

Effect of different storage condition on chemical composition of sugar beet roots

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Abstract

Sugar beet crop is a crop that has a rapid deterioration in its chemical and technological properties after harvest, so this crop cannot be stored in open air. Therefore, the chemical changes and other defeats, of beet roots, were studied during a storage period at 28 days under different conditions (storage in sunlight - storage in the shade) with different treatments covering with beet throne - rice straw and without covering (control). The obtained data indicated that the beet roots contain 64.4-77.9% moisture, 0.76-2.49% ash, 0.639-2.822% fiber, 18.83-27.6% total soluble solids, 17.23-10.06% sucrose, 0.43-2.42% reduced sugars, 1.4-2.9% alpha amino nitrogen. The moisture content of the sugar beet roots, was decreased accompanied by an increase in the daily weight loss rate and an increase in the ratio of total soluble solids, where the best results in the roots covering with beet throne and stored in the shade. Furthermore, decreasing the sugar content as a result of breathing and enzymatic activity, during the storage period. Also, the ratio of sucrose uptake was decrease due to the increase of impurities of alpha amino nitrogen. The data of statistical analysis showed that the invertase enzyme activity significantly increased with significant differences ($P < 0.05$) in all the treatments used in the study. However, the lowest enzyme activity was found the treated roots with throne cover and stored in shade.

Key words: Sugar beet roots, storage, chemical composition

Introduction

Sugar beet (*Beta.vulgaris L.*) belongs to the family *Chenopodiaceae*, is considered as the second important sugar crop all over the world after sugar cane (*Saccharum officinarum L.*). nearly it is grown in 57 countries. Sugar beet is mainly produced in Europe and, to a lesser extent, in Asia and North America (Brar, *et al.* 2015).

Roots of sugar beet at harvest, recorded that the moisture was in the range of 75 - 85% (Abu Shadi, 1994; Hozyan, 2002; Al -Jaridi, 2009; Alfaig, *et al.* 2011; Al-Jbawi *et al.* 2015 and Karim, 2015). The chemical analysis of sugar beet roots showed that the ash in the roots at harvest ranged from 0.56 - 3.97% (Abu Shadi, 1994; Hozyan, 2002; Al - Jaridi, 2009, Alfaig, *et al.* 2011 and Karim, 2015). The fiber in the roots of sugar beet is 1.33 to 6.0% (Abu Shadi, 1994, Hozyan, 2002 and Karim, 2015). Total soluble solids in the roots of sugar beet is 17.0 to 23.9% (Abu Shadi, 1994, Hozyan, 2002, Youssif, and Abou El-Magd 2004, Silvana, *et al.* 2004 and Al-Jbawi *et al.* 2015). The Reducing sugars in the roots of fresh beet ranged from 0.082 to 0.46%. (Abu Shadi, 1994, Hozyan, 2002 and Abou ElMagd, 2004). The Sucrose in fresh roots after harvest ranged from 14.60 to 17.25% (Abu Shadi, 1994, Hozyan, 2002, Al-Jbawi *et al.* 2015 and Karim, 2015). The activity value of the invertase enzyme in fresh sugar beet roots ranged from 10.2 to 42.5 unit/100mg (Abu Shadi, 1994; Hozyan, 2002; Youssif, and Abou ElMagd, 2004 and Karim, 2015).

The moisture content in the roots of beets was decreased during the storage period by a large

percentage and was observed at the beginning of storage at 79% and reached the end of storage to 61.9% at day 12 (Karim, 2015). The weight loss of topped and untapped roots increased at the end of storing period, where elevated percentages were showed by the topped roots stored under sunlight 47.61% and the untapped roots stored in shade 40.04% (Al -Jaridi, 2009). Loss of moisture increases the degree of wilting and changes processing properties of the crop (Vukov, 1977 and Trzebinski, 1984). moisture was decreased during the storage period in march, where the moisture drop in the open air on the third day was 2.98% and increased to reach 9.18% at day 12 at the end of storage. The rate of decrease was lower in the roots stored by covering with beet throne in an open atmosphere (Karim, 2015).

Total soluble solids in the roots of sugar beet increased during storage periods. The ratio of beet roots stored in open storage was 19.20 at the beginning of storage until it reached 22.30 at the end of storage period. The roots stored in the open air were higher than the stored roots by covering them with the beets. They reached 24.5 at the end of the day, while the stored roots in the chamber reached 22.3 at the end of the storage period at day 28, effectiveness of beet throne (Abu Shadi 1994).

Prolonging postharvest period of beet roots in the fields leads to an increase in total soluble solids significantly, this result is accompanying with (Kenter and Hoffmann, 2009) who stated that storage conditions in piles had negative consequences of accumulation of non-sucrose substances. The highest values were achieved in the last days of storage 33.7 and 32.1% for the fifth and

sixth days, respectively. Total soluble solids in beet roots increased during the storage period from 19.6% at the beginning of storage and continued to rise until the end of storage period, reaching 32.76% (Youssif and Abou ElMagd, 2004).

Inferior sucrose percentage was showed by the unstopped roots stored under sunlight 31.12% on dry basis. Significant differences ($P < 0.05$) were found in reduced sugars content between topped roots stored in shade and sunlight (1.20 and 1.34% respectively by the end of storing period), as well as between unstopped roots stored in shade and sunlight (1.35 and 1.50% respectively by the end of storing period) (Al-Jaridi, 2009).

During storage sugar concentration is reported to decline by around 0.02% per day (Jaggard *et al.*, 1997). The increment in clamp temperature improve the respiratory losses thereby root damage. The high temperatures hydrolyses sucrose to give the reducing sugars, glucose and fructose, which are then used in respiration (Wiltshire and Cobb, 2000). Respiration rate is highly and predictably correlated with sucrose loss (Al-Jbawi, *et al.* 2015). Sucrose in the roots of beet during the storage period of 20 days was increased in an open atmosphere where it was on the first day of storage at 17.81% and increased until it reached on day 20 which is the end of storage period to 22.72% (Youssif and Abou El Magd, 2004).

Amino-N and invert sugar, that impair sugar recovery storing beets should keep their quality as long as possible. It is thus essential to identify factors affecting the storability of sugar beet in order to improve storage management (van der Poel *et al.* 1998).

The height was also attributed to the beets stored in the chamber (shade) close to those stored in the covering of the beet throne where it reached 1.6 in the first day of storage to 2.4 at the end of storage (Karim, 2015).

The roots recorded by covering the beet throne increased from 2.38 % at the beginning of storage to 6.40 % at the end of storage (Abu Shadi, 1994 and Hozyan, 2002).

The main aim to undertake this work to study the changes of chemical composition of sugar beet during the storage period under different with different treatments.

Materials and Methods

Materials:

The roots of the sugar beet (*beta vulgaris*) veritie (Hossam) were obtained from the harvest of season 2017 from Kafr El-Sheikh farms, Sakha Agricultural Research Center, Sugar Crops Department, Kafr El-Sheikh.

Preparation of samples:

Beet root samples were prepared by divided into two main groups: The first group was storage in the

shade for 28 days. Three hundred kg root sugar of beet were divided into six subgroups the weight of each group of 50 kg and then was covered with beet throne for two groups as well as cover for the second group rice straw, and throne the last two groups without cover. The second group was storage in the sun light for 28 days. Three hundred kg of sugar beet root were divided into six subgroups of weight of each group of 50 kg and then was covered beet throne for two groups as well as covering the second group rice straw and left the last two groups without cover, the analysis was conducted at 0, 7, 14, 21 and 28 days during storage period.

Methods:

Chemical analysis:

The moisture, Ash, Fiber and total soluble solids contents were determined according to the procedure described in the A.O.A.C. (2012). Sucrose: Sucrose percentage was determined using sacharometer on a lead basis according to the procedure of Delta sugar company (Le Docte, 1927).

Total sugars: Total sugars (reducing and non-reducing sugars) were determined according to the colorimetric determination method described by Thomas and Dutocher (1924).

Alpha amino nitrogen: They were determined according to the procedure of Delta sugar Co. using Auto Analyzer type ZIG Venema Automation according to the methods described by Brown and Lilliland (1964) and Pergl (1945). The results calculated as milli-equivalents/100 gm beet.

Statistical analyses: The statistical analysis was carried out using SPSS program with multi-function utility regarding to the experimental design under significance level of 0-05 for the whale results and multiple comparisons were carried out Applying LSD according to steel *et al.* (1997).

Results and Discussion

Optimization of factor affecting chemical components of sugar beet roots:

Sugar beet roots were used for production of white sugar and affecting pilot plant production i-e. Storage condition, covering and storage period were studied. Change accruing in chemical composition was studied to select the excellent treatment for sugar production from sugar beet roots.

Moisture content:

Data in Table (1) show the effect of different storage conditions on moisture content of sugar beet roots. Statistical analysis showed that moisture content was significantly slight increase in sugar beet roots stored in shade than those stored in sunlight which contained 74.12 and 73.27% of its treatments respectively. It could be noticed that covering of sugar beet roots with beet throne and rice straw increased significantly moisture content comparing with control sample (without covering), which contained 74.77, 73.98, and 72.32% of sugar beet

roots covered with beet throne, covered with rice straw and control, respectively. Data revealed that moisture content of sugar beet roots was decreased significantly ($P < 0.05$) from 77.93 to 76.40, 76.40, 71.25 and 68.81 % by increasing storage period from 0 to 7, 14, 21, and 28 days respectively.

Statistical analysis indicated that there are more or less differences between either covering treatments or storage period within the different treatments of

storage conditions. Anyhow, moisture content ranged from 64.40 to 77.07% for sugar beet roots without covering stored in sunlight for 28 days and sugar beet roots covered with rice straw in sunlight stored for 7 days respectively, compared to 77.93% for the same treatments before carrying out the storage process. These results are in agreement with those obtained by (Hozyan, 2002; Maria, *et al.* 2005; Al –Jaridi, 2009 and Karim ,2015).

Table 1. Effect of different storage condition on moisture content of sugar beet

| Storage condition | Treatment | Storage period (day) | | | | | Mean |
|---------------------------|-------------|--------------------------|--------------------------|---------------------------|--------------------------|--------------------------|-------------------------|
| | | 0 | 7 | 14 | 21 | 28 | |
| Sunlight | Rice Straw | 77.93±0.33 ^{aA} | 77.07±1.46 ^{aB} | 72.67±0.07 ^{bC} | 72.47±0.93 ^{bC} | 68.07±0.33 ^{bD} | 73.64±1.00 ^b |
| | Beet throne | 77.93±0.33 ^{aA} | 76.17±0.64 ^{bB} | 74.30±0.65 ^{aC} | 73.30±0.21 ^{aD} | 70.88±0.76 ^{aE} | 74.52±0.68 ^a |
| | Control | 77.93±0.33 ^{aA} | 75.35±0.51 ^{cB} | 71.73±0.58 ^{cC} | 68.80±0.46 ^{cD} | 64.40±0.12 ^{cE} | 71.64±1.29 ^c |
| | Mean | 77.93±0.17 ^A | 76.19±0.54 ^B | 72.90±0.45 ^C | 71.52±0.76 ^D | 67.78±0.97 ^E | |
| Shade | Rice Straw | 77.93±0.33 ^{aA} | 76.28±0.58 ^{bB} | 75.20±0.20 ^{abC} | 71.40±0.28 ^{bD} | 70.84±0.59 ^{bD} | 74.33±0.76 ^b |
| | Beet throne | 77.93±0.33 ^{aA} | 77.00±0.50 ^{aB} | 75.73±0.52 ^{aC} | 72.38±0.53 ^{aD} | 72.07±0.64 ^{aD} | 75.02±0.67 ^a |
| | Control | 77.93±0.35 ^{aA} | 76.55±0.29 ^{bB} | 74.80±0.53 ^{bC} | 69.15±0.16 ^{cD} | 66.62±1.20 ^{cE} | 73.01±1.19 ^c |
| | Mean | 77.93±0.17 ^A | 76.61±0.26 ^B | 75.24±0.26 ^C | 70.98±0.51 ^D | 69.84±0.93 ^E | |
| Mean of storage condition | | Sunlight | | Shade | | | |
| | | 73.27±0.60 ^B | | 74.12±0.52 ^A | | | |
| Mean of treatment | | Rice Straw covering | | Beet throne covering | | Control | |
| | | 73.98±0.62 ^B | | 74.77±0.47 ^A | | 72.32±0.87 ^C | |
| Mean of storage period | | 0 | 7 | 14 | 21 | 28 | |
| | | 77.93±0.12 ^A | 76.40±0.30 ^B | 74.07±0.38 ^C | 71.25±0.45 ^D | 68.81±0.70 ^E | |

a, b & c: There is no significant difference ($P > 0.05$) between any two means, within the same column have the same superscript letter.

A, B & C: There is no significant difference ($P > 0.05$) between any two means for the same attribute, within the same row have the same superscript letter.

Total ash content:

Data in Table (2) show the effect of different storage conditions on ash content of sugar beet roots. Statistical analysis did not appear significant

differences of total ash between storage in sunlight and shade, which contained 1.39 and 1.44%, respectively.

Table 2. Effect of different storage condition on total ash content of sugar beet roots (g/100g on wet weight basis).

| Storage condition | Treatment | Storage period (day) | | | | | Mean |
|---------------------------|-------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|------------------------|
| | | 0 | 7 | 14 | 21 | 28 | |
| Sunlight | Rice Straw | 0.76±0.01 ^{aE} | 1.01±0.02 ^{aD} | 1.14±0.06 ^{bC} | 1.52±0.14 ^{bB} | 2.31±0.26 ^{bA} | 1.35±0.15 ^b |
| | Beet throne | 0.76±0.01 ^{aE} | 1.04±0.07 ^{aC} | 1.13±0.03 ^{bC} | 1.57±0.13 ^{bB} | 2.14±0.01 ^{cA} | 1.33±0.13 ^b |
| | Control | 0.76±0.01 ^{aE} | 0.98±0.03 ^{aD} | 1.33±0.10 ^{aC} | 1.93±0.03 ^{aB} | 2.49±0.05 ^{aA} | 1.50±0.17 ^a |
| | Mean | 0.76±0.00 ^E | 1.01±0.03 ^D | 1.20±0.05 ^C | 1.67±0.09 ^B | 2.31±0.09 ^A | |
| Shade | Rice Straw | 0.76±0.01 ^{aE} | 1.12±0.10 ^{aD} | 1.40±0.10 ^{bC} | 1.62±0.09 ^{bB} | 2.23±0.08 ^{bA} | 1.43±0.14 ^b |
| | Beet throne | 0.76±0.01 ^{aE} | 1.05±0.03 ^{aD} | 1.42±0.08 ^{bB} | 1.50±0.25 ^{cB} | 2.11±0.03 ^{cA} | 1.37±0.13 ^b |
| | Control | 0.76±0.01 ^{aE} | 1.04±0.04 ^{aD} | 1.54±0.08 ^{aC} | 1.86±0.07 ^{aB} | 2.37±0.08 ^{aA} | 1.51±0.15 ^a |
| | Mean | 0.76±0.00 ^E | 1.07±0.04 ^D | 1.45±0.05 ^C | 1.66±0.09 ^B | 2.24±0.05 ^A | |
| Mean of storage condition | | Sunlight | | Shade | | | |
| | | 1.39±0.09 ^A | | 1.44±0.08 ^A | | | |
| Mean of treatment | | Rice Straw covering | | Beet throne covering | | Control | |
| | | 1.39±0.10 ^B | | 1.35±0.09 ^B | | 1.51±0.11 ^A | |
| Mean of storage period | | 0 | 7 | 14 | 21 | 28 | |
| | | 0.76±0.00 ^E | 1.04±0.02 ^D | 1.33±0.04 ^C | 1.67±0.06 ^B | 2.28±0.05 ^A | |

a, b & c: There is no significant difference ($P > 0.05$) between any two means, within the same column have the same superscript letter.

A, B & C: There is no significant difference ($P > 0.05$) between any two means for the same attribute, within the same row have the same superscript letter.

It could be noticed that covering of sugar beet roots with beet throne and rice straw decreased significantly of total ash content comparing with control simple (without covering), which contained 1.39, 1.35 and 1.51% of sugar beet roots covered with beet throne and roots covered with rice straw and control, respectively. Statistical analysis did not appear significant differences of total ash content between the two treatments of sugar beet roots covering. Data in the same table revealed that total ash content of sugar beet roots increased significantly ($P<0.05$) from 0.76% to 1.04, 1.33, 1.67 and 2.28% by increasing of storage periods from 0 to 7, 14, 21, 28 days, respectively. Anyhow, total ash content of sugar beet roots stored in sunlight ranged from 1.01 to 2.49%, which was significantly lower in treatment covered with rice straw stored for 7days, while it was significantly higher in control simple while total ash content of sugar beet roots stored in shade ranged 1.01 to 2.37% which was significantly lower in control treatment (without covering) stored for 7 days, while it was significantly higher in the same treatment stored for 28 days. These results are in agreement with those obtained by (Abu Shadi, 1994; van der Poel *et al.* 1998; Hozyan, 2002; Al –Jaridi, 2009 and Karim, 2015).

Crude fiber content:

Data in Table (3) show the effect of different storage conditions on crude fiber content of sugar

beet roots. Statistical analysis showed that crude fiber content was significantly higher in sugar beet roots stored in sunlight than those of stored in shade, which contained 1.54 and 1.35% respectively. It could be noticed that statistical analysis did not appear significant differences in crude fiber content between sugar beet roots covered with rice straw and covered with beet throne, which contained 1.42 and 1.41% respectively. Data in the same table observed that crude fiber content in sugar beet roots increased significantly ($P<0.05$) from 0.64% to 1.02, 1.28, 1.84 and 2.46% by increasing storage period from 0 to 7, 14, 21 and 28 days, respectively. Statistical analysis showed that there are more or less differences in crude fiber content between covering treatments or storage periods within the different treatments of storage conditions. Anyhow, crude fiber content of sugar ranged from 0.97 to 2.82% stored beet roots in sunlight, which was significantly tower in control treatment stored for 7 days, while it was significantly higher in the same treatment stored for 28 days. Crude fiber content of sugar beet roots stored in shade ranged from 0.93 to 2.72%, which was significantly lower in control treatment (without covering) stored for 7 days, while it was significantly higher in the same treatment stored for 28 days. Those results are in agreement with those obtained by (Abu Shadi, 1994; van der Poel *et al.* 1998; Hozyan, 2002 and Karim, 2015).

Table 3. Effect of different storage condition on fiber content of sugar beet roots (g/100g on wet weight basis).

| Storage condition | Treatment | Storage period (day) | | | | | Mean |
|---------------------------|-------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------|
| | | 0 | 7 | 14 | 21 | 28 | |
| Sunlight | Rice straw | 0.64±0.10aE | 1.04±0.06bD | 1.33±0.04aC | 2.17±0.10aB | 2.55±0.08bA | 1.55±0.19a |
| | Beet throne | 0.64±0.10aE | 1.22±0.13aD | 1.37±0.05aC | 1.99±0.00bB | 2.34±0.19cA | 1.51±0.17a |
| | Control | 0.64±0.10aE | 0.97±0.21bD | 1.39±0.09aC | 2.02±0.27bB | 2.82±0.15aA | 1.57±0.22a |
| | Mean | 0.64±0.05E | 1.08±0.08D | 1.37±0.03C | 2.06±0.09B | 2.57±0.10A | |
| Shade | Rice straw | 0.64±0.10aE | 1.02±0.03aD | 1.27±0.07aB | 1.39±0.08bB | 2.13±0.03bA | 1.29±0.13b |
| | Beet throne | 0.64±0.10aE | 0.95±0.05aC | 1.05±0.03bC | 1.67±0.13aB | 2.19±0.05bA | 1.30±0.15b |
| | Control | 0.64±0.10aE | 0.93±0.06aD | 1.28±0.02aC | 1.78±0.07aB | 2.72±0.06aA | 1.47±0.20a |
| | Mean | 0.64±0.05E | 0.97±0.03D | 1.20±0.04C | 1.61±0.08B | 2.35±0.10A | |
| Mean of storage condition | | Sunlight | | Shade | | | |
| | | 1.54±0.11 ^A | | 1.35±0.09 ^B | | | |
| Mean of treatment | | Rice straw covering | | Beet throne covering | | Control | |
| | | 1.42±0.12 ^B | | 1.41±0.11 ^B | | 1.52±0.15 ^A | |
| Mean of storage period | | 0 | 7 | 14 | 21 | 28 | |
| | | 0.64±0.04 ^E | 1.02±0.04 ^D | 1.28±0.03 ^C | 1.84±0.08 ^B | 2.46±0.07 ^A | |

a, b & c: There is no significant difference ($P>0.05$) between any two means, within the same column have the same superscript letter.

A, B & C: There is no significant difference ($P>0.05$) between any two means for the same attribute, within the same row have the same superscript letter.

Total soluble solids (TSS):

Data in Table (4) shows the effect of different storage conditions on total soluble solids of sugar beet roots. Statistical analysis did not appear significant differences in total soluble solids between sugar beet roots stored in sunlight and shade, which contained 21.46 and 21.57%, respectively. It could be noticed that covering of sugar beet roots with beet

throne and rice straw were accompanied by significant decrease ($P<0.05$) in total soluble solids from 22.33% in control simple to 21.27 and 20.94% in rice straw and beet throne covering treatments respectively. Data revealed that total soluble solids content of sugar beet roots increased significantly ($P<0.05$) from 18.83% to 20.4, 21.18, 22.52, and 24.89% by increasing storage period from 0 to 7, 14, 21 and 28 days respectively. Statistical analysis

indicated that there are more or less differences between either covering treatments or storage period within the different treatment, of storage conditions. Anyhow, total soluble solids content ranged from 19.93 to 27.60% in sunlight storage which were significantly lower in treatment covered with rice straw and stored for 7 days, while were significantly higher in control simple stored for 28 days. Total soluble solids content of sugar beet roots stored in

shade ranged from 20.05 to 26.73% which were significantly lower in treatment covered with beet throne stored for 7 days, while were, significantly higher in control simple stored for 28 days, respectively. These results are in agreement with those obtained by (Hozyan, 2002; Youssif and Abou ElMagd, 2004; Kenter and Hoffmann, 2009 and Al Jbawi and Zubi, 2016).

Table 4. Effect of different storage condition on total soluble solids content of sugar beet roots (g/100g on wet weight basis).

| Storage condition | Treatment | Storage period (day) | | | | | Mean |
|---------------------------|-------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|
| | | 0 | 7 | 14 | 21 | 28 | |
| Sunlight | Rice straw | 18.83±0.12 ^{aE} | 19.93±0.41 ^{bD} | 20.47±0.42 ^{bC} | 21.57±0.26 ^{bB} | 25.07±0.48 ^{bA} | 21.17±0.59 ^b |
| | Beet throne | 18.83±0.12 ^{aE} | 19.63±0.20 ^{cD} | 20.57±0.15 ^{bC} | 21.33±0.26 ^{bB} | 23.67±0.46 ^{cA} | 20.81±0.46 ^c |
| | Control | 18.83±0.12 ^{aE} | 20.43±0.33 ^{aD} | 21.70±0.17 ^{aC} | 23.43±0.34 ^{aB} | 27.60±0.40 ^{aA} | 22.40±0.81 ^a |
| | Mean | 18.83±0.06 ^E | 20.00±0.20 ^D | 20.91±0.24 ^C | 22.11±0.36 ^B | 25.44±0.62 ^A | |
| Shade | Rice straw | 18.83±0.12 ^{aE} | 20.63±0.18 ^{aD} | 21.60±0.26 ^{bC} | 22.60±0.32 ^{bB} | 23.17±0.27 ^{bA} | 21.37±0.42 ^b |
| | Beet throne | 18.83±0.12 ^{aE} | 20.05±0.28 ^{aD} | 20.77±0.15 ^{cC} | 22.60±0.15 ^{bB} | 23.10±0.17 ^{bA} | 21.07±0.43 ^b |
| | Control | 18.83±0.12 ^{aE} | 20.18±0.27 ^{aD} | 22.00±0.23 ^{aC} | 23.57±0.24 ^{aB} | 26.73±0.19 ^{aA} | 22.26±0.74 ^a |
| | Mean | 18.83±0.06 ^E | 20.29±0.15 ^D | 21.46±0.21 ^C | 22.92±0.20 ^B | 24.33±0.61 ^A | |
| Mean of storage condition | | Sunlight | | Shade | | | |
| | | 21.46±0.37 ^A | | 21.57±0.32 ^A | | | |
| Mean of treatment | | Rice straw covering | | Beet throne covering | | Control | |
| | | 21.27±0.36 ^B | | 20.94±0.31 ^C | | 22.33±0.54 ^A | |
| Mean of storage period | | 0 | 7 | 14 | 21 | 28 | |
| | | 18.83±0.04 ^E | 20.14±0.13 ^D | 21.18±0.17 ^C | 22.52±0.22 ^B | 24.89±0.44 ^A | |

a, b & c: There is no significant difference ($P>0.05$) between any two means, within the same column have the same superscript letter.

A, B & C: There is no significant difference ($P>0.05$) between any two means for the same attribute, within the same row have the same superscript letter.

Reducing sugars content:

Data in Table (5) show the effect of different storage conditions on reducing sugars content of sugar beet roots. Statistical analysis observed that reducing sugars content were significantly higher in sugar beet roots stored in sunlight than those stored in shade, which contained 1.26 and 1.07%, respectively. From the obtained data, it could be noticed that beet roots covered with beet throne contained significantly content of reducing sugars than those of sugar beet roots, covered with rice straw or control treatments, the results in the same table observed that reducing sugars content of sugar beet roots increased significantly ($P<0.05$) from 0.43% to 0.56, 1.00, 1.63 and 2.20% by increasing storage period from 0 to 7, 14, 21 and 28 days, respectively.

Statistical analysis showed significant higher differences in the variation in reducing sugars of sugar beet roots stored in the sunlight. The lowest percentage reducing sugars content of sugar beet roots at days 7 at the roots covered with rice straw, and stored in the shade at 28 days, where the amount of sugars reducing sugars in the range of 0.45 and 2.43%, respectively. While the reducing sugar content of sugar beet roots covered with the beet throne stored in the shade was high. The lowest increase was observed at 7 days in sugar beet roots

covered with beet throne. The highest increase was recorded in 28 days in the roots stored without covering (control). In proportions in the range of 0.50 and 2.32%, respectively. These results are in agreement with those obtained by (Hozyan, 2002; Youssif and Abou El Magd, 2004; Al-Jaridi, 2009 and Al-Jbawi, *et al.* 2015).

Total sugars content:

Data in Table (6) show the effect of different storage conditions on total sugars content of sugar beet roots. Statistical analysis observed that the total sugars content was significantly higher in sugar beet roots stored in shade than those stored in sunlight, which contained 16.75 and 16.32% respectively. From the obtained results, it could be noticed that sugar beet roots covered with beet throne and its covered with rice straw contained significantly higher amount of total sugars than those of control simple, which contained 16.92, 16.63 and 16.05%, respectively. Statistical analysis did not appear significant difference in total sugars between sugar beet roots covered with beet throne or covered with rice straw. The result in the same table observed that the total sugars of sugar beet roots decreased significantly ($P<0.05$) from 18.65 to 17.12, 16.49, 15.6 and 14.82% by increasing storage period from 0 to 7, 14, 21 and 28 days respectively.

Table 5. Effect of different storage condition on reducing sugars content of sugar beet roots (g/100g on wet weight basis).

| Storage condition | Treatment | Storage period (day) | | | | | Mean |
|---------------------------|----------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|------------------------|
| | | 0 | 7 | 14 | 21 | 28 | |
| Sunlight | Rice straw covering | 0.43±0.02 ^{aE} | 0.54±0.01 ^{bD} | 1.19±0.02 ^{bC} | 1.77±0.01 ^{bB} | 2.36±0.03 ^{bA} | 1.26±0.20 ^b |
| | Beet throne covering | 0.43±0.02 ^{aE} | 0.56±0.01 ^{bD} | 1.03±0.04 ^{cC} | 1.67±0.02 ^{cB} | 2.15±0.01 ^{cA} | 1.17±0.17 ^c |
| | Control | 0.43±0.02 ^{aE} | 0.66±0.03 ^{aD} | 1.32±0.04 ^{aC} | 1.92±0.04 ^{aB} | 2.43±0.02 ^{aA} | 1.35±0.20 ^a |
| | Mean | 0.43±0.01 ^E | 0.59±0.02 ^D | 1.18±0.05 ^C | 1.79±0.04 ^B | 2.31±0.04 ^A | |
| Shade | Rice straw covering | 0.43±0.02 ^{aE} | 0.50±0.01 ^{bD} | 0.71±0.02 ^{bC} | 1.69±0.00 ^{aB} | 2.19±0.02 ^{bA} | 1.11±0.19 ^b |
| | Beet throne covering | 0.43±0.02 ^{aE} | 0.50±0.01 ^{bD} | 0.67±0.01 ^{cC} | 1.05±0.03 ^{bB} | 1.77±0.04 ^{cA} | 0.88±0.13 ^c |
| | Control | 0.43±0.02 ^{aE} | 0.62±0.01 ^{aD} | 1.09±0.05 ^{aC} | 1.71±0.02 ^{aB} | 2.32±0.03 ^{aA} | 1.23±0.19 ^a |
| | Mean | 0.43±0.01 ^E | 0.54±0.02 ^D | 0.82±0.07 ^C | 1.48±0.11 ^B | 2.09±0.08 ^A | |
| Mean of storage condition | | Sunlight | | Shade | | | |
| | | 1.26±0.11 ^A | | 1.07±0.10 ^B | | | |
| Mean of treatment | | Rice straw covering | | Beet throne covering | | Control | |
| | | 1.18±0.13 ^B | | 1.03±0.11 ^C | | 1.29±0.14 ^A | |
| Mean of storage period | | 0 | 7 | 14 | 21 | 28 | |
| | | 0.43±0.01 ^E | 0.56±0.02 ^D | 1.00±0.06 ^C | 1.63±0.07 ^B | 2.20±0.05 ^A | |

a, b & c: There is no significant difference ($P>0.05$) between any two means, within the same column have the same superscript letter.

A, B & C: There is no significant difference ($P>0.05$) between any two means for the same attribute, within the same row have the same superscript letter.

Table 6. Effect of different storage condition on total sugars content of sugar beet roots (g/100g on wet weight basis).

| Storage condition | Treatment | Storage period (day) | | | | | Mean |
|---------------------------|----------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|
| | | 0 | 7 | 14 | 21 | 28 | |
| Sunlight | Rice straw covering | 18.65±0.12 ^{aA} | 16.63±0.61 ^{bB} | 16.44±0.29 ^{aB} | 15.53±0.21 ^{bD} | 14.91±0.07 ^{bE} | 16.43±0.36 ^b |
| | Beet throne covering | 18.65±0.12 ^{aA} | 17.43±0.44 ^{aB} | 16.62±0.10 ^{aC} | 16.21±0.15 ^{aD} | 15.47±0.18 ^{aE} | 16.88±0.30 ^a |
| | Control | 18.65±0.12 ^{aA} | 16.47±0.10 ^{bB} | 15.87±0.30 ^{bC} | 14.20±0.27 ^{cD} | 13.02±0.13 ^{cE} | 15.64±0.52 ^c |
| | Mean | 18.65±0.06 ^A | 16.84±0.26 ^B | 16.31±0.17 ^C | 15.32±0.31 ^D | 14.46±0.38 ^E | |
| Shade | Rice straw covering | 18.65±0.12 ^{aA} | 17.43±0.45 ^{bB} | 16.35±0.37 ^{bC} | 16.01±0.34 ^{aC} | 15.72±0.32 ^{aC} | 16.83±0.32 ^a |
| | Beet throne covering | 18.65±0.12 ^{aA} | 17.77±0.37 ^{aB} | 16.72±0.26 ^{aC} | 15.95±0.48 ^{bD} | 15.68±0.73 ^{aD} | 16.95±0.34 ^a |
| | Control | 18.65±0.12 ^{aA} | 17.00±0.63 ^{cB} | 16.91±0.21 ^{aB} | 15.65±0.22 ^{bC} | 14.12±0.04 ^{bD} | 16.47±0.42 ^b |
| | Mean | 18.65±0.06 ^A | 17.40±0.27 ^B | 16.66±0.17 ^C | 15.87±0.19 ^D | 15.17±0.35 ^E | |
| Mean of storage condition | | Sunlight | | Shade | | | |
| | | 16.32±0.24 ^B | | 16.75±0.21 ^A | | | |
| Mean of treatment | | Rice straw covering | | Beet throne covering | | Control | |
| | | 16.63±0.24 ^A | | 16.92±0.23 ^A | | 16.05±0.34 ^B | |
| Mean of storage period | | 0 | 7 | 14 | 21 | 28 | |
| | | 18.65±0.04 ^A | 17.12±0.2 ^B | 16.49±0.12 ^C | 15.60±0.19 ^D | 14.82±0.26 ^E | |

a, b & c: There is no significant difference ($P>0.05$) between any two means, within the same column have the same superscript letter.

A, B & C: There is no significant difference ($P>0.05$) between any two means for the same attribute, within the same row have the same superscript letter.

Statistical analysis indicated that there are more or less differences between covering treatments or storage period within the different treatments of storage conditions. Anyhow, total sugars content of sugar beet roots ranged from 13.02 to 17.43% at storage in sunlight, which was significantly higher in

sugar beet roots covered with beet throne stored for 7 days, respectively. Total sugars content of sugar beet roots in shade ranged from 14.12 to 17.77%, which was significantly lower in control simple stored for 28 days, while it was significantly higher sugar beet roots covered with beet throne stored for 7 days,

respectively. These results are in agreement with those obtained by (Hozyan, 2002; Kenter and Hoffmann, 2009 and Al –Jaridi, 2009).

Sucrose content:

Data in Table (7) shows the effect of different storage conditions on sucrose content (non-reducing sugar) of sugar beet roots. Statistical analysis indicated that sucrose content was significantly higher in sugar beet roots stored in shade than those of treatment stored in sunlight, which contained 15.06 and 15.68%, respectively. It could be noticed that sugar beet roots covered with beet throne or rice straw contained significantly higher content from sucrose content than those of control treatment (without covering), which contained 15.89, 15.45 and 14.76% respectively. Statistical analysis indicated that sugar beet roots covered with beet throne contained significantly higher content from sucrose content than those of sugar beet roots covered with rice straw. From the results in same table, it could be observed that sucrose content of sugar beet roots decreased significantly ($P < 0.05$) from 18.22 to 16.56, 14.48, 13.62% by increasing

storage period from 0 to 7, 14, 21 and 28 days respectively.

Anyhow sucrose content of sugar beet roots. ranged from 10.59 to 16.86% on wet weight basis, which was significantly lower in control simple stored for 28 days, while it was significantly higher in treatment covered with beet throne stored for 7 days, respectively. Statistical analysis indicated that there are more or less differences between covering treatments of storage conditions. The sucrose content of sugar beet roots stored in shade ranged from 11.80 to 17.27% on wet weight basis, which was significantly lower in control simple stored 28 days, while it was significantly higher in treatment covered with tops of sugar beet stored for 7 days respectively. The decreasing of sucrose content during storage period may be due to the respiration of sugar beet roots, process for beet roots considering the possibility of ignoring the enzyme and even the individual chemical reaction, and considering the overall process. The results are in agreement with those obtained by (Hozyan, 2002; Youssif and Abou ElMagd, 2004; Al –Jaridi, 2009 and Al-Jbawi, *et al.* 2015).

Table 7. Effect of different storage condition on sucrose content of sugar beet roots (100g on wet weight basis).

| Storage condition | Treatment | Storage period (day) | | | | | Mean |
|---------------------------|----------------------|--------------------------|--------------------------|---------------------------|--------------------------|--------------------------|-------------------------|
| | | 0 | 7 | 14 | 21 | 28 | |
| Sunlight | Rice straw covering | 18.22±0.10 ^{aA} | 16.09±0.60 ^{bB} | 15.25±0.26 ^{bC} | 13.76±0.22 ^{bD} | 12.55±0.09 ^{bE} | 15.17±0.53 ^b |
| | Beet throne covering | 18.22±0.10 ^{aA} | 16.86±0.44 ^{aB} | 15.59±0.14 ^{aC} | 14.55±0.13 ^{aD} | 13.32±0.20 ^{aE} | 15.71±0.47 ^a |
| | Control | 18.22±0.10 ^{aA} | 15.81±0.13 ^{bB} | 14.55±0.27 ^{cC} | 12.28±0.27 ^{cD} | 10.59±0.14 ^{cE} | 14.29±0.72 ^c |
| | Mean | 18.22±0.05 ^A | 16.25±0.27 ^B | 15.13±0.19 ^C | 13.53±0.35 ^D | 12.15±0.41 ^E | |
| | | | | | | | |
| Shade | Rice straw covering | 18.22±0.10 ^{aA} | 16.93±0.46 ^{bB} | 15.64±0.35 ^{bC} | 14.32±0.33 ^{bD} | 13.53±0.33 ^{bE} | 15.73±0.47 ^b |
| | Beet throne covering | 18.22±0.10 ^{aA} | 17.27±0.38 ^{aB} | 16.05±0.27 ^{aC} | 14.91±0.47 ^{aD} | 13.91±0.76 ^{aE} | 16.07±0.45 ^a |
| | Control | 18.22±0.10 ^{aA} | 16.38±0.62 ^{cB} | 15.82±0.17 ^{abC} | 13.95±0.23 ^{cD} | 11.80±0.06 ^{cE} | 15.23±0.60 ^c |
| | Mean | 18.22±0.05 ^A | 16.86±0.28 ^B | 15.84±0.15 ^C | 14.39±0.23 ^D | 13.08±0.40 ^E | |
| | | | | | | | |
| Mean of storage condition | | Sunlight | | Shade | | | |
| | | 15.06±0.34 ^B | | 15.68±0.29 ^A | | | |
| Mean of treatment | | Rice straw covering | | Beet throne covering | | Control | |
| | | 15.45±0.35 ^B | | 15.89±0.32 ^A | | 14.76±0.47 ^C | |
| Mean of storage period | | 0 | 7 | 14 | 21 | 28 | |
| | | 18.22±0.03 ^A | 16.56±0.20 ^B | 15.48±0.15 ^C | 13.96±0.23 ^D | 12.62±0.30 ^E | |

a, b & c: There is no significant difference ($P > 0.05$) between any two means, within the same column have the same superscript letter.

A, B & C: There is no significant difference ($P > 0.05$) between any two means for the same attribute, within the same row have the same superscript letter.

Alpha Amino-N content:

Table (8) shows the effect of storage conditions on alpha amino nitrogen content of sugar beet roots. The percentage of increase in alpha-amino nitrogen content in the beet roots stored in the shade is less than these of the beet roots stored in the sunlight, where the percentage in the range of 1.83 and 1.97%

respectively. It is clear from the data that alpha amino nitrogen content of the sugar beet root differed with the differences in the sugar beet root storage. The root beets covered by the beet throne had the lower percentage of alpha-nitrogen content compared with the sugar beet roots covered with rice straw cover. The highest increase was alpha-nitrogen

content in treated roots with control simple and was 1.83, 1.88 and 1.96% respectively. The results obtained from the same table indicate that the increasing alpha-nitrogen content in the roots of sugar beet was increased with storage period and where the statistical analysis of the data gave significant differences ($p < 0.05$) of alpha amino nitrogen content during 0, 7, 14, 21 and 28 days, where sugar beet roots were contained in 1.37, 1.61, 1.87, 2.11 and 2.5%, respectively. From the results, the lowest increase of the alpha amino nitrogen content was observed in the sugar roots stored in the sunlight for 7 days and in the sugar beet roots covering with beet throne was the highest increase in

the outcome of the roots of sugar beet content when 28 days in roots treatment without cover (control) was in the range of 1.59 and 2.80% respectively, while the lowest increase noted in the alpha amino nitrogen content in the roots of beet sugar stored in the shade on 7 treatment to cover the throne of beet roots, and was the highest amount of increase at 28 days of alpha content amino nitrogen in beet roots treatment without cover (control) and was content in the range of 1.5 and 2.5% respectively. These results in agreement with those obtained by (Abu Shadi, 1994; van der Poel *et al.* 1998; Hozyan, 2002 and Karim, 2015).

Table 8. Effect of different storage condition on alpha amino-N content of sugar beet roots (mill/equivalents/100g on wet weight basis).

| Storage condition | Treatment | Storage period (day) | | | | | Mean |
|---------------------------|----------------------|-------------------------|--------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| | | 0 | 7 | 14 | 21 | 28 | |
| Sunlight | Rice straw covering | 1.37±0.20 ^{aE} | 1.72±0.13 ^{aD} | 1.94±0.03 ^{aC} | 2.03±0.04 ^{bB} | 2.73±0.12 ^{aA} | 1.96±0.13 ^{ab} |
| | Beet throne covering | 1.37±0.20 ^{aE} | 1.59±0.11 ^{bD} | 1.92±0.05 ^{aC} | 2.10±0.12 ^{bB} | 2.47±0.26 ^{bA} | 1.89±0.12 ^b |
| | Control | 1.37±0.20 ^{aE} | 1.70±0.06 ^{abD} | 1.93±0.04 ^{aC} | 2.47±0.09 ^{aB} | 2.80±0.06 ^{aA} | 2.05±0.14 ^a |
| | Mean | 1.37±0.10 ^E | 1.67±0.05 ^D | 1.93±0.02 ^C | 2.20±0.08 ^B | 2.67±0.10 ^A | |
| Shade | Rice straw covering | 1.37±0.20 ^{aE} | 1.54±0.09 ^{abD} | 1.80±0.05 ^{aC} | 1.97±0.05 ^{aB} | 2.32±0.08 ^{bA} | 1.80±0.10 ^a |
| | Beet throne covering | 1.37±0.20 ^{aC} | 1.50±0.17 ^{bC} | 1.77±0.03 ^{aB} | 2.07±0.22 ^{aA} | 2.17±0.02 ^{cA} | 1.77±0.10 ^a |
| | Control | 1.37±0.20 ^{aE} | 1.63±0.09 ^{aD} | 1.85±0.08 ^{aC} | 2.02±0.10 ^{aB} | 2.50±0.17 ^{aA} | 1.87±0.11 ^a |
| | Mean | 1.37±0.10 ^E | 1.56±0.07 ^D | 1.81±0.03 ^C | 2.02±0.07 ^B | 2.33±0.07 ^A | |
| Mean of storage condition | | Sunlight | | Shade | | | |
| | | 1.97±0.07 ^A | | 1.82±0.06 ^B | | | |
| Mean of treatment | | Rice straw covering | | Beet throne covering | | Control | |
| | | 1.88±0.08 ^{AB} | | 1.83±0.08 ^B | | 1.96±0.09 ^A | |
| Mean of storage period | | 0 | 7 | 14 | 21 | 28 | |
| | | 1.37±0.07 ^E | 1.61±0.04 ^D | 1.87±0.02 ^C | 2.11±0.06 ^B | 2.50±0.07 ^A | |

a, b & c: There is no significant difference ($P > 0.05$) between any two means, within the same column have the same superscript letter.

A, B & C: There is no significant difference ($P > 0.05$) between any two means for the same attribute, within the same row have the same superscript letter.

Loss in daily weight content:

Data in Table (11) shows the percentage of daily weight loss in the roots of sugar beet and the effect of weight loss on storage conditions and factors. The data obtained from the statistical analysis were weak ($P < 0.05$) where the daily weight loss in sugar beet roots stored in sunlight was the highest daily weight loss compared to the weight loss daily in the roots of sugar beet stored in the shade, the range from 42.09 and 40.88%, respectively. It was found that the daily weight loss in the roots of sugar beet differed in the amount of increase with different treatment type in the syrup in the storage of beet roots, where the loss of daily weight was lower in the roots of sugar beet beetroot treatment, while the percentage of daily weight loss was lower in beet roots Sugar treated with rice husk compared to daily weight loss ratio in

treatment roots without cover where the ratio was in the range from 39.83, 42.23 and 42.40%, respectively. During the periods of 0, 7, 14, 21 and 28 days where the amount of daily weight loss was increased in the range of 50, 45.41, 41.50, 37.73 and 33.27, respectively. The lowest daily weight loss in the roots of sugar beet stored in the sunlight of navigation at day 7 was in the roots beet sugar treated beet root, while the largest weight loss was the roots of beet treated without control (control) where the proportion of loss daily weight In the range of 47.48 and 30.73 at 28 days, respectively, while the lowest amount of reduction of loss daily weight in the roots of sugar beet stored in the day 7 and was in the roots of sugar beet treated with sugar beet tree, and the highest amount of weight loss in the daily root Sugar beet was in sugar beet roots

without treatment 28days control at 45.7 and 30.25, respectively. These results in agreement with those

obtained by (Hozyan, 2002; Al –Jaridi, 2009 and Al-Jbawi, *et al.* 2015).

Table 9. Effect of different storage condition on Loss in daily weight content of sugar beet roots.

| Storage condition | Treatment | Storage period (day) | | | | | Mean |
|---------------------------|----------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------|
| | | 0 | 7 | 14 | 21 | 28 | |
| Sunlight | Rice straw covering | 50.00±0.00 ^{aA} | 46.38±0.22 ^{bB} | 43.30±0.12 ^{aC} | 40.25±0.14 ^{aD} | 36.25±0.14 ^{bE} | 43.24±1.27 ^a |
| | Beet throne covering | 50.00±0.00 ^{aA} | 47.48±0.04 ^{aB} | 41.38±1.95 ^{bC} | 40.25±1.30 ^{aD} | 38.29±0.17 ^{aE} | 43.48±1.26 ^a |
| | Control | 50.00±0.00 ^{aA} | 43.24±0.08 ^{cB} | 38.75±0.14 ^{cC} | 35.10±0.00 ^{bD} | 30.73±0.13 ^{cE} | 39.56±1.78 ^b |
| | Mean | 50.00±0.00 ^A | 45.70±0.64 ^B | 41.14±0.87 ^C | 38.53±0.94 ^D | 35.09±1.13 ^E | |
| Shade | Rice straw covering | 50.00±0.00 ^{aA} | 45.15±0.20 ^{bB} | 41.25±0.14 ^{aC} | 37.88±0.07 ^{aD} | 33.55±0.03 ^{aE} | 41.57±1.52 ^a |
| | Beet throne covering | 50.00±0.00 ^{aA} | 45.70±0.06 ^{aB} | 41.11±0.06 ^{aC} | 37.60±0.06 ^{aD} | 30.53±0.25 ^{bE} | 40.99±1.79 ^b |
| | Control | 50.00±0.00 ^{aA} | 44.50±0.06 ^{cB} | 40.50±0.23 ^{bC} | 35.25±0.14 ^{bD} | 30.25±0.14 ^{bE} | 40.10±1.84 ^c |
| | Mean | 50.00±0.00 ^A | 45.12±0.18 ^B | 40.95±0.14 ^C | 36.91±0.42 ^D | 31.44±0.53 ^E | |
| Mean of storage condition | | Sunlight | | Shade | | | |
| | | 42.09±0.87 ^A | | 40.88±0.98 ^B | | | |
| Mean of treatment | | Rice straw covering | | Beet throne covering | | Control | |
| | | 42.40±0.99 ^A | | 42.23±1.10 ^{AB} | | 39.83±1.26 ^B | |
| Mean of storage period | | 0 | 7 | 14 | 21 | 28 | |
| | | 50.00±0.00 ^A | 45.41±0.33 ^B | 41.05±0.43 ^C | 37.72±0.54 ^D | 33.27±0.75 ^E | |

a, b & c: There is no significant difference ($P>0.05$) between any two means, within the same column have the same superscript letter.

A, B & C: There is no significant difference ($P>0.05$) between any two means for the same attribute, within the same row have the same superscript letter.

Finally, the obtained results, it is recommended that to manufacture the sugar beet roots immediately after harvest to reduce the percentage of sugar loss in these roots. On the other hand, if the manufacturing failure occurs due to the conditions of transport or increase in quantity of sugar beet roots or other reasons, it is recommended that to store the sugar beet roots in the shade and covering with beet throne, as it reduces the deterioration of chemical and enzymatic properties of sugar beet roots.

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تأثير ظروف التخزين المختلفة على التركيب الكيميائي لجذور بنجر السكر

يعتبر محصول بنجر السكر من المحاصيل التي يحدث لها تدهور سريع في خواصها الكيميائية والتكنولوجية بعد الحصاد أي أنها من المحاصيل غير القابلة للتخزين في الجو المكشوف.

ولذلك فقد تمت دراسة التغيرات الكيميائية وكذلك الخصائص التكنولوجية لجذور البنجر خلال فترة التخزين لمدة 28 يوما في ظروف مختلفة (تخزين في ضوء الشمس - تخزين في الظل) وبمعاملات مختلفة (تغطية بعش البنجر - تغطية بقش الأرز و بدون تغطية (كنترول)).

ومن أهم النتائج المتحصل عليها في هذه الدراسة كانت انخفاض نسبة الرطوبة في جذور البنجر مصاحبا معه زيادة في معدل فقد الوزن اليومي وكذلك زيادة في نسبة المواد الصلبة الذائبة الكلية و كانت أفضل النتائج في الجذور التي تم تغطيتها بعش البنجر والمخزنة في الظل وقد كانت زيادة نسبة السكريات المختزلة نتيجة لعمليات التنفس والنشاط الإنزيمي. وبالتالي حدث نقص في محتوى السكروز في جذور البنجر أثناء فترة التخزين مما أدى الى انخفاض نسبة السكروز المتحصل عليها نتيجة لزيادة الشوائب من ألفا أمينو نيتروجين بينما إنخفضت درجة نقاوة العصير تدريجيا خلال فترة التخزين.

وبناء على النتائج المتحصل عليها يوصى بتصنيع جذور البجر مباشرة بعد حصادها لتقليل من نسبة الفقد في السكر وينصح في حالة تأخر التصنيع بسب وجود صعوبة في عمليات نقل جذور بنجر السكر أو زيادة كميات الواردة إلى المصنع أو لأسباب أخرى بتخزين جذور بنجر السكر في الظل وتغطيتهم بعش البنجر الأخضر، حيث انها تقلل من التغيرات في الخواص الكيميائية وكذلك الخواص التكنولوجية في جذور بنجر السكر.