

TRUE SUGAR BEET QUALITY UNDER EGYPTIAN CONDITIONS

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ABSTRACT

From the fundamental equation: $Y = A + BX$ relation between apparent and true sucrose as well as apparent and true quality of sugar beet had been deduced. Application of the equations were illustrated by examples connected with sugar analysis for control purposes. These equations could be applied to the calculations set up by means of a calculator or computer.

INTRODUCTION

Since most of figures obtained in sugar analysis are not absolute, sugar house calculations are largely mostly more approximations, but however they are accurate enough to give comparable results. Sucrose is optically active and therefore may be determined in solutions by measuring the angle through which it rotates polarized light. Optically active substances are found chiefly in deteriorated beet, i.e. considerable amounts of dextran $[\alpha]_D^{20} = +200^\circ$ and raffinose $[\alpha]_D^{20} = +123^\circ$ as well as other optically active products of microbial metabolism. A higher dextran, and raffinose contents considerably increase the dextro-rotation, giving rise to sucrose content apparently higher than true sucrose. This apparent sucrose causes an error in the sucrose balance of the sugar factory and leads to increase of sugar loss in molasses and also error in quality of sugar beet roots James *et al.*, (1971)

El-Geddawi (1988) and Abou El-Maged *et al.* (2004) reported that sucrose increased during storage of sugar beet. It could be noticed that this increment of sucrose recorded apparent increase by (wet weight) and quality of sugar beet roots, and this sucrose which in terms increased by prolonging storage periods due to inversion of sucrose to more substances such as glucose moiety which form straight chains containing α -1,6 linked in presence of *Leuconostoc mesentroides* bacteria to form dextran which gives artificially high pol value, since it is dextrorotatory. Likewise, raffinose content in the beet is highly so dextrorotatory. It passes through all the processing operations and into the molasses, affecting the last stages of operations in the end of the company due to increase the storage periods, which result in more deterioration of beet. This in turn consequently increase the apparent sucrose and quality of beet, therefore reducing of rendement of sugar recovery % of the factory. Apparent sucrose and quality is widely used in sugar factory for control purpose, the test has general acceptance because of its convenience and simplicity. On the other hand, true sucrose has value in

comparing the work of different factories and in research work but is of limited application because of the time required (Meade and Chen, 1977). Therefore, new equations were required to calculate true sucrose and true quality in short time. The aim of the work is to obtain a simple new equations predicting the true sucrose and true quality values of sugar beet as a promising tool to minimize the losses in randment of sugar recovery % of the sugar factories.

MATERIALS AND METHODS

Representative composite samples of sugar beet delivered to Delta Sugar Company were collected during 2007 and 2008 working seasons. Collected samples were transferred to laboratory, the extracted juice was analysed for apparent and true sucrose and quality of beet roots. Five runs were taken at each data of analysis.

Apparent sucrose was determined using automatic saccharimeter on a lead acetate basic according to the procedure recommended by Delta Sugar Company, Le Docte (1977).

True sucrose was determined by a Double polarization Method. Accepted method G45/7-1 (1994) as described in ICUMSA (1994). The following formula was used to calculate the true sucrose content :-

$$\text{True sucrose \%} = \frac{100 (P - I)}{132.66 - 0.5 (t - 20)}$$

where:

P= The polarization value before inversion

I= The polarization value after inversion.

t= The temperature (C°) at which the reading were taken.

Beet quality was determined according to the procedure of Delta Sugar Company.

Data were subjected to analysis for correlation coefficient according to Dowdy *et al.* (2004) and for standard deviation according to Jaisingh (2000).

RESULTS AND DISCUSSION

Data of apparent and true sucrose as well as apparent and true quality of sugar beet roots are presented in Table (1). The results revealed that the correlation coefficient between apparent and true sucrose and quality of sugar beet were 0.83 and 0.99, respectively.

From the data presented in Table (1) it could be noticed that there were an increase in apparent sucrose and quality, while true values gave lower data than the recorded apparent values.

Table (1) revealed that apparent sucrose and quality were 18.94 and 80.11, while true parameter were 17.85 and 78.94, respectively. The difference between apparent and true sucrose and quality of sugar beet were 1.09 and 1.17, respectively. Such differences increased by prolonging the periods between harvesting and processing which resulted in an in the

economic costs of the factory. Such finding is in an agreement with the previously reported by Meade and Chen (1977), who stated that the dextrorotatory characteristics of dextran affected the polarization of the juice resulting in false sugar content and false sugar beet quality.

Table (1): Analysis of entering beet processing for apparent and true sucrose and beet quality.

Samples	Apparent sucrose	True sucrose	Apparent quality	True quality
1	18.70	17.89	78.80	77.84
2	20.20	19.30	85.18	84.49
3	20.01	18.87	71.02	69.27
4	20.70	20.12	84.10	83.72
5	16.30	15.93	74.05	73.44
6	16.85	16.12	80.20	79.34
7	20.45	19.39	80.90	79.83
8	19.90	17.14	79.87	76.63
9	16.07	15.57	73.53	72.67
10	18.00	17.18	72.91	71.62
11	18.20	17.86	76.26	75.81
12	19.02	18.67	81.18	80.83
13	19.45	18.23	83.44	82.34
14	18.92	17.83	83.09	82.05
15	18.81	17.88	82.80	81.91
16	18.96	18.46	79.91	79.37
17	20.08	18.69	83.46	82.20
18	19.65	18.34	83.20	82.00
19	19.80	17.18	83.91	81.46
20	18.71	17.59	80.39	79.14
21	18.44	18.10	80.81	80.45
22	19.63	17.18	83.16	80.76
23	18.61	17.41	80.31	78.95
24	18.26	16.72	80.86	79.10
25	20.60	19.39	85.66	84.77
26	18.85	18.48	74.80	74.29
27	18.20	16.44	79.23	77.01
Mean	18.94	17.85	80.11	78.94

Descriptive statistics of apparent and true of both sucrose and quality of sugar beet are presented in Table (2).

New equations were obtained using Microcal origin "Version 5", and using the statistical package for a social science (SPSS) analysis without english version 12.0 for windows (Coakes, 2005) as follows:

$$Y = 3.073 + 0.78 X$$

$$\bar{Y} = -0.401 + 0.99 \bar{X}$$

These equations could be applied to the calculation by means of a calculator or computer.

Table (2): Descriptive statistics of apparent and true of both sucrose and quality of sugar beet.

	Apparent sucrose (X)	True sucrose (Y)	Apparent quality (\bar{X})	True quality (\bar{Y})
Mean	18.94	17.85	80.11	78.94
Standard error	0.23	0.22	0.76	0.77
Median	18.92	17.88	80.81	79.37
Standard Deviation	1.20	1.12	3.96	3.98
Sample variance	1.45	1.27	15.66	15.88
Kurtosis	0.49	-0.33	-0.14	0.06
Skewness	-0.78	-0.14	-0.83	-0.78
Range	4.63	4.55	14.64	15.50
Minimum	16.07	15.57	71.02	69.27
Maximum	20.70	20.12	85.66	84.77
Sum	511.37	481.96	2163.03	2131.31
Count	27.00	27.00	27.00	27.00

The determination of true sucrose and true quality of sugar beet were based on the following simple equation: $Y = A + BX$

Where:

Y = True sucrose

X = Apparent sucrose

\bar{X} = True quality

\bar{Y} = Apparent quality

A and B = Coefficient.

Application of new equations to predict the true sucrose and true quality values of beet sugar factory during 2008 working season are presented in Table (3).

Table (3): Data of the new equation predicting the true sucrose and true quality values of beet sugar factory during 2008 working season.

True sucrose according to double polarization	True sucrose according to new equation	Apparent quality	True quality according to new equation
19.050	18.611	84.100	82.858
18.470	17.854	81.600	80.383
19.560	19.024	80.200	78.997
19.050	18.455	78.900	77.710
19.050	18.689	82.800	81.571
17.880	17.487	78.800	77.611
15.440	15.444	76.300	75.136
17.650	17.246	75.500	74.344
19.730	19.172	83.090	81.858
19.950	19.593	82.400	81.175
Mean 18.582	18.155	80.369	79.263

Conclusion

In conclusion, the present investigation could be recommended to offer the simple new equations predicting the true sucrose and true quality values of sugar beet as a promising tool to minimize the losses in randment of sugar recovery % of the sugar factories. On the other hand, the present investigation could be helpful for setting up an accurate parameters for purchasing the sugar beet in sugar factories.

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الجودة الحقيقية لبنجر السكر تحت الظروف المصرية

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من المعادلة الأساسية $A + B = C$ تم الحصول علي علاقة بين السكر الظاهري والحقيقي وكذلك جودة البنجر الظاهرية والحقيقية . تم تطبيق المعادلات بأمثلة مرتبطة بتحليل السكر لغرض المراقبة . هذه المعادلات يمكن تطبيقها عن طريق حسابها بالآلة الحاسبة أو الكمبيوتر .

قام بتحكيم البحث

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