EFFECT OF DEXTRANASE ON DEXTRAN LEVEL CONDUCTED FROM FOURSUGAR MILLS

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ABSTRACT

Dextran is a complex high molecular weight glucose polysaccharide, produced by *leuconostocmesenteriodes* during harvesting of sugarcane. Dextran elevates and gives false Polarization being a highly dextrorotatory substance.Most of the sugar mills do not monitor the Dextran level from First Expressed Juice to Final Molasses. Catalysts Biotechnologies Pvt. Ltd and FABCON Phil. Inc. conducted plant trials on four (4)-sugar mills on the effect of Enzydex dextranase on the Dextran level from First Expressed Juice to Final Molasses. Dextran profile was determined before and after application of dextranase ENZYDEX. After determining the Dextran profile from FEJ to Final Molasses before the application of dextranase, the dosage was set at 3 ppm and split equally into the following dosing points in Mixed Juice, before the last effect of the evaporator and B-Molasses. Enzydex reduced the Dextran more than 30% and the savings per day using Mill A is 9,908 kg sugar valued at P297,239.00. The net savings is Php 261,239.00 after deducting the cost of Enzydex amounting to P36,000 per day. The net savings justified the usage of Enzydex.

INTRODUCTION

Dextranis acomplex polysaccharide, produced by *leuconostocmesenteriodes*during harvesting of sugarcane. It is a high molecular weight glucose polysaccharide comprising mainly $\propto -(1-6)$ linkages.Most dextran in the sugarcane is linear but some branches may occur and linked with α-(1→2), α-(1→3) or α-(1→4) to the main chains.. The physical properties of Dextran have adverse affects on the processing of sugar cane. The effects of dextran in sugar processing are in clarification; increase viscosity, color formation, poor filtration, floc formation and sugar recovery.

Dextran is highly dextrorotatory thus inflating the % Pol of juice. It overstatedthe calculated sugar due cane and the distribution of sugar to the planters. It resulted to giving more sugar to the planters and resulted to subsidy. For every one (1) gram of dextran, four (4) of sucrose will be lost.

In sugar refining, there will be losses in the affination station due elongated crystals. Dextran in raw sugar for refining is not absorbed by carbonaceous absorbents and can also double or triple the viscosity of the liquor. In sugar processing, the use of Enzyme Dextranase is the most efficient in hydrolysing the dextran in sugar process materials i.e juices, syrup and molasses.

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Impact of Dextran on Sugar Processing

- ✓ Loss in terms of sucrose.
- ✓ Formation of irregular and needle shaped crystals
- ✓ Lower Molasses exhaustion
- ✓ Increase viscosity longer pan boiling
- ✓ Reduction of Centrifugal capacity due to longer wash time.
- ✓ Higher molasses purity &Final Molasses % Cane
- ✓ High steam &power consumption

The most efficient method in hydrolyzing the Dextran in the sugar processing materials i.e. juices, syrup and molasses is the use of enzyme dextranase. Depending on the dextran level, the most effective concentration of enzyme dextranase to reduce dextran level is from 5-10 ppm on cane.

OBJECTIVES

To determine the dextran profile from First Expressed Juice to Final Molasses.
To determine the effect of dextranase Enzydex to the process materials from mixed juice to B-Molasses.
To attain an average of 30% reduction of Dextran

MATERIALS & METHODS

ALCOHOL HAZE METHOD FOR ESTIMATION OF DEXTRAN CONTENT

Preparation of 10% TCA Solution

1. Dissolve 50 g TCA in distilled water and dilute to 500 mL in a 500 mL volumetric flask.

Estimation of dextran in First Expressed Juice (FEJ)/mixed juice/Clarified Juice

1. Measure 25 mL juice (measure Brix)
2. Transfer to 50 mL beaker and add 5 mL of 10% TCA to 25 mL juice. Mix well (dilution factor = 1.2)
3. Add approximately one spatula of acid washed kiesselghur and mix well.
4. Filter solution through Whatman Filter No. 5 or No. 1
5. Take 5 mL filtrate and transfer to a 50 mL test tube. Add 5 mL of absolute ethanol between 30 and 60 seconds.
6. For blank sample, take 5 mL filtrate and transfer to a 50 mL test tube. Add 5 mL distilled water.
7. Take absorbance (at 720 nm) of samples 20 minutes after the addition of absolute ethanol.
8. Calculate dextran content using linear equation from standard graph and multiply with dilution factor.

Estimation of dextran in syrups/massecuites/molasses/raw sugar

1. Syrup: measure 25 g (measure Brix)
   A massecuite: measure 20 g (measure Brix)
   B massecuite: measure 10 g (measure Brix)
   C massecuite: measure 10 g (measure Brix)
   Molasses: measure 10 g (measure Brix)
   Raw sugar: measure 50 g
2. Transfer sample in 100 mL beaker and dissolve in 50 mL distilled water.
3. Transfer diluted sample to 100 mL volumetric flask and fill up with distilled water up to 100 mL mark. (Measure the brix of this sample for raw sugar)
4. Transfer 25 mL aliquot to a 50 mL beaker and add 5 mL of 10% TCA. Mix well.

Dilution factor: Syrup	= 4.8
A massecuite	= 6.0
B/C massecuite & Molasses	= 12.0
Raw sugar	= 2.4

5. Add approximately one spatula of acid washed kiesselghur and mix well.
6. Filter solution through Whatman Filter No. 5 or No. 1
7. Take 5 mL filtrate and transfer to a 50 mL test tube. Add 5 mL of absolute ethanol between 30 and 60 seconds.
8. For blank sample, take 5 mL filtrate and transfer to a 50 mL test tube. Add 5 mL distilled water.
9. Take absorbance (at 720 nm) of samples 20 minutes after the addition of absolute ethanol.
10. Calculate dextran content using linear equation from standard graph and multiply with dilution factor. Standard Graph of Dextran is shown in **Annex 1**.
11. Computation of ppm Dextran is shown below.

- **Y = 0.00102 X – 0.04632**
- **X (Dextran Value) = (Y + 0.04632)/0.000102**
- Where:

Y = Net Absorbance
X = Dextran Value

- PPM Dextran = Dextran Value x Dilution Factor
- PPM Dextran/100 Bx = Dextran ppm x 100/Bx

Dilution Factor:

Juice & Mixed Juice	=1.2
Syrup	= 4.8
A-Mass	= 6.0
B/C Mass & Final Molasses	= 12
Raw Sugar	= 2.4

RESULTS &DISCUSSION

Dextran profile was determined before and after application of DEXTRANASE. After determining the dextran profile from FEJ to Final Molasses before the application of dextranase Enzydex, the dosage was set at 3 ppm and split into the following dosing points.

1) Mixed Juice - 1 ppm
2) Evaporator (before last Effect) - 1 ppm
3) B-Molasses - 1 ppm

Table 1. Sugar Mills cane supply 80 TO 90% fresh cane.

	MILL A, 10,000 TCD			MILL B, 8,000 TCD		
	BEFORE	AFTER	% REDT'N	BEFORE	AFTER	% REDT'N
	Average Dextran, ppm/100 Bx			Average Dextran, ppm/100 Bx		
FEJ	1159			594	535	
MIXED JUICE	695	556	20	672	666	1
CLARIFIED JUICE	946	416	56	625	472	24
SYRUP	655	438	33	794	474	40
B-MOLASSES	1572	880	44	1776	912	49
FINAL MOL	2468	1431	42	2511	1250	50
RAW SUGAR	0		0			
AVERAGE % REDUCTION			**39**			**33**

Table 2. Sugar Mills cane supply with 80-90% burnt cane.

	MILL C, 8,000 TCD			MILL D, 4,000 TCD**		
	BEFORE	AFTER	% REDT'N	BEFORE	AFTER	% REDT'N
	Average Dextran, ppm/100 Bx			Average Dextran, ppm/100 Bx		
FEJ	849	831		1171	1365	
MIXED JUICE	1168	928	21	1189	927	22
CLARIFIED JUICE	2013	884	56	2242	1373	39
SYRUP	1788	1204	33	3273	2151	34
B-MOLASSES	3972	2210	44	11301	7333	35
FINAL MOL	5754	3353	42			
RAW SUGAR	411	322	22			
AVE. % REDUCTION			**36**			**33**

**** OPERATION OF MILL D IS EXPERIENCING 3 TO 4 HOURS DUE CANE PER DAY.**

Two of the sugar mills cane supply is 90% burnt cane while the other two sugar mills have 80-90% fresh cane.

Table 1 above show that the level of dextran of fresh cane is below 1,000 ppm from Mixed Juice to Syrup. After applying 1 ppm of Enzydex on the dosing points, average % reduction attained for Mill A & B is 39% and 33% respectively.

Table 2 show that the dextran profiles of burnt cane and probably deteriorated cane before application of dextranase is above 1,000 ppm. At this level, dextran will affect manufacturing processes in terms of clarification, increase viscosity, longer pan boiling and affect centrifugal efficiency. Sugar losses will also increase. On Mill D, the deterioration is more prominent due to 3 to 4 hours of stoppage of milling operation due to insufficient cane supply. The delayed in milling enhanced the dextran development in cane. This is reflected in the dextran level built up in the final molasses. The average % reduction for Mill C & D is 36% and 33% respectively.It should be noted also the dextran level is building up from syrup to Final Molasses thus the need of Enzydex.

COST ANALYSIS

BASIS:

1 gram of Dextran Reduction	= 4 grams of Sucrose
1 ppm Dextran Reduction	= 4 gram of Sugar
Price of Sugar per LkG	= 1,500
Cost of Enzydex per kg	= 1,200
Enzydex Used/day, kg	= 30
Cost of Enzydex	= 36,000

SUGAR SAVED (Kg) = TCM x % Cane x Brix x Reduction in Dextran ($D_1 - D_2$) x 4/1000

Where: **D_1 = Before Application**
D_2 = After Application of dextranase

Using the data of **Mill A**, the Sugar saved is shown in Table 3 below. Total sugar saved per day is 9,908 kg with a value of Php 297.239.00. The net savings is Php 261,239.00.

Table 3. Sugar saved after Enzydex application.

	MILL A, 10,000 TCD						
	BEFORE	**AFTER**	**% REDT'N**	**% CANE**	**BRIX**	**SUGAR**	**VALUE**
	AVE. DEXTRAN					**SAVED, KG**	OF SUGAR
	ppm/100 Bx						
FEJ	1159						
MIXED JUICE	695	556	20	100.00	15.61	1,112	33,360
CLARIFIED JUICE	946	416	56	99.00	15.48	3,247	97,424
SYRUP	655	438	33	23.00	53.84	1,071	32,120
B-MOLASSES	1572	880	44	12.00	85.44	2,837	85,100
FINAL MOL	2468	1431	42	4.50	87.96	1,641	49,235
RAW SUGAR	0		0				
AVE. % REDUCTION			**39**			**9,908**	**297,239**

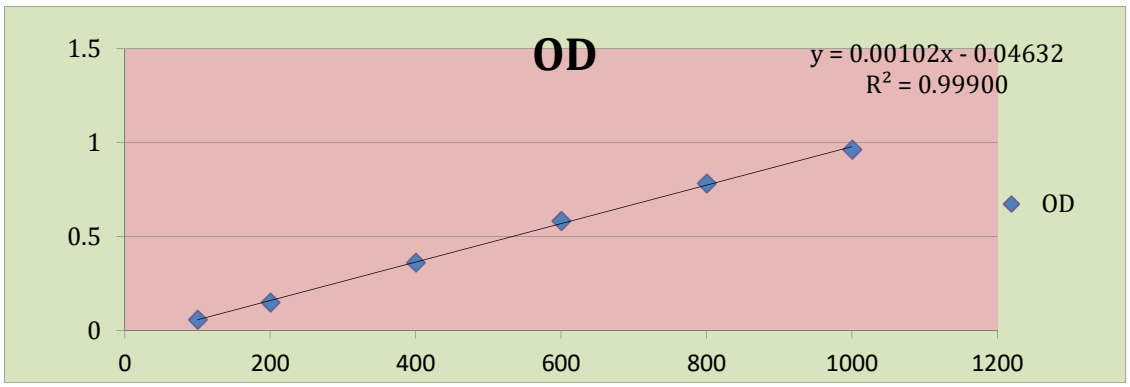
CONCLUSION & RECOMMENDATION

The application of dextranase Enzydex will control the building up of Dextran from FEJ to Final Molasses. If a refinery is annex to a sugar mill, Dextran in raw sugar will also affect the refining process. On dextran level between 800 - 1000 ppm in syrup, dosage of 3 ppm is enough to bring down the level of dextran to 600 and below. For mills with 80-90% burnt cane and the knife to knife is more than 24 hours, it is recommended to use initially 6 ppm Enzydex until the dextran level is reduced below 800 ppm in syrup. At 1000 ppm and higher Dextran in Mixed Juice, the dosage of 8 ppm should include the maceration juice 1 ppm; mixed juice 1 ppm; Evaporator before the last Effect 2 ppm A-molasses 1 ppm, and B-Molasses 2 ppm. Weekly analysis of Dextran should be conducted preferably on Wednesday and Friday to check the affectivity of the Enzyme Enzydex and adjust the dosage accordingly based on the level of Dextran. Typical dextranase application point Process Flow Diagram is shown in **Annex 2**. The sugar saved of 198LKg sugar per day amounting to a net savings of P261,000.00 justified the application of dextranase.

ANNEX 1

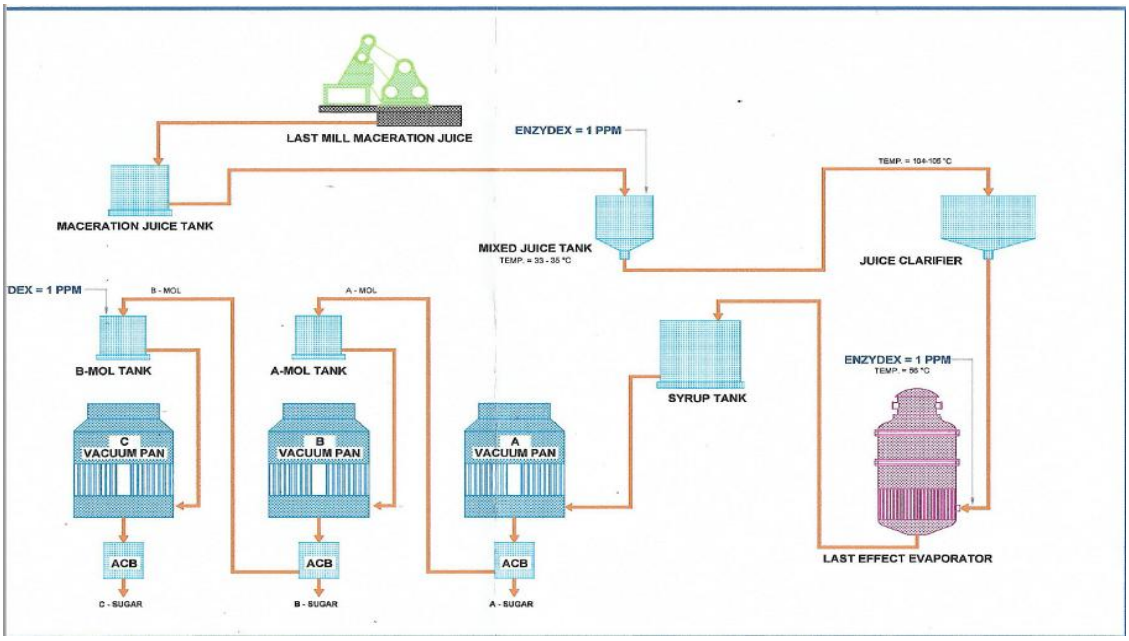
DEXTRAN STANDARD GRAPH

Con in ppm	OD
100	0.057
200	0.149
400	0.361
600	0.583
800	0.783
1000	0.923



ANNEX 2

Process Flow Diagram for Dextranase Application



Catalysts Biotechnologies Pvt. Ltd. developed ENZYDEX, an enzyme dextranase that hydrolyze insoluble and viscosity enhancer molecules dextran into simple soluble lower molecular weight sugar at a low dosage concentration of 3-6 ppm on cane.