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INFLUENCE OF PRE-HARVEST TREATMENTS AND STORAGE PERIOD ON SUGAR CANE QUALITY

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Abstract

The present work was conducted at El-Mattana Agricultural Research Station at Qena Governorate during the harvest season 2001 to study the effect of pre (burnt and non-burnt) and storage period (cane storage before crushing for 0, 2, 4, 6 and 8 days) on juice quality of the cane variety G.T.54-9

The results indicated that brix and reducing sugars tended to increase as storage periods increased up to 8 days after cutting. Meantime, the non-burnt sugar cane exhibited the lowest brix and reducing sugars values as compared with the burnt ones. On the other hand, the extracted juice %, sucrose %, purity % and sugar recovery % were decreased as the storage period was prolonged.

The interaction between the two variables affected markedly the rate of deterioration in all studied traits.

It is recommended that cane should be harvested without burning and meantime should be delivered as early as possible to sugar mill to minimize sugar losses.

INTRODUCTION

The changes in cane quality traits i.e. extracted juice, brix, sucrose, purity, reducing sugars and recovery sugar percentages sustained due to burnt and non-burnt cane before harvest and left under the field conditions for some days prior to crushing are very important, particularly under Egyptian conditions. Harvesting and milling season extends yearly from January to May, during this period a large magnitude of changes in the humidity and temperature take place.

In this connection Rizk and Normand (1966) reported that reducing sugar increased with the increase of invertases enzyme activity, while sucrose percentage decreased. Saleh and Sayed (1980) reported that the values of total soluble solids % (Brix) of burnt cane were increased more than non-burnt cane. Sayed *et al.* (1983) showed that extracted juice of both burnt and non-burnt cane stalk were decreased af-

ter six days from harvest date. Romero *et al.* (1993) reported significant losses in juice quality with the increase in time elapsed between harvesting and milling. Norman (1995) showed that un-burnt cane usually has a higher (4-5 %) sugar content than equivalent burnt cane with the increase in storage period. Besheit (1996) indicated that increasing the stored period up to 8 days leads to increase in cane weight losses and reducing sugar. In addition, juice extraction and purity percentages dropped, markedly, furthermore, brix degrees and sucrose percentage considerably increased in cane stored for four days and for six days, respectively, thereafter, a great reduction had been recorded. Allam (1997) reported that the decrease in juice extraction, brix, sucrose and purity percentages, were noted to be more in burnt stalk than those of non-burnt canes. While, the highest values of reducing sugars were obtained from burnt cane. Moreover, prolong storage period up to six days increased brix and reducing sugars values, while juice extraction, sucrose and purity percentages were decreased. Azzazy *et al.* (1999) showed that reducing sugar percentage increased by the increase in storage period up to seven days. However, the extracted juice, sucrose and purity percentages were decreased as the storage period prolonged. Moha-

hills the cane stalks were placed as hills in three replications each containing five bundles and each bundle 20 stalks, bundles were weighted and then crushed before and after storing for 0, 2, 4, 6 and 8 days after harvest. Both burnt and non-burnt stalks prepared in three replications.

The following parameters were recorded on crushed juice: -

1-Juice extraction percentage (J.E.P.) was calculated according to the following equation:

J.E.P % = juice weight x 100/cane weight

2- Total soluble solids percentage (brix %) was determined using Brix hydrometer standardized at 20 °C.

3-Sucrose percentage was determined using saccharometer apparatus according to A.O.A.C. (1995).

4-Purity percentage was calculated according to the following equation

Purity % = sucrose x 100 /brix

5- Reducing sugar percentage was determined in the Juice extraction according to Anonymous (1981).

6- Recovery sugar was calculated according the equation described by Yadav and Sharma (1980)

Recovery sugar = { sucrose - 0.4 (brix – sucrose) 0.73}

The obtained data were subjected to factorial statistical analysis in Randomized Complete Block Design (R. C. B. D.) according to Snedecor and Cochran (1981). Treatment means were compared using L.S.D at 5 % level of probability.

Table (1) The meteorological data from 21st – 28th March 2001 in Qena governorate

Date	Temperature °C		Humidity
	Min.	Max.	
21st	12.4	40.2	59%
22nd	19.6	31.2	33%
23rd	14.1	25.2	29%
24th	11.4	26.3	34%
25th	8.0	29.9	58%
26th	7.1	31.8	53%
27th	9.5	33.0	49%
28th	6.0	35.7	51%

RESULTS AND DISCUSSION

1-Juice extraction percentage (J. E%)

Data in Table (2) revealed that pre-harvest burning cane significantly and negatively affected juice extraction percentage (J. E %) recording 67.61 % as compared with non-burning canes 69.70. These results are in agreement with those reported by Sayed *et al.* (1983) and Allam (1997) who reported that the reduction in juice extraction was noted to be more in burnt stalks compared with non-burnt ones.

Dealing with storage treatments data in the same Table showed a gradual and significant decreases in J.E % as cane processing delayed for 2, 4, 6 and 8 days from harvest time. The magnitude of J.E % reduction depended greatly on the time elapsed between harvest and processing, where the reduction percent in J.E % amounted 0.98, 2.66, 3.24, and 5.63 corresponding to the delay in processing for 2, 4, 6 and 8 days as compared with cane processed immediately (in the same day of harvest). This reduction may be due to water evaporation losses during storage and/or the increase in fiber % content Tuner and Raja (1962). Moreover, in Egypt, Saleh and Sayed (1980), Azzazy *et al.* (1999) and Ahmed *et al.* (2002) reported that the reduction in juice extraction percentage in stored cane before crushing was accompanied by an increase in the final bagasse percentage cane.

With respect to the effect of the interaction between pre-harvest treatments and storage periods results showed that the rate of reduction in J. E % seems to be more rapid and statistically significant in burnt cane stalks with the delay in processing (Table 2).

Table (2): Effect of pre-harvest treatment and storage periods after harvest on juice extraction %

*Storage	Non-burnt canes	Burnt canes	Mean	Mean reduction %
0	70.75	69.90	70.33	0.00
2	70.34	68.93	69.64	0.98
4	70.03	67.73	68.88	2.66
6	69.41	66.68	68.05	3.29
8	67.96	64.80	66.37	5.56
Mean	69.7	67.61		

*Storage period after harvest/days

L.S.D.		
Burnt treat.	B	0.21
Storage	S	0.33
Interaction	B x S	0.47

2- Total Soluble Solids % (Brix):

Data in Table (3) showed that burning cane before harvest significantly increased total soluble solids (T.S.S %) trait, where, brix degrees recorded 20.43% and 21.49% for both non-burnt and burnt canes, respectively. Such effect may be due to that burnt cane suffered more weight losses and sugar conversion compared with burnt stalks. These results are in harmony with those reviewed by Saleh and Sayed (1980)

Dealing with the effect of storage period data in Table 3 showed that delaying cane processing significantly affected T.S.S. trait. In this connection T.S.S. increased gradually by the increase in storage period to reach its maximum value (22.86) after six days from cutting day. Therefore, T.S.S. value dropped to reach 22.67 after 8 days. The obtained results are in accordance with those of Mohamed (2001) and Ahmed *et al* (2002).

Concerning the interaction between the two studied factors, data cleared that the interaction significantly affected brix degrees and the rate of increase in brix was more pronounced in burnt cane than those of non-burnt cane.

Table (3): Effect of pre-harvest treatments and storage periods after harvest on TSS %

*Storage	Non-burnt canes	Burnt canes	Mean	Mean increase %
0	18.95	18.34	18.65	0.00
2	19.43	19.13	19.38	3.91
4	20.52	22.19	21.35	14.48
6	22.30	23.42	22.86	22.57
8	20.97	24.37	22.67	21.55
Mean	20.43	21.49		

*Storage period after harvest/days

L.S.D.	
B	0.78
S	1.24
B x S	1.75

3-Sucrose percentage

Data in Table (4) revealed that sucrose percentage was significantly affected by the pre-harvest treatment, where, the non-burnt canes recorded the higher sucrose values (14.73 %) as compared with burnt ones, which recorded (13.79 %). The obtained results are similar to those reviewed by Norman (1995).

Prolonging the period between harvest and milling significantly decreased the values of sucrose percentage. The percent of reduction amounted 5.89, 8.62, 13.18 and 20.34 with the delay in cane processing for 2, 4, 6 and 8 days as compared with cane crushed directly after harvest (Table 4). Such effect might be attributed to the high inversion rate of sucrose due to the increase in the activity of degrading enzymes and higher rate of respiration under the high temperature prevailing duringstorage period (Table 1). These results are in accordance with those obtained by Rizk and Normand (1969), Azzazy *et al.* (1999) and Mohamed (2001).

A speculative view to the interaction effect between the two studied variables which had a significant effect on sucrose trait, prolonging the storage period up to 8 days prior to milling for burning stalks recorded the greatest reduction in sucrose percentage.

Table (4): Effect of pre-harvest treatments and storage periods after harvest on sucrose percentage.

*Storage	Non-burnt canes	Burnt canes	Mean	Mean reduction %
0	16.05	15.50	15.78	0.00
2	15.24	14.47	14.85	5.89
4	14.99	13.86	14.42	8.62
6	14.19	13.21	13.70	13.18
8	13.16	11.92	12.54	20.34
Mean	14.73	13.79		

*Storage period after harvest/days

L.S.D.	
B	0.38
S	0 59
B x S	0.84

4-Purity percentage

Significant differences in purity percentage between burnt and non-burnt canes have been observed (Table5). The results also indicated that non-burnt cane exhibited the highest purity value (72.30 %) as compared with burnt ones (65.56 %), these results are in line with those reported by Allam (1997).

Data in the same table pointed out that the effect of storage periods on purity percentage was significant. As the interval period after harvest and prior to processing was increased juice purity values decreased to reach its minimum value after 8 days. In

this respect, the percent of reduction in juice purity recorded 10.15%, 20.69%, 31.06 % and 34.48% corresponding to the delay in milling for 2, 4, 6 and 8 days, respectively, as compared with cane processed immediately after cutting. These results may be due to the decrease in sucrose and/or increase in total soluble solids % where purity is calculated from both traits. Such effect may be attributed to the higher rate of sucrose inversion caused by degrading enzymes under high temperature and delay in crushing,. In this connection Mohamed (2001) and Ahmed *et al* (2002) reported that the rate of purity deterioration was closely correlated to cane variety, storage duration and temperature.

Regarding to the effect of the interaction between the two studied variables, data (Table 5) cleared that the interaction between pre harvest and storage treatments were significantly affected purity percentage. The lowest value of purity percentage (48.92 %) was of burnt canes delayed 8 days after harvest and before milling.

Table (5): Effect of pre-harvest treatments and storage periods after harvest on purity percentage

*Storage	Non- burnt canes	Burnt canes	Mean	Mean reduction %
0	86.61	84.17	85.39	0.00
2	77.56	75.88	76.72	10.15
4	73.01	62.44	67.72	20.69
6	61.33	56.40	58.87	31.06
8	62.91	48.92	55.95	34.48
Mean	72.30	65.56		

*Storage period after harvest/days

L.S.D.	
B	3.48
S	5.51
B x S	7.79

5-Reducing sugar

The data presented in Table (6) revealed that reducing sugars percentage was significantly increased in burnt cane (1.04) as compared with those of non-burnt ones (0.707 %). These results are in line with those obtained by Allam (1997).

Reducing sugars values were significantly and gradually increased by delaying cane processing. The percent of increase reached four folds (409 %) when cane pro-

cessed after 8 days as compared with those processed immediately after harvest. The increasing in reducing sugar probably may be due to sucrose inversion. Rizk and Normand (1969) and Ahmed *et al* (2002) reported similar findings

The results in the same table cleared that the reducing sugar percentage was significantly affected by the interaction between the two studied factors. The highest value of reducing sugars (1.560) recorded by burning canes and delay processing for 8 days from cutting time.

Table (6): Effect of pre-harvest treatments and storage periods after harvest on reducing sugar percentage

*Storage	Non- burnt canes	Burnt canes	Mean	Mean increasing %
0	0.323	0.400	0.362	0.000
2	0.370	0.817	0.593	63.812
4	0.483	1.100	0.792	118.784
6	0.953	1.273	1.113	207.459
8	1.403	1.560	1.482	309.392
Mean	0.707	1.040		

*Storage period after harvest/days

L.S.D.	
B	0.034
S	0.054
B x S	0.077

Recovery (sugar percentage):

Data in Table (7) showed that the response of recovery sugar percentage to the pre-harvest treatments was significant. Data also cleared that recovery sugar % of non-burnt cane (the green cane) surpassed those of burnt ones by 1.75 %. These results are in accordance with those reported by Norman (1995).

Also, The results in the same table indicated that recovery sugar percentage significantly and gradually decreases with the increase in the time elapsed between cutting and processing, where, the sugar recovery percentage decreased from 10.63 % in fresh cane to 6.17 after 8 days from cutting (Table 7). These results are in harmony with those reviewed by Mohamed (2001) and Ahmed *et al* (2002).

Data in Table (7) also showed that recovery sugar percentage was significantly affected by the interaction between pre-harvest and storage period where, the highes-values (11.11%) was attained from non- burnt caned crushed in the same day, while the lowest ones (5.00%) was of the burnt cane after 8 days from cutting.

Table (7): Effect of pre-harvest treatments and storage periods after harvest on recovery (sugar percentage).

*Storage	Un burnt canes	Burnt canes	Mean	Mean reduction %
0	11.11	10.14	10.63	0.00
2	9.90	9.12	9.55	10.16
4	9.32	7.68	8.50	20.04
6	7.99	6.66	7.33	31.04
8	7.33	5.00	6.17	41.96
Mean	9.13	7.38		

*Storage period after harvest/days

L.S.D.	
B	0.45
S	0.75
B x S	1.01

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تأثير معاملات ما قبل الحصاد وطول فترة التخزين على صفات الجودة لقصب السكر

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أجريت هذه الدراسة بمحطة البحوث الزراعية بالمطاعنه - أسنا - محافظه قنا خلال موسم العصير ٢٠٠١ لدراسة تأثير معاملات ما قبل الحصاد (حرق نباتات القصب القائمة) وفترات التخزين (تأخير توريد القصب لمدد ٠ و٢ و٤ و٦ و٨ أيام) بعد الحصاد على الصفات الكيماوية والتكنولوجية لعصير قصب السكر للصنف التجاري جيزة تايوان ٥٤-٩ وقد أستخدم في ذلك تجربة عاملية في تصميم القطاعات التامة العشوائية وأشارت النتائج المتحصل عليها إلي ما يلي :

- اتجهت قيم النسبة المئوية للمواد الصلبة الذائبة الكلية والسكريات المختزلة إلى الزيادة بزيادة فترة التخزين حتى ثمانية أيام من الحصاد.

- انخفضت النسبة المئوية للعصير المستخلص و السكروز و للنقاوة وناتج السكر معنويا بطول فترة التخزين (تأخير توريد القصب بعد الكسر).

- وجدت فروق معنوية في جميع الصفات تحت الدراسة بين عصير القصب المحروق و عصير القصب غير المحروق.

- يوصى البحث بعدم إجراء عملية الحرق للقصب قبل الحصاد إضافة إلي عدم تأخير توريد القصب للتصنيع بقدر الإمكان.