



Plenary Session

***Late S.N.Gundurao
Memorial Lectures.**

By
Dr. Y. S. Nerkar

&

***Late Shri. J.P.Mukherji
Memorial Lectures**

by
Dr. M. S. Sundaram



SUGARCANE : PAST, PRESENT AND FUTURE

**By
Dr. Y. S. Nerkar**

SUGARCANE : PAST, PRESENT AND FUTURE

Dr. Y.S. NERKAR

INTRODUCTION

In the beginning of the twentieth century, India had to meet most of her sugar requirement from imports, mainly from Jawa (Indonesia). After the evolution of the improved sugarcane varieties ('Co-canes') by the sugarcane breeding Institute at Coimbatore from 1918 AD onwards, and their cultivation with improved practices developed at the sugarcane research station at Shahjahanpur (U.P) and other centers, sugarcane and sugar production in India was revolutionized, making the country self-sufficient in her sugar requirement by 1935. Today India has become a world leader in sugar production, contributing a sizeable share to the world sugar market. Sugarcane farming and the sugar industry in India, particularly in the Deccan Plateau, have brought about a silent socio-economic revolution in the rural areas demonstrating an extraordinary example of the confluence of farmers' hard work, rural industry leadership, proper developmental policies of the government and dedicated research and development work. It is worthwhile to review the history of improvement of the sugarcane crop, evaluate its present status and plan for the future for prosperity and sustainability.

ANCIENT HISTORY OF SUGARCANE

India is the homeland of sugarcane. The oldest reference to sugarcane cultivation in India (along the banks of river Kaveri) is found in Tamil literature dating back to 2000 BC. Atharvaved, which dates back to 1500-800 BC, mentions 'Ikshu' (Sanskrit name of sugarcane) as one of the products offered to the fire God in the 'Yadnya'. Lord Shriram was born in the Ikshwaku dynasty which practiced sugarcane (Ikshu) farming. Charak and Sushruta Sanhitas (written in 600 and 500 BC, respectively) highlighted the medicinal value of sugarcane. Charak classified sugarcane into two types viz., Ikshu and Paundra. Sushruta described 12 different types of sugarcane based on their taste, chemical properties and medicinal value. Production of sugar by boiling the sugarcane juice was first discovered in India in the first millennium BC. The Puranas have described the processes of extracting juice from sugarcane, boiling it and preparing liquid jaggery, jaggery (Gul / Gud) and sugar (Sharkara, Khand in Sanskrit). Greek, Persian and Chinese scholars who visited India during that period have also recorded about sugarcane cultivation and jaggery production in India. In 1000 AD, sugar was reported to be an extremely costly item; Italian marble, precious stones and gold used by the kings in the middle-east for their palace construction were traded for their weight in sugar!

DISCOVERY OF SEXUAL REPRODUCTION IN SUGARCANE AND EARLY BREEDING WORK

Sugarcane cultivation in India was mainly localised in the Indo-Gangetic plain having sub-tropical climate. Sugarcane in those days were thin and susceptible to diseases and pests. Superior clones in nature were selected, clonally propagated and used for cultivation by the farmers. Propagation of sugarcane by seed was not known to the early researchers in India and elsewhere, or the phenomenon was overlooked by them.

Sugarcane was introduced to many countries including the new world by the Europeans in the

16-17th centuries for cultivation in the tropical climate there. Sugarcane crop flourished there and sugarcane clones were exchanged between these countries and India by the researchers in the 18-19th centuries. However, the planters and botanists believed that sugarcane cannot produce seed and, therefore, can be propagated only vegetatively. This notion persisted until 1858 AD, when I. I. Harper working in Barbados in the Caribbean discovered that tiny seeds from the sugarcane arrow (inflorescence) germinated and developed into full grown plants. In 1862, N. H. Prodo working in Java also reported the development of sugarcane plants from seed. The first successful artificial sugarcane cross was reported by J. D. Kobus from Java in 1880. After these discoveries about sexual reproduction in sugarcane, a number of sugarcane breeding research stations were established by 1930 in major sugarcane growing countries. Prominent among those were: Gaudelope (1878), Jawa (1886), Louisiana (1886), Barbados (1887), Reunion (1889), Demereca (1889), Mauritius (1893), Hawaii (1895), British West Indies (1897), Queensland (1900), Coimbtore (1912), Fiji (1913), Poerto Rico (1913), Tucuman (1916), Canal Point, USA (1920), Natal, S Africa (1925), Egypt (1930), and Padegaon, India (1932).

These breeding stations developed a number of good clones from the seedlings raised from the seed developed by open pollination or by artificial pollination. First successful hybrid sugarcane variety, POJ213 was produced in Java by J. D. Kobus in 1897 by crossing the Java variety Black Cheribon with the Indian variety Chunni. This variety saved the Java sugar industry from the dreaded disease 'Sereh'. POJ 213 was also grown successfully in U.P. in India before the adoption of the 'Co canes'. J. Jesweit (1921) developed the variety POJ 2878, the first 'wonder cane' that was cultivated on large scale in the world. Java and Barbados made significant advances in the production of seed derived canes to serve their sugar industry. In the search for disease resistance, the Java researchers found scope in the wild species related to sugarcane viz., *Saccharum spontaneum* and *Erianthus arundinaceus*. The traditional high sugar varieties of India including the Java variety Black Cheribon were classified as *Saccharum officinarum*, while variety Chunni (with thin, fibrous, slender cane having high sugar content) was classified as *Saccharum barberi*. The crosses of *S. officinarum* with *S. barberi* made by J.D. Kobus or the crosses of *S. officinarum* with *S. spontaneum* (obtained as natural F₁ hybrids named as 'Kassoer' by the other Java researchers) had some undesirable traits. To eliminate the undesirable traits, they backcrossed the F₁ hybrids to *S. officinarum*. *S. officinarum* canes were known as 'noble canes' because of their desirable characters and robust appearance (except susceptibility to diseases). The process of backcrossing of these F₁ hybrids to the 'noble canes' was referred as 'nobilization' by the Jawa workers.

EARLY SUGARCANE BREEDING RESEARCH IN INDIA

Because of the most congenial climate for sugarcane flowering at Coimbatore, the Sugarcane Breeding Institute was established in 1912 at Coimbatore in the erstwhile Madras Presidency. Dr. C. A. Barber was appointed as the Imperial Sugarcane

Expert and Sir T.S. Venkatraman was appointed as his Chief Assistant. They attempted to cross the tropical sugarcane *S. officinarum* with the indigenous varieties under cultivation in North India, classified as *S. barberi*. However, their crossing work was not successful. They observed a vigorously growing grass, the wild sugarcane species *S. spontaneum*, adjoining

their fields and it flashed to them to utilize it in their breeding programme. They crossed the noble cane variety Vellai (*S. officinarum*) with this grass (*S. spontaneum*) successfully. The F1 (hybrid) generation provided the first commercial variety 'Co 205' that was released in 1918 for cultivation in the subtropical areas of North India. Subsequently, clones of *S. barberi* (e.g., variety Chunni having thin, fibrous but high sugar canes) were nobilized and the resultant hybrids were crossed to *S. spontaneum* lines to give tri-specific hybrids:

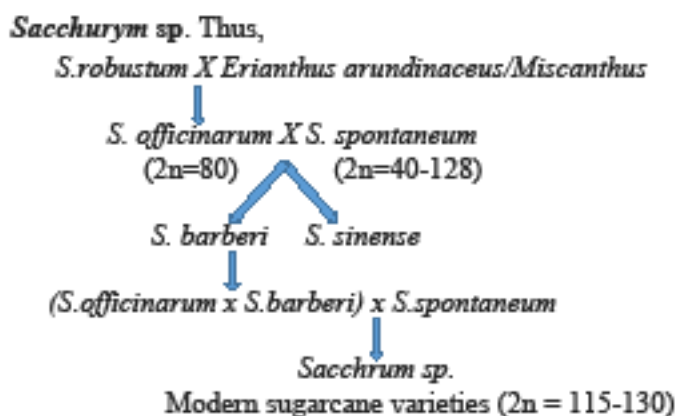
(S. barberi x S. officinarum) x S. spontaneum.

These hybrids gave 50% higher yield over the prevalent varieties and proved very successful for cultivation in India, both under the sub-tropical as well as the tropical conditions. They were also cultivated on poor soils and were widely used in the breeding programmes of many countries. Varieties developed through this programme viz., Co 213, Co 244, Co 312, Co 313, etc., became popular 1930 onwards and revolutionized sugarcane cultivation and the sugar industry in the sub-tropical belt, making the country self-sufficient in sugar requirement by 1935.

The breeding work to develop suitable varieties for tropical India was started in 1926. The first 'wonder cane' for the tropical India, Co 419 was released for cultivation in 1933. Soon, the entire tropical belt was saturated with this variety, increasing sugarcane area and sugar production in India. This variety proved successful in many countries, thus becoming a 'wonder cane of the world'. In 1949, the second wonder cane of India, Co 740 was released.

GENOMIC CONSTITUTION OF THE MODERN SUGARCANE VARIETIES

Based on the cytogeographic studies, the most accepted view is that *Saccharum officinarum* was developed in the east Indonesia / New Guinea area from the natural crossing between *S. robustum* and *Erianthus / Miscanthus*. Further natural crossing of *S. officinarum* with *S. spontaneum* has resulted in the development of *S. barberi*, the Indian sugarcanes on one side, and *S. sinense*, the Chinese sugarcane on the other. The artificial crossing by sugarcane breeders has resulted in the development of modern sugarcane varieties, which are now referred as *Saccharum* species hybrid or merely *Sacchurym sp*



Studies using molecular markers and in situ DNA hybridization technique have led to the conclusion that the present sugarcane varieties (having 115 to 130 chromosomes) possess

80% genome of *S. officinarum*, 10% genome of *S. spontaneum* and 10 % of the hybrid chromosomes of the two species. Thus, sugarcane is one of the first domesticated crops evolved by man using the related wild species.

PRESENT STATUS OF SUGARCANE IMPROVEMENT IN INDIA

The Indian Institute of Sugarcane Research (IISR) was established at Lucknow in 1952 by the Indian Council of Agricultural Research (ICAR), to undertake research on sugarcane and jaggery production. State governments and State Agricultural Universities in the sugarcane growing belt have also established their sugarcane research stations. In addition, the sugar industries have their own sugarcane research and development farms. To strengthen and coordinate the sugarcane research in the country, the ICAR started the All India Coordinated Research Project on Sugarcane (AICRP-S) in 1970 with its headquarters at the IISR, Lucknow. The AICRP-S has characterized the sugarcane growing areas of the country into five zones viz., Peninsular, East Coast, North West, North central and North East Zones. A strong nationwide network of 22 regular and 15 voluntary research centres has been established. A National Hybridization Garden (NHG) having sugarcane germplasm with important traits has been established at the SBI, Coimbatore. This facility is being utilized by the sugarcane breeders from all over the country for crossing and seed (fluff) production. The breeders grow seedlings from this seed at their respective locations and develop location specific varieties. Near Coimbatore, at Agali in Kerala, a facility is created for making crosses of sugarcane with its distant relatives. World sugarcane germplasm is maintained at Kannur in Kerala and Miami in Florida (USA). The VSI, Pune has developed crossing facility in Amboli, Maharashtra (2005). The sugarcane genotypes, and crop production and protection techniques developed by the research centres undergo rigorous multilocation testing (for at least three crop seasons), on the basis of which location specific recommendations are made for the five zones. Until 2020, over 140 improved sugarcane varieties developed through this project have been notified and released for commercial cultivation by the Central Variety Release Committee (CVRC) of the Government of India. These varieties have revolutionized the sugarcane and sugar production in the country. Prominent varieties among these are Co 1148, Co J64, B0 91, CoS 767, CoSe 92423, CoLK 8102, CoPant 84211, Co 0238, etc. in the sub-tropical region. The variety Co 0238 has been the most popular variety in the past decade, covering almost 85% area of the region. Similarly in the tropical area, the prominent varieties have been CoC 671, Co 62175, CoM 88121, CoM 0265, Co 86032, MS 10001, VSI 12121, etc. The variety Co 86032 has covered almost 65% area for the past 25 years and still is the ruling variety.

IMPACT OF THE SUGARCANE IMPROVEMENT RESEARCH IN INDIA

Increased productivity of the 'Co canes' supported by the proper cultural practices developed at Shahjahanpur (UP) and the protective policies of the government towards sugar mills led to rapid expansion of sugarcane area, fast establishment of sugar mills and substantial increase in sugar production in the first phase during the thirties. In 1930, the number of sugar factories were only 32, which increased to 112 in 1934 and 150 in 1941. Sugar production was merely one lakh tonnes in 1930, which increased to 12.54 lac tonnes in 1936-37, making the country not only self-sufficient for sugar requirement but having surplus of 54,000 tonnes of sugar.

The second phase in the sugarcane and sugar production started after independence when

more irrigation facilities were created, fertilizer factories were established and sugar plants were fabricated. The third phase started after the initiation of the AICRP-S in 1970, giving impetus to sugarcane varietal improvement along with the development of crop management practices. Improved practices of land management, manure and fertilizer management, irrigation management and disease and pest management were evolved. Improved varieties with high productivity and sugar recovery, resistance to diseases like whip smut and red rot ,and tolerance to salts, drought, waterlogging have been developed. Genotype of a variety contributes 50% to high productivity, while crop management contributes to the rest 50%. Microbial consortia have been developed, growth regulators are being used, use of micro-irrigation / fertigation, machines and sensors is increasing, all of which are helping in precision farming. Farmers and sugar mills are participating in research validation, seed setts production and technology transfer. All these factors have contributed to higher productivity, production and sugar recovery. This impact is evident from the statistics presented in Table 1. There has been gradual increase in the area under sugar cultivation, except in the years of extreme drought. However, the sugarcane and sugar production have been increased substantially, mainly as a result of sugarcane improvement and technology development in the country.

Table 1: Sugarcane Area, Production, Yield / Ha, Cane crushed, Sugar produced, Sugar Recovery and Operational Factories in India

Year	Area (lac Ha)	Production (lac tonnes)	Yield / Ha (tonnes)	Cane crushed (lac tonnes)	Sugar production (lac tonnes)	Sugar Recovery (% cane)	Factories (No.)
1930-31	11.36	363.54	32.1	13.39	1.20	8.96	29
1940-41	16.18	519.78	32.1	114.92	11.13	9.70	148
1950-51	17.07	548.23	32.1	113.48	11.00	9.99	140
1960-61	24.16	1100.01	45.4	310.21	30.21	9.74	180
1970-71	23.90	1135.79	47.5	310.15	31.13	10.04	220
1980-81	26.67	1542.48	57.8	515.84	51.50	9.98	315
1990-91	36.86	2410.45	65.4	1223.38	120.47	9.84	385
2000-01	43.16	2959.56	68.6	1766.60	185.11	10.48	436
2010-11	48.86	3423.82	70.1	2398.07	243.94	10.17	527
2014-15	50.67	3623.33	71.5	2730.73	283.13	10.37	538
2016-17	44.36	3060.70	69.0	1934.34	202.62	10.48	489
2018-19	51.14	4001.57	78.3	3011.79	331.63	11.01	531
2019-20	46.03	3705.00	80.5	2590.43	273.85	10.86	464

During the 2020-21 season, India's sugar production was 310.26 lac tonnes and in the 2021-22 crushing season until August, 2022 Indian sugar production touched a record highest production of 355.81 lac tonnes. In addition to meeting the local consumption and keeping buffer stocks, we have been exporting a sizeable quantity in the recent years. About 25 lac tonnes sugar production has been diverted to ethanol production which is blended with petrol , saving about Rs. 3000 crore worth petrol imports. India's sugar export during 2021-22 reached to 75 lac tonnes , which can be increased up to 100 lac tonnes. The present annual turnover of the sugar industry can be estimated to be worth 1 lac crore rupees , employing about 60 lac people in sugarcane farming and about 6 lac skilled workers in the industry.

CURRENT TRENDS AND FUTURE PROSPECTS IN SUGARCANE IMPROVEMENT

On the basis of photosynthesis (the process of food synthesis by plants using sunlight, CO₂ and water), crops are classified as C₃ and C₄ plants, the latter being more efficient in utilizing CO₂. Sugarcane, a C₄ plant has the potential to produce about 600 tonnes of biomass per hectare annually. The award winning farmers in Maharashtra have already harvested nearly 350 to 400 tonnes per hectare (in 18 months). Some of the current research projects under progress at the SBI, Coimbatore, IISR, Lucknow and in other countries, summarised below may lead to further increase in sugarcane productivity.

1. Use of Reciprocal Recurrent Selection Procedure to break the undesirable chromosome linkages: Parental clones are crossed reciprocally, superior plants are selected in the progeny, which are further crossed reciprocally, followed by further selection in the progeny. The process is repeated for 2-3 cycles.
2. Use of Alternate Cytoplasms: The present sugarcane varieties have cytoplasm from the mother species *S. officinarum*. This renders the crop vulnerable to disease outbreaks. Certain genes present in the cytoplasm of the related wild species play an important role in their resistance, growth and yield. Hence, efforts are being made to develop sugarcane varieties having cytoplasm from these species.
3. Isolation of Somatic Mutations in Tissue Culture: The tissue culture technique is being used for rapid multiplication of new varieties, maintaining their genetic purity. This technique is also used for isolating somatic mutations to develop new varieties. The variety Co 94012 developed at Coimbatore and VSI 434 developed at Manjri, Pune are somatic mutations of the variety CoC 671.
4. Molecular Marker-Aided Selection: Molecular markers are being used to identify specific desirable traits in the progeny of crosses. This makes the selection procedure precise and rapid in the breeding programme.
5. Isolation of Inbred Lines for developing F1 Hybrid Varieties: There is an indication that the concept of first generation (F1) hybrid vigour, being commonly used in many crops, can also be used in sugarcane (by selfing and by using the dihaploid technique) to get higher yield. Therefore, work is under progress to isolate pure inbred lines in sugarcane for the development of high yielding hybrid varieties.
6. Distant Hybridization with Related Species and Genera: It has been discussed earlier that the present sugarcane crop is a multi-species hybrid derivative. Desirable genes for tolerance to biotic and abiotic stresses including sudden climate changes are present in the different wild species and genera related to sugarcane. Research on the transfer of such genes into sugarcane by cross breeding is under progress at the SBI, Coimbatore and in other countries. The cross of sugarcane and *Erianthus arundinaceus* grows profusely giving very high biomass, which can be utilized for the production of fodder, paper and biofuel. Scope also exists for developing efficient sugarcane varieties giving higher yield per unit of fertilizer and water, thus reducing cost of production.

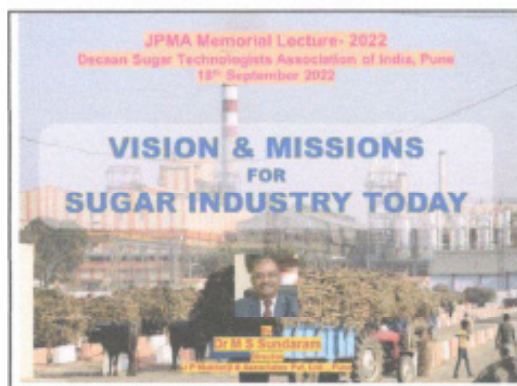
7. Use of Genetic Engineering Technique for transferring Alien Genes: Improved varieties of many crops developed through the genetic engineering(GE) technology are worldwide cultivated on more than 20 crore hectare area. In 2018 a sugarcane variety having the 'Bt Cry 1 Ac' gene has been released for commercial cultivation in Brazil. This variety has resistance to shoot borer and was planted on about 70,000 ha in the 2021-22 season. Another variety having the gene 'Cry 8 Sa1', conferring resistance to the insect white grub (Humni), has been developed in Brazil. Under the Indonesia-Australia Co-operation Research Project, a red rot disease resistant variety of sugarcane has been developed in which the 'Bet 1' gene has been transferred through GE technique. This variety has been given for cultivation in Indonesia recently. In Australia, sugarcane varieties are being developed for biodegradable plastic and other chemicals production. Work on isolation of desirable genes from wild species and transferring them into sugarcane through GE technique is under progress in the USA. To tackle the problem of the twining climber and other weeds in sugarcane, the herbicide tolerance gene needs to be transferred to sugarcane.
8. Use of the latest Gene Editing technology for desired Directed Mutagenesis: The CRISPR-Cas9 gene editing technology, discovered simultaneously by two ladies in 2010, has been successfully employed to bring about desired mutations in wheat, rice, soybean, tomato, potato and mushrooms. Improved varieties evolved through this technology are under cultivation since last 4-5 years in USA, China, Japan, Germany and France. For this discovery Jennifer Doudna (USA) and Emmanuelle Charpentier (Germany) were awarded Nobel Prize in Chemistry for the year 2020. Scientists in Japan have developed a high sugar tomato variety by making the invertase enzyme gene silent. This can be done in sugarcane to increase sucrose content and avoid post-harvest losses in sugar. Sugarcane is an ideal crop to be improved by gene editing in the near future.

To Conclude:

Sugarcane is really a huge, green bio-factory powered by the solar energy. It should be cashed upon not only for its sugar, ethanol, spirit, bio CNG , electricity, and plant nutrients(press mud) , but also for the production of vaccines, vitamins and other chemicals by transferring alien genes by resorting to the modern technologies. By 2050, India will have to produce over 500 lac tonnes of sugar. By proper policies and unreserved support to research, India can certainly surpass that goal by precision sugarcane farming supplemented by tropicalized and resistant sugarbeet cultivation. Perhaps by then India might be capturing the European sugar market. Future sugarcane improvement should be destined towards that task.**Crop improvement is not merely a science but is also an art, technology and above all commitment to the society!**

VISION & MISSIONS FOR SUGAR INDUSTRY TODAY

**By
Dr. M S Sundaram**



1

Introduction

Sugarcane is consumed

- 70 – 75 % by the food manufacturing sector
- Balance by other sectors including biofuel sectors

Sugar Cane Cultivation and processing to produce Sugar and Bio-fuels supports livelihoods for around 100 million people across the world.

Due to surplus Sugar production, Indian domestic sugar market is facing lot of problems as the market price of sugar is fluctuating very badly.

2

Introduction

Indian Government introduced various policies to help Sugar Mills and Sugar cane farmers, by way of increasing exports and diversification.

Both options are having its own complexities:

- Increasing sugar exports may not be easy when world prices are sluggish.
- Sacrificing sugar for production of renewable fuels, mainly ethanol, also has its own challenges, including Ethanol Capacities, Ethanol Pricing, Weak financials of sugar units, etc.

3

Introduction

India produces Mill White Sugar by double sulphitation process.

Major junk of Sulphur imported.

WHO also discourages use of Mill White Sugar due to presence of sulphur in the final product.

Most of the countries in the world are producing either Raw Sugar or Refined Sugar or both.

Few countries like India, Java are only producing Mill White Sugar through Sulphitation process.

4

Introduction

Export of Mill White Sugar has limited demand as compared to export of Raw Sugar or Refined Sugar.

Can India also follow Raw cum Refined route ?

Yes. Trend is set rolling now.

Few factories in India have started producing Sulphurless Sugar.

5

Vision

**Indian Sugar Industry today
is to overcome all challenges and
maintain its sustainability
by producing Sugar
to the common man at affordable price,
to meet the industrial and export Sugar demand
competitive with quality product
and
diversify to produce value added products.**

6



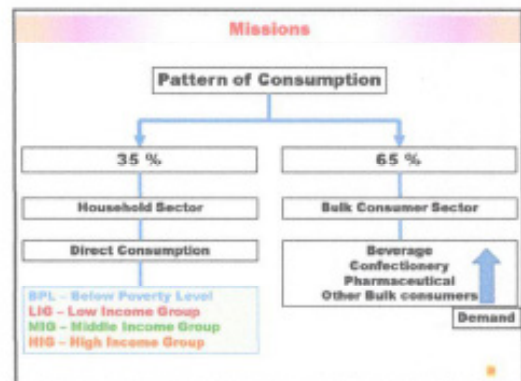
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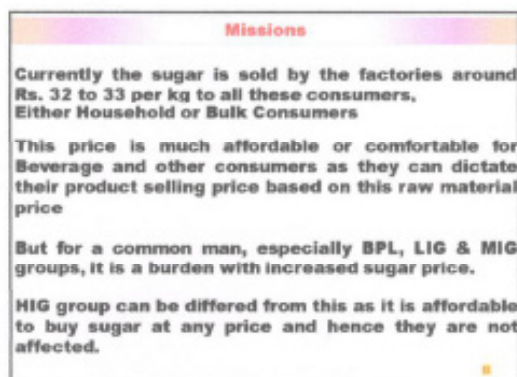
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10



11



12

Missions
Present Double Sulphitation process is not suitable for producing different varieties.
Sulphitation process to be replaced by Raw cum Refined sugar process , which is conducive to produce different varieties of sugar.
Raw Sugar Fixed & Acceptable Quality
Refined Sugar Variable Quality as per different market Demand

13

Missions
Raw Sugar is produced with natural chemical - Milk of Lime -
Hence, it is best suited to call as Natural Cane Sugar for Common Consumer
Natural Cane Sugar Can fulfill the need of 35 % Household consumer sector at most affordable price.

14

Missions
Healthier and natural products these days have become the priority choice by the consumers, therefore, Raw Sugar too has its potential for a sustainable market and acceptance among consumers.
While, jaggery has become a popular sweetener with growing market prospects, Raw Sugar too can be an attractive opportunity for direct human consumption as " Natural Cane Sugar "

15

Missions
Natural Cane Sugar can be produced using the comparable method as adopted for raw sugar production thus requiring minimum input of process chemicals.
Natural Cane Sugar may not be White and Lustrous as compared to white sugar but will have more minerals and other nutrients available originally in cane juice and thus may be considered as more nutritious.

16

Missions
Natural Cane Sugar
➤ 400 to 500 ICUMSA colour.
➤ Normally white but with yellowish/brownish tinge
➤ Taste wise - No major change compared to White Sugar. Only Mind Set needs to be changed
➤ To be sold to Household consumers (common man like BPL, LIG, MIG people) <u>at Government fixed price</u> , either through <u>dedicated outlets</u> or through <u>PDS</u> (Public Distribution System)
➤ Price can be fixed around <u>Rs. 20 to 22 per kg.</u>

17

Missions
Advantages of Natural cane sugar
<ul style="list-style-type: none"> • Apart from nutritional benefits of such natural product, other advantages viz.-a-viz. minimum changes involved in the processing and infrastructural facilities of the factory. • Minimum use of process chemicals, no use of Sulphur thereby producing sugar by environment friendly process. Double Sulphitation process results in processing at low pH and thereby leads to more inversion losses and corrosion, which can be avoided. • Therefore, with minimum process changes the sugar industry can offer its consumers a better, much healthier product. • Less cost of production

18

Missions

Balance 65 % sugar
can be produced with
High Quality Refined Sugar
as per the demand of Bulk consumers

Various Speciality Sugars
Can meet the need of **65 % Bulk consumer sector**
at **Traded Price** comfortable to Industry

Average Price to be around **Rs. 45 per kg** and above.

Export of Raw Sugar and Refined Sugar
can also be considered
if internationally competitive.

19

Missions

Sugar Quality vis-à-vis Market Demand-The Essentials

- Sugar production as per consumer preferences & market demand
- Cleaner and greener process of sugar production
- Packaging under hygienic conditions and in consumer friendly packs
- Speciality sugars
- Branding

20

Missions

Various Specialty Sugars

21

Missions

Go Healthy!

With the rising health conscious consumers, the demand towards products tagged as "natural" or "bio" or "organic" are gaining momentum.

"Natural Cane Sugar", "Organic Sugar", "Mineral Sugar", "Fortified Sugar" are the new face of the sugar world.

High value added products - 'SUSTAINABLE SUGAR'

22

Process Options

Sugar Plant – 5000 Capacity

Boils = Pol % Cane: 12.50, Filtr % Cane: 14.50, Imbibition % Cane: 250

Option - 1
Mill White Sugar – Final Molasses

Productions:	
Sugar	Mill White Sugar
Household Consumer	35 %
Bulk Consumer	65 %
Molasses for Ethanol	Final Molasses
Syrup Diversion	Nil

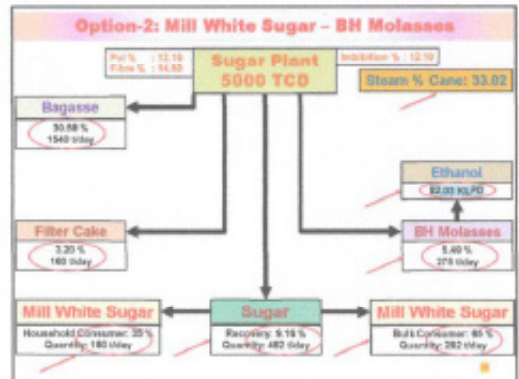
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Option-1: Mill White Sugar – Final Molasses

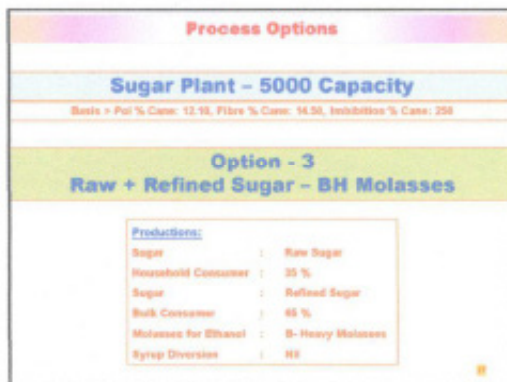
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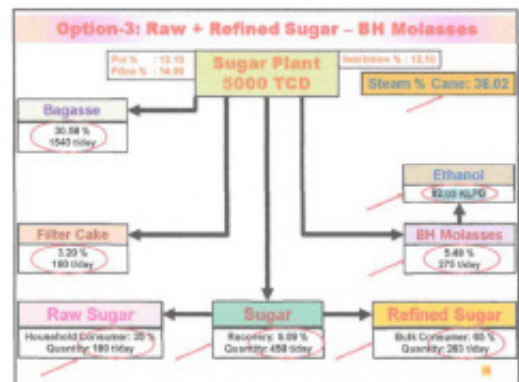
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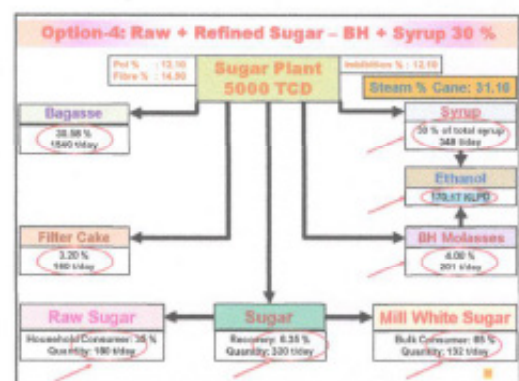
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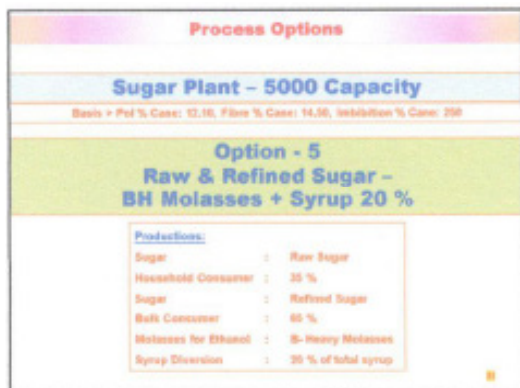
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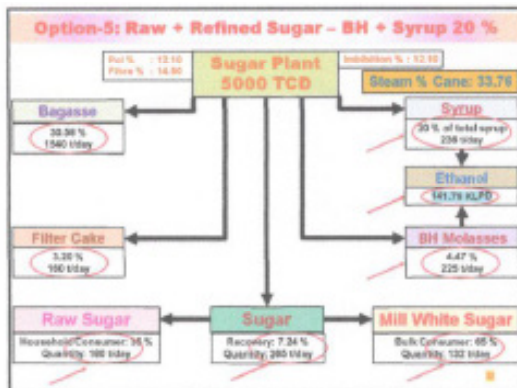
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31



32

Ethanol Production

Government of India is encouraging to produce more Ethanol for achieving 20 % target blending with attractive pricing for different feed stocks from Sugar and Grains.

Ethanol Procurement Price (Year 2021-22)

Sl No.	Feed Stock	Rs / Litre
1	C-Heavy Molasses	46.66
2	B-Heavy Molasses	59.08
3	Juice / Syrup/ Sugar	63.45
4	Damaged Food Grains	61.66
5	Surplus Rice issued by FCI	66.87
6	Corn	61.66

Source: Ministry of Petroleum and Natural Gas, Government of India

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Ethanol Production

For facilitating increased Ethanol Production

BH molasses only produced with 2-masseccuite boiling

BH molasses and Syrup up to 30 % of total syrup is diverted

- > During season Syrup is diverted for Ethanol production
- > BH stored during season and processed during off season
- > Distillery capacity – 120 KLPD.
- > Distillery operated for 220 days.

BH molasses and Syrup up to 20 % of total syrup is diverted

- > During season Syrup is diverted for Ethanol production
- > BH stored during season and processed during off season
- > Distillery capacity – 75 KLPD.
- > Distillery operated for 300 days.

34

Raw & Refined Sugar

Both Raw and Refined Sugars can be exported if the price is Internationally competitive.

Raw sugar can be exported between 600 and 1200 ICUMSA rang as per the demand and price.

Distillery capacity can be optimized to operate 300 days by storing Raw sugar in season.

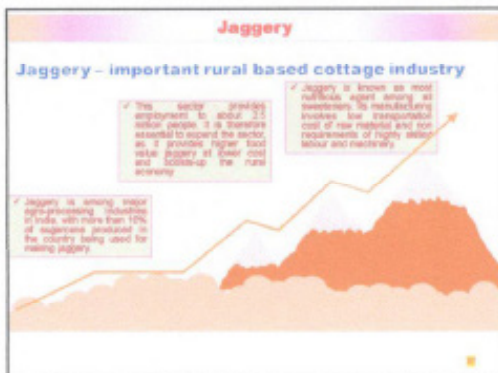
- > Refinery operated for 300 days
- > Excess Raw Sugar stored during season and processed during off season
- > Raw Sugar can be stored in Jumbo bags.
- > Raw Sugar house capacity to be suitably sized for producing excess Raw Sugar during season.
- > Bagasse & Steam balance to be adjusted for off season operation.

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Value Added Products

Other Value Added Products

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Bagasse

Bagasse is a major byproduct of the industry used for Cogeneration of Power.

With various steps taken for energy consumption, more bagasse is saved for producing power.

After meeting in-house requirement, excess power is exported to Grid.

However, cogeneration is not attractive nowadays due to non-attractive power tariffs offered by Electricity Board.

Diversion of bagasse for producing Particle Board & Tableware (Cutlery) is another best option. But the demand is much less as compared to amount of bagasse produced.

Production of 2G Ethanol and other products are being explored. But viability is yet to be established.

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Bagasse

TABLEWARE (CUTLERY) FROM BAGASSE

Best Substitute to single use plastic

- India uses nearly 18,000 tonnes of single use plastic every day including plastic bags, multilayer laminate and disposable cutlery. Environment has no single use plastic is likely to create huge demand for alternatives that can replace such products.
- One such opportunity is emerging in the tableware sector, where use of plastic plates/cutlery/bowls/benches to be replaced.
- Bagasse based tableware, an eco-friendly alternative to single use plastic, is gaining tremendous market preference as they are 100 % compostable. Such products also find its application in quick service restaurants, schools, cinema halls, railway services & take aways etc.
- The market for plastic based tableware is estimated that nearly 3 lakh tonnes per annum, assuming that biodegradable cutlery can initially replace 35 % of the plastic based products, its market could be around 78,000 tonnes per annum.

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Bagasse

Bio-degradable Cutlery/Tableware : Some Facts

- # Very stable and sturdy
- # Good thermal property
- # Water repellent and grease proof
- # Light weight
- # Easy to use
- # Easy to dispose, completely bio-degradable & compostable
- # Hygienic

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Bagasse

BAGASSE BASED PARTICLE BOARD

The continuous increase in global human population resulted in the continuous increase in consumption of resources causing concern on the ability of the future generation to meet their needs in the years to come.

The solution is the principle of sustainable development. One of the ways to achieve sustainable development is to recycle the waste in a way that can be useful to the economic, social and environmental goals.

One such step is to divert the surplus bagasse for products such as particle board.



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Bagasse

Uses of Bagasse based Particle Board

- > Paneling
- > Partitioning
- > Ceiling
- > Floors & Sub floors
- > Door and Window shutters
- > Furniture and built-in furniture
- > Thermal insulation
- > Acoustic insulation
- > Rodent proof construction and exterior cladding

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Bagasse

DEMAND POSITION

"Initially the demand was less. The demand is increasing fast and also the ratio of Ply wood to other board is very high which is almost reverse in many developed countries"

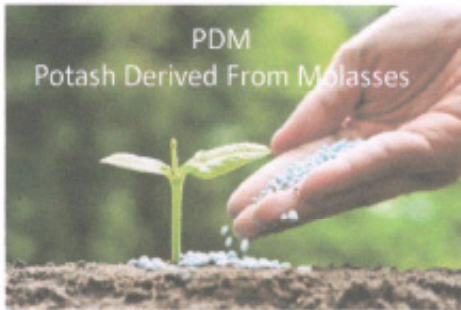
Million Cubic meter

Year	Plywood	Veneer	Particle Board	MDF Board	Total
1996	16.70	0.20	0.10	0.10	17.10
1999	16.90	0.20	0.10	0.14	17.34
2000	17.80	0.27	0.10	0.14	18.31
2005	14.60	0.34	0.10	0.17	15.21
2010	17.80	0.40	0.20	0.20	18.60
2015	21.80	0.64	0.30	0.34	23.08
2020	29.20	0.70	0.30	0.28	30.50

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PDM (Potash Derived from Molasses)

PDM Potash Derived From Molasses



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PDM (Potash Derived from Molasses)



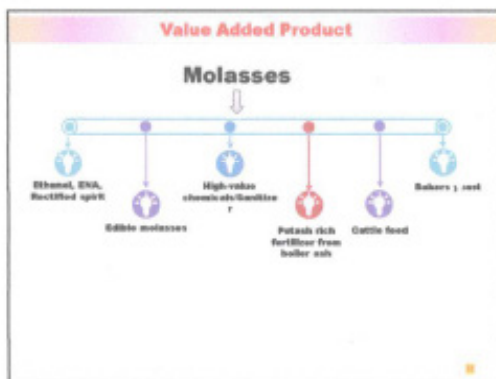
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CO ₂ Liquefaction Plant	
• Distillery Capacity	: 100 KLPD
• CO ₂ production	: 50 T/Day
• Selling price	: Rs. 3.5 to 4.5 per kg.
• Production cost of CO ₂	: Rs. 2.5 to 2.75 per kg
• Installed Cost of CO ₂ liquefaction Plant	~ Rs. 400 Lacs
• Suppliers offers buy-back purified CO ₂ and sell to their customers.	

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Value added Product - Pricing Pattern

Value added Product	Selling Price
Sugarcane Juice Packaging	Rs. 120 – 160 per kg
Jaggery Powder	Rs. 60 – 100 per kg
Demerara Sugar	Rs. 100 – 350 per kg
Brown Sugar	Rs. 340 per kg
Muscavado Sugar	Rs. 40 – 200 per kg
CO ₂ Liquefaction Plant	Rs. 3.5 to 4.5 per kg
Bagasse Pulp	Rs. 25-30 per kg
Bio Gas to Bio-CNG Plant	Rs. 48.30 per kg
Press Mud to Bio-CNG	Rs. 45 per kg
Syrup / BH Oven to Distillery	Differential Pricing
PCM – Potash Derived from Molasses	Rs 10-16 per kg

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Conclusion

Following Vision Statement holds good with various Missions elaborated above.

Indian Sugar Industry today is to overcome all challenges and maintain its sustainability by producing Sugar to the common man at affordable price, to meet the industrial and export Sugar demand competitive with quality product and diversify to produce value added products.

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Conclusion

Missions to be accomplished.

- ✧ Raw + Refined Sugar route to be followed
- ✧ Discontinue Sulphitation process.
- ✧ Produce Natural Cane Sugar, around 35 %, for Household consumers (BPL, LIG, HIG groups) at fixed price [Rs. 20 – 22 per kg]
- ✧ Produce Refined sugar, speciality sugars, Branded Sugars, around 65 %, for Bulk consumers at traded price comfortable for the industry. [Average price Rs. 45 per kg and above]

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Conclusion

Missions to be accomplished.

- ✧ Export Raw and Refined Sugar subject to international competitive price.
- ✧ Refinery to operate 300 days by storing excess Raw Sugar during season and process during off season.
- ✧ B- Heavy molasses only for Ethanol
- ✧ Diverse syrup to the extent possible for Ethanol production with optimum capacity of Distillery.
- ✧ Distillery to operate 300 days
- ✧ Cogeneration of Power

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Conclusion

Missions to be accomplished.

Produce Value Added Products

- ✧ Jaggery Production
- ✧ PDM from Molasses
- ✧ CO₂ Liquification
- ✧ Bio-Gas / Bio-CNG from Filter Cake
- ✧ Tableware (Cutlery) from Bagasse
- ✧ Particle Board from Bagasse

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THANK YOU



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