ISSN No:-2456-2165

Analytical Study of Different Sample of Guda *(Jaggery)*

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Abstract:- Jaggery is the sugarcane based traditional Indian sweetener. Jaggery is nutritious and easily available to the rural people. In the present study, five samples were collected from different areas wise Jaggery shop at market of Satna, Chitrakoot, Khajurahoo, Karwi and Korba. Sample were kept in separate sterile plastic container and were capped. The investigation were carried out for Determination of Organoleptic characters and physicochemical evaluation such as moisture content, sugar content, sucrose, total ash, acid insoluble according to standard procedures.

Keywords:- *Jaggery, Organoleptic, Physicochemical , Traditional etc.*

I. INTRODUCTION

Jaggery is an unrefined sugar obtained by processing of sugarcane (Saccharumofficinarum L.) and regarded as 'whole sweetener' because of its 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 (Kumar and Tiwari, 2006). Jaggery is used as a media for the preparation of different Ayurvedic formulations such as Asava, Arishtas, Lehya, Gula etc. It is also used as an important vehicle during administration of drugs. It contains up to 50% sucrose, upto 20% invert sugars with some other insoluble matter such as ash, proteins and bagasse fibers (Ghosh and Agrawal, 1983). It is directly consumed by humans and used in animal feed mixtures. Jaggery is a natural sweetener made by the concentration of sugarcane juice prepared without the use of any chemicals (Singh, 1985). Jaggery has great nutritive and medicinal value. Jaggery purifies the blood, prevents the rheumatic afflictions and disorders of bile and process properties of higher order (Sahu and Paul, 1998; Sahu and Saxena, 1994). Jaggery contains proteins, vitamins and minerals, which are essential constituents for the body. It is also a potent source of iron and copper (Beguin, 1978).

Now a day, Ayurvedic drug industries face some problems regarding the quality of medicinal products like asava, arishta, guda etc. and its standards. These problems directly points towards the quality of jaggery. Moreover the society needs awareness about the types of jaggery in the markets, different sources, methods of preparation, quality of jaggery, any standard measures for the purity of jaggery etc. Hence for the present study I have chosen to work on Jaggery.

Jaggery is available in the market mainly in the three forms namely solid Jaggery , liquid Jaggery and granular Jaggery . Of the total production of Jaggery in India approximately 80% of the Jaggery is prepared in solid form and the remaining 20% is in liquid as well as granular form. Liquid Jaggery is a part of diet in most parts of Maharashtra and West Bengal and is gaining commercial importance. The granular Jaggery is also popular particular among rural masses. Sugarcane juice is an opaque liquid and varies in colour from dark grey, green to light yellow depending upon the colour of cane (PVK JagannadhaRao and SK Das, 2006).

II. COMPOSITION

It 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 such as ash, proteins and bagasse fines. It contain all the vitamins. It is rich in important minerals (*viz.*, 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 jaggery), vitamins (viz., Vitamin A-3.8 mg, Vitamin B1-0.01 mg, Vitamin B2- 0.06 mg, Vitamin B5-0.01 mg, Vitamin B6-0.01 mg, Vitamin C-7.00 mg, Vitamin D2-6.50 mg, Vitamin E-111.30 mg, Vitamin PP-7.00 mg), and protein-280 mg per 100 g of jaggery(P. Shrivastav, A.K.Verma, R.Walia, R.Parveen, A.K.Singhet, 2016).

III. METHODOLOGY

- *Method of Sample Collection*

Five samples were collected from different areas viz from Satna, Chitrakoot, Khajuraho, Karwi and Korba. Samples were kept in separate sterile plastic container and were capped, and were analysed by using standard method(Rajesh CK, Shajahan MA, 2016), (Mandal *et al*, 2006) for:-

1. Determination of Organoleptic characters
2. Determination of moisture content
3. Determination of Sugar content
4. Determination of Sucrose
5. Determination of total ash

6. Determination of Acid insoluble ash
7. Determination of pH value

IV. RESULTS AND DISCUSSION

In the study following parameters were analysed and the result are tabulated below from table 1 to 11

A. Determination of Organoleptic characters
B. Determination of moisture content
C. Determination of Sugar content
D. Determination of Sucrose
E. Determination of total ash
F. Determination of Acid insoluble ash
G. Determination of pH value

A. Determination of Organoleptic Characters

Organoleptic character for all five samples are given in table-1

Character	Chitrakoot	Khajuraho	Korba	Satna	Karwi
Color	Whitish yellow	Dark brown	Redish white	Yellow	Dark brown
Smell	Pleasant	Pleasant	Pleasant	Pleasant	Pleasant
Taste	Sweet	Sweet	Sweet	Sweet	Sweet
Consistency	Solid	Solid	Solid	Solid	Solid
Texture	Circular	Irregular shape	Cubic shaped	Circular	Circular

Table 1:- Organoleptic characters of each sample of jiggery

It depicts the colour, smell, taste, consistency and texture. Table-1 reveals that the colour of Jaggery sample is whitish yellow to dark brown. There smell is pleasant and they are all solids. In texture they are varying from irregular to circular shape.

B. Determination of Moisture Content

Table 2-6 given below gives the moisture content value of all the five samples.

S. No.	Petri plate weight	Port weight 1	Port weight 2	Difference
A1	46.5124	46.4365	46.4340	0.0784
A2	40.9154	40.8301	40.8285	0.0869
A3	44.4847	44.4430	44.4123	0.0724

Table 2:- Determination of moisture contents of sample A (chitrakoot)

- *AVERAGE = 0.0792*

LOD = Average x 100 / weight of sample taken
= 0.0792×100 / 2
= **3.96**

S. No.	Petri plate weight	Port weight 1	Port weight 2	Difference
B1	40.0945	39.9868	39.9859	0.1086
B2	38.7362	38.6520	38.6410	0.0952
B3	46.3579	46.3374	46.2630	0.0949

Table 3:- Determination of moisture contents of sample B (Korba)

- *AVERAGE = 0.0996*

LOD = Average x 100 / weight of sample take
= 0.0996×100/ 2
= **4.98**

S. no.	Petri plate weight	Port weight 1	Port weight 2	Difference
C1	42.7137	42.5666	42.6678	0.0459
C2	42.8803	42.8396	42.8275	0.0528
C3	45.723	45.6997	45.6837	0.0406

Table 4:- Determination of moisture contents of sample C (Khajurahoo)

- *AVERAGE = 0.0464*

LOD = Average x 100 / weight of sample taken
= 0.0464×100 / 2
= **2.32**

S. No.	Petri plate weight	Port weight 1	Port weight 2	Difference
D1	49.0758	49.0575	48.9936	0.0822
D2	42.0756	41.9902	39.9886	0.0870
D3	47.5597	47.4240	47.4893	0.0704

Table 5:- Determination of moisture contents of sample A (Satna)

- *AVERAGE = 0.0799*

LOD = Average x 100 / weight of sample taken
= 0.0799×100 / 2
= **3.99**

S. No.	Petri plate weight	Port weight 1	Port weight 2	Difference
E1	49.2462	49.2131	49.2012	0.045
E2	40.2763	40.2569	40.2349	0.0414
E3	40.6928	40.6274	40.6255	0.0673

Table 6:- Determination of moisture contents of sample E (karwi)

- *AVERAGE = 0.512*

LOD = Average x 100 / weight of sample taken
= 0.512 × 100 / 2
= **2.56**

ISSN No:-2456-2165

Above tables 2,3,4,5,6 reveals the value of LOD and it is 3.96, 4.98, 2.32, 3.99, and 2.56 for Chitrakoot, Korba, Khajuraho, Satna and Karwi respectively . Reasons for the increase in moisture content may be due to, Relative humidity in the environment and Jaggery contains hygroscopic substances such as reducing sugars, minerals like chlorides, sodium, potassium etc making the jaggery liable for moisture absorption. In a small scale industry of jaggery, the storage is done by palm leaves and then covered with the plastic cover. Excess use of chemical clarificants may be a reason for increase in moisture (Rajesh CK, Shajahan MA, 2016).

Total moisture gives an idea about the impurity. So, in the present sample the maximum impurity was observed in sample B(korba) and minimum impurity was observed in sample C (Khajurahoo).

C. Determination of Total Ash

Determination of total ash is depicted in table-7 given below

S. No.	Crucible weight(A)	1st day weight(B)	2nd day weight(c)	3rd day(D)
A	19.3917	19.4993	19.4963	19.4960
B	18.6530	18.7553	18.7527	18.7529
C	20.3065	20.4414	20.3997	20.3993
D	15.0398	15.1464	15.1443	15.1444
E	16.3500	16.4973	16.4960	16.4959

Table 7:- Total ash values of all the five samples.

- *Calculation:* Total ash = (D - A x 100) / weight of sample taken.

For sample A = **2.086**
For sample B = **1.990**
For sample C = **1.850**
For sample D = **2.092**
For sample E = **2.910**

Table-7 Shows the value of Total ash and it is 2.086, 1.990, 1.850, 2.092 and 2.910 for Chitrakoot, Korba, Khajuraho, Satna and Karwi samples respectively . Reasons for increased Ash values in the market samples of jaggery may be due to non removal of attached green or dry leaves and roots at the time of crushing. Due to the presence of any organic waste material during boiling of cane juice and if there is any organic waste in the collecting vessel. Presence of weeds during cutting phase and improper preservation during the study period may alter the ash value(Rajesh CK, Shajahan MA, 2016).

In the present sample the maximum Total ash was recorded for sample E(Karwi) and the minimum for sample C(khajurahoo).

D. Determination of Acid Insoluble Ash

Determination of Acid Insoluble Ash is depicted in table-8 given below

S. No.	Crucible weight	1st day weight	2nd day weight	Difference
A	19.3917	19.3990	19.3977	0.006
B	15.0398	15.0556	15.0556	0.0158
C	18.6530	18.6604	18.6598	0.0068
D	20.4065	20.3065	20.3065	0.0999
E	16.3300	16.3297	16.3410	0.0110

Table 8:- Acid Insoluble ash values of all the five samples.

- *Calculation:* Total acid insoluble ash = (difference x 100) / weight of sample taken.

For sample A = **0.12**
For sample B = **0.79**
For sample C = **0.136**
For sample D = **1.998**
For sample E = **0.22**

Table-8 shows the value of Acid Insoluble Ash and it is 0.12, 0.79, 0.136, 1.998 and 0.22 for Chitrakoot, Korba, Khajurahoo, Satna and Karwi samples respectively.Reasons for the increased Acid insoluble ash content in the Market samples may be due to crushing of Canes without proper washing, Presence of soil particles or silica in the cane, Presence of soil particles or impurities in the collecting vessels, Impurities in the boiling pan, Storage of jaggery in a plastic pack without proper cleaning, Due to the exposure of jaggery in the open markets and no proper preservation of samples during study period(Rajesh CK, Shajahan MA, 2016).

In the present sample the maximum Acid Insoluble ash was noticed in sample D(Satna) and minimum Acid insoluble ash value in sample A(Chitrakoot).

E. Determination of PH Value

Determination of pH is depicted in table-9 given below

S. No.	Sample name	pH value
1	A	5.08
2	B	5.12
3	C	5.09
4	D	6.01
5	E	5.18

Table 9:- pH values of all the five samples

Table-9 shows the value of pH and it is 5.08, 5.12, 5.09, 6.01 and 5.18 for Chitrakoot, Korba, Khajurahoo, Satna and Karwi samples respectively. Reasons for lower pH values can be related to a deficient quantity of lime in the clarification process of the juice and also might be because of moisture absorption and sucrose inversion which in turn facilitates

production of organic acids that are responsible for fall in pH (Mandal *et al*, 2006).

In the present sample the maximum pH was recorded for sample D(Satna) and the minimum pH value recorded for sample A(Chitrakoot).

F. Determination of Total Sugar

Before and After inversion of Total sugar is given below in table-10 and table-11

S. No.	Sample name	Initial reading	Final reading
1	A	00	83.33
2	B	00	81
3	C	00	83
4	D	00	60
5	E	00	91

Table 10:- Determination of total sugar before inversion of all the five samples

S. No.	Sample name	Initial reading	Final reading
1	A	00	13.29
2	B	00	15
3	C	00	12
4	D	00	13
5	E	00	16

Table 11:- Determination of total sugar After inversion of all the five samples

➢ *Calculation***:** Before inversion (total reducing sugar)
After inversion (non-reducing sugar)

Strength of $CuSo_4$ = invert sugar × 0.001
= 46.5× 0.001
= 0.0465

Total reducing sugar,

Percent by mass = $\frac{250\times100\times S}{H\times M}$

Where,
S = Strength of copper sulphate solution.
H = volume in ml, of jiggery solution required for titration.
M = Mass in gram of Jaggery.

For sample A :
Total reducing sugar = 1150/86.5 = **13.29**
Non-reducing sugar = 1150/13.8 = **83.33**

For sample B:
Total reducing sugar = 1150/81 = **14.19**
Non-reducing sugar = 1150/15 = **76.66**

For sample C:
Total reducing sugar = 1150/83 = **13.85**
Non-reducing sugar = 1150/12 = **95.83**

For sample D:
Total reducing sugar = 1150/60 = **19.16**
Non-reducing sugar = 1150/13 = **88.46**

For sample E:
Total reducing sugar = 1150/91 = **12.64**
Non-reducing sugar = 1150/16 = **71.87**

➢ *Total Sugar:*

Total sugar = sucrose, percent by mass + non reducing sugar, percent by mass

For sample A = 68.02+ 13.29
= **81.31**

For sample B = 63.17 + 15
= **78.17**

For sample C = 77.9 + 13.85
= **91.75**

For sample D = 65.83 + 13
= **78.83**

For sample E = 56.27 + 12.64
= **68.91**

The value of total sugar of the present samples is 81.31, 78.17, 91.75, 78.83 and 68.91 for Chitrakoot, Korba, Khajurahoo, Satna and Karwi respectively .Reasons for lower content of Total sugar in the market samples may be due to the preparation of Jaggery from a low yielding variety and also due to harvesting at an early stage *i.e.*before peak maturity, Along with their placing of canes in the open sunlight causes depletion in the total sugar level. Above samples might have been prepared during monsoon or rainy season and without proper removal of suspended impurities from the juice causes reduction in the sugar content. Due to adding of top few internodes part, which contains more of non sugars than sugars. Due to improper proper storage and Jaggery produced from soils of high salinity and pH (Rajesh CK, Shajahan MA, 2016).

In the present samples the maximum total sugar was observed for sample C(Khajurahoo) and minimum sugar for sample E(Karwi).

G. Determination of Sucrose

Sucrose, percent by mass= {(reducing sugar after inversion, percent by mass) – (reducing sugar before inversion, percent by mass)} × 0.95

For sample A:
= (83.33-13.29) × 0.95
= **66.53**

For sample B:
= (76.66-14.19) × 0.95
= **63.17**

For sample C:
= (95.83-13.83) × 0.95
= **77.9**

For sample D:
= (88.46-19.16) × 0.95
= **65.83**

For sample E:
= (71.87-12.64) × 0.95
= **56.27**

The value of Sucrose in the present study is 66.53, 63.17, 77.9, 65.83, and 56.27 for Chitrakoot, Korba, Khajurahoo, Satna and Karwi samples respectively.Reasons for lower content of Sucrose in the market samples may be due to the preparation of Jaggery from low yielding variety of sugarcane. Due to lateness in extraction of juice i.e. more than 24 hrs after harvest, because of that inversion of sucrose into glucose, fructose and other harmful substances produced in jaggery. So there is a chance of depletion of sucrose. Above samples may be prepared during monsoon or rainy season. Without proper removal of suspended impurities from the juice causes reduction in the sugar content. Due to adding of top few internodes, which contain more of non-sugars than sugars and due to without proper storage may be a Reasons for lower content of Sucrose(Rajesh CK, Shajahan MA, 2016).

In the present samples the maximum Sucrose content was observed for sample C(Khajurahoo) and minimum was noted for sample E(Karwi)

V. CONCLUSION

Jaggery is widely used in pharmaceutics and easily available in the markets. There are many forms of jaggery available in the market. Agmark standards are available for jaggery as a whole. Purity and quality of jaggery must be ensured on public health ground as it is a popular food item and used as sweetening agent based on the therapeutic purposes in Ayurvedic medicine. To attain the purpose of quality, standards should be set to all varieties of guda (jaggery) from sugarcane that is sold in the market.

In all, it is concluded that the sample C(Khajurahoo) was the best amongst all other samples. It contained 2.32% Moisture, 5.09% pH, 1.85% Total ash, 0.79% Acid insoluble acid, 91.75% Total sugar and 77.90% Sucrose.

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