J. Agric. Sci. Mansoura Univ., 28(7): 5479 - 5488, 2003

QUALITY ASSESSMENT OF SUGAR BEET AND ITS PROCESSING BY-PRODUCTS

Abbas, H. M.
Food Sci. Dept. Fac. Agric., Minia Univ., Minia, Egypt.

ABSTRACT

Physical and chemical characteristics of beet as the main raw material and the by-products of white sugar manufacture were determined. Samples used in this investigation were obtained from Abou-Qurkas sugar factory, El-Minia, Egypt, during 2001 working season.

The obtained data showed that there were significant differences concerning physical and chemical parameters between the studied samples during processing periods. The physical properties of studied fresh beet cossettes gave the following values: 19.38-20.18%, 76.83-79.58 %, 10.04-11.30 % and 67.42- 73.01 % for total soluble solids (T.S.S.), purity, rendement and quality index, respectively. The chemical analysis of fresh beet revealed that contained 59.16-63.23% sucrose, 0.12-0.47% reducing sugars, 3.93-5.79% nitrogen, 18.03-20.78 % marc (fibers) and 3.66-4.76 % ash content. The α-amino-nitrogen, potassium and sodium contents were 3.79 - 4.23, 7.78 - 8.52 and 3.36 - 4.17 milliequivalent/100g fresh beet, in order. The chemical composition determination showed that pressed pulp contained about 5.60-7.81 %, sucrose 5.14-6.98% nitrogen, 1.03-1.37 % ash and 75.90-80.09 % marc. The sucrose % of analyzed filter cake ranged from 5.60-7.10 %, total nitrogen % was 0.91-1.11 % and ash content represented 84.22 - 90.19 %. For the studied physical properties of molasses there were no significant variations in T.S.S. % (83.03-83.80 %), specific gravity, refractive index and purity (60.75-61.89%), While, the differences in color, pH, and N.S.S. % were significant during the working season.

The chemical composition of the molasses was as follows: 26.71-27.08 %, 67.90-69.88 %, 1.09-1.24 %, 0.28-0.40 %, 0.38-0.49 % and 11.85-13.30 %, for moisture, sucrose, reducing sugars, nitrogen, ether extract and ash contents, respectively.

Comparison of the obtained data with the literature values of European sugar beet factories, indicated a lower sugar beet quality and higher sucrose losses in the by-products studied in this investigation.

INTRODUCTION

Sugar beet (*Beta vulgaris var. altissima döll*) is one of just two sugar crops (the other being sugar cane) which constitute the only important sources of sucrose. It is grown under rather moderate climates in the northern hemisphere in particular, i.e. Europe, Canada, USA and Russia. It could be also cultivated successfully as a winter crop in the moderate zone or in the terminal semi-tropical zone, e.g. Asian (Iran, Iraq, Syria and Lebanon) and North Africa such as Morocco, Algeria, Tunisia, and Egypt (Ghanem & Gomaa, 1985 and Cooke & Scott, 1993). The beet sugar production represents 28.23 % of the total world sugar production, i.e. 132.82 million tons, while cane sugar amounts to 71.77 % of each annual production in season 2000 (Anonymous, 2000).

In Egypt, the beet sugar production increased from about 17 thousand tons in 1982 to about 356 thousands tons in 2000, from it about 43.5 thousands tons produced from Abou-Qurkas Sugar Factory, El-Minia governorate (12 % of the total beet sugar production). It is the only factory in Egypt, where sugar cane and sugar beet are together processed. However, the two crops are harvested at different times and processed as a single crop at different times of the year.

In addition, the beet sugar production in 2000 is represented 25.5 % of the total local sugar production, which reached about 1.4 million tons in year 2001 (Afifi, 2001). The sugar consumption in Egypt reached 2.2 million tons according to statistical of 2003, this means a gap of about 0.8 million tons of sugar (Gudoshnifcov, 2003).

The trails to increase the sugar production through the improvement of sugar cane cultivation and processing conditions are limited, however, the successful production of beet under Egyptian conditions sparked bright hopes and ambitions for expanding beet cultivation in the newly reclaimed areas and erect 5 more beet factories (beside 4 working factories) in the near future (Abou-El-Magd, 1998; Anier, 1998 and Metwally, 1998).

The technological purpose of sugar industry is to recover the maximal sugar yield with the lowest possible costs. This could be achieved by using a high quality sugar beet and optimizing all the processing steps. The beet quality was affected by beet cultivars, agricultural treatment, environmental conditions and other factors (McGinnis, 1971). The further utilizing of sugar industry by-products should be also considered (Mohamed, 2003).

Losses of materials are a character of any industrial process such as sugar industry, it can be divided through sugar processing steps into two divisions : known or determinable loss, i.e. pulp loss, (≈0.24 % of beet), filter cake loss (≈0.08 % of beet) and final molasses loss (≈2.12 % of beet), the second division is unknown or indeterminable loss, which include mechanical, chemical, apparent and bio-chemical loss. The evaluation of sugar factories efficiency is carried out by calculation of materials balances e.g. sucrose balance.

The non-sucrose substances especially reducing sugars, α-amino nitrogen and minerals (K & Na) had great effect on processing and play a great role in the determination of the final obtained quantity and quality of crystallized sugar in particular sugar beet, where white sugar was directly produced (Anonymous, 1984). The quality control of the sugar factory should determine the optimal processing conditions to obtain the maximal sugar recovery with best quality characteristics and in the same time to reduce the sugar losses to their minimal economical limits (Olbrich, 1963 and El-Syiad, 1996).

A considerable research efforts has been expended to reduce the large lost of sucrose content that can be occur in the field and after harvesting till processing and throughout the processing steps. Therefore, this investigation was carried out to determine physical and chemical characteristics of the raw material (beet cossettes) and the main by-products of white sugar manufacturing at Abu-Qurkas factory i.e. pressed pulp, filter cake and final molasses. Important quality parameters such as harmful non-sucrose substances, sucrose recovery and sucrose losses were also determined. The obtained data were compared with literature values for similar factories in the developed countries.

MATERIALS AND METHODS

MATERIALS

Samples of beet cossettes, pressed pulp, filter cake and molasses were obtained from Abou-Qurkas Sugar Factory, El-Minia governorate at three different periods (R_1, R_2 and R_3) covering the 2001 working season. Where: R_1 is the beginning, R_2 the middle and R_3 the end of the season. Sampling was carried out 3 times through 3 days for each period.

METHODS

PHYSICAL PROPERTIES

Total soluble solids (T.S.S.) and refractive index (R.I.) were determined by Abbè refractometer at 20°C according to A.O.A.C. (1995). The pH values were determined using a "Beckman" pH-meter according to Collins *et al.* (1977). Specific gravity (Sp. Gr.) was determined at 20°C according to A.O.A.C. (1995). Purity represented the percentage of sucrose in the total soluble solids content (%) of the studied samples. Non-sucrose substances (N.S.S. %) were calculated as the difference between the total soluble solids % and the sucrose % of the sample according to Anonymous (1984). Color index was evaluated by measuring the extinction of the samples using spectrophotometer, then the result were expressed in ICNMSA-unit according to Reinefield and Schneider (1983) . Rendement, recoverable sucrose % of beet, sucrose losses % of beet and beet quality index of beet (recoverable sucrose % Pol %) were calculated according to Ferweez (2002) using the following formulas.

Rendement = Pol % - [0.29 + 0.343 (K + Na) + α-N (0.094)].

Where: K, Na and α-N determined as milliequvalent/100g fresh beet.

Sucrose loss % = Pol % - Rendement.

$$\text{Quality index} = \frac{\text{Rendement}}{\text{Pol \%}} \times 100.$$

Chemical composition:

The moisture content was determined using drying oven at 105°C till constant weight as described in A.O.A.C. (1995). Total solid content was calculated by subtraction the moisture content % from 100. Sucrose content as Pol % was determined using saccharimeter according to Rauscher *et al.* (1986). Reducing sugars (R.S.) and total sugars (T.S.) were determined by Lane-Eynon volumetric method as described by Schneider (1979). Total nitrogen content (T.N.) was estimated by microkjeldahl as described in A.O.A.C. (1995). Ash content was determined by burning the samples in

Muffle Furnace at 550°C till constant weight according to A.O.A.C. (1995). Ether extract was determined using a Soxhlet apparatus and petroleum ether as a solvent according to A.O.A.C. (1995). Marc or fibers content was estimated according to the method described in A.O.A.C. (1995). Alpha amino nitrogen (α-amino – N), sodium (Na) and potassium (K) contents were determined according to the procedure used by sugar factory with an auto analyzer as described in Cook and Scott (1993). The results expressed as milliequivalent per 100 grams fresh beet.

The obtained data in this study were presented as an average of three runs and subjected to statistical analysis using Duncan's multiple range test according to Snedecor and Cochran (1980).

RESULTS AND DISCUSSIONS

Physical properties of fresh beet cossettes:

The technological important physical properties of beet cossettes during the processing season of white sugar manufacture are shown in Table 1. The data show that T.S.S. % was significantly decreased during processing season from 20.18 to 19.38%, sucrose % was also decreased from 16.06 to 14.89%, purity had similar trend and ranged from 79.58 to 76.83%, while N.S.S.% was first decreased from 4.33 to 3.60 % then increased to 4.17%.

Table (1): Physical properties of beet cossettes during sugar processing season compared with literature values.

Property	Sampling periods			Average	Literature average values**
	R_1	R_2	R_3		
T.S.S. %	20.18^{a}	19.62^{ab}	19.38^{b}	19.73	20.00
Sucrose (Pol %)*	16.06^{a}	15.48^{b}	14.89^{c}	15.48	16.50
Purity	79.58^{a}	78.90^{ab}	76.83^{b}	78.44	82.50
N.S.S.* %	4.12^{b}	4.14^{b}	4.49^{a}	4.25	3.50
Rendement	11.02^{b}	11.30^{a}	10.04^{c}	10.79	13.26
Sucrose losses	5.04^{a}	4.18^{c}	4.86^{b}	4.69	3.24
Quality index	68.62^{b}	73.01^{a}	67.47^{c}	69.68	80.38

*** On wet weight basis.**
**** Average values C.F. Anonymous, 1986; Baloh 1978 and Mauch, 1987).**
Means in the same row having the same letter(s) are not significantly different.

Rendement and quality index were increased from the beginning to the middle and then gradually decreased to the end of the season. Sucrose losses % of beet was first decreased from 5.04 to 4.18 % then increased to 4.86 % at the end of the season. The comparison between the average obtained data with similar values from European factories revealed that the studied beet sugar had lower quality parameters values. Where, purity was about 4 %, rendement about 2.5 % and quality index was more than 10 % lower in local beet. The data show also that the literature values were higher concerning T.S.S. %, but lower for N.S.S. % and sucrose losses, than the obtained values. Baloh, 1978 and Anonymous, 1984, reported that the good quality beet should have purity of about 82.5 – 87 %.

The variation of the studied parameters between Egyptian and European sugar beet could be caused through differences in cultivars, climatic conditions, agriculture practices and also post-harvest-treatments (Goto *et al.*, 1992 and Yehia, 2002).

Chemical composition of fresh beet cossettes:

Data in Table 2 illustrated that the chemical composition of beet cossettes was also varied throughout processing periods. Sucrose content was decreased gradually from 63.23 to 59.16 % by the end of the season. Reducing sugars, total nitrogen and ether extract contents were first decreased then increased during processing season. Marc content was increased from 18.03 to 20.78 % while ash content was decreased from 4.76 to 3.66 % by the end of the season.

Table (2): Chemical composition %* of beet cossettes during sugar processing season compared with literature values.

Constituents	Sampling periods			Average	Literature average values***
	R_1	R_2	R_3		
Moisture	74.60^a	75.21^a	74.83^a	74.88	76.50
Sucrose	63.23^a	62.44^b	59.16^c	61.62	70.21
Reducing sugars	0.47^a	0.12^b	0.36^a	0.32	0.30
Total sugars	70.94^a	69.42^b	66.94^c	69.10	71.49
Total nitrogen	5.79^a	4.72^b	3.93^c	4.81	1.70
Ether extract	1.65^a	1.13^c	1.31^b	1.36	0.43
Marc (fibers)	18.03^c	19.20^b	20.78^a	19.34	21.28
Ash	4.76^a	4.15^b	3.66^c	4.19	0.38
α-amino-N**	4.23^a	3.79^c	4.01^b	4.01	0.70
K**	8.52^a	7.78^c	8.22^b	8.17	7.56
Na**	4.17^a	3.36^b	3.98^a	3.84	0.74

* On dry weight basis.
** Milliequivalent/100 grams fresh beet.
*** Average values C.F. Anonymous, 1986; Baloh 1978 and Mauch, 1987).
Means in the same row having the same letter(s) are not significantly different.

The processing harmful substances i.e. α-amino-N, potassium and sodium were lowest at the middle of the season. Researchers defined not more than 100-150 mg α-amino-N/100g sugar (sucrose) for the high quality beet and > 200 mg/100g sucrose for the lowest quality beet. They added that an increase of 100 mg α-amino-N/100g sucrose caused a decrease of about 0.75 % in the sucrose content of beet (Mohamed, 2003).

The literature values reported in Table 2 indicated higher sucrose but lower nitrogen, ash, α-amino-N and sodium contents than the Egyptian beet. The data in Tables 1 and 2 revealed that the studied beet cultivars, which processed in Abou-Qurkas sugar factory, had lower processing quality than those processed in beet sugar factories in Europe.

Chemical composition of pressed pulp:

The data in Table 3 represent important constituents of extracted and pressed beet pulp. The total solids ranged from 22.19 to 27.26 % and consisted of 5.60-7.81 % sucrose, 0.11-0.27 % reducing sugars, 5.14-6.98% nitrogen, 0.54-0.66% ether extract, 1.03-1.37 % ash and 75.90-80.09 % mark (fibers). It was clear from the results that pressed pulp had a high fibers content, considerable sugars and nitrogen contents. While, it had lower ether extract and ash contents. The literature values were lower than those of the local pressed pulp except for marc content. The data show also that the sucrose losses in local pressed pulp were higher, that means lower sugar recovery efficiency but higher value and better application possibilities for the pressed pulp.

Table (3): Chemical composition %* of pressed pulp during sugar processing season in comparison to its literature values.

Constituents	Sampling periods			Average	Literature average values**
	R_1	R_2	R_3		
Moisture	77.81^a	72.74^b	73.08^b	74.54	77.00
Sucrose	6.85^b	7.81^a	5.60^c	6.72	3.96
Reducing sugars	0.27^a	0.18^b	0.11^c	0.20	---
Total sugars	7.35^b	8.44^a	5.79^c	7.19	6.65
Total nitrogen	5.14^c	6.16^b	6.98^a	6.17	2.17
Ether extract	0.54^b	0.66^a	0.59^{ab}	0.59	0.22
Ash	1.08^b	1.03^b	1.37^a	1.18	0.13
Marc (fibers)	77.74^b	75.90^c	80.09^a	77.89	83.57

* On dry weight basis.
** Average values C.F. Anonymous, 1986; Baloh 1978 and Mauch, 1987).
Means in the same row having the same letter(s) are not significantly different.

These differences might be due to variation in the used fresh beet cossettes and the treatments undergo after and through processing. These results agree with those obtained by Anonymous, 1984. The data reveal also that pressed pulp contained considerable amounts of nutrients i.e. sugars, nitrogenous compounds and high fibers content. It could be therefore use in many other applications such as animal feed, in paper and cellulose industry .... etc. This appeared clear from the stand point of the pressed pulp represents great amount of about 26 % of the processed sugar beet (Mohamed, 2003).

Chemical composition of filter cake:

The chemical composition of filter cake (filter mud) resulted from beet extract filtration processes are shown in Table 4. The data obtained reveal that the analyzed filter cake had high sucrose content (7.10 %) which gradually decreased and reached its minimal content by the end of the season (5.60 %). This might be due to the increasing of the working efficiency of the factory throughout the season, that means reduction of sucrose losses in all by-products (McGinnis, 1971).

Table (4): Chemical composition %* of filter cake resulted during beet sugar processing compared with its literature values.

Constituents	Sampling periods			Average	Literature average values**
	R_1	R_2	R_3		
Moisture	49.22[a]	44.17[b]	45.32[b]	46.24	48.00
Sucrose	7.10[a]	6.34[b]	5.60[c]	6.32	1.73
Reducing sugars	0.35[a]	0.14[a]	0.24[a]	0.24	0.08
Total sugars	7.70[a]	6.52[b]	6.00[c]	6.71	1.94
Total nitrogen	1.04[a]	1.11[a]	0.91[a]	1.02	0.96
Ether extract	0.31[a]	0.27[a]	0.20[a]	0.26	---
Ash	90.19[a]	84.22[c]	86.30[b]	86.80	82.69

* On dry weight basis.
** Average values C.F. Anonymous, 1986; Baloh 1978 and Mauch, 1987).
Means in the same row having the same letter(s) are not significantly different.

Total solids % was ranged between 50.88-55.83 % while, ash content represented about 86.80 % of the total solids. The results in Table 4 revealed also that the filter cake studied had about 1.02 % total nitrogen content. The comparison of the average values of the data obtained with literature values illustrated that the main difference was in sucrose content (6.32-1.73%). The filter cake (represents about 6-8 % of beet) has many uses e.g. cement similar materials, chalk processing (after discoloration), isolation materials, carrier for pesticides, as fertilizers especially for acidic soils. Recycling of filter cake in the sugar industry is so far in the experimental stage (Anonymous, 1984). In Egypt, there are some field experiments to use it as fertilizer in the new reclaimed soils which need a good source for macro- and micro-elements and organic matters (Mohamed, 2003).

Physical properties of molasses:

Molasses are the most important by-products of the sugar industry. This is due to its high T.S.S. content (> 80 %) which mainly consists of sugars and other components e.g. minerals, nitrogenous compounds, lipids ...etc. The molasses yield represents about 3.5-5.5 % of beet (Mauch, 1987).

Physical properties of molasses produced during beet sugar processing are shown in Table 5.

Table (5): Physical properties of molasses produced during beet sugar processing compared with literature values.

Property	Sampling periods			Average	Literature average values**
	R_1	R_2	R_3		
T.S.S. %	83.80[a]	83.03[a]	83.40[a]	83.41	82.00
Sucrose(Pol %)*	51.86[a]	50.44[a]	50.67[a]	50.99	48.00
Specific gravity	1.42191[a]	1.4326[a]	1.4412[a]	1 4343	1.4237
Refractive index	1.5010[a]	1.4995[a]	1.5000[a]	1.5002	1.4960
Color	51813.00[a]	48038.00[a]	49653.00[a]	49835.00	15100.00
pH	7.62[a]	7.18[b]	7.30[b]	7.37	7.7
Purity	61.89[a]	60.75[b]	61.76[a]	61.46	58.54
N.S.S. %*	31.94[a]	32.59[a]	32.73[a]	32.42	32.00

* On wet weight basis.
** Average values C.F. Anonymous, 1986; Baloh 1978 and Mauch, 1987).
Means in the same row having the same letter(s) are not significantly different.

It was noticeable from the Table that the T.S.S. %, specific gravity and refractive index showed no significant variations neither within the different processing periods nor between studied samples and literature values. There were s ignificant d ifferences c oncerning p H a nd p urity w ithin the processing periods, also between values of studied samples and literature values.

The results showed no significant differences among the values of N.S.S. % during processing season, while there were slight variation between the studied molasses samples and the literature values. The data showed lower pH (0.33), higher sucrose (about 3 %) and higher purity (about 3 %) for studied samples than the literature values.

Chemical composition of molasses:

Changes in chemical composition of beet molasses during processing season and beet molasses composition produced in Europe are presented in Table 6. The data revealed no significant differences during processing season for all components except for ash, which decreased from 12.57 to 11.85 % in the middle then increased again to 13.30 % by the end of the season. Data showed that the sucrose and reducing sugars content were higher in the studied molasses (68.65 and 1.17 %) than the literature values (60.00 and 0.88 %). That means higher sucrose losses in the molasses and lower sucrose recovery. This is might be due to higher impurities (invert sugars, nitrogenous compounds and minerals) of the studies sugar beet. These results are agreement with the findings of Baloh, 1978 and Mauch, 1987.

Beet molasses had already a lot of applications especially in biotechnology field, where many chemicals and biochemicals products i.e. citric acid, acetone ethyl alcohol and yeast also other new compounds could be produced.

Table (6): Chemical composition %* of molasses produced during beet sugar processing compared with literature values.

Constituents	Sampling periods			Average	Literature average values**
	R_1	R_2	R_3		
Moisture	26.79[a]	26.71[a]	27.08[a]	26.86	20.00
Sucrose	69.88[a]	67.90[a]	68.16[a]	68.65	60.00
Reducing sugars	1.24[a]	1.09[a]	1.18[a]	1.17	0.88
Total sugars	76.76[a]	74.65[a]	74.02[a]	75.15	65.00
Total nitrogen	0.40[a]	0.35[a]	0.28[a]	0.34	0.63
Ether extract	0.49[a]	0.46[a]	0.38[a]	0.44	---
Ash	12.57[b]	11.85[c]	13.30[a]	12.57	11.88

*** On dry weight basis.**
**** Average values C.F. Anonymous, 1986; Baloh 1978 and Mauch, 1987).**
Means in the same row having the same letter(s) are not significantly different.

It is noteworthy here to mention that there are a great differences between molasses resulted during beet and cane processing. The main difference in the sugars composition, where cane molasses contain lower sucrose (35-45 %) but higher reducing sugars (20-30 %) compared to that of beet processing. There are other variations in color, mineral content and nitrogenous compounds (Baloh, 1978).

Finally, this work revealed that cultivation and processing of sugar beet under Minia region (Abou Qurkas Factory) could be successfully run throughout the extension of the working season. However, technical data of beet and processing by-products were often worse than those obtained from other international sugar beet factories. Therefore, improvement of sugar beet quality and optimization of processing conditions should be the aim of sugar industry in Egypt. Development new applications for the by-products of sugar beet industry was also important.

REFERENCES

A.O.A.C. (1995). Association of Official Analytical Chemists. Official methods of analysis, 16th Ed. Washington, D.C., USA.

Abou El-Magd, B.M. (1998). Biochemical Studies on Sugar Beet. Ph.D. Thesis, Fac., Agric., El-Mansoura Univ.

Afifi, F. (2001). The role of the central council for sugar crops in the Egyptian sugar industry. Thirty-one Annals Conference, Egyptian Society of Sugar Technologists (ESST), January 2001, Giza, Egypt.

Ainer, A.K.E. (1998). Economics of the production and processing of the sugar crops in A.R.E., M.Sc. Thesis, Fac. Agric., Al-Azhar Univ., Cairo.

Anonymous (1984). Die Zuckerherstellung 3. Auflage VEB Fachbuchverlag Leipzig, FRG.

Anonymous (2000). Annals report for sugar crops. Central council for sugar crops, Ministry of Agriculture, Egypt.

Baloh, A. (1978). Zuckertchnoligie. Skript zur vorlesungen, TUB-FB13, Berlin, FRG.

Collins, J.L.; I.E. McCarty and J.D. Peavy (1977). Quality of sorghum syrup produced in Tennessee. Farm and Home Science, Report USA, Oct. – Dec., Vol. 104, 1245.

Cooke, D.A. and R.K. Scott (1993). The Sugar Beet Crop. Scientific Practice Published by Chapman & Hall, London.

El-Syiad, S.I. (1996). Evaluation of the quality parameters of cane juice and its liquors during raw sugar manufacture. Assiut J. Agri. Sci., 27(1): 143-151.

Ferweez, H.M.H. (2002). Chemical and Technological Studies on Sugar Beet. Ph.D. Thesis, Food Sci. Dept., Fac. Agric., Minia Univ.

Ghanem, S.A. and M.A. Gomaa (1985). The influence of nitrogen fertilization and growth regulators on yield and quality of sugar beet. Zagazig J. Agric. Res., 12(2): 229-252.

Goto, A.; M. Sato; M. Sasaoka; K.K. Fujii; A. Shinsenji; T. Sugawara and M. Kimura (1992). Interaction between varietal characteristics and environmental conditions. 1- Location of experiment and harvest time. Proceeding of the Japanese Society of Sugar Beet Technologists, No. 34, 64-69. (C.F. Mousa, 1990).

Gudoshnikov, S.(2003). The prospects for sugar consumption and imported demand in the Arab region and Africa, International Conference on Arab region and Africa in the World Sugar Context, Aswan, Egypt 9-12 March, 2003.

Mauch, W. (1987). Zuckertechnologie. Skript zur Vorlesungen, TUB-FB13, Berlin, FRG.

McGinnis, R.A. (1971). Beet Sugar Technology. Second Edition, Beet Sugar Development Foundation. Fort Collins, Co. USA.

Metwally, A.M. (1998). Effect of Some Agricultural Practices on Sugar Beet (*Beta Vulgaris* L.). Ph.D., Thesis, Fac. Agric., El-Minia Univ.

Mohamed, M.Y. (2003). Utilization of sugar cane scums (filter muds). Thirty-three Annals Conference, Egyptian Society of Sugar Technologists (ESST), January 2003, Giza, Egypt.

Olbrich, H. (1963). Principles of sugar technology (second edition, edited by Honig. P.) Elsevier Publishing Co., New York, USA.

Rauscher, K.; R. Engst and U. Fvrimuth (1986). Untersuchug Von Lebensmittel. 2. Auflage, VEB Fachbuchverlag Leipzig, FRG.

Reinefeld, E. and F. Schneider (1983). Analystische Betriebskontrolle der Zuckerindustrie. Teil A and B, Verein der Zucherindustrie, Verlag Dr. Albert Bartens, Berlin, FRG.

Shneider, F. (1979). Sugar Analysis Official and Tentative Methods Recommended by the International Commission for Uniform Methods of Sugar Analysis (ICUMSA), British Sugar Corporation, Peterborough.

Snedecor, G.V. and W.G. Cochran (1980). Statistical method, six[th] Edition, Iowa State Univ., Press, Ames, Iowa, USA.

Yehia, Y.I.D. (2002). Effect of sugar beet quality on the sugar production processes. Thirty-two Annals Conference, Egyptian Society of Sugar Technologists (ESST), January 2002, Giza, Egypt.

تقييم جودة بنجر السكر والنواتج الثانوية لتصنيعة

حمدى محمد عباس

قسم علوم الأغذية ــ ذكلية الزراعة ــ جامعة المنيا ــ المنيا ــ مصر

تناول هذا البحث تقدير معايير الجودة الطبيعية والكيميائية لبنجر السكر كمادة خام رئيسية والنواتج الثانوية لتصنيع السكر الأبيض. تم الحصول على العينات المستخدمة فى هذه الدراسة من مصنع سكر أبو قرقاص ــ محافظة المنيا ــ خلال موسم التصنيع ٢٠٠١ م.

وقد أوضحت النتائج وجود إختلافات معنوية فى الصفات الطبيعية والكيميائية للعينات المختلفة المأخوذة خلال فترات التصنيع. أعطى تحليل شرائح البنجر الخام القيم التالية: ١٩,٣٨ ــ ٢٠,١٨ %، ٧٦,٨٣ ــ ٧٩,٥٨ %، ١٠,٠٤ % ــ ١١,٣٠ %، ٦٧,٤٢ ــ ٧٣,٠١ للمواد الصلبة الذائبة، النقاوة، نسبة السكر المبلور الناتج، ومعامل الجودة على التوالى. وقد احتوت هذه الشرائح على ٥٩,١٦ــ٦٣,٢٣ % سكروز، ٠,١٢ــ٠,٤٧ % سكر مختزل، ٣,٩٣ــ٥,٧٩ % نتروجين كلى، ١٨,٠٣ــ٢٠,٧٨ % ألياف، ٣,٦٦ــ٤,٧٦ % رماد وكانت نسب النتروجين الأمينى، البوتاسيوم والصوديوم ٣,٧٩ــ٤,٢٣، ٧,٧٨ــ٨,٥٢، ٣,٣٦ــ٤,١٧ ملليمكافئ/١٠٠جم بنجر على الترتيب. أوضح تقدير التركيب الكيماوى أن لب البنجر المستخلص المعصور أحتوى على حوالى ٥,٦٠ــ٧,٨١ % سكروز، ٥,١٤ــ٦,٩٨ % نتروجين، ١,٠٣ــ١,٣٧ % رماد، ٧٥,٩٠ ــ ٨٠,٠٩ %ألياف. تراوحت نسبة السكروز فى طينة المرشحات التى تم تحليلها بين ٥,٦٠ إلى ٧,١٠ %، كان النتروجين الكلى ٠,٩١ ــ ١,١١ % ومحتوى الرماد ٨٤,٢٢ ــ ٩٠,١٩ %. بالنسبة للصفات الطبيعية لعينات المولاس المدروسة فلم تكن هناك اختلافات معنوية فى محتوى المواد الصلبة الذائبة (٨٣,٠٣ ــ ٨٣,٨٠ %)، الوزن النوعى، معامل الإنكسار والنقاوة. أما الاختلافات فى اللون، درجة الحموضة والمواد غير السكروز فكانت معنوية خلال موسم التصنيع. أعطى التركيب الكيماوى للمولاس القيم التالية: ٢٦,٧١ــ٢٧,٠٨ %، ٦٧,٩٠ــ٦٩,٨٨ %، ١,٠٩ ــ ١,٢٤ %، ٠,٠٢٨ ــ ٠,٤٠ %، ٠,٣٨ ــ ٠,٤٩ % و١١,٨٥ ــ ١٣,٣٠ % لمحتويات الرطوبة والسكروز، السكر المختزل، النتروجين، المستخلص الأثيرى والرماد على التوالى. وبمقارنة النتائج المتحصل عليها مع القيم المرجعية لمصانع بنجر السكر الأوروبية أتضح انخفاض درجة جودة البنجر وارتفاع معدلات فقد السكروز فى النواتج الثانوية للعينات المدروسة.