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Research Article

Determination of Physicochemical Properties of Main Product (Sugar) from Sugarcane at New Halfa Sugar Factory Sudan

Ibrahim Osman Ibrahim[1], Osman Mohamed Saad[2*] and Mohamed Osman Ahmed[3*]

[1]M.Sc. Student, Department of Chemistry, Faculty of Education, University of Kassala, Sudan
[2]Assistant Prof. Department of Chemistry, Faculty of Education, University of Kassala, Sudan
[3]Assistant Prof. Food Science and Technology Dept. Faculty of Agriculture, University of Kassala, Sudan

*Corresponding Author
Osman Mohamed Saad and Mohamed Osman Ahmed

Abstract: The main objective of this research work is to determine the Physicochemical Properties of Sugar Produced from Sugarcane at new Halfa Sugar Factory, Sudan, for season 2017/2018. For this purposes, three types of Sugar products (S_1 , S_2 , S_3) named as (Dark , Colored and White) at three periods (T_1, T_2, T_3) corresponding to (November , January and March), respectively. the parameters include: Total soluble solids (Brix) using Automatic Digital Refractometer, the sucrose % (Pol) using Automatic digital Polarimeter. Reducing sugars by ICUMSA Method GS1/3/7-3 (2005), Carbonated and sulphated Ash Nitrogen content , Moisture content, Viscosity and pH values. The results revealed that, the average levels of Total Soluble Solids (TSS), Sucrose, Sweetness, Reducing sugars, were 99.7%, 98.45%, 98.68%, 0.185%,respectively, Traces of ash were found in sugar samples, they did not exceed 0.04. Moreover, the Nitrogen content not exceeding 0.15 in sugar samples, The colour ranged between 288 , 240 and 65 (IU) for the dark , colored and white sugar respectively, the relative viscosity is ranged between 0.810 – 0.908. The kinematic (absolute) viscosity of the sugar solutions ranged between 1.804 and 1.908, the pH values of the sugar solution were found to be in the range of 6.90-6.99, and the moisture content is ranged between 0.16 – 0.23% for the three samples of sugar.

Keywords: sugarcane**,** Sugar industry and physicochemical analysis.

INTRODUCTION

Sugar industry in Sudan was established in the early 1960s and currently, it is one of the most important hard currency earners that, contribute substantially to the national economy in terms of investment volume contribution to the total value of the national investment activities. The sugar commodity also, plays a significant role in the national economy with locally produced sugar filling the gap of the sugar consumption and improving trade balance by refreshing the national economy. (Bushara and Abu Sin, 2016). Sugar cane is the main source of sugar in all tropical and subtropical countries of the world. It is an important food commercial crop in Sudan, and the main source of sugar produced for both export and domestic consumptions (Dafaalla , 2017). Sugarcane is an ancient agro industrial crop, which contributes to more than ninety percent of the sugar production in China. Recently, this industry produces about 13 million tons of sugar and many other products such as pulp, paper, alcohol, yeast, Xylitol, Chemicals, drinking cane juice, biomanure, feed, and electricity (Zeqing Xiao *et al.*, 2017). Raw sugar is an intermediate product of refining and affination process of sugar manufacturing that consists of pale yellow to brown sugar crystals covered with a film of syrup. This is in fact, an intermediate stage in the production of sugar, having sucrose and water contents 95% - 97% and 0.25% - 1.1%, respectively.(Zia-ud-Din*, and Ghulam Rasool , 2015). Sugar is the organic compound commonly known as sucrose. A white, odorless, crystalline powder with a sweet taste, it is best known for its nutritional role. Sucrose can be found in many medical dosage forms such as chewable tablets, syrups, lozenges, or gums. Sugar-free formulations of many of these dosage forms exist as well. While sugar is essentially non-toxic, it can be associated with dental caries, exacerbation of diabetes, and weight gain. The molecule is a disaccharide composed of the monosaccharide glucose and fructose with the

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molecular formula $C_{12}H_{22}O_{11}$ (Touil and Ammar, 2017). Sugar from sugarcane is extracted today more than it was at the last century. It is processed as raw sugar at sugar mills and then further purified to refined white sugar in a sugar refinery, using energy intensive processes (Khalid, 2002). During different processes which have been being done on sugar beet or sugarcane in sugar factory, Sugar is extracted as the famous product. Sucrose is disaccharide which is produced through many processes is in different kinds in market, such as: syrups or crystal sugar with different concentrations, qualities and purities (Farrokhi *et al.*, 2012). The main objective of this research work is to determine the Physicochemical Properties of Sugar Produced from Sugarcane at new Halfa Sugar Factory, Sudan, for season 2017/2018.

STUDY AREA:

New halfa is located in the lining plain on the west bank of the River Atbara between latitude (15° 20′ – 15˚ 30′ N) and longitude (33˚ 25′– 33˚ E). About 360 kilometers in the direction of the east of Khartoum and 50 kilometers west of the town of Kassala, and mediates many of the most important cities Gedaref- Kassala - Atbara - Shendi. (Sawsan 2005). It is considered of important stabilization of New Halfa Sugar factory that brings success to the process of sugar production. The gross area of the scheme is about 42,000 acres. The New Halfa project scheme was developed in the 1960s in the context of the resettlement of people who were displaced when Lake Nasser was formed (Abbass, and El_Hag, 2013).

MATERIALS AND METHODS

Comprehensive Laboratory analysis were carried out for sugar products of sugarcane in New Halfa Sugar Factory (Sudan) for season 2017/2018 to find out the physicochemical properties of this products. for this purpose, The analysis was conducted on samples from three types of sugar (Dark (S_1) , colored (S_2) and white (S_3)) Sugars at three periods (T_1, T_2, T_3) corresponding to (November , January and March), respectively. The parameters include: Total soluble solids (Brix) using Automatic Digital Refractometer, The sucrose % (Pol) using Automatic digital Polarimeter, Reducing sugars by Carbonated and Sulphated ash. Nitrogen content, Moisture content, Viscosity and pH values.

RESULTS AND DISCUSSION

Results:

Table 1: Sucrose, TSS and Sweetness of final product (sugar)

Sugar Sample	Sucrose%			TSS			Sweetness		
	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3
Dark Sugar	**97.49**	**97.44**	**97.45**	**98.72**	**98.74**	**98.76**	**98.75**	98.68	98.67
Colored	**97.48**	**97.50**	**97.49**	**98.56**	**98.52**	98.54	98.90	98.96	98.93
Bright white	**97.46**	**97.44**	**97.46**	98.37	98.32	98.29	**99.07**	**99.10**	**99.16**

T_1 = November. T_2 = January. T_3 = March

Table 2: Reducing sugars, Nitrogen and Ash content of final product (sugar)

Sugar Sample	Red. Sugars			Nitrogen%			Carbonated ash %			Sulphated ash %		
	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3
Dark Sugar	0.182	0.184	0.180	0.152	0.150	0.152	0.043	0.036	0.038	0.034	0.045	0.048
Colored	0.145	0.143	0.143	0.128	0.129	0.126	0.034	0.022	0.027	0.028	0.035	0.039
Bright white	—	—	—	—	—	—	traces	traces	traces	Traces	traces	traces

T_1 = November. T_2 = January. T_3 = March

Table 3: Physical properties of final product (sugar) at November 2017

Sugar Sample	Moisture %			Colour (IU)			Relative viscosity			kinematic viscosity			pH value		
	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3	T_1	T_2	T_3
Dark Sugar	0.22	0.23	0.21	**287**	**288**	**288**	0.908	0.903	0.904	1.908	1.908	1.905	6.96	6.93	6.92
Colored	0.19	0.20	0.18	**239**	**237**	**241**	0.859	0.860	0.858	1.856	1.866	1.868	6.99	6.90	6.95
Bright white	0.17	0.18	0.16	**65**	**65**	**64**	0.810	0.811	0.813	1.811	1.806	1.804	6.99	6.99	6.98

T_1 = November. T_2 = January. T_3 = March

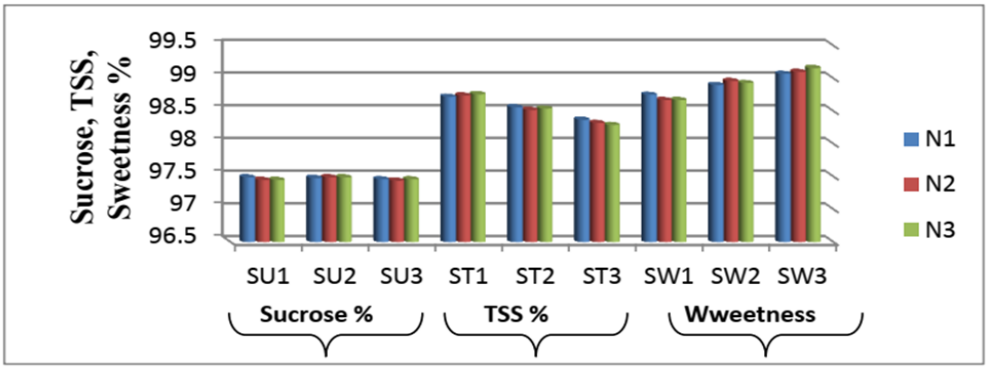

Fig (1): Sucrose, TSS and Sweetness of final product (sugar)

S1= Dark colored sugar S2 = colored sugar S3 = white sugar
T1= November T2 = January T3 = March

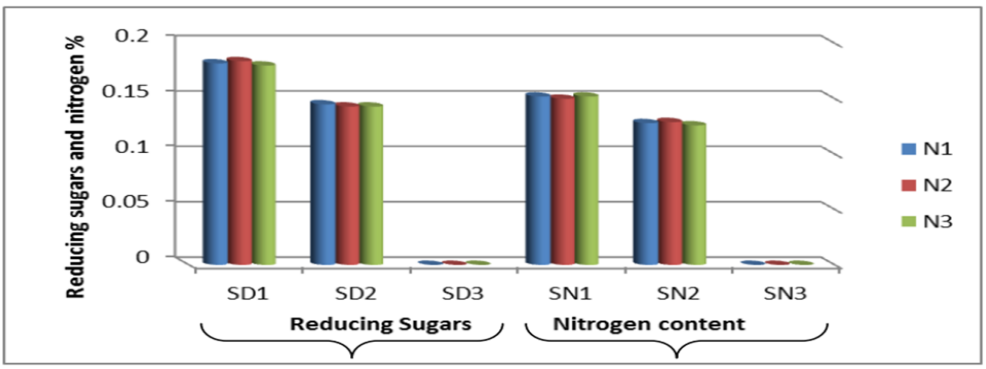

Fig (2): Reducin3g sugars and Nitrogen content of final product (sugar)

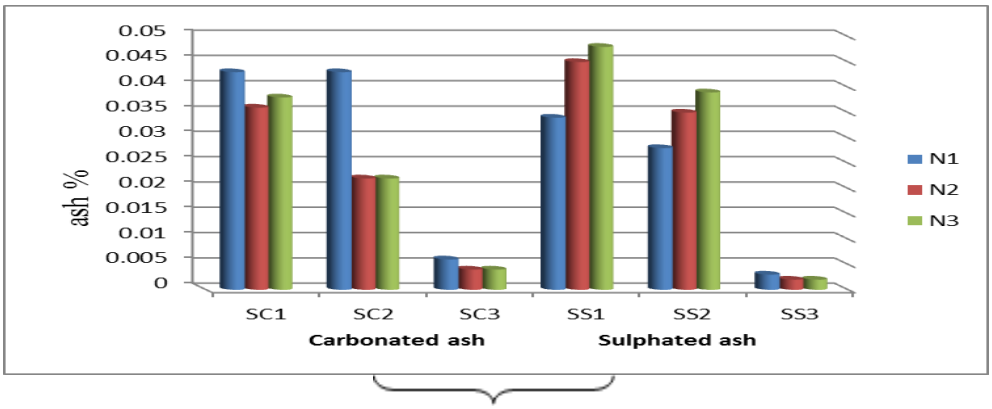

Fig (3): Carbonated and Sulphated Ash content of final product (sugar)

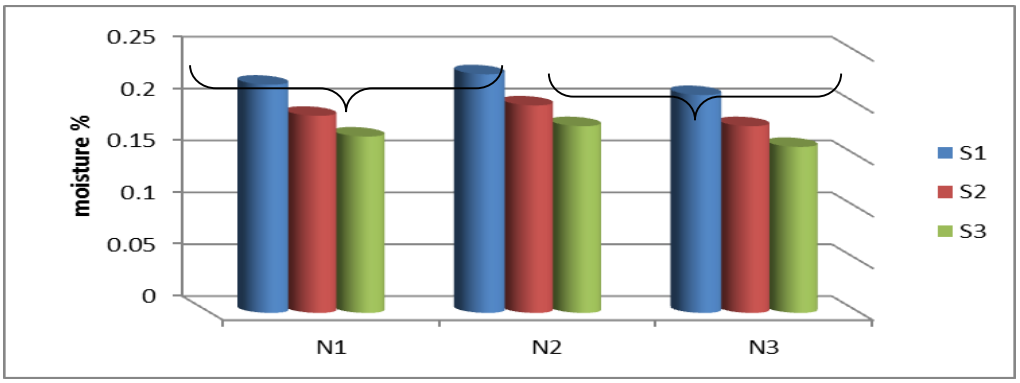

Fig (4): Moisture content of final product (sugar)

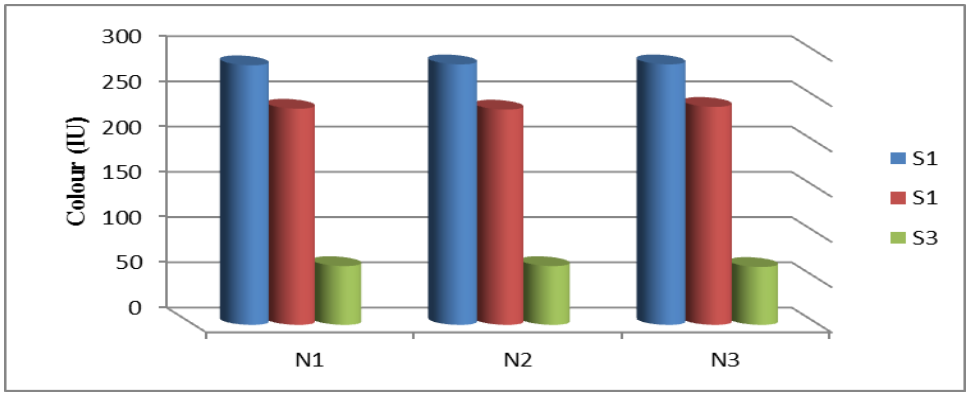

Fig (5): Colour of final product (sugar)

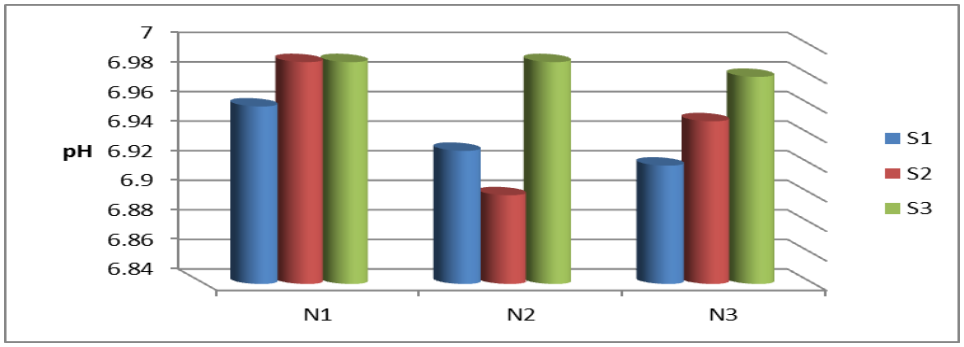

Fig (6): pH of final product (sugar)

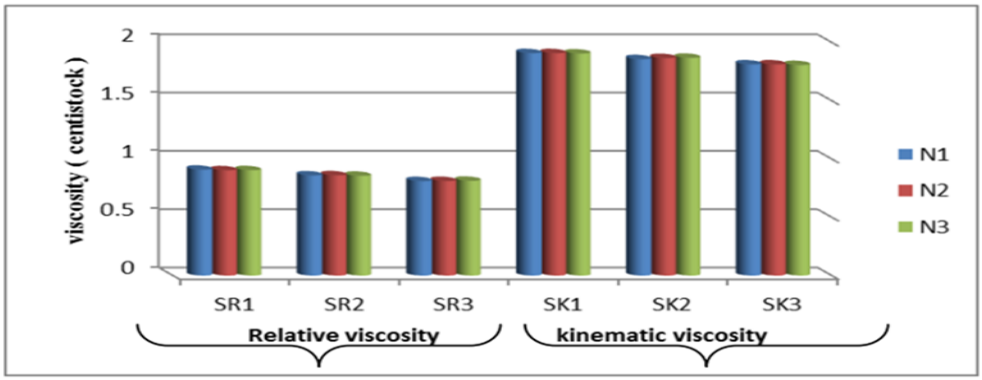

Fig (7): Viscosity of final product (sugar)

DISCUSSION:

Table (1) show the total soluble solids in sugar samples which ranged between 98.32 – 98.76 % for the three samples at the three months respectively. No significant difference at P ≤ 0.05 was found for the total soluble solids neither between samples nor at the different months. The results are in agreement with those reported by [Gloybin,1995 and fok,1989]. The table shows the sucrose content of sugars which ranged between 97.44 – 97.50 %. The results indicated no significant differences at P ≤ 0.05 neither between samples nor at the different months, These results are in agreement with that stated by [Gloybin,1995 and fok,1989]. The above table shows the sweetness (purity; sucrose ×100/T.S.S), which ranged between 98.67 – 99.16%, These results are in agreement with those stated by [Gloybin,1995 and fok,1989]. As shown in table 2, the values of reducing sugars was 0.182 and 0.143 % for the dark and colored sugar respectively, while no reducing sugars found in the white sugar. No significant differences were found among the three months, and also between the two colored sugars at P≤ 0.05 The results are in agreement with that stated by[Gloybin,1995 , Ahmed, 1999, and Anon, 1990] . Table 2 also shows the mean values of nitrogen and ash content in the final product (sugar) which were 0.126 - 0.152 % nitrogen , 0.038 - 0.027% as carbonated ash and 0.046-0.035as sulfated ash for the dark and colored sugars respectively while it was traces in the white sugar. The results show no noticeable difference at P ≤ 0.05, between the three months. The results are related to the results stated by [Gloybin,1995, Fok,1989 and Braner, 1974]. Tables 3 illustrates the evaluation of colour of the final product (sugar) among the three samples at different durations. The colour ranged between 64 ICOMSA unit (IU) as the lowest value and maximum value 288 (IU). No significant differences at P ≤ 0.05 were found at the three months for each

sample, but highly significant differences were found between the samples. The results are in agreement with that found by[Lal mathure,1993 and ASI, 2006]. Table 3 shows also the mean values of the viscosity , pH of sugar solution and moisture content. The relative viscosity ranged between 0.810 – 0.908. The kinematic (absolute) viscosity of the sugar solutions ranged between 1.804 and 1.908 centistokes. The pH values range between 6.90 - 6.99, while moisture ranges between 0.16 - 0.23. These results are in accordance to [Awad, 2003 Neil,. and Charles,1990].

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