AN OVERVIEW OF INDIAN CANE MOLASSES QUALITY AND NEED FOR ALTERNATE FEED STOCKS

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INTRODUCTION

At present world is passing through an energy crisis due to fast depleting fossil fuels.

These fuels may not last beyond six or seven decades, if their use continues at current pace.

Indian scenario is more serious since ours is fast developing economy and is expected to grow at the rate of 7% in the years to come and as such the energy demand shall also increase.

- ✓ We are importing more than 70% of requirement o petro products at the expense of huge drainage o foreign exchange.
- ✓ Ethanol is a fuel which can partially or totally replac fossil fuels since it can be mixed with petrol up to a extent of 25% and more.
- ✓ Government of India has already made it mandatory t mix 5% ethanol in petrol and 10% EBP has been targete from October 2017.
- ✓ The requirement of ethanol for 5% EBP has been aroun 1340 million liters which has been achieved. Howeve 2680 million liters of ethanol shall be required for 10% EBP.

PRODUCTION OF SUGAR AND MOLASSES IN THE COUNTRY

- ✓ Majority of alcohol in India, is produced by fermentation/distillation of diluted cane molass production of which is dependent on the quantity of c produced/crushed and subsequent generation of molasses the sugar factories.

- ✓ The production of sugar in the country has been q fluctuating in last six years. Maximum sugar productior 283 lakh tons was in the season 2014-15 which droppec 251 lakh tons in the season 2015-16 and in the curr year, it is estimated to be around 212 lakh tons only.

- ✓ The data with molasses production have also varied considerably and this year molasses production is estimated to be around 90 lakh tons.

- ✓ The estimated alcohol production from this molasses shall be around 2100 million litres as compared to earlier years where estimated alcohol production had been around 2500 million litres or more.

Production of Sugar, Molasses and estimated Alcohol production of the country

Sugar season	Sugar production (Lakh tonnes)	Total Molasses production (Lakh tonnes)	Molasses available for alcohol production (Lakh tonnes)	Estimated alcohol production potential (Million litres)
2010 – 2011	243	109.70	104.22	2449
2011 – 2012	263	118.24	112.33	2639
2012 – 2013	251	117.44	111.57	2621
2013 – 2014	243	108.82	103.38	2429
2014 – 2015	283	124.82	118.58	2786
2015 – 2016	251	109.71	104.40	2453
2016 – 2017*	212	93.00	88.35	2076

Statement showing estimated production, availability and requirement of alcohol of the country

	particulars	Nov.2016 - Oct 2016	As per alcohol year
	Estimated sugar production during the year	25.00	Million tonnes
	Molasses production as per ISMA	11.25	Million tones
	Wastages and other uses 5%	0.56	Million tones
	Molasses available for production (2-3)	10.69	Million tonnes
	Alcohol production @225liters per tonne of molasses	2405	Million ltrs
	Quantity of alcohol from non food feedstock	1500	Million ltrs
	Total alcohol available	3905	Million ltrs
	Requirement		
	I.M.F.L plus C.L. (Country liquor)	2100	Million ltrs
	Total consumption for potable	2100	Million ltrs
	Net alcohol for other sectors	1805	Million ltrs
	Other uses i.e. chemicals etc	600	Million ltrs
	Availability for ethanol blending*	1205	Million ltrs
	Total (9+11+12)	3905	Million ltrs

MOLASSES QUALITY IN DIFFERENT REGIONS OF THE COUN

In addition to above, not only the quantity of molasses produced fluctuating, the quality of molasses in the various regions of the coun is also quite different with regard to total reducing sugar content (TR and other parameters.

We have collected molasses samples from various sugar factories of country viz. Tamil Nadu (three), Maharashtra (six) and Uttar Prade (eight).

The detailed chemical analysis of molasses samples for TRS, reduc sugars (RS), un-fermentable sugars (UFS), fermentable sugars (F volatile fatty acids (VFA) and deterioration in TRS content (on store for two months) have been conducted and the results are -

Chemical Composition of molasses collected from sugar mills of Tamil Nadu

Sl No.	Name of Factory	TRS%	RS%	UFS%	FS%	VFA mg/l	Deterioration in TRS units in 60 days
1.	Odapalli, Erode	40.56	13.52	5.05	35.51	3540	0.39
2.	Papanasam, Thanjavur	42.30	14.58	4.48	37.82	3957	0.30
3.	Arignar, Karungulam	44.53	13.67	4.91	39.62	3693	0.51
	Average	43.00	14.00	5.00	38	3700	0.40

Chemical Composition of molasses collected from sugar mills of Maharashtra

lo.	Name of Factory	TRS%	RS %	UFS %	FS%	VFA mg/l	Deterioration in TRS units in 60 days
	Jawahar SSK, Hupari	33.33	10.80	5.68	27.65	3773	0.95
	Doodhganga SSK, Kagal	42.78	8.65	4.75	38.03	3711	1.72
	Sayadri SSK Yeshwantpur	43.04	7.88	5.32	37.72	3436	0.04
	Sanjivani SSK, Kopergaon	51.80	10.47	4.74	47.06	3715	1.80
	Vignhar SSK, Shiroli	49.22	10.51	4.83	43.39	3485	1.02
	Samarth SSK Jalna	49.64	12.27	5.97	43.67	3841	2.14

The chemical analysis of molasses samples collected fro
nine different sugar mills of Uttar Pradesh

The data falls in two categories (i) TRS 40% or less (thr
factories) and (ii) TRS 44 – 46% or more (five factories).

The TRS content in first category of factories ranged fro
36.2 – 40.2%, RS from 10.8 - 16%, UFS from 5.09 – 5.89
and VFA from 3576 – 3608 mg/l. In the second category
factories the TRS ranged from 44 – 48.95%, RS from 12.04
16.10, UFS from 4.9 – 5.51% and VFA from 3520 – 395
mg/l.

It can be seen from the data that the TRS content
molasses samples showed variations to a large extent.

Similar was the case with regard to RS content which ranged from 10.8 – 16.!% though UFS content as well as VFA did now show major difference.

Deterioration of molasses samples on storage for two months varied considerably and was in the range of 0.2 – 3.47%.

Chemical Composition of molasses collected from sugar mills of Uttar Pradesh

No.	Name of Factory	TRS%	RS%	UFS%	FS%	VFA mg/l	Deterioration in TRS units in 60 days
	Simbhaoli Sugars Chilbaria	40.20	16.00	5.40	34.80	3608	2.37
	KSCM, Nanpara	40.00	10.80	5.09	34.91	3618	0.20
	BCML, Akbarpur	36.20	11.60	5.89	30.31	3576	0.43
	DSCL, Ajbapur	44.00	16.10	4.96	39.04	3520	0.53
	Dalmia Sugars, Nigohi	45.00	14.90	5.27	39.73	3739	2.00
	Uttam Sugars Libberheri	46.37	12.04	4.90	41.47	3846	2.83
	Triveni Sugars Deobandh	46.00	13.65	4.94	41.06	3950	3.47
	Dalmia Chini Mills, Jawaharpur	48.95	14.36	5.51	43.44	3651	2.09

It may be concluded from the chemical analysis of molass samples from various states that in most cases the TR content was around 42-43% except for few regions Maharashtra where it is 50% or more and fermentable sug content usually ranged from 37 to 39% only. VFA content most of the samples was more than 3500 mg/l and UR content was around 5% in most cases.

However, lot of variation was seen with regard deterioration of TRS in molasses stored up to a period of tw months.

Thus the quality of molasses to be used for the fermentati production of ethanol is declining and availability is n certain.

THE ESTIMATED ETHANOL YIELD FROM MOLASSES SAMPLES FROM THREE STATES BASED ON FERMENTABLE SUGAR CONTENT

It is seen that fermentable sugar content is ranging from as low 27.65 and as high as 47.06%. But in most of the samples FS content w less than 40% (76%) which correspond to alcohol content ranging fr 179.4 to 214.3 litres/ton (149.1 in case of molasses of factory MH 1)

Only in Six factories out of seventeen (24% marked red) the fermental sugar content was more than 40% corresponding to ethanol yield of 221 to 235.4 l/ton with the exception of molasses sample of factory MH which had a FS content of 47.06% from which 253.7 l/ton alcohol expected.

It may be concluded that quantity as well as quality of molasses decreasing and contain less fermentable sugars. Thus there is need improve ethanol yield from it or to use other cheap raw materials wh can replace molasses as raw material.

The estimated ethanol yield from molasses samples from three states based on Fermentable Sugar content

tate	Factory Name	TRS g%	UFS g%	FS g%	Ethanol yield l/ton
amil Nadu	TN 1	40.56	5.05	35.51	191.5
	TN 2	42.40	4.48	37.82	203.9
	TN 3	44.53	4.91	39.62	213.6
Maharashtra	MH 1	33.33	5.68	27.65	149.1
	MH 2	42.78	4.75	38.03	205.1
	MH 3	43.04	5.32	37.72	203.4
	MH 4	51.8	4.74	47.06	253.7
	MH 5	49.22	4.83	43.39	233.9
	MH 6	49.64	5.97	43.67	235.4

U.P	UP 1	40.20	5.40	34.8	187.6
	UP 2	40.00	5.09	34.91	188.2
	UP 3	36.20	5.89	30.31	179.4
	UP 4	44.00	4.96	39.04	210.5
	UP 5	45.00	5.27	39.73	214.3
	UP 6	46.37	4.90	41.47	223.6
	UP 7	46.00	4.94	41.06	221.4
	UP 8	48.95	5.51	43.44	234.2

POTENTIAL ALTERNATE FEED STOCKS:

Thus, to use of alternate feed stocks is essential not only for enhanced availability of Ethanol to meet EBP 10 requirements but also to improve capacity utilization of the existing distilleries.

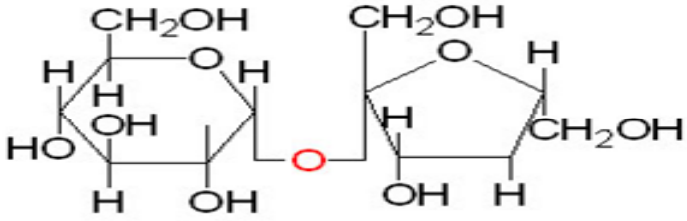
Thus, while it will help the sugar factories having integrated distilleries to improve their financial health on one hand, it will also facilitate availability of higher quantities of Ethanol, a cleaner and greener fuel, thus not only addressing environmental issues but saving considerable amount of forex.

The various routes to be exploited for Ethanol production, in times to come, may be as follows:

RAW MATERIALS FOR ALCOHOL PRODUCTION

Simple → **Sucrose**

Single Stage Hydrolysis

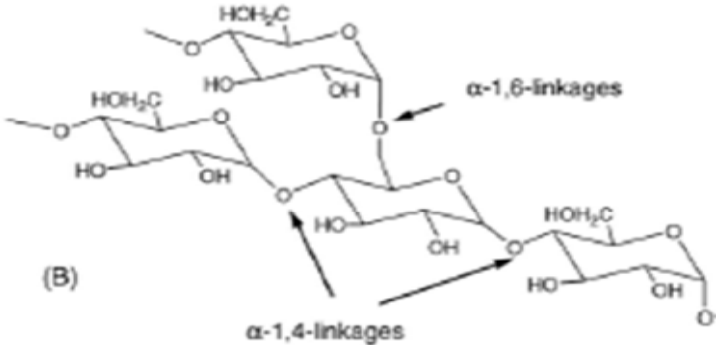


Cane juice ; Beet juice; Molasses

Moderate → **Starch**

Complex

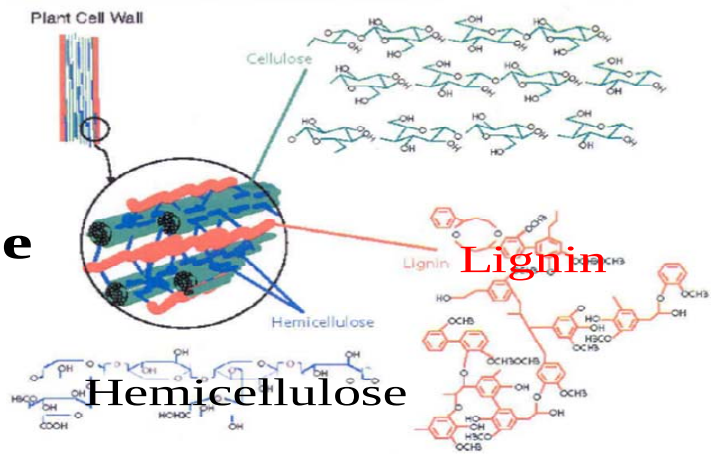
Two Stage Hydrolysis



Cassava; wheat rice; sorghum; millets

Most Complex → **Cellulose**

Pretreatment Followed by Liquefaction



Bagasse; wheat & rice straw; grass

Hemicellulose

As per the experiments carried out at the institute, the fe
cks e.g. Sugar Beet, Sweet Sorghum and Cassava (as Cassa
der) have the potential to yield Ethanol @ approx. 100-1
rs/MT, 45-50 liters/MT and 340-360 liters/MT.

The diversion of sugarcane juice and B-heavy molasses c
d Ethanol @ 65-75 liters/MT and 280-310 liters/M
pectively. The yields shall, however, vary depending upon t
al fermentable sugar content. As far as production of Etha
n Cellulosic material is concerned, the cost effective technolo
et to come.

CONCLUSION

- ✓ As discussed, molasses route alone or in combination with grain based eth shall not be adequate to cope up the requirement of all the secto particularly, considering 10% Ethanol blending and hence there is dire n for exploiting the potential of alternate feed stocks for Ethanol produc through "SMART" distilleries and in fact by converting conventional su factories into "BIO-REFINERIES".

- ✓ With the increase in the price of the sugar to the extent the economics b in favor of sugar production, the sugar factories try to exhaust the molas to the maximum possible extent, which is reflected from the total su content also.

- ✓ The production of ethanol through grains has serious limitations and there always be a debate on Fuel versus Food. Thus, there is imperative need enhancing the fermentation and distillation efficiencies along with harnes the potential of alternate feed stocks available in various regions.

Thank you