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EFFECT OF DELAYED DELIVERY OF INJURED AND HEALTHY ROOTS ON THE QUALITY OF THREE SUGAR BEET VARITIES UNDER ASSIUT CONDITIONS

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ABSTRACT

The present investigation was designed to study the effect of delayed delivery in open area and beet cases on the quality of three sugar beet varities under Assiut condition. Samples were collected from the Farm of Agriculture Faculty, AL-Azhar University, Assiut. Results showed that sucrose content of all studied samples decreased during delayed delivery under the different cases of sugar beet. Also results reflected that reducing sugar content of beet roots varities increased during delayed delivery periods. The juice purity of all samples was decreased under different delayed delivery periods and beet cases. The rate of deterioration was varied according to sugar beet variety, periods of delayed delivery and cases of sugar beet. The results revealed that expected white sugar of all studied beet root samples decreased with the delayed delivery periods and beet deterioration. The specific activity of invertase of three different sugar beet varities increased during delayed delivery of both healthy and injured sugar beet varities.

INTRODUCTION

Sugar beet (*Beta vulgaris* L.) is one of the most important sugar crops in the world, as about ٢٢ % of sugar is produced from sugar beet

roots. In is (Badawy, ١٩٩٢). Sugar beet (*Beta vulgaris* L.) is the second sugar crop in Egypt after sugar cane. In Egypt, sugar beet could be cultivated in the newly reclaimed soil according to agricultural view. It represents the strategic crop to reduce the gab between production and consumption of sugar in Egypt, which is estimated to be ٨٤٣ thousand tons of sugar in ٢٠٠٧. Since it was introduced to the Egyptian farming system in ١٩٨٢, sugar beet cultivated area increased from ١٦.٩٤٣ to ٢٣٢ thousand fed. So, it produces ٣٨.٢٪ of the total sugar (Allam ٢٠٠٨). In most beet-growing areas, harvest periods are short and sugar beet delayed delivery is necessary. In all plants a small delayed delivery supply of beet is needed to transport the sugar beet to the factory, which is a must for efficiency and operation nearly as possible to capacity at all time. Sugar beet is one of the living organisms that losses its weight by storage and subsequently can be injured by microbiological processes. The rate of sugar loss increase exponentially when the temperature rise. Furthermore, when a beet respires it gives off heat. Often this causes a further rise of temperature followed by faster respiration (Thomas, ٢٠٠٠). The delivery delaying sugar beet to factory had significant effect on poly and sugar loss as a result of decreasing in moisture content (Ferweez et. al., ٢٠٠٥). The present investigation was designed to study the effect of delayed delivery in open area and beet cases on the quality of the three sugar beet varities under Assiut conditions, collected from the farm of Agriculture Faculty, AL-Azhar University, Assiut, Egypt.

MATERIALS AND METHODS

This work was carried out at the Experimental Farm of Faculty of Agriculture, AL-Azhar University, Assiut. The seeds were sown on October, ٢٠, ٢٠٠٩. Nitrogen fertilization was added according to the recommendation of the Ministry of Agriculture. The rate of ٨٠ kg N/fed in form of ammonium nitrate (٣٣٪) was added at two equal doses after thinning and one month later. Also, ١٥ kg/fed P_2O_5 (in the form of calcium super phosphate ١٥.٥٪ P_2O_5) were added at sowing. and, potassium sulfate (٤٨٪) was applied at the rate of ٤٨ k_2O / fed

with the first dose of nitrogen fertilizer. Other agricultural practices were performed as recommended. Irrigation was stopped ١٥ days before harvest. Harvesting dates were carried out after ١٨٠ days from sowing. Samples of sugar beet roots (*Beta vulgaris* L.) of three varities cultivars, Ebo ٦٢٦, Helo ٥ and Yemer were collected during ٢٠١٠. Samples of each variety were divided into two groups (healthy and injured roots). All samples of sugar beet were stored in open area for three days. Analysis was conducted at ٠, ١, ٢ and ٣ days.

Sucrose content was determined using saccharometer on a lead basis according to A. O. A. C. (١٩٩٠). Reducing sugars was determined according to Lane and Eynon A. O. A. C. (١٩٩٠). Dextran was determined according to the procedure of Roberts (١٩٨٣). Juice purity was obtained according to Spronov (١٩٧٩) using the following equation:-

Purity = (sucrose % X ١٠٠) / total soluble solids.

Sugar recovery percentage was calculated according to the procedure of Delta Sugar Company.

Protein extraction and enzyme activity assay:

Protein extracts were prepared from collected root tissue after ٠, ١, ٢ and ٣ days in delaying, with all extraction steps were conducted at ٤^{o}C. Lyophilized root tissue was homogenized in ١٠ volumes (w/v) of extraction buffer containing ١٠٠ mM Hepes-NaOH (pH ٧.٢), ١٠ mM $Na_٢SO_٣$, ٥ mM DTT, and ١mM $MgCl_٢$ (Klotz and Finger, ٢٠٠٤). The homogenate was passed through Miracloth and centrifuged at ٢٠,٠٠٠×*g* for ٢٠ min. The supernatant was passed through Sephadex $G_{٢٥}$ column equilibrated with ١٠ mM Hepes-NaOH (pH ٧.٢). Desalted extracts were used for assaying invertase activities. Assays for acid invertase activity contained ١٠٠ mM sodium acetate (pH ٤.٧), ١٠٠ mM sucrose, and ١٠٠ µL enzyme extract in a total volume of ٢٠٠ µL. Invertase assay reactions were carried out at ٣٧^{o}C for ٣٠ min and terminated by adding ٣٠٠ µL Nelson–Somogyi copper reagent. Released reducing sugars were determined by the method of Nelson (١٩٤٤). Enzyme extracts treated with Nelson–Somogyi copper reagent before the addition of the reaction mixture were used as controls for

invertase reactions. Total protein concentration was determined using the Bio-Rad protein assay kit with bovine serum albumin as a standard.

RESULTS AND DISCUSSION

It is important to evaluate the quality of sugar beet roots in order to evaluate their quality for sugar production and their suitability for delayed delivery. Three varities of sugar beet *i.e* Ebo ٦٢٦, Helo ٥ and Yemer were collected from Farm the of Agriculture Faculty, AL-Azhar University, Assiut.

Table ١ : Effect of delayed delivery in open area of healthy and injured three varieties of sugar beet roots on sucrose, reducing sugar content and dextran levels (ppm/ Brix) (on dry weight basis).

Variety	Parameter	Beet cases	Delayed delivery (days)			
			٠	١	٢	٣
Ebo ٦٢٦	Sucrose	Healthy	٧٨.١٣	٧١.٤٩	٧٠.٠١	٦٨.٥٢
		injured	٧٧.١٩	٦٩.٢٦	٦٥.٩١	٦٢.٥٣
	Reducing sugars	Healthy	٣.٤٥	٤.٦٦	٥.٣٧	٧٨.٤٠
		injured	٤.٦٢	٨.١٤	٩.١١	١١.٧٤
	Dextran	Healthy	١١٨	١٢٧	١٣٤	١٤١
		injured	١٤٠	١٥١	١٦٣	١٧٥
Helos	Sucrose	Healthy	٧٥.٢٢	٧١.٤٤	٦٨.٧٨	٦٦.١٧
		injured	٧٤.٢٥	٤١.٠١	٦٥.١٨	٦٣.٥٣
	Reducing sugars	Healthy	١.٢١	١.٨٤	٢.١٩	٣.١٥
		injured	٢.٤٨	٣.٦١	٤.٠٩	٨.١٢
	Dextran	Healthy	١٢٣	١٤٧	١٥١	١٦٧
		injured	١٥٠	١٧٢	١٩١	١٨٤
Yemer	Sucrose	Healthy	٧٢.٩٤	٧١.١٦	٦٩.١٨	٦٦.٩٤
		injured	٧١.٨١	٦٨.١٩	٦٤.٣١	٦١.٢٢
	Reducing sugars	Healthy	١.١٣	١.٨٢	٢.٣١	٢.٨٢
		injured	٢.٥٤	٤.٦٧	٦.٨٩	٩.٤٣
	Dextran	Healthy	١٢٤	١٣٥	١٤٧	١٦٨
		injured	١٤٢	١٦١	١٧٩	١٨٢

Quality of sugar beet under Assiut condition

Data in Table ١ show the effect of delayed delivery period and beet cases on the changes of sucrose content of sugar beet roots of studied varities. Results showed that sucrose content of all studied samples decreased during delayed delivery. The lowest decrease was recorded with Yemer variety, while the bigger one was observed with Ebo ٦٢٦ variety. This may be due to the action of micro organisms, respiration rate of roots and biochemical transformation of sucrose. In general, the sucrose losses indicate that no clear trend or effect on the relative sucrose losses as results of the effect of injured beet. Mccready and Goodwin (١٩٦٦) reported that the loss of sucrose during delayed delivery may be due to spoilage by micro organisms which may be used up sugar by respiration and produced enzymes which convert sucrose to invert sugars and oligosaccharides, the second reason of sugar loss may be due direct respiration by stored sugar beets and a third reason of sugar loss is through biochemical transformation of sucrose to invert sugars, that inhibit crystallization and caused difficulties in beet sugar processing. Our results of the changes of sucrose content during delayed delivery periods are in agreement with the findings of Mousa (١٩٩٠), Martin and Narum (١٩٩٣), Zalat (١٩٩٣), Abou shady (١٩٩٤), Abd El-Rahman et.al. (١٩٩٥), Berghall et.al.(١٩٩٦), and Sakalo and Tyltue (١٩٩٧).

Data in Table (١) also show the effect of delayed delivery and beet cases on changes of reducing sugar content of sugar beet varities under investigation. It is well known that the lowest value of reducing sugars in the roots is the highest degree of quality. Reducing sugars are decomposed at a temperature higher than ٥٥^{O} C forming harmful stable dark decomposition products affecting the color of sugar followed by an increase of lime salts which added to clear the juice (Ram, ١٩٧٨). Roots with low reducing sugars content are easy for purification especially during crystallization process. Harvey and Dutton (١٩٩٣) reported that invert sugar is undesirable quality parameter because at the basal level in beet it breaks down in carbonation to yield acids and some colors. Both are melassigenic and any corrective sodium carbonate added by the factory to minimize lime salts and to maintain pH less than ٧.٠ is melassigenic. At higher

level, it represents sugar los and greater acid and color production. The results indicated that reducing sugars content of sugar beet roots increased during delayed delivery periods and in injured roots. From Table (١) it could be noted that the amount of invert sugars at harvest was low. These results are inline with those reported by McCready and Goodwin (١٩٦٦) who found that reducing sugars of beet at harvest is normally very low. Generally, the present results of the changes of reducing sugars content during delayed delivery and injured roots were comparable with those reported by many investigators such as (Wyse (١٩٧٤), Cole, ١٩٩٧, El-gharbawy et. al., ١٩٨١ and Mousa, ١٩٩٠).

Data in Table ١ show the effect of delayed delivery period of the healthy and injured sugar beet roots on dextran levels. The results revealed that the levels of dextran content of both healthy and injured roots were increased during delayed delivery periods. The highest value of dextran content was recorded in injured roots after delayed deliver periods. The increase in dextran values was compatible with the increase of *leuconostic mesentroides*. By comparing the results of dextran levels of healthy beet roots with the results of dextran of injured beet roots it could be noted that the increase of dextran content of injured beet roots was higher than in healthy beet roots at the end of delayed delivery periods. The data illustrated in Table ٢ show the effect of delayed delivery periods after harvesting on the changes of sugar beet juice purity of the varieties under investigation. It can be seen that the juice purity of all samples decreased during delayed delivery. The rate of deterioration varied according to the sugar beet variety and cases of roots. The loss in juice purity under different factors was directly related to the loss in sucrose and increase of total reducing sugars as a result of invertase effect as well as roots respiration during storage in open area. Similar results were obtained by Mousa (١٩٩٠) and Ferweez et. al., (٢٠٠٥). They studied the effect of delayed delivery conditions of sugar beet on the juice purity of two varieties (Cerespoly and Kawemira) and found that juice purity of sugar beet roots decreased during delayed delivery conditions.

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The effect of delayed delivery periods in open area for ٣ days on the changes in the percentage recovery of white sugar content of three sugar beet varieties under investigation were calculated and illustrated in Table (٢).

Table ٢: Effect of delayed delivery in open area of healthy and injured three sugar beet roots varieties on juice purity and sugar recovery.

Variety	Parameter	Beet cases	Delayed delivery (days)			
			٠	١	٢	٣
Ebo ٦٢٦	Juice purity	Healthy	٨٥.٦١	٨٣.٦٨	٨١.٥٧	٧٧.٤٣
		injured	٨٤.٧٠	٨٢.٢٢	٨٠.٧١	٧٦.٤٣
	Sugar recovery	Healthy	٥١.٦٨	٤٨.٩٦	٤٦.٣٤	٤٤.٣٤
		injured	٥٠.٠١	٤٧.٣٧	٤٤.١٧	٤٤.٢٣
Helos	Juice purity	Healthy	٨٧.١٠	٨٦.٣٤	٨٥.١٢	٨٣.٦٤
		injured	٨٥.٨٨	٨٤.١٣	٨١.٧٤	٧٧.١١
	Sugar recovery	Healthy	٥٤.٩٣	٥١.٥٢	٤٩.٢٣	٤٥.٦٨
		injured	٥٣.٠٩	٥٠.١٧	٤٧.٣١	٤٣.٣٣
Yemer	Juice purity	Healthy	٨٣.٧٠	٨٢.٥٦	٨١.١٤	٧٨.٦٢
		injured	٨١.٩٠	٨٠.١٧	٧٩.٤١	٧٦.٥٠
	Sugar recovery	Healthy	٦٠.٢٧	٥٨.٣٢	٥٦.٢٣	٥٢.٦٨
		injured	٥٨.٤٤	٥٧.٠٢	٥٥.١١	٥١.٩١

The results revealed that the white sugar content of all studied samples of beet roots were clearly decreased with the delayed delivery periods due to sort and cases of beet varieties. The present results of the effect of delayed delivery periods on sugar recovery in sugar beet roots are in agreement with those obtained by **Aboushady (١٩٩٤)** who mentioned that white sugar of four varieties of sugar beet roots decrease during delayed delivery period under different delayed delivery conditions.

The effect of delayed delivery periods on the changes of specific activity of invertase of three sugar beet varieties; Ebo ٦٢٦, Helos and Yemer was studied, is shown in Table ٣. The data revealed that specific activity of invertase at harvest time in healthy and injured Ebo

٦٢٦ were ٠.٣٩ and ٠.٥١ Unit /mg protein, respectively. The corresponding values in Yemer variety (healthy and injured roots) were ٠.٦٣ and ٠.٧١ Unit /mg protein, respectively. Specific activity of invertase of all studied samples of beet roots were increased during delayed delivery. These results are in agreement with those reported by Mousa (١٩٩٠), Aboushady (١٩٩٤), Abd EL-Rahman et. al., (١٩٩٥), Sakalo and Tyltue (١٩٩٧) and Sarwar et. al., (٢٠٠٨).

Table ٣: Effect of delayed delivery in open area on the changes of specific activity of invertase (Unit /mg protein) of healthy and injured three varieties of sugar beet roots.

Variety	Parameter	Beet cases	Delayed delivery (days)			
			٠	١	٢	٣
Ebo ٦٢٦	Invertase activity	Healthy	٠.٣٩	٠.٧٢	٠.٨٣	٠.٩٩
		injured	٠.٥١	١.١٢	٢.٣٦	٣.٥٧
Helos	Invertase activity	Healthy	٠.٤٥	٠.٧٩	٠.٩٠	٠.٩٤
		injured	٠.٦٤	١.٠٥	٢.٦٠	٣.٤٦
Yemer	Invertase activity	Healthy	٠.٦٣	٠.٧٤	٠.٨٤	٠.٨٩
		injured	٠.٧١	١.١٧	٢.٦٨	٣.٥٧

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Quality of sugar beet under Assiut condition

تأثير تأخير التسويق على جذور البنجر المصاب والسليم على جودة ثلاثة أصناف من بنجر السكر تحت ظروف أسيوط

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اجري هذا البحث لدراسة تاثير تاخر وصول جذور بنجر السكر للتصنيع تحت ظروف الجو العادي وحالات البنجر المختلفة (سليمة ومصابة) على جودة ثلاثة اصناف من بنجر السكر تحت ظروف اسيوط تم تجميع الاصناف من مزرعة كلية الزراعة باسيوط – جامعة الازهر.

أشارت النتائج ان السكروز للأصناف الثلاثة يقل بتاخير الوصول للمصنع وكذلك في حالات البنجر المختلفة. يزداد محتوى السكريات المختزلة بزيادة التاخير وتقل نقاوة العينة. يختلف معدل التدهور حسب صنف البنجر، والمدة قبل التصنيع وحالات البنجر. يقل ايضا نسبة السكر الابيض المتوقع انتاجة بزيادة مدة التاخير لحالات البنجر المختلفة. يزداد نشاط انزيم الانفرتيز بزيادة المدة للاصناف الثلاثة لكل حالات البنجر السليم والمصاب.