

RESEARCH PAPER

## Physio-chemical Properties of Grapes

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### ABSTRACT

Physio-chemical properties of Manikchaman variety of grapes has been measure at 79.178% (wb). *Manik Chaman* variety is mutants of *Thompson* seedless. The juice is sweet with a TSS of 20-22°B. Variety has a good keeping quality and is used for table purpose and raisin making. The hundred grams of grape contains 75 to 85 per cent moisture, 18.1 g carbohydrates, 15.48 g sugars. Size, shape and physical dimensions of grape are important in sizing, sorting and other separation process. Various physio-chemical properties of grapes has been determined i.e. Moisture content, length, width, thickness, bulk density, true density, TSS, Titrable acidity, pH, Reducing sugar, Total sugar, Non-reducing sugar, Ascorbic acid, colour yellowness index. The moisture content was 79.17%, length 29.72 mm, width 14.14 mm, thickness 17.95 mm, bulk density 1.058 g/cc, true density 1.058 g/cc, TSS 19.9°B, Titrable acidity 0.678%, pH 4.3, Reducing sugar 17.395%, Total sugar 19.417%, Non-reducing sugar 2.015, Ascorbic acid 5.88 mg, yellowness index 81.35.

**Keywords:** Grape, Physiochemical, Manikchaman

Grapes (*Vitis vinifera* L.) belong to the Vitaceae family is believed to have originated in Armenia near the Black and Caspian seas in Russia. Grape production is widespread throughout the world, exceeding 68 million tons (FAOSTAT, 2010). The production of fresh grapes in India is about 26.83 million MT with an area of 1.36 million ha under cultivation. Maharashtra is the leading state occupying 72.76 per cent of total area of the country with an extent of 1.03 million ha, producing 21.37 million MT of grapes per annum (NHB, 2017).

Manik Chaman variety is mutants of thompson seedless. This variety is grown in Maharashtra, Andhra Pradesh, Tamil Nadu and Karnataka. It has wide adaptability with seedless, ellipsoidal-elongated, golden-yellow berries with medium-thin skin. The juice is straw coloured, sweet with a TSS of 20-22°B. Variety has a good keeping quality and

is used for table purpose and raisin making, Anon (2015).

The nutritive value of grape has been appreciated for a very long time and it provides a more balanced diet than many other fruits. From the nutritional point of view, grape has a 94 % edible part with a calorific value ranging from 69 kcal per 100 g (USDA, 2016). Although fat and protein contents are very low, grape are rich in different antioxidants essential for cancer treatment as well as some minerals, notably phosphorus which is essential for bone development, potassium and calcium. The chemical composition of grape varies among the different cultivars. The hundred grams of grape contains 75 to 85 per cent

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moisture, 18.1 g carbohydrates, 15.48 g sugars, 0.9 g dietary fiber, 0.16 g fat, 0.72 g protein, vitamins viz; 0.069 mg thiamine (B<sub>1</sub>), 0.07 mg riboflavin (B<sub>2</sub>), 0.188 mg niacin (B<sub>3</sub>), 0.05 mg pantothenic acid (B<sub>5</sub>), 3.2 mg vitamin C, 0.19 mg vitamin E and some minerals like 0.36 mg iron, 7 mg magnesium, 0.071 mg manganese, 20 mg phosphorus, 191 mg potassium and 10 mg calcium, 2 mg sodium, 0.07 mg zinc and 0.6-1.0 g tartaric acid (USDA, 2016).

Quality is defined as the absence of defects or degree of excellence and it includes appearance, colour, shape, injuries, flavour, taste, aroma, nutritional value and being safe for the consumer (Abbott, 1999). Due to a higher market exigency as for high quality products, the juice and pulp industries have been looking for fruits with better internal and external features, including fruit length and width, fruit weight, pulp, seed and peel percentages per fruit, peel diameter; soluble solids (°Brix), titratable acidity (%), vitamin C content (mg/100g of fresh fruit), pulp pH, total soluble solids and titratable acidity ratio.

The physical properties of agricultural products affect the adjustment and performance of processing machines. It is necessary to determine physical properties of grape, which mainly depend on moisture content, to aid in the design of equipment and machines for handling conveying, drying, separation, storing, packaging and processing of grape. These physical properties affect the conveying characteristics of solid materials by air or water. Size, shape and physical dimensions of grape are important in sizing, sorting and other separation process. Bulk and true densities of grape are necessary to design the equipment for processing and the porosity of fruits is the most important for packing (Khodaei, 2012).

Karasu *et al.* (2016) reported that Lengths and diameters of the grapes differed significantly ( $P \leq 0.05$ ). Lengths of the grapes of *Kara Dimrit*, *Antep Karas*, *Efes* and *Cardinal Red* variety varied between 1.52 and 2.45 cm and diameters ranged from 1.66 to 2.66 cm. *Kara Dimrit* had the lowest diameter, whereas *Antep Karas* and *Cardinal Red* had the greatest diameter and length, respectively. *Cardinal Red* also had the highest

weight value.  $L$ ,  $a$  and  $b$  values of the grapes varied significantly ( $P \leq 0.05$ ) and were found to be 21.71–31.81, 0.46–6.67, and 0.97–3.89, respectively. The highest  $L$  value was obtained from *Müsküle*, which is the white grape variety, and the highest  $a$  value was found in *Cardinal Red*. The pH values of the samples varied from 3.32 to 3.87 ( $P \leq 0.5$ ) and the highest and lowest pH values were obtained from *Antep Karas* and *Kara Dimrit*, respectively. The highest Brix and dry matter values of the samples were found to be 23.85% (*Antep Karas*) and 26.11% (*Cardinal Red*), respectively.

Various researchers reported acidity in various varieties of grapes ranging from 0.64 to 0.72 per cent (Dan *et al.* 1987), 0.49 to 0.94 per cent (Chika Subbanna, 2010) 0.37 to 0.72 per cent (Doreyappa Gowda *et al.* 1998), 0.24 to 1.12 per cent (Diakou *et al.* 1997), 0.66 to 0.91 per cent (Mane *et al.* 2003).

In present study, the physio-chemical properties of fresh ripe grapes of Manikchaman variety is studied varies properties i.e., Moisture content, TSS, pH, Titratable acidity, Total sugar, Reducing sugar, Colour, ascorbic acid, Bulk density, True density is planned to determine.

## MATERIAL AND METHODS

### Sample preparation

Grapes (*Vitis vinifera* L.) bunches of Manikchaman variety were purchased from local market located at Agricultural Produce Market Committee (APMC), Vashi. The grape bunches were washed with the tap water thoroughly and the dirt was removed.

### Moisture content

The moisture content of fresh grapes was determined as per AOAC, 2010. Initial moisture content of fresh grapes was determined by the hot air oven method at 105°C ±1°C for 24 hours. The final weight of fresh grapes were recorded after 24 hours. The moisture content of the fresh grapes was determined by following formula (Chakraverty, 1994).

$$\text{Moisture content (db) \%} = \frac{W_1 - W_2}{W_2} \times 100 \quad \dots(1)$$

Where,

$W_1$  = Weight of sample before drying, g

$W_2$  = Weight of sample after drying, g

#### Dimensions (L, W and T)

The three principal dimensions namely length, width (diameter) and thickness was measured for each individual grape along X, Y and Z axis with the help of Vernier caliper (least count of 0.01 mm). The spatial dimensions were measured for 30 fruits and average value has been reported. Geometric mean diameter was calculated by following equation (2):

$$D_g = (L \times b \times T)^{\frac{1}{3}} \quad \dots(2)$$

where,

$D_g$  = Geometric Mean Diameter, mm

$L$  = Length, mm

$B$  = Breadth, mm

$T$  = Thickness, mm

#### Bulk density

The bulk density was determined by using the mass/volume relationship. Grapes were filled in measuring cylinder having volume 500 ml. Total mass of the grape were measured with the electronic balance having 0.0019 g accuracy. Fruit density ( $\text{kg}/\text{m}^3$ ) was calculated by using the following equation (3). The experiments were repeated with five times and average value was reported. The bulk density of grape fruit was determined by using following formula as suggested by Mohsenin (1986).

$$\rho_b = \frac{M}{V} \quad \dots(3)$$

where,

$P_b$  = Bulk density ( $\text{kg}/\text{m}^3$ )

$M$  = Bulk mass of fruit (kg) and

$V$  = Volume of gunny bag (100cm × 60cm × 30cm)

#### True density

The true density of grape fruit was determined by using toluene displacement method. Weight of single grape fruit was taken with electronic precision balance with least count of 0.001 g and fruit was immersed carefully into measuring cylinder partially filled with known volume of toluene. The volume of toluene displaced by the fruit was noted. The true density was calculated by using following Eqn (4).

$$P_t = \frac{W}{V_{td}} \quad \dots(4)$$

where,

$P_t$  = True density (g/cc)

$V_{td}$  = Volume of cylinder content (cc)

$W$  = Weight of grape fruits

#### Total soluble solids

A total soluble solid of ripe fresh grapes juice was determined using Refractometer (M/s. Atago, Japan) and the values were corrected at 20°C. The equipment was calibrated with distilled water and the TSS of the fresh grapes was determined. The experiment was replicated three times average reading was reported.

#### pH

pH of fresh grapes was measured by using digital pH meter. The digital pH meter is firstly calibrated by using 4 pH and 7 pH buffer solution. The electrode was washed with distilled water and blot led with tissue paper. 10 ml of grape juice was taken in beaker, then the tip of electrode and temperature probe was then submerge in to the sample. The pH reading display on the primary LCD and temperature on secondary one. The pH of fresh grapes was determined by three replication.

#### Titrateable acidity

The Titrateable acidity of fresh grapes was determined by Ranganna (1978). 10 g of sample was crushed in beaker with 20-25 ml distilled water. It was then transferred to 100 ml volumetric flask, made

up the volume and filtered. A known volume of aliquot (10ml) was titrated against 0.1N sodium hydroxide (NAOH) solution using phenolphthalein as an indicator (Ranganna, 1978). The acidity was calculated as given below and the results were expressed as percent anhydrous citric acid. The three replications were carried out and the average reading was reported.

$$\text{Titrateable acidity (\%)} = \frac{N \times T \times E}{W \times V \times 1000} \times 100 \dots (5)$$

Where,

$N$  = normality of alkali

$T$  = titrate reading

$E$  = equivalent mass of acid, g

$W$  = weight of the sample, g

$V$  = total volume of the sample, g

#### Reducing sugars

The reducing sugars for fresh grape was estimated by using Lane and Eynon Method with modifications suggested by Ranganna (1978). 25 g of fresh grapes were crushed with distilled water using lead acetate (45%) for precipitation of extraneous material and potassium oxalate (22%) to de-lead the solution. This lead free extract was used to estimate reducing sugars titrating against standard Fehling mixture (Fehling 'A' and 'B' in equal proportion) using methylene blue as an indicator to brick red end point. The three replication were carried out and the average reading was reported.

Reducing sugar % =

$$\frac{100}{\text{Burette reading}} \times \frac{\text{Volume prepared}}{\text{Initial volume}} \times \text{GV of fehling's solution} \dots (6)$$

Where,

GV = Glucose value

#### Total sugars

Total sugars was estimated for fresh grape juice was

determined by the procedure of reducing sugar after acid hydrolysis of an aliquot of delead sample with 50 percent of hydrochloric acid followed by neutralization with sodium hydroxide (40%) and calculated as below (Eq.7). The experiment was repeated three times to get the replication.

Total sugar (%) =

$$\frac{\text{Factor} \times \text{Dilution}}{\text{Titre reading} \times \text{Weightn of sample}} \dots (7)$$

#### Colour

The crushed fresh grapes was used to measure the colour value by using colorimeter (M/S Konica Minotta, Japan; Model-Meter CR-400). The equipment was calibrated against standard white tile and black tile. Around 20 g fresh grapes was taken in the glass petri dish, the equipment was placed on the sample petri dish. The colour was recorded in terms of L= lightness (100) to darkness (0); a = Redness (+60) to Greenness (-60); b = yellowness (+60) to blueness (-60).The yellowness index of the grapes raisins was determined from L, a, and b values as per equation (8) reported by (Rhim *et al.* 1999).

$$YI = \frac{142.86b}{L} \dots (8)$$

Where,

$L$  = Lightness to darkness

$B$  = Yellowness to blueness

#### Ascorbic acid (Vit. C)

Ascorbic acid content in fresh grape was determined by 2,6-Dichlorophenol-Indophenol visual titration method as suggested by Ranganna (1977).

3% metaphosphoric acid ( $\text{HPO}_3$ ) in prepared by dissolving sticks of  $\text{HPO}_3$  in distilled water, Dye solution was made up by 2,6 dichlorophenol indophenol and standardise with standard ascorbic acid.

Fresh grapes are crushed into mortal and pistle and a crushed grapes sample of 10g was mixed with 3%

metaphosphoric acid solution and volume was made to 100 ml using volumetric flask. The extract was filtered by using filter paper. 10ml aliquot was taken by using pipette into the conical flask and titrated against standard dye solution at room temperature. The end point of the titration in pink colour. The ascorbic acid content of the fresh grapes was calculated taking into consideration the dye factor as given below.

Ascorbic acid =

$$\frac{\text{Titre} \times \text{Dye factor} \times \text{Volume made up}}{\text{Aliquot of extract taken for estimation} \times \text{Wt. or volume of sample taken for estimation}} \times 100 \quad \dots(9)$$

## RESULTS AND DISCUSSION

### Physical properties of fresh grape fruits

Table 1 shows the physical properties of grape fruits. Various physical properties of grape fruits i.e. (a) Moisture content; (b) Length; (c) Width, (d) Thickness, (e) Bulk density and (f) True density for were reported and discussed.

**Table 1:** Physical properties of grape fruits

Sl. No.	Properties	Range	Average	Standard deviation
(a)	Moisture content (%)	78.45-80.32	79.178	0.745
(b)	Length (mm)	28-31	29.722	1.035
(c)	Width (mm)	13.3-15.2	14.144	0.672
(d)	Thickness (mm)	17-19.5	17.955	0.836
(e)	Bulk density (g/cc)	0.636-0.654	0.640	0.006
(f)	True density (g/cc)	1.044-1.080	1.058	0.0114

#### 1. Moisture content

Moisture content of grape found to be in the range of 78.45 to 80.32 % wet basis (370.57 to 405.27 %db). The result are in agreement with the result obtained for fresh grape fruits by Doymaz (2002) which is having moisture content ranges from is 77.3 to 80.5 % (wb). Singh *et al.* (2016) reported the moisture content of grape variety thompson seedless was 79.94% (wb).

#### 2. Dimensions (Length, Width and Thickness)

The length, width and thickness of grape fruits was found to vary in the ranges from 28 to 31, 13.3 to 15.2 and 17 to 19.5 mm, respectively. The average values of dimension in terms of length, width and thickness were found to be 29.72, and mm, respectively. The result were in agreement with the result obtained for fresh grape fruits of *Kara Dimrit, Antep Karas, Efes and Cardinal Red* variety reported by Karasu *et al.* (2016) for length and width as 15.20 to 24.50 mm and 16.6 to 26.6 mm, respectively.

#### 3. Bulk density

The bulk density of grape fruit was in the range of 0.633 to 0.654g/cc and the average value was 0.640 The results are in general agreement with the result obtained for fresh grape fruits of local variety by Kiliccedil *et al.* (2010) was in the range of 0.6131 to 0.6261 g/cc.

#### 4. True density

The true density of grape fruits was in the range of 1.044 to 1.080g/cc and average was g/cc. The result are in general agreement with the result obtained for fresh grape fruits of local variety by Kiliccedil *et al.* (2010) was in the range of 1104.9 - 1052.6 kg m<sup>-3</sup>.

### Chemical properties of grape fruits

Table 2 shows the physico-chemical properties i.e. TSS °(B), titratable acidity (%), pH, reducing sugars (%), total sugars (%), Non reducing sugar (%), Ascorbic acid (mg) colour yellowness for the grape fruits.

**Table 2:** Chemical properties of fresh grape fruits

Sl. No.	Properties	Range	Average	Standard deviation
1	TSS °(B)	19.2-21	19.9	0.492
2	Titratable acidity (%)	0.65-0.71	0.678	0.020
3	pH	4-4.5	4.3	0.173
4	Reducing sugars (%)	16.12-18.51	17.395	0.716
5	Total sugars (%)	19.31-19.57	19.417	0.087
6	Non-reducing sugar	0.8-3.39	2.015	0.751
7	Ascorbic acid (mg)	5.0-7.0	5.88	0.740
8	Colour (yellowness)	80.86-83.46	81.35	0.99

### 1. TSS

The TSS of fresh grape fruits was in the range from 19.2 to 21°B and average was 19.90.492°B. The result of TSS are in general agreement with the result obtained for fresh grape fruits of different variety by Dan *et al.* (1987) was in the range of 20.00 to 23.13°Brix; Adsule *et al.* (2008) reported the TSS of grapes was 21.94°B for Manikchaman variety.

### 2. Titratable acidity

The titratable acidity of grape fruits was in the of range 0.65 to 0.71% and average was 0.670.17. The results of titratable acidity are in general agreement with the result obtained for fresh grape fruits by Dan *et al.* (1987) having ranges from 0.64 to 0.72%; Gowda *et al.* (1998) reported the Titratable acidity of grapes was 0.37 to 0.72%.

### 3. pH

The pH of grape fruits range was observed in the range of 4.0 to 4.5 and average was 4.3. The results of pH are in general agreement with the result obtained by Banan *et al.* (2006) which was range from 2.97 to 4.11 for fresh grape fruit.

### 4. Reducing sugars

Reducing sugars of fresh grape fruits were ranges from 16.12 to 18.51% and average was 17.390.716. The reducing sugars reported for fresh grape fruits of *Manikchaman* variety by Mane *et al.* (2003) was 16.60%.

### 5. Total sugars

Total sugars of fresh grape fruit was in the range of 19.31 to 19.57% and average was 19.410.08. The result of total sugars are in general agreement with the result obtained for fresh grape fruits of *Manikchaman* by Mane *et al.* (2003) which was 17.70%.

### 6. Non reducing sugar

Non reducing sugar of fresh grape fruit was in the range of 0.8 to 3.39% and average was 2.0150.751. The result of non-reducing sugars are in general

agreement with the result obtained for fresh grape fruits of *Manikchaman* by Mane *et al.* (2003) which was 1.34%

### 7. Ascorbic acid

Ascorbic acid of fresh grape fruits were ranges from 5.0 to 7.0 mg/100g and average was 5.88 mg 0.74. The ascorbic acid reported for fresh grape fruits by Patil *et al.* (1994) was 5.4 to 6.3 mg/100g.

### 8. Colour

The yellowness index of fresh ripe grape varies in the range of 80.86 to 83.46 and the average was 81.35 ± 0.99. The colour L, a, b values are reported by Lydakis (2003) 50-55, 7.5-5.5, 18-21, respectively.

## CONCLUSION

Physiochemical properties of grapes investigated and observed that moisture content 79.17% (wb), Length 29.72 mm, Width 14.14 mm, Thickness 17.95 mm, Bulk density, 0.640 g/cc true density 1.058 g/cc, TSS 19.9°B, Titratable acidity 0.678 %, pH4.3, Reducing sugar 17.39%, Totalsugar 19.41%, Non-reducing sugar 2.015, Ascorbic acid 5.88 mg, yellowness was 81.35, respectively.

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