**1,84,23,223**	**1,97,24,371**	**2,04,68,971**	**2,18,63,281**	**2,49,81,312**	**2,62,67,783**

#Only Aug 18 -March 2019 data is available for 2018-19

Although there are many factors which contribute to air pollution, but the quantum of vehicular emission cannot be ignored or underestimated. Unfortunately, out of the 50 most polluted cities of the world, 25 cities are in India as reflected from their poor air quality index (AQI). Bio-ethanol, being a clean and green fuel can play a dominant role in pursuit of reducing emission levels providing a relatively cleaner environment. Example of Brazil is before us which speak for drastic improvement in the air quality after adoption of the EBP 27 programme. In a report published by Indian Sugars (Indian Sugars 2020) União da Indústria de Cana-de-Açúcar UNICA mentioned that Brazil has seen success cases in its large cities with improved pollution levels (particulate matter) close to the World Health Organisation levels. Such levels were achieved mainly due to adoption of ethanol by Brazil in vehicle fuel. Therefore, India too can improve its air quality levels by introducing a mandatory ethanol blend and diverting a part of its sugarcane production to produce ethanol fuel. More diversion of cane towards ethanol rather than sugar would help reduce the glut in the sugar market and greater use of the biofuel would reduce India's dependence on crude oil imports, ensure energy security, reduce pollution, and generate local jobs. Studies and reports reveal that India is determined for an ethanol blending target of 10% by 2022.

FILTER CAKE

Amongst the by-products of the sugar industry, filter cake in particular is second main solid waste generated from the sugar industry with annual production of around 9-10.5 million metric ton (A. Sanjay et. al 2019). Proper disposal of this by-product is of great concern for the industry. Its management, handling, storage and transportation becomes difficult due to high water content of filter cake and also its peculiar smell which causes insect and pest infestation. Filter cake is largely being utilized as bio-fertilizers and is used as compost in sugarcane fields. Since direct use of filter cake pose risk and several limitations, it is used with other fertilizers to improve the fertility of the soil, pH balance in soil, improve drainage and also to promote growth of healthy microflora to enhance soil quality for better crop management (P. Renato de Mello et. al. 2013).

An emerging trend to utilize the press cake for production of Bio-gas or Bio-CNG is gaining momentum in coming times. The press cake since contains appreciable proportion of biodegradable organic matter which has very good potential for the production of biogas. The biogas produces as a result of anaerobic reaction of various degradable substrates including press cake serves as clean energy and may also prove to be a value added product from the by-product of the sugar industry (A. Sanjay et. al 2019). Considering filter cake % cane been about 3.5 and limited option available for its commercial exploitation, this by-product having substantial amount of organic material can be used for production of bio-gas, compressed biogas/ bio-CNG. With proper investment and planning, this untapped potential can be harnessed which will also help in value addition for the sugar factories. Although a thorough study relating to the cost of production and the quality of the raw material is to be carried out.

As the sugar industry generates surplus amount of waste, these can be utilized as bio-resource for production of ethanol, animal feed, paper and many more resourceful products as detailed in the chapter. However, still appreciable amount of the by-products is leftover for disposal and could not be put to better use. For efficient disposal and sustainable utilization of such waste or by-product of the industry, vermicomposting is one such method which as per several studies have found to be an effective method to enrich the soil and farms with organic matter (Sherman, R. L. (2011). Vermicomposting is a decomposition process wherein coupled action of earthworms and microorganisms on the waste and cow dung mixture takes place. Vermicompost is said to a peat-like substance or material which is highly porous and is enriched with plant nutrients that facilitate sustainable agriculture by supporting as essential nutrient growth media along with being a hub for several microbes. Using sugar waste alone does not support vermicomposting as the earthworms cannot survive in pure sugar waste. However, when mixed with cow-dung, sugar waste such as filter cake or bagasse may serve the purpose for successful vermicomposting process. Cow-dung being a rich source of microorganisms, enhances the overall nitrogen content of the Vermicompost (Nagavallemma et. al. 2006). Figure 5 illustrates the use of sugarcane bagasse and filter cake for vermicomposting. In a nutshell, vermicomposting a said to be a friendly, sustainable and economically viable alternate for utilizing organic waste such as filter cake from sugar industry (Saranraj, P., & Stella, D. 2014).

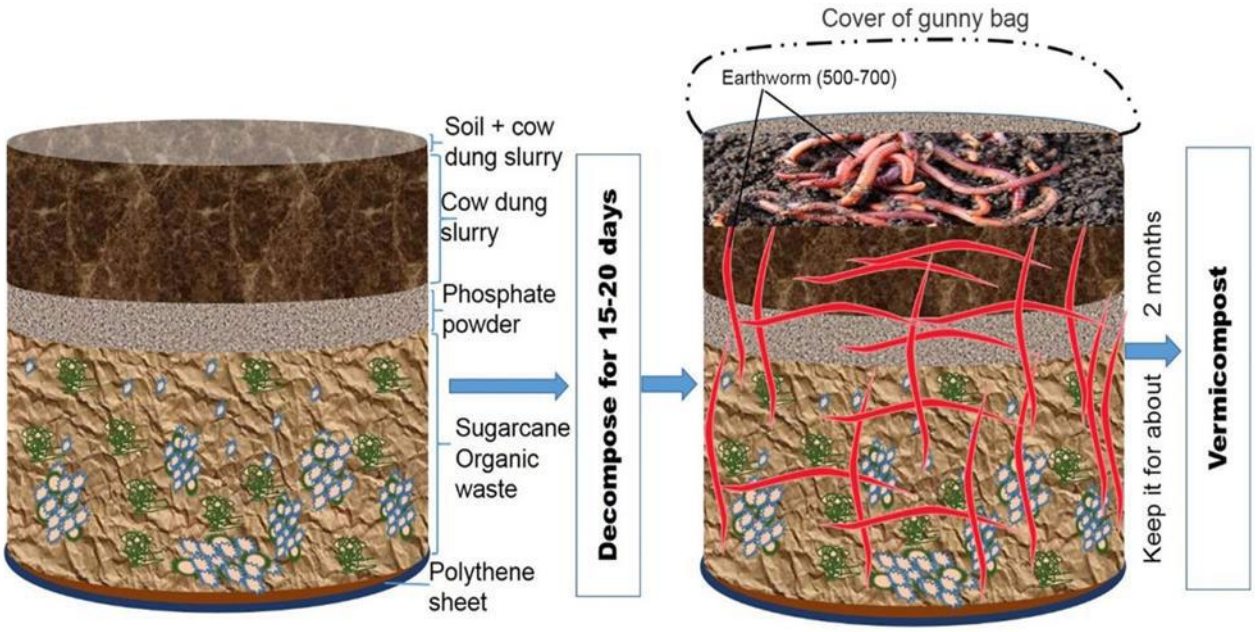

Fig 5 Vermicomposting using sugarcane filter cake and sugarcane bagasse

WATER

Sugar industry is responsible for being the major water consumers and effluent generators. Approximately, 20-30 tonnes of water is required in order to cater to the process requirements for production of around one tonne of sugar. Around 10-20 % of water is rendered surplus as waste water. The waste water originating from different segments of the sugar factory viz. milling house, process house as well as boiler house all contribute together to form a great volume of waste water that the industry generates which holds potential to cause environment imbalance. It is said that the amount of effluent generated from the industry depends on the cane crushing capacity of the individual industry and the manner in which water usage is managed within the industry. For example, in India, around 1 kL of waste water is generated from one tonne of sugarcane processed by the sugar industry. So, an industry with 2500 tons crushed per day (TCD) capacity would result in generating around ml of waste water for an average crushing season of 6 months (Ingaramo et. al. 2009). The waste water generated from the sugar industry is characterised by high biochemical oxygen demand (BOD), chemical oxygen demand (COD), and total soluble solids. Proper disposal of this waste water from the industry is an area of concern worldwide. Studies have shown several methods adopted for wastewater management of sugar industry for instance, a review published by Kushwaha revealed various advancements and upgradation in aerobic, anaerobic and physico-chemical treatment techniques (Kushwaha, J. P. 2015). The studies give a comprehensive idea about the primary, secondary, and tertiary treatment techniques of wastewater wherein physico-chemical treatment methods such as ultrasonic (US) and nanoparticle exposure were adopted. Still more could be done in this field, advance methods for example electrocoagulation, ozone treatment, ultrasonic membrane anaerobic system could be promising approached where the sugar industry could innovate and evolve. To conclude, as per requirement, different other innovative technologies could be adopted in the long run with a view to help sugar industry mitigate the problem of waste water

disposal as well as stand as an industry that could return certain portion of the water to the society which in turn could be in any form viz-a-viz for irrigation purpose, water suitable for other human needs and even for drinking purposes. Therefore, the sugar industry can be a hub for 'bio-water'.

CONCLUSION

An integrated strategy towards sustainable waste management and value-addition and utilization of by-products in an innovative manner is an effective approach for economic feasibility and sustainability of the sugar industry altogether. It is anticipated that sustainable waste management strategies will contribute to efficient management of the triple bottom line components of environmental responsibility, economic return and social development for the overall growth and development of the sugar industry. The essence of success will be "attitude" to invest in a judicious way rather than building capacities. While quality raw material development shall be the priority, diversifications and integrations are going to be the key to success.

REFERENCES

A. Sanjay, P. Seema and M. Narendra July 2019, "Bioenergy from filter cake," proceedings of 77th Annual convention of SATI: 505-515.

Gopal, A. R., & Kammen, D. M. 2009. Molasses for ethanol: the economic and environmental impacts of a new pathway for the lifecycle greenhouse gas analysis of sugarcane ethanol. Environmental Research Letters, 4, 044005.

Gourav Dhiman January 2019, 'Lignin Bio-refinery: An effective Biomass conversion to Value added Product.'

Indian Sugar – The Complete Sugar Journal, January 2020, volume XX, issue 11

Ingaramo, A., Heluane, H., Colombo, M., & Cesca, M. (2009). Water and wastewater eco-efficiency indicators for the sugar cane industry. Journal of Cleaner Production, 17, 487–495.

Kushwaha, J. P. 2015. A review on sugar industry wastewater: sources, treatment technologies, and reuse. Desalination and Water Treatment, 53, 309–318.

M. Narendra and K.K. Anoop 2019, "Biomass energy for economic and environmental sustainability in India," Sugar Tech (Mar-April) 21(2): 197-201.

Nagavallemma, K. P., Wani, S. P., Lacroix, S., Padmaja, V. V., Vineela, C., Babu, R. M., & Sahrawat, K. L. (2006). Vermicomposting: recycling wastes into valuable organic fertilizer. SAT eJournal, 2, 1–16.

P. Ashok, S. Carlos, N. Poonam & T.S. Vanete August 2000, "Biotechnological potential of agro-industrial residues. I: Sugarcane bagasse," Bioresource Technology. 74. 69-80.

P. Renato de Mello, C Gustavo, C. Cid Naudi Silva July 2013, "Filter cake and vinasse as fertilizers contributing to conservation agriculture," Applied Environmental Soil Science, 1:1-8.

Poopak, S. & Reza, A. R. 2012. Environmental benefit of using bagasse in paper production—a case study of LCA in Iran, INTECH.

R. PJ Manohar 1997, "Industrial utilization of sugarcane and its co-products," ISPCK publishers & distributors.

Saranraj, P., & Stella, D. 2014. Composting of sugar mill wastes: a review. World Applied Sciences Journal, 31, 2029–2044.

Sherman, R. L. 2011. Vermicomposting for businesses and institutions. Boca Raton: CRC Press.

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ABSTRACTS:

Comparison of two methods of retrofitting a bagasse boiler: increasing the heating-surface areas and installing a flue-gas dryer by Somchart Chantasiriwan published in International Sugar Journal in October, 2020.

The efficiency of a bagasse boiler increases as the final flue-gas temperature decreases. High flue-gas temperatures may be used to reduce the moisture content of bagasse in a flue-gas dryer. Alternatively, increasing the surface areas of an economizer and air heater can also decrease the flue-gas temperature. In this paper, both methods of retrofitting a low-efficiency bagasse boiler, based on a boiler model and a flue-gas dryer model, are compared. The bagasse boiler in this model consists of a furnace, evaporator, steam drum, super heater, boiler bank, economizer, and air heater.

Exploration of sugarcane products as a major source of antioxidant phenolic extracts in commercial foods and beverages by Gillian Eggleston & Giovanna Aita published in International Sugar Journal in October, 2020.

Consumers in the USA and around the world are becoming increasingly more familiar with health benefitting antioxidants, and are looking for beverages/foods that are good sources of antioxidants. Sugarcane is a rich source of phenolic compounds and antioxidants. Plant phenolic compounds including flavonoids have been recognized as important nutrients in foods and beverages that contribute to the consumption of antioxidants, and allow for health and wellness claims for a particular foodstuff. Phenolic compounds are frequently found in fruits, vegetables, and cereals and are available in concentrated form in botanical extracts, e.g., cranberry, rosemary, and tea extracts.

Optimization of a phenotyping system in sugarcane to evaluate different strategies against Diatraea saccharalis (Fabricius) by F Budeguer, MF Perera, G Michavila, J. Racedo, G Gastaminza, MI Cuenya & AP Castagnaro published in International Sugar Journal in October, 2020.

Sugarcane borer Diatraea saccharalis (Fabricius) (Lepidoptera: Crambidae) is the most important sugarcane pest in Tucumán, Argentina. Older larvae (L3, L4) bore into the stalks, disrupting the physiological integrity of the plant, facilitating fungi and bacteria colonization which indirectly reduce yield and quality of sugar. The aim of the present work was to optimize a sugarcane plant-infestation method with D. saccharalis under controlled conditions to help to evaluate different strategies to manage the pest. Different numbers of neonate larvae were placed in the leaf whorl of sugarcane seedling (two-month-old) of cultivars TUC 95-10, TUC 03-12 and LCP 85-384.

Low steam % cane – Almoiz Industries' road to success by Khalid Rashid, Salman Shehryar & Muhammad Arif published in International Sugar Journal in October, 2020.

Energy conservation is an integral part of steam, power, fuel and water management in the sugar industry and energy conservation within a sugar mill has become more important globally in the context of both thermal and electrical energy. Sugar mills that can be operated at high pressure with co-

generation will be more profitable and viable, as these have an ability to optimize the process steam and electrical power. Therefore, high-pressure boilers (65 bar, 500°C), evaporators (with a complete set of falling film), high-pressure turbines, electrically driven mills (with compact planetary gears and flexible couplings), continuous vacuum pans.

Cellulosic ethanol production potential from bagasse of elite sugarcane varieties/clones by Jaspreet Kaur, Monica Sachdeva Taggar, Gulzar Singh Sanghera, Anu Kalia & Mohammed Javed published in International Sugar Journal in October, 2020.

Sugarcane is one of the most efficient crops for generation of liquid biofuels. In addition to juice, bagasse represents an additional abundant lignocellulosic biomass that has great potential to increase ethanol production from this crop. To achieve efficient conversion of sugarcane bagasse into ethanol, various components that affect recalcitrance of bagasse as well as generation of fermentable sugars from it need to be studied. In the present study, bagasse of 29 sugarcane clones/varieties were analyzed for total solids, moisture content, ethanol extractives, and different cell wall components.

Reasons for the unusually low molasses purities in Louisiana sugarcane factories during the 2018 processing season by Gillian Eggleston , David Stewart, Chardcie Verret, Alexa Triplett, Belisario Montes, Tyrenee Foster, Eldwin St. Cyr & Peter Gaston published in International Sugar Journal in November, 2020.

Target purity difference (TPD) of final molasses, calculated by subtracting a target purity from the true sucrose purity determined by high performance liquid chromatography, is used by Louisiana (LA) factories to determine how well they are recovering sugar from their massecuites. Generally, a lower TPD indicates greater recovery of sugar. During the 2018 processing season, ten of the eleven Louisiana factories experienced markedly lower TPD values than previous seasons as well as unusually low purities in final molasses, which could not be explained by conventional analyses.

Towards a molecular toolkit to assess biological health of soil by Anthony J Young, Neil L Wilson, Melody B Thomson, Shane Fitzgerald, Ken Fitzgerald, Chris Baldock, Marcelle Stirling & Graham Stirling published in International Sugar Journal in November, 2020.

Sugarcane farmers are becoming increasingly aware of the importance of soil health. However, there are limited tools by which the health of soils can be measured. Nematodes are known to be an excellent indicator of soil health, but their identification and enumeration is laborious and requires the expertise of a diminishing pool of trained scientists. Molecular methods are being used to detect specific nematode targets and estimate their numbers, but in the sugar industry this work has focused on two key pests: root-lesion nematode (Pratylenchus zeae) and root knot nematode (Meloidogyne spp.).

Vitroplantas Project of the EEAOC (Tucumán, Argentina): results at the stage of hardening of plantlets in a greenhouse (2001-2017) by C. Díaz Romero, MB Garcia, MF Figueroa & MI Cuenya published in International Sugar Journal in November, 2020.

In 2001, the Estación Experimental Agro industrial Obispo Colombres (EEAOC) started the Vitroplantas Project in order to provide sugarcane growers with high-quality seed cane (free from systemic diseases and with guaranteed genetic purity) of commercial cultivars so as to improve productivity of new plantings. The Vitroplantas Project consists of the following stages: i) production of plantlets (vitroplantas) in the laboratory, from meristems extracted from healthy donor plants, ii) hardening of vitroplantas in a greenhouse, and iii) sequential propagation of material in nurseries and distribution to growers in the Tucumán area.

Characterization of dissolved organic matters in molasses by using LC-OCD-OND by Mahshid Farzanehsa, Korshed Chinu, Mohammadreza Behi, Dale McClure, Geoff Barton & John Kavanagh published in International Sugar Journal in November, 2020.

Molasses is widely used in many fermentation processes. As wastewater from molasses fermentation can pose an environmental problem, scientific characterization of the non-sugar components of molasses is worthwhile. Whilst most previous work has focused on the nutrient content and chemical composition of molasses, the present study investigates molasses fractionation based on molecular weight distribution. In this study, Size Exclusion Liquid Chromatography Organic Carbon Detection (LC-OCD) was utilized to characterize the dissolved organics in six molasses samples. Through this method, the dissolved organic matter of each sample was fractionated into six groups, which could then be quantified.

Immuno-nephelometry method for detection of dextran: a comparison with ICUMSA Haze method and its use in Chinese sugar factories by Liu Ying, Liu Gui-yun, Chang Guo-wei, Zhang Jiu-hua, Li Zhi-de, Huang Zeng-wei, Liang Da-feng & Chen Jun-jia published in International Sugar Journal in December, 2020.

The problems associated with dextran during cane sugar and beet sugar processing are well documented in the literature. An immune-nephelometry method, based on monoclonal antibody technology, was compared with the ICUMSA Haze method. Both immune-nephelometry and Haze methods gave varied responses to different average molecular weights (MWs) of dextran. The immune-nephelometry method had a lower detection limit and was more sensitive to high MW dextran's, which may lead to a better understanding of their impact and practical guidance for dextranase addition in sugar factories.

Economic analysis of two sprinkler irrigation systems for sugarcane and soybean crops in Brazil by Job Teixeira de Oliveira, Fernando França da Cunha, Rubens Alves de Oliveira, Aziz Galvão da Silva Júnior & Vinicius Bof Bufon published in International Sugar Journal in December, 2020.

The economic viability of two center pivot irrigation systems (traditional or coupled to the corner system) for sugarcane and soybean crops were evaluated. Sugarcane cultivation with an 8-year cycle, followed by soybean cultivation for sugarcane renovation and the beginning of a new 8-year cycle of sugarcane to complete 27 years of the system was used for the simulations of economic feasibility for the Chapadões region, Brazil. The calculation

of the indicators was performed using the AmazonSaf-Embrapa spreadsheet, according to the technical coefficients of the agricultural cultivation for the region.

Key considerations for high-performance continuous vacuum pans by BStC Moor, S Rosettenstein & N du Plessis published in International Sugar Journal in December, 2020.

The two most important objectives for a high-performance continuous vacuum pan (CVP) are good crystal quality and high exhaustions. To achieve these, the pan design needs to incorporate features that promote plug flow (a narrow crystal residence-time distribution), a high heat-transfer coefficient (HTC) and vigorous circulation. Focusing on these will also achieve an energy efficient pan that can operate on a low steam-massecuite temperature differential. Good plug flow is an essential for good crystal quality (low CV), which enables good purging with minimal washing and good exhaustions. This in turn minimizes re-boiling and its associated energy and sucrose losses. Low CVs also aid affination and for this reason are frequently included in raw-sugar specifications. Measures to achieve good plug flow include a good circulation profile and good inter-compartment massecuite-transfer arrangements. Achieving plug flow has presented the greatest challenge to CVP designers, but the problem is shown to have been mastered in some horizontally-configured vertical tube pans. Key requirements for high exhaustions are appropriate seed supply, good feed (super saturation) control, vigorous circulation and a high final Brix. Various ways in which circulation can be promoted are described. Recent information is that, contrary to previous belief, longer tubes perform as well as or better than shorter tubes in CVPs.

Characterisation of non-sugar compounds in molasses by LC-OCD-OND by Mahshid Farzanehsa, Khorshed Chinu, Dale McClure, Geoff Barton & John Kavanagh published in International Sugar Journal in December, 2020.

Molasses is widely used in many fermentation processes producing significant quantities of highly coloured effluents. While, the majority of previous research has focused on the nutrient content and chemical composition of molasses, characterization of the non-sugar compounds of molasses has not received significant attention in previous studies. In the present work, the dissolved organic material in six fermented molasses samples was characterized using Liquid Chromatography Organic Carbon Detection-Organic Nitrogen Detection (LC-OCD-OND).

Efficacy of Sett Treatment with Heat and Bavistin wp 50 To Control Smut (Ustilago Scitaminea) of Sugarcane by M. A. K. Al Azad, M.I.H Mian, A. M. Akanda, A.A. Khan, M. I. Hossain published in Indian Sugar Journal in October, 2020.

A field experiment was conducted during 2011-2012 cropping season to find out the effectiveness of sett (seed cane) treatment with hot water at 50 or 52 °C for 2 or 3 hr with or without subsequent treatment with 0.2% Bavistin 50 WP to control the smut disease. Two budded sets of variety Isd37 were used in the investigation. In the year, smut incidence was 0.33, 0.66 and 0.66% under control. The disease incidence was 0.33, 1.00 and 1.00% at 108, 138 and 168 days after planting (DAP) when sett were treated with moist hot air at 54

°C for 4 hr. Sett treatment with hot water at 50 °C for 2 or 3 hr and with or subsequent treatment with 0.2% Bavistin 50 WP for 30 min reduced smut incidence by 100%. sett treatments with hot water alone or subsequent treatment with 0.2% Bavistin 50 WP was effective to control the disease. Setts treatment with moist hot air at 54 °C for 4 hr and hot water at 50 °C for 2 hr or 3 hr increased millable cane number by 25.00 and millable cane yield by 48.00 13.71 and 41.71%, respectively over control. The length of millable cane increased by only 1.83, 8.22 and 6.85% over control due to treatment of setts with MHAT at 54 °C for 4 hours and treatment with only hot water at 50 °C for 2 hour and 3 hours, respectively.

Fast Multiplication of Sugarcane Varieties through IVPS (In Vivo Proliferation System) Technique by P.K Gupta, Chandra Mohan Published in Indian Sugar Journal in November, 2020.

Development of Package and practice of a very cost effective new propagation Technique IVPS (In Vivo Proliferation System) technique for the fast multiplication of sugarcane varieties in Vivo condition (outside condition) and conducted field trials at Sugar Mill R&D center & farm as well. To further propagate disease free planting material, Tissue culture hardened plantlets were used as mother plants for further propagation/multiplication purpose. Continuous multiplication (proliferation) was obtained. In first phase of experimental trial, only 630 TC plantlets were planted in open beds (In Vivo condition) and formed 15873 IVPS plantlets, 25 times multiplication rate was achieved within a period of five months at our R&D Centre and after 2 week of hardening in simple shade net house same propagated plantlets were planted in 1.5 Acre area as a seed nursery at the farm of Magadh Sugar & Energy Ltd. Unit- New Swadeshi Sugar Mill, Narkatiaganj, Bihar.

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