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COMPOSITION OF VARIOUS VARIETIES OF GUR (AN INSPISSATED SUGARCANE JUICE) PRODUCED IN PAKISTAN
Part II

S.T. A. Bokhari, S. Shaukat Ali, Shafiullah Khan, M.Y. Ikram-ul-Haq, Fazal-ur-Rehman and Ehsan Ali

PCSIR Laboratories, Lahore, Pakistan

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Fifty five samples of gur were collected from different parts of Pakistan and analysed with respect of moisture, total ash, acid insoluble ash, reducing and non-reducing sugars, and colour. Moisture content varies from 3-11%. Presence of high amount of moisture affects the shelf-life of gur. Ash content varies from 2-4.5%, but most of the samples give less than 4% ash. The Ash comprises of sugarcane juice ash and ash due to added inorganic salts. An appreciable amount of acid insoluble ash indicates the presence of silica. Reducing sugar varies from 3.5 to 10%, depending upon the pH for the juice and the stage at which the clarifying agents are incorporated. Increase in the amount of reducing sugar affects the colour and shelf-life adversely. Such a wide range of variation of the characteristics of gur are due to the non-uniformity of the processing techniques employed for gur manufacturing, soil and the harvesting time.

INTRODUCTION

The state of art for the processing of sugarcane at village level has been described in Part-I[1]. Gur, no doubt (it is an inspissated juice expressed from the sugarcane), is the most common sweetening agent used in Pakistan, yet it is least investigated[2]. It has been observed that there are many techniques to manufacture gur. Purification or juice clarification techniques vary from place to place. Chemicals used for clarification and their time of addition vary from processor to processor. Gur is consumed by 80% population of Pakistan either directly or through some palatable dish. So far no comprehensive study[3] about the impurity and quality of gur has been carried out. Sugarcane juice consists of water and elements dissolved in it as ions, salts or parts of organic compounds. Phosphates, silica and magnesium are partially removed during clarification only at mill level whereas potassium, chloride, sodium and low concentrations of sulphate are not removed and remain present in molasses. At village level, the salts used during clarification process are also present in the final product in addition to the original constituents of the juice. Keeping in view the importance of gur as a food, a number of samples were collected from different parts of Pakistan and evaluated with respect to their moisture, ash, reducing sugar, total sugars and colour.

MATERIALS AND METHODS

Collection of Gur. Gur samples were collected from Sind, Punjab and NWFP provinces during our survey for the Village Level Food Processing Programme, during 1978-79 season. These samples were stored in polythene bags and used for the determination of their composition.

Fehling's Solution [4]. No. 1 Copper sulphate ($CuSO_4 5H_2O$; 69.27 g), was dissolved in water and the solution was made upto one litre.

No. 2 Sodium hydroxide (100 g) and sodium potassium tartarate (34.6 g) were dissolved in water and the solution was made upto one litre.

Gur Solution. Gur solution was prepared by dissolving gur (5 g), in distilled water making total volume to 100 ml. To which lead acetate basic (1.0 g) for sugar analysis according to Horn, and potassium oxalate (0.5 g) were added. The suspension formed was filtered and the filterate was marked as "gur solution."

Gur Solution for Reducing Sugar. Gur solution (50 ml) was diluted to 100 ml with distilled water and this solution was used for titration against Fehling's solution for the estimation of reducing sugar.

Gur Solution for Total Sugars. To gur solution (5 ml), one normal hydrochloric acid (7 ml) and water (60 ml) were added, boiled for 2-3 minutes and diluted to 100 ml with distilled water. This solution was used for titration against Fehling's solution for the estimation of total sugars.

Moisture Determination[5]. A cleaned stainless steel dish with cover was weighed accurately. Gur sample was placed in the dried dish, covered and weighed. The dish containing sample was placed in a electric oven previously heated to 105-110°. The cover was removed and the dish was kept for 3-4 hours in the oven. The dish was cooled

in a desiccator and weighed to a constant weight. The percentage moisture was calculated as follows:

$$\text{Moisture percentage} = \frac{\text{Loss in weight during drying}}{\text{Weight of gur sample taken}} \times 100$$

Total Ash Determination[6]. A porcelain crucible having 50 ml capacity was ignited, cooled in a desiccator and weighed.

Gur sample (10 g) was weighed in the crucible. The crucible was heated gently with a Bunsen burner until there was no smoke. Then crucible was placed in an electric muffled furnace, previously heated to 250°. Temperature of the furnace was gradually increased and was maintained between 500-550°, for a period of three hours until all the carbonaceous matter had burnt off. The crucible was removed from the furnace, allowed to cool in a desiccator and finally weighed. The percentage of ash was calculated as follows:

$$\text{Ash percentage} = \frac{\text{Weight of ash}}{\text{Weight of gur sample taken}} \times 100$$

Hydrochloric Acid Insoluble Ash Determination. To the finally weighed crucible containing ash, concentrated hydrochloric acid (5 ml) was added. The crucible was heated gently for 2-3 minutes over the burner. The crucible was cooled. The content was diluted with water (20 ml), filtered through the pre-weighed Wattman No. 40, filter paper and the residue was washed thrice with distilled water. The residue was dried for one hour at 105-110° in an electric oven, and weighed. The percentage of acid insoluble ash was calculated as follows:

$$\text{Hydrochloric Acid Insoluble Ash} = \frac{\text{Wt. of Acid Insoluble Residue}}{\text{Wt. of gur sample taken}} \times 100$$

Reducing and Non-reducing Sugar Determination. Lane and Eynon's[4], method was adopted to determine reducing and non-reducing sugars.

Preliminary Titration. Fehling's solution (No. 1: 5ml + No.2: 5 ml) was taken into a conical flask, and sugar solution (5 ml) was added from the burette. The liquid was boiled and further quantity of the sugar solution (1 ml at a time) was added at 10-15 seconds intervals to the boiling liquid until the blue colour nearly discharged. Then 1% aqueous methylene blue solution (2-3 drops) was added and the titration was continued until the colour of the indicator completely decolourised.

Accurate Titration. Fehling's solution (No. 1: 5 ml + No. 2: 5 ml) was taken into a conical flask, and almost all the sugar solution required to effect reduction was added from the burette. The solution was boiled gently for two minutes. The methylene blue indicator (3-5 drops) was added and the titration was completed within a total boiling time of three minutes. At the end point the blue colour discharged and the liquid turned orange. The proportions[6] of the reducing sugar equivalent to Fehling's solution (10 ml) were consulted from the Table.

Similarly, preliminary and accurate titrations were carried out, using gur solution prepared for the estimation of total sugars and the proportions of the sugars were consulted from the Table.

DISCUSSION

It has been well established that gur, in addition to its sweetening properties has also nutritive value because it contains minerals, amino acids, proteins and vitamins. Table 1, clearly indicates that gur produced in the country has no uniform qualities as regards to moisture, sugars and colour. A number of chemicals irrespective of their hazardous nature are used to impart lustre temporarily, so that the product may fetch a good price in the market.

The moisture content of gur controls its shelf-life and market value. Its moisture percentage varies from 3-11% which is caused due to seasonal effect. Gur prepared during the months of November, to January has much more moisture as compared to gur made during the months of February, to April. During rainy season the moisture content of gur sometimes increases to such an extent that the look of it makes it unattractive for human consumption. The moisture content of gur also depends upon the amount of reducing sugar (dextrose) which forms during the processing of gur, due to the addition of certain hazardous chemicals employed for imparting the colour and lustre to gur. The high moisture content also deteriorates the shelf-life of the product. The high processing temperature[7] which ranges from 100-115° also effects the quality of gur.

The ash content of the gur samples varies from 2-5%. It consists of mineral constituents of the sugarcane as well as the insoluble impurities added during the processing (open pan). These impurities contain soluble salts from 0.7-1.4%(Table 2) which are mostly added for clarification and decolorization purposes of the juice. Acid insoluble ash is generally silica, this depends upon the nature of soil and the weather conditions on the day of processing. Windy

Table 1. Analytical data of gur (an inspissated sugarcane juice) crushing season 1977-78.

		ASH					
Sample No.	Moisture %	Total %	Water Insoluble %	Acid insoluble %	Reducing sugar %	Total sugar %	Colour index
1.	9.64	2.17	0.97	0.40	6.48	84.70	8.88
2.	7.15	2.54	1.49	0.70	7.64	85.74	9.20
3.	10.00	2.17	1.11	0.59	6.79	84.87	9.60
4.	10.96	3.32	1.24	0.58	5.67	84.35	10.40
5.	7.22	2.25	0.98	0.45	7.42	86.09	9.96
6.	8.28	2.57	0.91	0.44	7.97	86.17	9.96
7.	8.21	2.39	1.14	0.67	3.69	87.07	5.44
8.	4.21	2.93	1.25	0.65	4.71	88.68	6.52
9.	8.06	3.72	0.16	0.12	9.68	84.41	7.72
10.	9.46	4.55	0.47	0.14	5.94	81.93	6.08
11.	6.17	3.59	0.79	0.11	9.95	87.38	8.60
12.	7.98	3.50	0.71	0.07	7.54	83.83	7.76
13.	4.02	4.47	0.66	0.06	6.45	89.26	5.64
14.	3.79	2.44	0.67	0.07	4.57	90.82	3.56
15.	7.07	3.19	0.68	0.07	3.33	87.00	10.44
16.	10.52	4.01	0.91	0.06	5.81	87.55	6.08
17.	5.93	3.71	2.42	1.60	3.20	88.32	2.00
18.	1.24	2.36	2.12	1.67	4.09	88.70	1.10
19.	6.63	2.36	1.62	0.71	4.85	79.42	2.17
20.	1.14	1.42	1.00	0.89	5.01	96.18	0.16
21.	4.79	3.44	1.09	0.18	5.12	82.31	2.62
21.	2.57	2.52	1.83	1.33	6.10	94.78	0.36
23.	6.58	4.05	2.48	1.85	5.60	85.05	2.75
24.	7.13	4.04	0.30	0.17	7.32	88.32	0.46
25.	4.01	5.04	0.79	0.24	7.76	86.44	2.00
26.	3.35	3.21	0.35	0.06	3.40	84.35	2.99
27.	4.62	3.47	0.59	0.29	5.51	84.70	2.54
28.	7.62	4.17	0.34	0.15	6.30	85.74	2.29
29.	8.38	3.60	0.28	0.17	6.10	85.05	1.06
30.	8.03	4.38	0.25	0.14	6.39	84.70	2.56
31.	6.07	4.58	0.77	0.41	3.05	89.45	13.33
32.	8.04	4.19	1.33	1.16	7.02	87.19	10.29
33.	6.18	3.78	0.94	0.63	8.40	87.94	13.38
34.	10.57	4.42	0.99	0.28	7.02	82.96	16.63
35.	7.05	3.52	1.26	1.03	5.68	87.94	9.53
36.	8.58	3.30	1.03	0.41	9.35	88.70	7.75
37.	6.12	3.41	0.95	0.42	5.66	87.94	10.67
38.	5.97	4.04	1.25	0.65	7.91	87.94	8.49
39.	7.75	3.82	1.35	0.74	9.25	87.19	8.52
40.	6.90	3.62	0.93	0.46	6.58	87.19	12.73

Continued (. . . . .)

(Table 1, continued)

41.	4.11	2.87	0.71	0.15	6.79	88.32	16.51
42.	2.61	3.59	0.77	0.18	4.67	90.20	29.17
43.	5.29	2.87	0.87	0.18	10.68	86.44	31.09
44.	2.90	3.29	0.74	0.16	5.32	92.26	27.63
45.	2.66	3.99	0.91	0.24	5.20	89.45	28.95
46.	2.42	3.46	0.88	0.06	4.29	92.26	25.52
47.	4.9	4.31	0.70	0.12	5.92	88.70	36.93
48.	5.75	4.36	0.70	0.09	6.83	88.70	35.30
49.	5.59	3.35	0.59	0.02	8.10	91.02	10.81
50.	4.35	3.93	0.69	0.10	5.67	89.82	27.78
51.	6.50	3.58	0.76	0.11	4.43	91.02	19.02
52.	4.89	3.73	0.83	0.06	6.83	93.50	10.04
53.	8.11	3.81	0.75	0.14	4.67	87.57	6.94
54.	7.9	2.44	0.70	0.12	5.78	90.20	6.84
55.	5.1	4.25	0.87	0.22	10.01	87.94	9.83

and dusty day increases this impurity.

The specification mentioned in the West Pakistan Pure Food Ordinance (VII of 1960)[10], for the total ash is 6%, which is much higher. The ash content (6%) is actually for the mill molasses. It has been noted[9] that ash content of the unclarified cane juice is 0.3%. If this 0.3% ash content is converted on solid basis, it comes to 1.5%. It is further observed that the purity of sugarcane juice is 85%, Table 3, which is higher as compared to the mill juice Table 4. It is reported that the mill juice is a mixture of different extractions of sugarcane juice. The first mill-extraction of juice is of maximum purity 85%, whereas the purity of the last mill-extraction of juice is 67%. The repeated washings are responsible for a higher ash contents in the molasses, Table 5, and this further increases due to the removal of crystalline sugar. It can be safely summed up that the ash contents of gur should not be more than 3% i.e., 1.5% from the sugarcane and maximum 1.5% from the add impurities. Comprehensive study carried out by India[3] shows ash content 2-5%. We suggest The West Pakistan Pure Food Ordinance should be re-examined in the

Table 2[7]. Amount of chemicals used in gur making

Rongolit %	Sodium carbonate %	Gaozaban %
0.23	0.23	0.30
0.21	0.21	0.27
0.43	0.43	0.52

Table 3[7]. Purity of juice in different provinces

	No. of cases	Purity %
Punjab	34	86.6
Sind	30	88.5
NWFP	30	80.0

Table 4[8]. Purity obtained from milling with compound saturation.

Source of samples	Brix	Pol	Purity
Double crusher	17.16	14.50	84.50
First mill			
Front roll	17.08	14.12	82.67
Back roll	16.13	13.06	80.97
Second mill			
Front roll	7.63	5.83	76.41
Back roll	9.37	7.31	78.01
Third mill.			
Front roll	5.04	3.73	74.01
Back roll	6.14	4.54	73.94
Fourth mill.			
Front roll	3.00	2.18	70.60
Back roll	4.52	3.26	72.12
Fifth mill			
Front roll	1.31	0.88	67.18
Back roll	2.55	1.78	69.80

Table 5[9]. Ash percentage of sugarcane molasses.

Light colour	6.3
Medium	8.5
Blackstrap	10.5

light of our observations.

The gur manufacturers at the villages use a number of chemicals for the clarification of cane juice for making gur. They have no knowledge of the after-effects of these chemicals which are responsible for the deterioration of keeping quality and colour of gur. They also over-heat the sugarcane juice during concentration, and thus the final product is caramilised. Tnere is a need of detailed study of the effects of chemicals for the general benefit of gur manufacturers and consumers.

The total sugars vary from 79-96%, though the quality of gur is controlled by the amount of sucrose only. Higher amount of sucrose will impart lustre and improve the texture of gur. The working period of sugar mills is limited to 180 days and rest of the year they remain idle . Attempts have been made to run the mills on gur during the idle period. The recovery of sucrose has not been found economical because it does not exceed 50% on the gur basis and 5% on cane basis. The recovery of sugar from gur is economical if gur is of better quality, moreover mills can operate round the year. It is concluded that there is a need to develop a standard method to produce gur of uniform and better qualities without the addition of chemical which are harmful to human consumption.

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