Pakistan J. Sci. Ind. Res., Vol. 27, No. 3, June 1984

SUGARCANE PROCESSING AT THE VILLAGE LEVEL

Part IV – A Method for the Preparation of Sugarcane Syrup Rich in Trace Metals and Trace Metals of Gur (Jaggery, Panila)*

S.T.A. Bokhari, S. Shaukat Ali, K.M. Janjua and Ehsan Ali

PCSIR Laboratories, Lahore-16, Pakistan

(Received January 3, 1984)

A method for the preparation of syrup, free from impurities and without the use of chemicals, from sugarcane juice has been developed. The syrup can be used in place of sugar in milk, tea, coffee and other soft drinks. The trace metal contents of the syrup and gur, collected from the market were quantitatively determined with Atomic Absorption Spectrophotometer. Trace metals such as copper, chromium, lead, iron, nickle, zinc, sodium, calcium, magnesium, managanese and potassium have been estimated. With the exception of lead nearly all other meatls have good effects on human health. Amount of lead varies from 0.18 ppm to 0.67 ppm, which is quite below the maximum limits prescribed by FAO/WHO. The amount of chromium varies from 0.04 ppm to 0.30 ppm. Chromium metal is the most beneficial of all the metals present. Due to the presence of chromium and other metals, whole cane syrup and gur is far superior to white sugar.

INTRODUCTION

In sugarcane juice, nature has combined a number of different constitutents in addition to sugar. Sugar is a pure chemical and many nutrition experts agree that harm done by sugar lies in its concentration into a pure form. In sugarcane the dilution of pure sugar with large amount of fibre, alongwith all its vitamins and minerals might reduce the harmful effects of sugar on our health [1].

It is mentioned in the ancient literature that old gur purifies blood, prevents rehumatic effect and disorder of bile in addition to the nutritive properties of a high order [2]. Even today, sugar is considered an arch foe of human beings and reduction of death rate had been observed due to eating less sugar [1].

Nutrition experts have become increasingly concerned about the possible healthy effects of certain trace metals in food [3]. The medicinal value of gur may be co-related to certain trace metal constitutents. Gur, syrup and brown sugar prepared without the use of chemicals, contain nearly all the natural constitutents having a useful effect on the human health. The sugarcane contains a number of trace metals which are useful for health. The level of trace metal in sugarcane depends upon the natural condition of soil, climate, genetic properties of plants, chemical composition of fertilizer and environmental conditions.

This paper reports the quantitative assessment of certain trace metal contents of syrup and gur prepared from sugarcane, collected from different rural areas in Pakistan.

*Inspissated juice expressed from sugarcane is known as Gur in Pakistan, Jaggery in India and Panila in South America.

EXPERIMENTAL

Polyacrylamide Solution (Poly Electrolyte Solution). Polyacrylamide (2 g) was dissolved in water (10 litres), by vigorously stirring.

Sugarcane Juice Syrup. Sugarcane juice (88 kg), free from dust and dirt was transferred to a steam jacketed pan, sodium dihydrogen phosphate (1 g) and one litre of polyacrylamide solution (.02%) was added to the juice and thoroughly mixed. The juice was boiled and the scum was removed with a sieve having long handle. The juice was cooled and passed through a Sharply Centrifuge. The resulting juice was clear having negligible impurities. The juice was again boiled and the remaining polyacrylamide solution was added in parts during boiling. Floating impurities were removed during the processing and the juice was concentrated to 70 Brix. Yield (20 kg), 23% on juice.

Atomic Absorption Spectrophotometer Measurements. [4] Measurements of absorption were carried out in ketone phase by using Perkin Elmer 280-B, atomic absorption spec-

trophotometer, with lamps having different wavelengths, given below:

Sr. No.	Element	Wavelength in mn units
1.	Copper	324.7
2.	Chromium	257.9
3.	Lead	283.3
4.	Iron	248.3
5.	Nickel	232.0
6.	Zinc	213.9
7.	Sodium	589.0
8.	Calcium	422.7
9.	Magnesium	285.2
10.	Manganese	279.5
11.	Potassium	766.5

Air-acetylene mixture was used and the amount of trace metals determined have been recorded in Table 1.

The syrup was tested by a taste penel consisting of people of varied taste. It was found suitable for soft drink and sweetening agent in milk, tea, coffee etc. in place of white sugar.

DISCUSSION

The method for the preparation of the best quality gur has been reported in the previous paper[5]. The elements present in syrup have been compared with gur, white sugar and shakkar (powdered inspissated juice expressed from sugarcane). The quantitative results have been recorded in Table 1. Nearly all the elements detected are well within the maximum limits prescribed by the health authorities concerned, such as FAO/WHO[6]. Many trace metals such as copper, manganese, zinc, iron, cobalt, chromium, nickle, potassium, sodium etc. are essential to the vital process of routine body function, while lead is of proven toxic potential[7]. The sugarcane juice analysed contains most of the trace metals required to maintain the health. Chromium is the metal which is found only in the natural fruits and vegetables which contain sucrose. The present studies establish the presence of chromium in the sugarcane products, produced in Pakistan (Table 1).

Chromium. Trivalent chromium was first recognised as essential in mammals in 1955, when its deficiency was shown to impair glucose tolerance, perhaps by reducing the tissue response to insulin[8]. According to Dr. Mertz theory, presence of chromium protects the sugarcane eaters from the side variations in blood sugar, which is destructive to the health. He tested the molasses laden sugar and found it to contain more chromium (.280 ppm) than any food he had ever tested. He also suggested that chromium in raw sugar was in active form and the amount detected in white sugar was in inactive form[1]. It is interesting to note that natural sugar, for instance honey, black-strap molasses, raw sugar and orange juice, all posses some traces of chromium (Table 2). White sugar and other refined food in contrast,

Table 1. Trace metal in white sugar, raw cane sugar (gur, shakkar) and syrup.

Samp. No.	Copper (ppm)	Chromium (ppm)	Lead (ppm)	Iron (ppm)	Nickel (ppm)	Zinc (ppm)	Sodium (ppm)	Calcium (ppm)	Magnesium (ppm)	Manganese (ppm)	Potassium (ppm)
1	2	3	4	5	6	7	8	9	10	11	12
1.	ND	ND	ND	ND	ND	ND	0.776	ND	ND	ND	--
2.	ND	ND	ND	ND	ND	ND	0.346	ND	ND	ND	–
3.	0.02	0.04	0.18	0.30	0.035	0.02	1.126	2.492	0.119	8.15	–
4.	0.03	0.06	0.041	0.45	0.090	0.13	0.765	5.643	0.100	1.44	–
5.	0.03	0.20	0.42	1.93	0.055	0.58	1.856	2.570	1.250	0.76	–
6.	0.03	0.25	0.45	0.40	0.050	0.12	0.827	3.694	0.105	1.85	–
7.	0.02	0.18	0.55	0.75	0.08	ND	0.645	2.863	0.108	6.60	–
8.	0.05	0.25	0.53	0.83	0.107	ND	0.602	1.664	0.118	3.17	4900
9.	0.08	0.25	0.64	0.75	0.017	ND	0.713	1.751	0.115	5.38	5100
10.	0.11	0.30	0.67	0.86	0.010	ND	0.536	1.088	0.130	4.30	1760

NO. 1-2 = White sugar; No. 3-5 = Gur; No. 6 = Shakkar; No. 7-10 Syrup; ND = Not detectable.

lose almost all the natural chromium (Table 1) during their manufacturing, only gur is comparable to honey as regards to the chromium content.

Table 2[3]. Chromium in sweet things.

Source	Average Micrograms per gram
Glucose	0.03
White Sugar	0.07
Dark Raw Sugar	0.24
Orange Juice	0.13
Fructose of Fruit Sugar	0.18
Molasses Black Strap	0.22
Maple Syrup	0.18
Honey	0.29

It has already been mentioned that the trace metals in any natural vegetation varies with the natural condition of soil, climate, genetic properties of plants, chemical composition of fertilizer and invironmental conditions. The amount of chromium determined in varios samples of gur, shakkar and white sugar has been recorded present studies also show the total absence of chromium in white sugar (Table 2). The amount of chromium varies from 0.04 ppm to 0.30 ppm, in gur, shakkar and sugarcane juice syrup which is comparable with the reported results (Table 2). A huge population of Pakistan lives in villages where gur is the most common sweetening commodity and the villagers rarely have diseases such as *Diabetes mellitus* which are common among city dewellers, using white sugar. Use of gur, shakkar and sugarcane juice syrup prepared under the hygenic conditions without the use of any hazardous chemical, will be definitely better than white sugar.

Potassium. Potassium plays an important role in muscle energising and propagation of nerve impulse in the human body. Potassium is the main element in the water inside the cells, and sodium in the water out side the cells. Every time we use a nerve or muscle, the pressure at the walls of the cells changes and the result is that the potassium in pushed out of the cell, and sodium enters. A correct potassium-sodium balance is vital for nerves to react normally and for muscles to work properly[3].

During the wheat harvesting season when farmers feel exhausted they take soft drink of gur. Their muscle fatigue vanishes and they soon feel recovered. This is due to the presence of reasonable amount of potassium (1760 ppm - 5100 ppm) in gur, (Table 2).

Lead. Patterson has estimated that 90% of the amount of lead ingested is derived from food intakes and as much as 5% of this is abosrbed by the human body[7]. The lead alkyls used as gasoline additives provide an major source of lead in the atmosphere. An average gasoline contains lead (3 g per gallon) and approximately two thirds of lead added in gasoline is exhausted by the automobiles[9]. The lead falls inevitably on food crops and water and it is an established fact that lead contents in the crops increase both with the proximity to highways and automobile traffic volume.

Lead present in gur, shakkar and syrup, varies from 0.18 ppm to 0.67 ppm (Table 1). Gur is prepared at the village level in the open and gets contaminated from the surroundings. The reported lead metal in the raw sugar is 0.25 ppm. The samples of gur collected from villages far away from the thickly populated areas contain almost one third the amount of lead (0.18 ppm) as compared to the gur samples prepared from sugarcane grown and processed in the thickly populated areas of the city (.64 ppm). White sugar shows no traces of the metal. Our results indicate that daily intake of lead from gur by man will be appreciably lower than FAO/WHO[6], maximum acceptable total daily intake of lead, i.e., 0.005 mg/kg body weight[10].

Maximum lead is found in coffee (0.74 ppm), tea (0.15 ppm) dried canned food (0.21 ppm) wine (0.13 ppm) and bacon (0.15-0.74 ppm)[4]. Fortunately, these food products are not as much in use in Pakistan as in Europe, therefore, the total lead intake in Pakistan will be much lower than the maximum limit (3 mg per person per week) set by the FAO/WHO[6].

Acknowledgement. The authors are grateful to Dr. Karimullah, Ex. Director PCSIR, Laboratories, Lahore, for useful discussion and relevant information. The authors are also thankful to Mrs. Taqi-ul-Hasan and Mrs. Shagufta Butt, of The Public Health Engineering Laboratories, Lahore for helping in determination of trace metals.

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