

# Comparative Study of Varied Minerals and Physico-Chemical Properties in Two Jaggery (Light Brown and Dark Brown) and Two Sugar (White and Brown) Sample

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## ABSTRACT

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Aim of our present study was to compare jaggery and sugar samples available in local market on the basis of their nutritional value. Jaggery is produced from sugarcane juice. Jaggery is a vast cottage industry and also known as health friendly sweetener among rural masses since long time. Production of jaggery is seasonal and usually stored over a fairly long period of 6-8 months. Jaggery is an unrefined sugar and regarded as 'whole sweetener' because of its good nutritional value. Many organic and inorganic compounds present in sugarcane juice are retained along with sucrose and hence more nutritive than that of refined sugar.

We found that pH value almost same range between 6.03 to 6.98, ash value 0.0003 to 0.0322 %, vitamin C between 0.01 to 0.14 g/100gm, total acidity 0.06 to 0.828 g/100 gm, significant difference in potassium 25 to 608.3 mg/100gm and sodium 0 in sugar while 125 mg/ 100gm in jaggery, phosphorus 0.1838 to 0.9084 mg/ 100gm and iron 0.425 to 24 mg/100gm of samples. Based on the result obtained we found that jaggery has very high nutritional value than sugar samples.

### Article History

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## I. INTRODUCTION

Sugarcane (*Sacharum officinarum*. L) is one of the important cash crops in Indian peninsula which are available in plenty during the season. It is a good source of sugar, minerals and polyphenols. Sugar cane used for production of liquid jaggery from the its juice. This method is widely used in country side and

become big profitable industry of farmers [1]. Jaggery is produced from sugarcane juice. Jaggery is a vast cottage industry and also known as health friendly sweetener among rural masses since long time. Production of jaggery is seasonal and usually stored over a fairly long period of 6-8 months [2].

Jaggery is the sugarcane based traditional Indian sweetener. Jaggery is nutritious and easily available to

the rural people. Jaggery is an unrefined sugar and regarded as 'whole sweetener' because of its good nutritional value. Many organic and inorganic compounds present in sugarcane juice are retained along with sucrose and hence more nutritive than that of refined sugar [3]. Jaggery is used for various purpose such as a media for the preparation of different Ayurvedic formulations such as Asava, Arishtas, Lehya, Gula etc. It is also used as vehicle during administration of drugs. It contains up to 50% sucrose, up to 20% invert sugars with some other insoluble matter such as ash, proteins and bagasse fibers [4].

Jaggery is a natural product obtained from the concentrated juice of sugarcane, sugar beet, coconut palm date palm, palmyra etc. Jaggery is also known as Gur in India, Desi in Pakistan, Hakaru in Sri Lanka, Htanyet in Myanmar and jaggery in African countries [1].

The quality and price of jaggery is varies and it depends upon its external features like color and texture. Good quality jaggery is identify on features like golden yellow in color, hard in texture, crystalline structure, and its unique sweet taste, less in impurities like molasses and some crystals and low in moisture. The quality of jaggery is affected by many factors such as the variety of sugarcane grown (organically or conventionally), fertilizers used (natural or chemicals), quality of water in particular soil region and the method of clarification, processing time, storage condition and packaging methods adopted. Grading of jaggery is based on its physical quality parameters like colour and texture, and chemical quality parameters like sucrose content, reducing sugar, moisture, water insoluble material, etc [5] (Kumar *et. al.*, 2013)

Kumar and Singh showed antioxidant properties of jaggery along with selenium. Jaggery contains potassium and low amount of sodium which helps to maintain the acid balance in the body cells, and also

fight to controls body blood pressure. Jaggery is called as rich source iron which helps to prevent anemia. Because of its anti-allergic properties it helps to relief tension and takes care of asthma [5, 6]. Jaggery contains good amount of proteins, vitamins and minerals, which are essential constituents for the body. It is also a potent source of iron and copper [7]. The high water activity values leads to microbial deterioration and biochemical degradation reactions [8].

Composition of jaggery can vary from golden brown to dark brown in colour and contains up to 50% sucrose, up to 20% invert sugars, moisture content of up to 20%, and the remainder made up of other insoluble matter, proteins, various vitamins and bagasse. Shivkumar *et.al.* suggest that jaggery is a good source of important minerals such as Calcium-40-100 mg, Magnesium-70-90 mg, Potassium-1056 mg, Phosphorus-20-90 mg, Sodium-19-30 mg, Iron-10-13 mg, Manganese-0.2-0.5 mg, Zinc-0.2- 0.4 mg, Copper-0.1-0.9 mg, and Chloride-5.3 mg per 100 g of jiggery. It contains good amount of vitamins such as Vit. A-3.8 mg, Vit. B1-0.01 mg, Vit. B2- 0.06 mg, Vit. B5-0.01 mg, Vit. B6-0.01 mg, Vit. C-7.00 mg, Vit. D2-6.50 mg, Vit. E-111.30 mg, Vit. PP-7.00 mg, and protein-280 mg per 100 g of jiggery [9].

The sugar is the chemical class of carbohydrates with the general formula  $(CH_2O)_n$  for monosaccharides. Sugar is the common name for sucrose, the solid crystalline sweetener for foods and beverages. Sucrose, a disaccharide, is found in various plants, but for high commercial recovery in sugarcane and sugar beet plants. The sugar in plants is the result of photosynthesis and occurs in abundance in sugarcane (*Saccharum officinarum*) a perennial tropical grass between 12 – 15 % and sugarbeets (*Beta vulgaris*) ranging from 13–20% by weight. Some other sources of sugar are sorghum (*Sorghum vulgare*), the sugar maple (*Acer saccharum*), and the date palm (*Phoenix dactylifera*).[10,11]

## II. MATERIAL AND METHODS

Fresh two different types jaggery cubes (brown and golden yellow colored) samples were collected from local market. Two granulated sugar samples one is white and other is brown colored samples were also collected from the local market for the its physico chemical and mineral analysis. The results of jaggery and sugar samples were compared with each other and finally drawn conclusion about the nutritional value and mineral contents and which one is healthy for human being.

In the present study different physical and chemical properties of all four samples were tested. Some of the parameters tested was pH, conductivity, moisture, ash, water contents, acidity in terms of ascorbic acid, total acidity, amount of sodium, potassium, iron, phosphorus etc. For the analysis of jaggery and sugar samples we used ordinary simple laboratory techniques and instruments available in our laboratory.

Sample preparation – pH, conductivity and density parameters were tested by preparation of 10 % solution of jaggery and sugar (dissolved 5 gram of sample with distilled water and made it to 50 ml of volumetric flask). All measurements are taken in triplicate and average of all the readings were used for calculation.

### ***pH***

pH gives us the acidic nature of the sample. The pH was measured as per the method followed by Practical handout of Higher College of Technology, using a digital pH meter. Buffers of pH 4.0 and 7.0 were used to calibrate the instrument. 10% of Jaggery solution was prepared in distilled water and the pH was determined.

### ***Conductivity***

Conductivity was measured with 10 % solution of jaggery and sugar samples by using ordinary conductivity meter in our laboratory. It gives total ionic particles in the solution.

### ***Moisture***

Moisture content was determined as per AOAC (2000) [12]. Hot air oven method used for moisture contains. A known weight of the sample in a preheated and weighed dish was kept in an oven maintained at temperature at 110<sup>o</sup> C for 1 hour, then the dish was removed and transferred to desiccator, allowed it to cool and then weighed until the constant weight.

### ***Ash content***

Ash represents different inorganic oxides left after complete combustion of sample. Total ash content was determined as per AOAC (2000) [12]. Accurately weighed samples were taken in silica crucible (previously heated and weighed) was ignited on a heater until fumes ceased and then crucible was transferred to a muffle furnace and burn at 550 ± 150 C until ash was obtained. The ash content was calculated in %.

### ***Total Acidity***

Total Acidity was measured by titrating samples with standardized sodium hydroxide solution and using phenolphthalein indicator. Total acidity represents acidic nature of sample.

### ***Density***

Density was measured by preparation of 10 % solution of all four samples. 25 ml picnometer was used for measurement of density of samples.

### ***Vitamin C***

Vitamin C was measured by using standard iodine solution and freshly prepared starch solution as an indicator. All samples were dissolved in distilled water and dilute to mark. These samples were used for determination of vitamin C.

### Minerals

Different minerals were measured by making ash of the samples. Ash was then dissolve in acid and digest for some time and then filter and dilute to the mark in volumetric flask. This sample solution was used for the measurement of sodium, potassium iron and phosphorus by using flame photometer for sodium and potassium AAS for iron and colorimetric method for analysis of phosphorus.

### III. RESULT AND DISCUSSION

The result of all different parameters tested for two jaggery and two sugar samples are shown in table 1. pH and conductivity are representing some initial information about the jaggery and sugar samples. The concentration of jaggery and sugar used for the

analysis of pH and conductivity was 10% solution (w/v). pH plays an important role in the stability and storage quality of the jiggery. The results are shown in the table no. 1. Both sugar and jiggery samples having almost similar range of pH range between 6.03 to 6.98. The important observation during the analysis shows there was no direct relation between pH and total acidity of the sample. Two jaggery samples (Sample 1 & sample 2) was shown 0.828 g/100gm and 0.42 g/ 100 gm of sample. Total acidity of two sugar samples brown sugar and white sugar was in the range of 0.072 to 0.06 g/100 gm of sample. While conductivity was in the range of 1.669 to 9.43 MS/cm. It shows that jaggery samples having more amount of organic acids as compared sugar samples. The relation between pH and acidity is shown in figure 1.

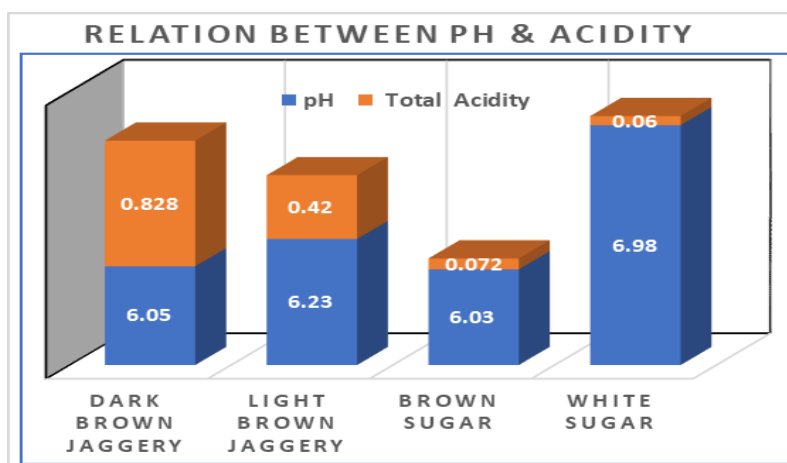


Fig. 1. Relation between pH and total acidity of jiggery and sugar samples.

Total dissolved solids or % brix of both jiggery and sugar samples were in the range of 6.5 % to 7.17 %. Total % ash represents the different mineral oxides are formed after complete combustion of sample in a furnace at 500 to 550°C. % of ash all four sample showed that both jiggery samples have high amount while sugar have less amount of ash. It shows jiggery has a good amount of minerals while sugar hardly have some minerals which are helpful for various metabolic activities in the human body. Figure 2 represents different physico-chemical parameters in each sample.

Vitamin C or ascorbic acid is considered as the good for our health it will increase the immunity. Our results shows that both jiggery samples have good amount of vitamin C while sugar have very less amount of vitamin C. The range of vitamin C was in the range of 0.01036 to 0.418 g/ 100gm of sample. Density of the samples were measured with 10 % solution of samples. All samples have near about same quantity of density. It was in the range of 1.03 to 1.08 g/ml with respect to 10 % (w/v) solution.

Parameters	Dark Brown Jaggery	Light Brown Jaggery	Brown Sugar	White Sugar
pH	6.05	6.23	6.03	6.98
Conductivity (10%) MS/cm	1.6693	3.7533	1.9843	9.4366
% Brix (10%)	8.5	6.5	7.17	7.17
% Ash	0.0143	0.0322	0.0003	0.002
Density g/ml(10%)	1.039	1.06	1.08	1.03
Vitamin C g/100 gm	0.1667	0.418	0.0383	0.01036
Moisture %	5.29	6.37	7.27	1.18
Total Acidity g/100gm	0.828	0.42	0.072	0.06
Potassium mg/100 gm	316.7	608.3	25	58.3
Sodium mg/100 gm	38.82	125.88	0	0
Iron mg/100 gm	0.891	0.583	0	0.352
Phosphorus mg/100 gm	0.9084	4.08	0.1838	0.7

Table 1. Result of different parameters of all four samples

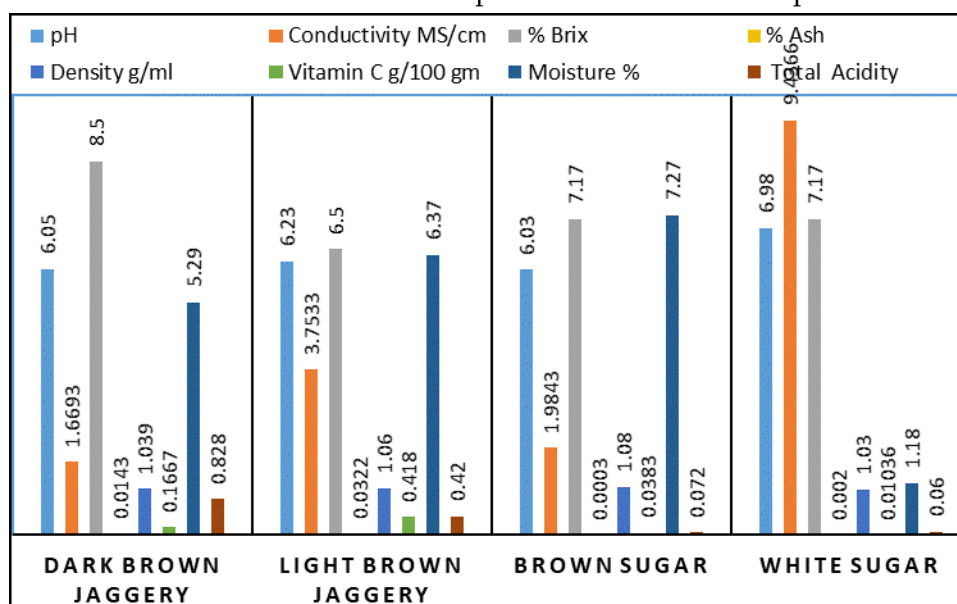


Fig. 2. Comparison of different physicochemical parameters of jaggery and sugar samples.

Various mineral contents are showed in the table 1. We studied sodium, potassium, iron and phosphorus in the all four samples. All four samples were found different concentration of minerals that depends upon the quality

of sugarcane used, manufacturing process used, different chemicals used and soil of sugarcane crop produced. The comparison of various minerals present in jaggery and sugar samples are shown in figure 3.

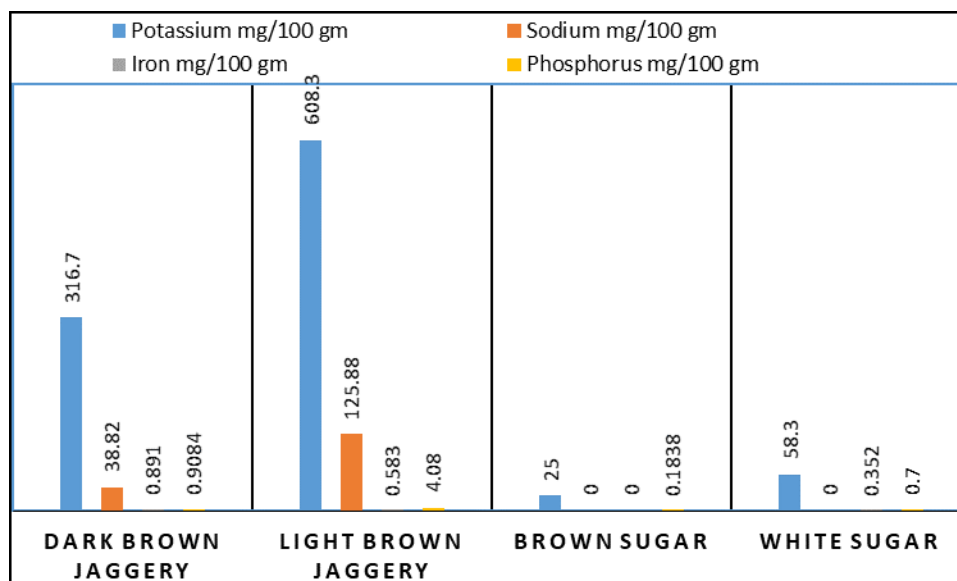


Fig. 3. Comparison of different minerals in jaggery and sugar sample.

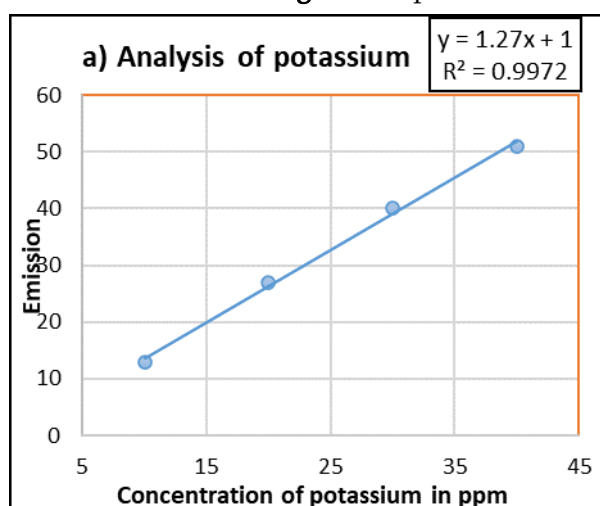


Figure 4. Calibration curve of potassium

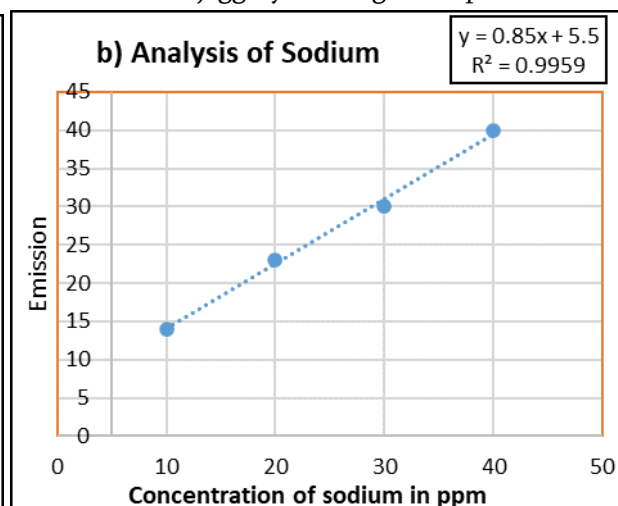


Figure 5. Calibration curve of sodium.

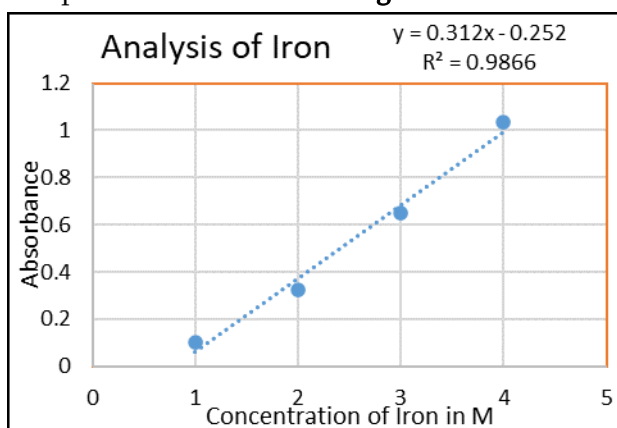


Figure 6. Calibration curve of Iron

Potassium contents in jaggery sample showed good amount of potassium. Two samples dark brown and light brown samples was having 316.7 and 608.3 mg/100 gm of sample respectively. Calibration curve

and regression equation was shown in figure 3. While sugar had a very less quantity of potassium i.e. in the range of 25 to 58.3 mg/100gm of sample. Amount of sodium was found 38.82 and 125.88 mg/100gm of dark brown and light brown jaggery respectively. While sugar samples did not find any amount of sodium. The calibration curve and regression equation of potassium and sodium are showed in figure 4 and 5 respectively.

The contents of iron was also significant difference in jaggery and sugar samples. Jaggery sample was found 0.891 and 0.583 mg/100gm in dark brown and light brown jaggery respectively while brown sugar did find any iron contents and white sugar had 0.352 mg/100gm.

The amount of phosphorus found to be 0.9084 and 4.08 mg/ 100gm in dark brown and light brown jaggery sample while 0.1838 and 0.7 mg/100gm in brown sugar and white sugar respectively. The calibration curve and regression equation of iron is shown in figure 6.

#### IV. CONCLUSION AND RECOMMENDATIONS

After analysis and interpretation of all physicochemical and mineral parameters of two jaggery and two sugar samples found that, jaggery samples were found rich of vitamin C, higher acidity, higher amount ash along with very good amount of mineral contents of sodium, potassium and iron. While both sugar samples were very low amount of these values. Healthy point of you jaggery samples have good amount material and helpful for various metabolic activities. On the basis of result obtained and after comparison between jaggery and sugar author recommends we can prefer jaggery over sugar health point of view.

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