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# Catalysts

# **PG. 08** Acceleration of Laboratory analysis With automation



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# ALCOHOL Tolerance PG. 31

SIMPLE HABITS TO SAVE MONEY PG. 26



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- **Our Vision & Values**
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- **Biofuels like Ethanol Reduced Cancer Risk**
- Do you know camphor can make indoor air germs & odour free



Liquid Chromatography (HPLC) in fermentation Process



making things happen ...

# OUR VISION

"A Globally acclaimed company creating value for all stake-holders by providing innovative and sustainable solutions."

# OUR VALUES

C ustomer Oriented
A daptability
T eam-work
A mbitious
L earning Attitude
Y es to Life
S ystem Driven
T aking Initiative
S elf-Discipline & Integrity



ounded in 2003 in India, The Catalysts Group is an Indian Biotechnology company, focused on offering wide range of enzyme based eco-friendly solutions to many industry verticals in India and Overseas. The company leverages latest technology trends and disruptive approach to create process-based customize solutions. The goal is to provide measurable outcomes to its customers, across industries and sectors by offering a gamut of enzymes solutions, from strategy to execution. In span of 17 years, Catalysts is well on its way to become a global brand in the Industrial Biotechnology space in this decade. With a reach already spanning 3 continents, 10+ countries and 400+ cities globally and a clientele that's rich in industry-leading companies, the company has traversed the evolution from an Indian to an Asian and soon a Global company. Catalysts is focused on generating employment opportunities through manufacturing and delivering centers across globe and focusing on safeguarding the environment. Dedicated team consists of highly qualified, dynamic, passionate and experienced research professionals. They

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# CORPORATE PROFILE

are capable of delivering robust results for customer centric requirements. Catalysts team always strives to use innovative tools and technological advancements to stay abreast with the rapidly changing industry scenarios and to meet the customer's evolving needs. Having acquired quality certifications like ISO9001:2015, FSSC 22000, FSSAI, NABL, HALAL and Kosher, our Research and Development Centre has been recognized by the Department of Scientific and Industrial Research (DSIR).

With real time processes and troubleshooting support, we provide our best services to a variety of industrial verticals like:

- Molasses • Sugar • Starch
- Brewery
   Grain Processing
   Malt Extract
- For more information, please visit : https://www.thecatalystsgroup.com/
- or email us at: marketing@thecatalystsgroup.com

# **MESSAGE FROM THE MANAGING DIRECTOR**



**MUNISH MADAAN** 

Pelcome to our next edition of Catalysts Connect for the year 2021. We all stepped into this year with hope and optimism on account of the launch of Covid Vaccines and economies recovering sharply across the world after a challenging year 2020. Though we have witnessed a decent economic recovery, the challenges posed by recurring mutations of the virus is keeping everyone at the edge. As we prepare to step into the new year, it seems these challenges will continue considering only 40% of the world population is fully vaccinated as on date.

Indian economy restricted by the devastating second wave of Covid in Q-1 of this F.Y. has shown remarkable recovery since then. Fast pace of vaccination and lower daily cases have led to this sharp economic recovery and it is expected to achieve double digit GDP growth in this F.Y.

Ethanol blending in Petrol in India has grown to 8.3% in the Ethanol Supply year 2020-21 (October to November) from 1.53% in 2013-14. Excess sugar produced every year is now being converted into Ethanol. This is a remarkable achievement led by positive Ethanol policy initiatives of the Indian Government. It has not only given a big boost to the long ailing sugar sector, but has also helped improve incomes for Sugarcane farmers in India.

The Indian Government with a vision and commitment to achieve 20% Ethanol blending target by 2025, has taken many policy initiatives, like allowing the usage of Grains like Rice, Maize etc. being produced in excess every year for Ethanol production. This will not only help achieve much required balance between demand-supply of Grains (in turn improving income of Indian farmers), it will also help India become more self reliant by reducing imports of crude-oil.

This new Ethanol policy initiative has not only created a huge opportunity for Indian entrepreneurs to venture into the Ethanol sector but also encouraged already established distillers to enhance their current product capacities. Whenever there is an opportunity, there are challenges as well.

We as Catalysts being India's No.1 and most trusted solution providers in Biotechnology space for Distilleries producing Ethanol, are proactively identifying these challenges and are actively engaging with industry experts as well as our principals on mitigating these challenges. We are also ramping up infrastructure and upgrading manpower competencies at all our offices and labs in anticipation of the increased requirements from our clients in future.

As I sign off! I take this opportunity to wish a very happy and exciting new year 2022 to all of you and your families. May this year bring happiness, health and prosperity to all.

Best wishes

Kan m

Munish Madaan



# **ACCELERATION OF** LABORATORY ANALYSIS WITH

he success of the new product development lies on the quantum of quality time we spend on research. It has been increasingly becoming a tough task in service-oriented product development organizations, who has to handle the analysis of customer samples and focus on product development. The scientists have to spend lot of time to prepare the reagents and needs optimization of complex workflows in a dynamic manner that creates lot of stress which ultimately reduces their focus & quality time they spend on research studies. In order

Dr. K.V.T.S. Pavan Kumar G.M (Head) R&D, QA/QC



to survive and thrive in the highly competitive market, it is highly recommended to adopt the lean practices. Lifesciences / Biotechnology industry needs more robust, cost-effective, reliable, and reproducible results and required to shift towards automation. The Quality Control department has to conduct repetitive studies to ensure quality of the product and customer satisfaction which has been left untouched by the lean practices. The organizations achieve maximum efficiency by evaluating and streamlining laboratory workflows by

transforming manual processes to automation that helps in lower operational costs and a higher productivity.

Lack of reproducibility is the major concern in a survey published in nature journal indicates 70% of researchers tried and failed to reproduce another researcher experiments and more than half couldn't reproduce their own (Baker; 2016). Freedman et.al., published another study in 2015 that estimates, the amount spent on non-reproducible research in USA alone accounts USD 28 Billion. Considering the current scenarios, the organizations working on innovations are giving more emphasis on lab automation, advanced testing to increase the overall efficiency of lab to accelerating their discoveries/new product development efforts. The latest revisions in regulatory guidelines also making the lab automation process feasible to comply the standards and simpler validation approaches that can deliver significant economic benefits to the industry.

Catalysts Biotechnologies Pvt Ltd, having a DSIR approved in-house R&D laboratory aiming on adopting the technology advancements and introduced automation via advanced equipment like



Traditional Technique **Operator Dependent Resource** intensive Time taking Handling Errors

Large sample volume **Reagents Consumptio** Sample gets destroyed Multiple equipment High Waste Disposal Increased Cost per analysis **Drains Profitability** 

Long Turnaround time Low throughput Labor Intensive **Extensive Training** 

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FOSS distillation unit and Multitier Plate Reader etc as an initiative towards improving quality of products and customer satisfaction.

### **Reference:**

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https://doi.org/10.1038/533452a

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https://doi.org/10.1371/journal.pbio.1002165



S	Modern Technology			
	Operator Independent			
	Minimal Resource			
	Fast and Accurate			
	Minimal/Zero Errors			

n	High
b	

Less sample Volume Reduced/No Reagents Sample intact Single instrument Low/Nil waste Generation Reduced cost per analysis **Increases Profitability** 

Fast and accurate High throughput Easy to operate Minimal training

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# CONVERSION OF UNFERMENTABLE SUGARS (UFS) OF MOLASSES TO YEAST ASSIMILABLE BUILDING BLOCKS (YABB) TO IMPROVE ETHANOL FERMENTATION YIELD AND EFFICIENCY

olasses is a by-product of Sugar process and one of the feedstocks for ethanol industry. The compositional study of molasses exhibits the presence of fermentable sugars, inorganic components, vitamins, minerals and approximately 4- 10 % of substances are not available for yeast which are Dr. K.V.T.S. Pavan Kumar G.M (Head) R&D, QA/QC



categorised as unfermentable substances. The fermentable components of molasses are metabolized by yeast to produce ethanol with the help of enzymes and other co-factors. However, the unfermentable portion of molasses containing a variety of components such as starch, dextran, levans, sarkaran, pectin's, cellulosans, hemicelluloses, mannose, and certain unknown components, which cannot be assessable to yeast in their original form. Due to this constraint, the unfermentable components in molasses remain unused. This creates an opportunity to convert the unfermentable portions of molasses to yeast-accessible forms by enzymatic conversion to increase ethanol productivity. As on date, no such solution is available in the market and development of such process or product in this area, would be helpful to maximise the yields.

Enzymes are the Biocatalysts known to play a vital role in complex metabolic conversions and can-do random hydrolysis of complex components of unfermentable sugars to produces smaller subunits via a wide variety of stereoselective preferential cleavage mechanism. The components of the unfermentable sugars were majorly linked with 1, 3 linkages, 1, 6 linkages & 1, 4 linkages. The exo-hydrolysing amyloglucoside mechanism of enzymes breaks these linkages to the less carbon, small building blocks which are readily available and taken up by yeast as building blocks for the growth, cell structure, repair & maintenance. However, this would be difficult to measure as the enzymatic reactions and yeast metabolism happens simultaneously. But can be measured by indirectly via increase in fermentation efficiency/ethanolyield.

Catalysts has done extensive research on UFS content from across the geography and developed a sustainable and ecoa m a y p T f e t c Ir

friendly product. It is unique enzyme cocktail formulation consists of depolymerization enzymes specifically acts on complex unfermentable molecules in molasses into useful yeast assimilable building blocks required for yeast housekeeping activities such as propagation and repair mechanism. Therefore, the dependency of yeast on fermentable sugars for its propagation will be reduced which in turn makes availability of fermentable sugars to yeast towards ethanol will also increase.

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Increase of 0.2% ethanol will give INR 1,00,000 profit per day to the industry calculating cost of ethanol @ INR 50/liter



Increase ethanol yield

Increase Yeast metabolic activity UFS2YABB

Enhance cell growth and substrate consumption Increase the availability to Yeast

Increase free amino groups and essential peptides

# DETERGENT FROM SUGAR



Mr. Gautam Kapoor Associate Vice President (Sugar)



Mr. Pradosh Sanyal Retired Professor at NSI

# PROLOGUE

India amounts nearly 35% of world sugar production . Besides India maintains a buffer stock of sugar within the country only for the use of edible purposes as an energy food as well as sweetening agent. However, in India it is little known as a raw material for getting many more utilities by means of chemical synthesis.

Petroleum and coal which are the core material for mostly organic synthesis products and can be deemed to be depleted some day. Naturally some alternative source of organic compounds has to be found out well in time of vegetation means. As a renewable source the sugar cane and cane sugar both can be befitting replacement.

Among the relevant products which can be originated from sugar industry other than sugar, the co-generation has been proved at the top of commercial success. Although it generate highest degree of pollution. Some of the many products which can be produced from sugar cane towards more efficient use of fiber component includes the co-generation. The new gasifier / gas turbine technology will improve energy efficiencies . Pulp and Paper production increased steadily from 1970 ~ 1985 , maintaining a slower increase thereafter . Techniques for partial or complete hydrolysis of hemicellulose are presenting opportunities for upgrading the feed value of bagasse and for producing a fermentable substrate from bagasse.

Second comes the Molasses fermentation to produce

Alcohol and it's related products. The Brazilian fuel ethanol programe is the first major step involving the growth of cane for the sake of an end - product other than sugar.Like way many other products are in the pipe line for commercialisation . However , ethanol fuel is catching up fast in India by diverting sugar into alcohol. Press mud is another source as a byproduct for producing fertilizers.

Out of these main products, the sugar itself other then it's usual use can prove for many derivatives as raw material. The general transformation of sucrose compared with Glucose & Fructose is much in France in a cooperative research programme are of immense utility. The application of those Sucro - Chemicals in polymer detergents and basic chemicals for paints , fertilizers , pesticides etc. are drawing much attention . Sucrose easters as plasticizer for biodegradable plastic may be having good future prospects.

Keeping the above discussion this brief presentation relates to commercialise the detergent of preferable quality as synthesised from sucrose.

# QUEST

However, some of the vital needs of an industry in introducing any new product with process Technology is to have limited gestation period in stabilizing the changes and realising the benefits, profitability and to tread over the long run along with the competitors for the product success. In case of Sugar Detergents, it has to be part of home grown technology activity to develop this product.

The prominence in recent years among the important industrial chemical made from sucrose / sugar are the synthetic detergent. In USA, France , Japan etc. these are being in use in large quantities . The products with sugar detergents



are of highest quality , inexpensive cleaners , and are also colourless, substantially tasteless and odourless , nutritious, non- toxic , non - imitating and digestible solids . In comparison to other detergents , these sugar based synthetic detergents are more superior to manufacture of shampoos , shaving soaps and creams . These products are completely non- irritating to skin & eyes . The detergent bars can prove with increased economy in hard waters . It has als application in the preparation of permanently emulsified dressing , as bread softeners and in washing fruits and vegetables.

It has the great advantage in their application for edible and palatable nature of preparations . This is the added advantage over common detergent . The criterion of low foaming characteristics as required for sewage disposal plants which are having trouble with foam caused by synthetic detergents is a great advantage in case of sugar detergents . Similar in case of most commercially used clothes washers and dish washers with low foaming detergents and successfully sugar detergents meets the desired quality , sugar based detergents are best to use for emulsification of insecticides because of their effectiveness and low cost.

Further to this, the problem of osteoporosis in aged people, which causes their bones to become fragile can be remedied by adding sugar based detergents to diet and already successful experiments with dogs have been carried out long back. Further work however, is in progress.



# BASICS

Detergency is a complex process depending upon number of parameters and mechanisms .it's formulation, nature of soil and surface water hardness, temperature, pH along with the mechanical energy are all important factors in this process. Besides this complexity, good detergency demands a specific mixture of surfactants which is both effective and efficient in lowering the surface and interfacial tension between different phases. This is particularly applicable in products like shampoos, dishwashing liquids, where surface active agents are the prime requirement for the cause of cleaning & foaming.

Cleaning performance is the products ability to loosen and remove soils, keep it suspended in water and prevent the re- deposition on to the surface . Measurement of surface and interfacial tension provides a precise means to asses efficiency and effectiveness of surfactants. Effectiveness is defined as the minimum value to which a surfactant cab lower the surface tension. As such the surface tension profiles are the actual detection criterion. Non-ionic surfactants are usually considered to be low or moderate foams ( 1-3) hence they are used as active ingredients in heavy duty liquid laundering, textile and machine bottle and dishwashing formulations (4-6). And so the sugar based detergents are commonly non-ionic in nature and meets the demand of non foamer characteristics.

The general characteristics of a surfactant agent base of sugar Easter from fatty acids of animal fat or vegetable oil with sugar . The chemical structure is given below;

**R--COO-- C12H21O11** Where R is corresponding radical to the fatty acids.

The length of the carbon atom as well as the degree of saturation of this radical influences the

final properties of the surfactant in this way can be used their principal products as source of fat matter like tallow fatty acid , vegetable fatty acid etc.

In general the acid value varies between 2.0 to 3.0 with 100% solubility in water & 14 -- 16 HLB and less than 4% free sucrose . As discussed above it falls under the category of non - ionic , stability between 5--10 pH.

These surfactants / detergents are having the power of surface tension reduction of water to 35 -- 40 dynes / cm at 25° C with 10 --- 20 dispersion number.

Among the prominent characteristics of it can be mentioned in general;

- # Completely biodegradable
- # Non toxic
- # Minimum foam formation
- # High-quality surface active agent
- # High quality detergency



# PROCESS

In this process fatty acids from natural fats have been condensed with sucrose to produce detergent . The yield approximately 1.7 kg detergent from 1kg of sucrose. Sucrose easter are obtained from the chemical reaction of fatty acids with sucrose . The intensive superficial action of each sucrose easter will depend on the fatty acid Easter and of the conditions adjusted in the chemical reaction . These products are identified as mono -- easter of fatty acids of the animal fat with sucrose.

Sucrose mono caprate and sucrose monolaurate (7-9) are new non-ionic detergents that contains sucrose as the hydrophilic group and caprate or laurate as the hydrophobic group. These detergents are designed to solubilise membrane proteins (e.g enzymes, receptors and transport carriers ) without causing denaturation. these detergents can be removed by dialysis because of their high hydrophilicity and CMC values due to their low absorbance at 280 nm, they can be used for the quantification of proteins by measuring absorbance.

# **PRODUCT VALUE**

In today's word scenario the total production of soap and detergent requirements is approximately 25 million tons and if the whole detergents are produced from sugar, it would need 15 million tons of sugar. It is not possible how ever, to replace soaps and other detergents by sugar detergents, but sugar detergents my consume a major proportion of the world sugar surplus.

From the above presentation the most conspicuous points is the complete bio biodegradability nature of sugar detergent, which is the prime consideration of the present days demands. In addition its non toxicity, non irritation to eyes in particular are the most valuable consideration.

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# CONCLUSION

This brief presentation pertains to introductory parts of the sugar detergents which can be an alternative for the use of sugar other than edibility purpose. Besides a number of additional benefits, the cost of the product cannot be higher than that or ordinary soap.

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# **BIOFUELS LIKE ETHANOL**

Dr. K.V.T.S. Pavan Kumar G.M (Head) R&D, QA/QC



ancer, the disease characterised by abnormal cell development, considered to be a genetic disorder, can also occur due to exposure to environmental and occupational carcinogens. The Epigenetic defects such as histone deacetylation,

microRNA dysregulation and DNA hypermethylation are considered as characteristic changes for cancer that may occur majorly due to environmental factors rather gene mutations. These environmental carcinogens include the toxic emissions from the vehicles run on fossil fuel and are the major source of air pollution in urban areas accounting for more than 75% of the atmospheric pollutants. These pollutants include more than 250 different hydrocarbons like polycyclic aromatic hydrocarbons (PAHs), volatile organic compounds (VOCs), particulate matter etc.

Based on the epidemiological and experimental data from The International Agency for Research on Cancer (IARC), the components in fossil fuel such as Benzene, acetaldehyde, butadiene, 2-methylnaphthalene, toluene, 1,2,4-Trimethylbenzene, xylene, and many PAHs are carcinogenic even at low doses and higher incidence of chronic lymphocytic leukemia (CLL), myelodysplastic syndrome (MDS) and acute myeloid leukemia (AML).

The aromatic hydrocarbons have high octane numbers and are added to the fossil fuel to serve as anti-knocking agents. These hydrocarbons could be replaced by ethanol and have the following benefits:

- 1. Ethanol is simple hydrocarbon and do not have aromatic compounds.
- 2. The blending of ethanol dilutes the aromatic compounds present in fossil fuel.
- 3. The high-octane number of ethanol than gasoline improves energy efficiency.
- 4. Ethanol alters the distillation curve of fuel thereby reduces toxic emissions.
- 5. Studies of Durbin et al, 2007 revealed that the regulated gases such as carbon monoxide emission will be reduced by increased blending of ethanol in the fuel.
- 6. The reports from The U.S. EPA states that usage of ethanol substitutes toxic aromatics in fuel and further endorsed by the outcomes of Munoz et al. experimental studies.
- 7. Ethanol is non-toxic and biodegradable.

Having these positive impacts on environment and human health, countries like India is giving more emphasis on replacing the aromatics with ethanol via programs like EBP (Ethanol Blending Program)



Air pollutants induced malignant transformation via epigenetic aberrations (Source: Mueller, S; 2021)

# **EMISSION REDUCTION POTENTIAL OF ETHANOL-GASOLINE BLENDS**

Emissions	Gasoline	Two wheelers		Four Wheelers	
		E10*	E20*	E10*	E20*
Carbon Monoxide	Baseline	20% Lower	50% Lower	20% Lower	30% Lower
Hydrocarbons	Baseline	20% Lower	20% Lower	20% Lower	20% Lower
Oxides of Nitrogen	Baseline	No significant trend	10% higher	No significant trend	Same

\*E10 project was carried out in 2009-10, E20 project in 2014-15. Hence, the test vehicles were not the same. However, the emission trend was similar

Source: Road map for ethanol blending in India 2020-25



Source: © 2021 Growth Energy

# DO YOU KNOW CAMPHOR CAN MAKE INDOOR AIR GERMS & ODOUR FREE

Mr. Dharmendra Pathak Senior Manager – Technical



n Hindu community, camphor or kapoor is generally used as an essential part of every puja, aarti, house warming and holy occasions. It is well known that the flame is believed to help drive away the negative energies and evil forces. Uses of camphor has various additional benefits for human being and environment. This article will focus on how to purify indoor air and home environment. **Germs killing effect:** Camphor has inimitable ability to helps in killing the germs exposed in indoor environment and it can be used as excellent tool to clean & purify the indoor air in the living atmosphere. So, camphor or kapoor burning every day can be an excellent idea to make the home free of germs.

**Insecticide action:** Camphor comes in a category of natural insecticide due to its excellent performance in this regard so the use of camphor at home whenever anyone see the presence of mosquitoes, ants and bed bugs.

*How to address Ants:* The ants can be vanished immediately by spraying water after dissolving a small amount of camphor in that.

*How to address Bed bugs:* Using camphor for bed bugs treatment is very effective. Putting a piece of camphor tightened with muslin cloth between the bedspread or mattresses during drying under the sun after washing will help to efficiently drive away any type of bed bugs.

How to address Mosquitoes: Camphor play an extremely efficient role to address the mosquitoes' presence in the home. As a natural agent, make via extraction from tree, camphor has very safe and longest repellent activity against mosquito against other available natural products. Mosquitoes can be easily addressed by just lightning the camphor in the closed room by ensuring all the doors & windows should closed and leave the room as it is for about twenty minutes make the room mosquito-free.



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**Bad odour removal:** To remove bad odour from indoor air is very challenging in metro cities even after use of artificial air fresheners those contain phthalates which is one of the amongst other harmful chemicals, that could be the major cause of health problems specially in children, old persons and pregnant women. Uses of camphor in day to day life to get rid of bad odour can be an excellent way for home instead of using various harmful chemical-laden air fresheners. Fragrant smell of burn camphor can spread in entire indoor area by putting this in a lamp at centre of the area.



# **PRODUCTION, PURIFICATION AND ANALYSIS**

### **1.Ethanol Production**

1.1.Substrates - Substrates are chosen for ethanol production according to regional availability and economic efficiency. Sucrose containing materials (sugar cane, sugar bet, and sugar sorghum), Starch containing materials (Corn, potato, sweet potato, cassava and wheat) are mainly used for ethanol production whereas lignocellulosic biomass (maize silage, barley hull, and paper sludge) is the area of investigation due to some difficulties of using it as a substrate. Poor porosity, high crystallinity, and lignin contents are problem related to lignocellulosic



Sr. Research Associate

biomass. Various pretreatment techniques are investigated, like steam treatment (Linde et al., 2008), acid treatment (Nichols et al., 2008), and alkali treatment (Hu and Wen, 2008).

1.2 Production process - Starch-containing materials undergo two major processes, i.e., dry milling and wet milling to convert into ethanol. Dry milling is preferred over wet milling as it produces more alcohol, 2.8 gallons of ethanol per bushel of corn (Rendleman and Shapouri, 2007). Dry milling is shown in (figure a) and wet milling in (figure b).

### **Ethanol Purification**

2.1.1. Byproducts of fermentation- Ethanol is produced by yeast fermentation with byproduct formation. Starch and Lignin are two byproducts. Esters, organic acids, and higher alcohols are starch-originated byproducts. Cyclic and heterocyclic compounds are Lignin-originated byproducts.

3.1.2. Purification techniques- Byproducts need to be removed to obtain pure ethanol. Mostly it is removed by the process of distillation. Volatile Byproducts tend to be more in ethanol. However for drinking and pharmaceutical uses we don't need concentrated ethanol, so further distillation is of no use therefore an alternative purification is required and studies have been done on it. Adsorption, Ozonation, pervaporation and gas stripping are the other purification methods which come with their own advantages and disadvantages (Figure c).

### 4.Ethanol analysis

4.1.Gas Chromatography (GC) - It is an analytical technique used for the analysis of volatile and semi volatile compounds. Ethanol analysis can be done by GC as ethanol contains mostly volatile impurities and is itself volatile (Hida et al., 2001, Rodrigues et al., 2008). A sample when injected is vaporized at the injection port and sent through the columns having stationary phase (chosen according to our target compound). Gas (N2, He) is used as a mobile phase. Each compound in the sample is separated by its physical and chemical property and is detected by the detector. Choice of detector should be in accordance with compound of interest. Gas chromatography in tandem with mass spectrometry (GC-MS) is an integrated system of two analytical equipment's. Mass spectrometry is the detector which identifies target analytes separated by GC. It is an accelerated technique with enhanced separation and identification.

4.2. High performance liquid chromatography (HPLC) - It is an analytical technique where liquid mobile phase is used. Nonvolatile or heat sensitive compounds can be analyzed by HPLC as samples are not heated at the injection port. Extensive research in ethanol analysis by researchers has been done (Sen et al., 1995, Yarita et al., 2002, Alcázar et al., 2006). HPLC is more comprehensive than GC in terms of sample limitations and is expensive and less sensitive than GC.

4.3.Infrared Spectroscopy- It uses an infrared adsorption technique. Infrared at different wavelength is passed through a liquid sample. Samples are detected by comparing infrared absorbability by a compound which differs with other compounds. However instrument is cheap and analysis is quick it can be used for quality assurance and classification purpose of alcoholic beverages (Pontes et al., 2006). IR does not have a high resolution as GC and HPLC.

4.4.0lfactometry- This is a sensory analysis which is usually coupled with GC. It is utilized for alcoholic beverage analysis for flavor enhancement. For a typical GC-Olfactometry (GCO) system, a GC column is connected to a



separator where analytes are separated in two ways, olfactometry and a detector such as MS Etc. It is a system comprised of an open- ended column; analytes coming out is sniffed by the analyst. Peak in the chromatogram depicts the intensity of the analyte which is recorded by the analyst who also records the odor characteristics. Olfactometry provides flavors data instead of stoichiometric chemical data.

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![](_page_11_Picture_15.jpeg)

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# FIGURE (A)

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![](_page_12_Picture_1.jpeg)

# ROLE OF GAS CHROMATOGRAPHY (GC) AND HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC) IN FERMENTATION PROCESS

he process of fermentation is the old act of mankind which led to the formation of alcoholic beverages. The production of beer from malt, rice and molasses has different techniques involved in it and it also has traditional practice in it. There are various volatile aromatic compounds, carbohydrates, organic acids and amino acids which are formed during the fermentation process. Ethanol production from renewable resources i.e., corn, rice, malt or molasses follow a process which involves utilization of yeast and enzymes to convert starch and sugars into ethanol. There are certain key factors which play a major role in managing stress level of yeast in the fermentation process to elevate the ethanol production. Lactic acid, acetic acid, glycerol, glucose and ethanol are the important compounds to be monitored

throughout the fermentation process.

Gas Chromatography (GC) and High -Performance Liquid Chromatography (HPLC) helps in the analysis of such compounds and provide information of the compounds. Although there are different established analytical and enzymatic procedures for the quantification of volatile compounds present in food beverages there is an easy, cheap and rugged analysis method through GC- MS/ HPLC. It offers increased sensitivity and accuracy than old traditional methods followed. Volatile compounds are the important factor in the fermentation process which is already present in food beverages which lead to increased concentration in the final fermentation product as compared to raw material. This detection was

earlier done by traditional methods such as dichromate oxidation spectrophotometry, densimetric analysis, refractive index method and near-infrared spectroscopy was in continuous use for ethanol analysis for many years. Disadvantages of these methods were use of large sample size which did not fit for small sample sizes and pretreatment methods. Enzymatic assays were also used for quantification of Ethanol and Acetic acid in biological samples but due to Instability of enzymes it shows poor reproducibility. Several chromatographic conditions have been reported for quantification of fermentation end products mostly using HPLC with detector (RID/UV) and GC with FID detector. HPLC methods shows poor resolution when using complex matrices, similarly GC with FID also shows low specificity. Therefore in search of higher developed techniques GC-MS method provides enhanced sensitivity, accuracy, specificity, reproducibility, resolution in quantification of end products of fermentation. HPLC is useful in analysis of carbohydrates using a RID detector, analysis of amino acids using UV detector which also

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involves sample preparation by derivatization process. Aromatic compounds (Ethanol, Butyric acid, Valeric acid) are also analyzed by GC-MS which quantifies with high resolution.

However, using GC-MS/HPLC is simple inexpensive, robust method to rapidly quantify the compound in different types of food matrices and Beverages.

### References

- 1. Rapid Quantification of Major Volatile Metabolites in Fermented Food and Beverages Using Gas Chromatography-Mass Spectrometry, Farhana R. Pinu 1,\* ID and Silas G. Villas-Boas 2
- 2. HPLC and GC-MS analyses of organic acids, carbohydrates, amino acids and volatile aromatic compounds in some varieties of rice beer from northeast India Arup Jyoti Das,1 Prerna Khawas,1 Tatsuro Miyaji2 and Sankar Chandra Deka1 \*

परिव सी रूपये RESERVE BANK OF

Sometimes the hardest thing about saving money is just getting started. This step-by-step guide for how to save money can help you develop a simple and realistic strategy, so you can save for all your short- and long-term savings goals.

### **Record Your Expenses:**

The first step to start saving money is to figure out how much you spend. Keep track of all your expenses-that means every household item, EMIs & other expenses.

Once you have your data, organize the numbers by categories, such as gas, groceries and EMIs, and total each amount. Use your credit card and bank statements to make sure you are accurate and don't forget any.

# Distinguish Between "Want" and "Need"

Understand the differences between needs and wants and identify yours. Be able to say no when something doesn't align with your financial goals today and in the future.

**Budget For Savings** 

Once you have an idea of what you spend in a month, you can begin to organize your recorded expenses into a workable budget. Your budget should outline how your expenses measure up to your income so you can plan your spending and limit overspending. Be sure to factor in expenses that occur regularly but not every month, such as car maintenance.

Mr. Tarun Tyagi

General Manager - Finance

You may include a savings category—aim to save at least 10 to 15 percent of your income.

### Start Now

Remember that, whatever your goal is, start now. Something will always come up and compete for your resources. Saving for the future should stay in the forefront of your mind and your finances, regardless of whatever else comes around.

## Find Ways You Can Cut Your Spending

If your expenses are so high that you can't save as much as you'd like, it might be time to cut back.

Identify nonessentials that you can spend less on, such as entertainment and dining out. Look for ways to save on your fixed monthly expenses like television and your cell phone, too.

# Set Saving Goals

One of the best ways to save money is to set a goal. Start by thinking of what you might want to save for perhaps you're getting married, planning a vacation or saving for retirement. Then figure out how much money you'll need and how long it might take you to save it.

### Decide on your priorities.

After your expenses and income, your goals are likely to have the biggest impact on how you allocate your savings. Be sure to remember longterm goals—it's important that planning for retirement doesn't take a back seat to shorterterm needs.

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# Make Saving Automatic

Almost all banks offer automated transfers between your checking and savings accounts. You can choose when, how much and where to transfer money or even split your direct deposit so a portion of every payout goes directly into your savings account.

Splitting your direct deposit and setting up automated transfers are simple ways to save money since you don't have to think about it, and it generally reduces the temptation to spend the money instead.

### *Review your saving/investment*

Review your budget and check your progress every month. Not only will this help you stick to your personal savings plan, but it also helps you identify and fix problems quickly. Understanding how to save money may even inspire you to find more ways to save and hit your goals faster.

# **CANE SYRUP TO INDIAN SCENARIO**

![](_page_14_Picture_3.jpeg)

Mr. Kuldeep Argade Assistant Manager - BD (West)

sugar syrup/ sugar are used for production of

Introduction

India's net import of petroleum was 185 million ton at a cost of US \$ 551 billion in 2020-2. Most of the petroleum products are used in transportation. Hence, a successful E20 program can save the country US \$4 billion per annum, i.e. Rs. 30,000 cr.

Besides, ethanol is a less polluting fuel, and offers equivalent efficiency at lower cost than petrol. Availability of large arable land, rising production of food grains and sugarcane leading to surpluses, availability of technology to produce ethanol from plant based sources, and feasibility of making vehicles compliant to ethanol blended petrol make E20 not only a national imperative, but also an important strategic requirement.

ethanol, and the production increases beyond the licensed capacity without any expansion of the existing plant & machinery or technology, the Ministry of India has exempted such increase in production by up to 50%, due to change of raw materials.

Administered Price of Ethanol by Source Raw material Source Ex-mill Ethanol Price (Rs. /litre) B-Heavy 59.08 C-Heavy molasses 46.66 Sugar/Sugar Syrup 63.45.

### **Cane syrup preparation Process**

Cane Syrup is concentrated form of cane juice which has approximately 600 Brix. In this scenario Sugar factory divert part of sugar in the form of cane syrup to make Ethanol. After cane crushing, raw Juice needs to be clarified and use

of hot liming is sufficient. Single sulphitation to be followed by mud filtration. Clear juice (CJ) having brix around 12 to 14 transferred to evaporator to make concentrated syrup brix to 60. This syrup contain maximum sucrose concentration.

![](_page_14_Figure_14.jpeg)

# Use of Syrup for Ethanol fermentation

- The fermentation process required Syrup quantity cane be diverted to distillery and rest portion of syrup processed further to make sugar and B-heavy/ C-heavy molasses.
- Syrup requires cool down before introducing to fermentation for that cooler required. After cooling of syrup, it is directly used in process.
- Syrup should be dilute in Pre-fermentation which requires 5 to 7% sugar concentration for yeast Propagation.
- As FAAN content in cane syrup is on lower side Nutrient dosing such as Urea, DAP, MgSo4 and Znso4 should be used.
- After reaching desired yeast count (above 300) million/ml) or it can be transferred to fermentation.
- Before transferring Pre-fermenter, required process water should be taken in fermentation.
- As per designed alcohol concentration in fermentation cane syrup should be fed through diluter in fermenter.
- Feeding time should keep 18 to 20 hours for avoiding higher sugar concentration in fermentation.
- Mode of fermentation should be Fed-batch type for better process and getting maximum alcohol concentration in final mash.
- · Considering 13% alcohol concentration in

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- fermentation complete reaction time including feeding time requires 38 to 40 hours.
- · Spent wash prepared after distillation of fermented wash having solids concentration around 2 to 3% can be recycled in fermentation up to 50%.

# Advantages of Cane Syrup

![](_page_14_Figure_32.jpeg)

## **Challenges in Syrup Fermentation**

- Cane syrup transport from sugar factory to distillery, Cane Syrup having maximum sucrose concentration so it has tendency to form crystals so it may leads to line chocking during transferring of syrup from sugar factory to distillery. To mitigate this problem cane syrup required to be inverted before it transferred to distillery.
- Spent wash management: Spent wash which is generated after distillation can be recycled up to 50% in fermentation. Rest of spent wash which has lesser solids impacting steam consumption in evaporation. For managing spent wash it can be concentrated till 30% of solids and further it can be given to composting yard. Spent wash can fed to biogas unit and after COD reduction it can further given for composting.

• pH of fermented wash and alcohol

![](_page_15_Figure_1.jpeg)

 Normal pH value of cane syrup with single sulphitation process are 6 to 7 pH, if cane syrup given double sulphitation it impacts pH of cane syrup with pH values to 5 to 5.5

- As cane syrup has low buffering capacity as compared to molasses it impacts pH of fermented wash further after distilling fermented wash pH of alcohol gets down to 2.5 to 3 pH which gives corrosion in re-boiler tubes and column plates.
- Cane syrup is rich media for bacterial growth if it's get stored for longer time impacts pH values of syrup which ultimately gives corrosion in distillation.
- Higher retention time Though cane syrup contains more fermentable sugars as compare to molasses it has less quantities of Vitamins, micronutrients, FAAN quantities which is required by yeast growth and its active transport of sugar molecule. So it impacts growth yeast in pre fermenter as well as in fermenter which impacts retention time of fermentation.

**References -** Roadmap for ethanol blending in India 2020-25 (Niti Ayog)

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# FEATURE

# ALCOHOL TOLERANCE THE ROLE OF MEMBRANE ELECTROCHEMICAL GRADIENT

east is an important ingredient in ethanol manufacturing via fermentation and the industry demand yeast strains that can tolerate high temperature, ethanol, sugar levels to increase plant productivity. The composition of fermentation medium like molasses is not uniform and varies depending on physical and ecological factors. The compositional changes in molasses that include the toxic substances, furan aldehydes and volatile acids, make it as one of the difficult bottlenecks impacting higher production. The ethanol, native metabolic product of yeast, also acts as a cellular toxic substance and triggers cell death. The fundamental mechanism of alcohol toxicity on yeast is due to the increased permeability of plasma membrane leading to hampered membrane potential. The combinatorial toxicity of ethanol and other toxic substances potentially worsen the ethanol production. Based on the study of researchers from the Metabolic Engineering group, Massachusetts Institute of Technology, the yeast membrane is charged by opposing gradients of potassium (K+) and proton(H+) ions and elevating the extracellular K+ and pH reduce the instability of membrane potential there by significant improvement in ethanol tolerance. The up regulation of membrane K+ and H+ pumps would transform

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Dr. K.V.T.S. Pavan Kumar G.M (Head) R&D, QA/QC

the low tolerance strains to high tolerant strains to boost alcohol titers considerably.

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So, it is very important that the fermentation aids must have tolerance to specific components of the substrates utilized in conventional ethanol production to improve efficacy. The right strain of yeast should be used in the process for maximum efficiency. The yeast manufactures will consider all these aspects while producing ACTIVE DRY YEAST to meet the expectations in standard bioethanol production.

### **References:**

1. H. Lam, A. Ghaderi, G. R. Fink, G. Stephanopoulos, Engineering alcohol tolerance in yeast. Science. 346, 71–75 (2014)

2. M. Wasylenko, G. Stephanopoulos, Metabolomic and 13C-metabolic flux analysis of a xylose-consuming Saccharomyces cerevisiae strain expressing xylose isomerase. Biotechnol Bioeng, 112, 470–483 (2015).

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**FIRST AID & FIRE TRAINING** 18<sup>th</sup> & 19<sup>th</sup> Aug 2021

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13<sup>th</sup> Aug 2021

**EMPLOYEE ENGAGEMENT** 2021-22

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DRAWING COMPETITION ON THE OCCASION OF INDEPENDENCE DAY

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# **EMPLOYEE ENGAGEMENT** 2021-22

TABLE TENNIS TOURNAMENT ON 04<sup>th</sup> Sept. 2021

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# **TRAINING & DEVELOPMENT**

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Market insights are very important for the continual improvement of existing products and new products / technology and development.

At Catalysts we have a wonderful ecosystem where our sales and Business Development teams are constantly in touch with R&D and Production teams for new innovations based on market research.

The above is the glimpse of such session where our Sugar industry BD resource, Mr. Gautam Kapoor, A.V.P (Sugar), shared the sugar industry process insights and market demands with our R&D and Production teams.

# **EMPLOYEE ENGAGEMENT** 2021-22

# **OFFSITE MEETING**

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Catalysts Strategy Meet at Jim Corbett National

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Sometimes strategizing the future growth plan on a trip with employees is an excellent idea as travel and change of place imparts new vigour to the mind.

# **WEBINAR**

13 OCTOBER 202

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"Tips for technical performance improvement of sugar factory" was the webinar's title held in Belgaum. The Catalysts Group was part of the webinar and delivered a presentation on "Preservation of BH/Syrup during storage". Our research scientists, Mr. Anil Kumar Rai and Mr. Bhoopendra Bhardwaj deliberated about the challenges being faced during BH/Syrup preservation, the reasons behind molasses/syrup deterioration e.g., microbial, environmental causes and proposed solution/tips to preserve the B heavy molasses/ syrup using Catalysts enzyme solutions and combinatorial inversion technology.

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# **DUSSEHRA CELEBRATION**

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Dussehra! Celebrations at Catalysts -celebrating the auspicious day - victory of the forces of good over evil.

# **AWARDS**

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Mr. Munish Madan, Managing Director Catalysts group, receiving award for the Industry Excellence 2021 at the recently held, STAI Convention for his contribution to the field of Enzymes.

# **EMPLOYEE ENGAGEMENT** 2021-22

# **DIWALI PUJA 2021**

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On occasion of Diwali, Lakshmi puja was held across all our offices in India

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# **CAPABILITIES EXPANSION**

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R&D and Production Team

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**Research and Development Centre** 

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