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## ANALYSIS OF PHYSICAL AND CHEMICAL CHARACTERS OF DIFFERENT VARIETIES OF POMEGRANATE (*Punica granatum* L.) AT DIFFERENT MATURITY STAGES

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### ABSTRACT

*A study was conducted to investigate the physical and chemical characters of four varieties of pomegranate at three stages of physiological maturity at Agriculture Lab, D.A.V. College, Abohar during year 2015. The varieties studied under investigation were Fulle arkta (FA), Ganesh (G), Mridula (M) and Bhagwa (B). The fruits were harvested at stage 1 (15<sup>th</sup> July), stage 2(5<sup>th</sup> August) and stage 3(25<sup>th</sup> August). Various physical and chemical characters such as fruit size, fruit volume, specific gravity, palatability rate, aril weight, total soluble solid, titratable acidity percentage and TSS: TA were studied. The most suitable variety on the basis of physical and chemical characters was Ganesh variety and the most suitable stage for harvesting was Stage 3<sup>rd</sup>.*

**Keywords:** *Bhagwa, Chemical characters, Fullearkta, Ganesh, Maturity stages, Mridula, Physical characters, Pomegranate.*

### INTRODUCTION

Pomegranate (*Punica granatum*) is grown in tropical and subtropical regions of the world. *Punica granatum* L., belongs to the Punicaceae family and is one of the oldest known edible fruits. Some botanists place it in the family Lythraceae, of the peculiar type of fruit, called as balausta, most authorities make it the only genus in the family Punicaceae. It belongs to genera Punica and family Punicaceae. It is a genus of large shrubs or small trees with 2 species. One is *Punica protopunica* found wild on Socotra island and the other is *Punica granatum* cultivated in tropical and subtropical parts of the world for its edible fruits. Maharashtra is the major producer of pomegranates (67.7% of total production) with a share of 79.2% of the total land under pomegranate cultivation. The varieties raised in Maharashtra are Ganesh, Bhagwa, Mridula, Fulle Arakta, etc. The fruit has great nutritional value due to which its demand in the local and international market is increasing day by day. The pomegranate is a non-climacteric many-seeded berry. The fruits are round, oblate or obviate in shape and vary in

weight and size (8 to 12 cm diameter). On an average, edible portion fruit represents about 52% of total fruit weight comprising about 78% juice and 22% seeds. The fruit skin may be thick or thin but smooth, leathery and tough with color varying from pale-yellow to crimson-red. Inside, the fruit is filled with numerous seeds coated with juicy pulp shining like pearls or jewels. These are called arils, which are the edible portion. The pulp in fruits of superior quality is thick, soft, fleshy and dripping juicy. The color of the pulp varies from light pink to crimson-red. The taste of the pulp also varies from sweet and aromatic to sour and insipid. The seeds may be hard or soft but edible. The softer seeded varieties are designated seedless. Pomegranate is currently ranked 18th in terms of fruits consumed in the world. It is thought that as a result of its health benefits, it is expected to move to 10th place in next 10 years. However, exports from India are only ~35,000 tons which is about 6-7% of the total pomegranate trade. This is despite the fact that Indian varieties are widely accepted amongst the best fruit. The limiting factor in this case is the attack of various pests like mealy bug and diseases like bacterial blight which result into reduced production, both in terms of quantity and quality. Although grown extensively, the current produce is insufficient to meet the market demands owing to crop losses and inferior quality. The most serious problem with pomegranate is the occurrence of fungal diseases which affects both the leaves and the fruit, causing premature leaf loss and also resulting in fruit splitting on the plant. While the leaf drop may be ignored, fruit splitting is a serious issue, since the splitting usually occurs just as the fruit begins to mature. Sucking pests like mealy bugs, thrips, etc. are some of the other major obstacles during pomegranate cultivation. As a result, the overall production process suffers. There is ample scope and huge market for export of tropical fruits (such as pomegranates and grapes) to other developed countries leading to inflow of foreign exchange. However, the same is not observed for pomegranates as opposed to grapes, mainly because of compliance to food safety requirements.

## METHODS AND MATERIAL

The study was carried out on four different varieties of pomegranate – Fulle arkta, Ganesh, Mridula & Bhagwa at four stages of fruit maturity after fruit setting, collected from Punjab Agriculture University Regional Fruit Research Station, Seed Farm, Abohar Distt. Fazilka. Four sample of each variety at each stage were studied to evaluate various physical and chemical characters. Sample of Full A0rkta variety was named FA<sub>1</sub> to FA<sub>12</sub>, Ganesh variety samples G<sub>1</sub> to G<sub>12</sub>, Mridula variety samples M<sub>1</sub> to M<sub>12</sub> & Bhagwa variety samples B<sub>1</sub> to B<sub>12</sub>.

**Physical characters:** Morphological features like fruit size, fruit volume, specific gravity, palatability rate and aril weight were studied.

**Chemical characters:** Pomegranate fruits were analyzed for its total soluble solid, titratable acidity percentage and TSS: TA.

## RESULT AND DISCUSSION

### Physical characters

#### Fruit size

**Table 1.** Fruit length (cm) of pomegranate fruits of four varieties at three physiological stages.

Variety Stages	Fullarkta	Ganesh	Mridula	Bhagwa
Stage 1	6.48	7.87	6.68	6.87
Stage 2	7.35	8.15	7.01	7.40
Stage 3	7.56	8.23	6.97	7.35

From the above investigation, maximum fruit length was recorded in Ganesh variety 8.23 cm over Fullarkta, Mridula and Bhagwa varieties which have fruit length 7.56, 6.97 and 7.35 cm respectively in 3<sup>rd</sup> stage. Similar results were obtained by Onuegbu *et al* (2011) while studying on the physical properties of Ube (*Dacryodesedulis*) at different stages of fruit development and found that the fruit length values ranged from 5.13cm to 5.43cm at the (17th – 21st week) which corresponds with the period of the bluish black color development in the fruit which indicates ripening. The fruit length increased significantly from the fifth week till the ninth week and remained steady till harvest maturity. The slight changes within the 11th to 21st week showed the period of slow structural development within the fruit.

**Table 2.** Fruit breadth (cm) of pomegranate fruits of four varieties at three physiological stages.

Variety Stages	Fullarkta	Ganesh	Mridula	Bhagwa
Stage 1	6.98	7.89	6.78	6.82
Stage 2	7.37	8.80	6.90	7.11
Stage 3	7.42	8.82	6.98	6.98

From the table 2 maximum fruit breadth was obtained in variety Ganesh 8.82 cm over Fullarkta, Mridula and Bhagwa varieties showing fruit breadth 7.42 cm, 6.98 cm and 6.98 cm respectively in 3<sup>rd</sup> stage. Similar results have been observed by Onuegbuet *al* (2011) while studying on the physical properties of Ube (*Dacryo desedulis*) at different stages of fruit development and found that the fruit width significantly increase from the 5th week to the 7th week after fruit set and had only slight changes at the (9th- 21st week) as the fruit developed to harvest maturity.

### Fruit volume

**Table 3. Fruit volume (cc) of pomegranate fruits of four varieties at three physiological stages**

Variety Stages	Fulle arkta (FA)	Ganesh (G)	Mridula (M)	Bhagwa (B)
Stage 1	160.0	257.5	156.2	180.0
Stage 2	200.0	310.0	200.0	201.2
Stage 3	192.5	316.8	192.5	206.5

From the table 3, it has been observed that the volume increases rapidly from stage 1 to stage 2 and then increases at very slow rate. Maximum fruit volume was obtained in variety Ganesh 316.8 cc over Fulle arkta, Mridula and Bhagwa variety which shows fruit volume 192.5 cc, 192.5 cc and 206.5 cc respectively at 3<sup>rd</sup> stage of fruit maturity. Similar work was carried out by Sharma *et al* (2014) on wood apple pulp collected from unripe, half ripe and full ripe stages were studied. He observed that fruit volume decreases from unripe stage to full ripe stage.

### Specific gravity

**Table 4. Specific gravity (g / cm<sup>3</sup>) of pomegranate fruits of four varieties at three physiological stages.**

Variety Stages	Fulle arkta (FA)	Ganesh (G)	Mridula (M)	Bhagwa (B)
Stage 1	1.120	0.971	0.933	0.892
Stage 2	1.086	0.954	1.031	1.020
Stage 3	1.039	0.956	1.034	0.956

From the table 4, specific gravity was recorded. The maximum specific gravity was recorded in Fullearkta variety at 2<sup>nd</sup> stage and lowest specific gravity was recorded in Ganesh and Bhagwa variety 0.956cc in both. Specific gravity can be regarded as maturity index to estimate its maturity. The lower specific gravity indicates optimum maturity stage for harvesting. Similar trend was observed on study by Ghanbarian *et al* (2007) on the physical properties of two cultivars of cantaloupe fruit during various maturity stages. The results showed that there was concurrent decrease in specific gravity at full ripe stage.

### Aril weight

**Table 5. Aril weight (g) of pomegranate fruits of four varieties at three physiological stages.**

Variety Stages	Fulle arkta (FA)	Ganesh (G)	Mridula (M)	Bhagwa (B)
Stage 1	105.70	125.90	121.89	117.50
Stage 2	138.75	200.75	137.00	139.75
Stage 3	173.80	266.35	163.97	164.30

From the experiment carried out on pomegranate, aril weight was studied at three physiological stages of maturity. From the results it has been recorded that aril weight increases rapidly from 1<sup>st</sup> stage of maturity to 3<sup>rd</sup> stage of maturity. The maximum aril weight was found in Ganesh variety which was 266.35 g over the Fulle arkta, Mridula and Bhagwa variety which shows 173.80g, 266.35g and 164.30g respectively. Similar, results has been recorded by Ghanbarian *et al* (2007) while studying the physical properties of two cultivars of cantaloupe fruit during various maturity stages. The results showed that flesh (%) of both cultivars increased in the full-ripe stage of maturity.

**Palatability rate****Outer appearance****Table 6. Outer appearance of pomegranate fruits of four varieties at three physiological stages.**

<b>Variety Stages</b>	<b>Fulle arkta (FA)</b>	<b>Ganesh (G)</b>	<b>Mridula (M)</b>	<b>Bhagwa (B)</b>
<b>Stage 1</b>	6.50	5.50	7.50	7.50
<b>Stage 2</b>	7.50	5.50	8.00	8.50
<b>Stage 3</b>	7.75	6.50	8.50	8.50

Palatability rate was carried out by “Hedonic Test” which includes results obtained by judges. The rating was done on the basis of outer appearance of the fruit. The results obtained from the table shows that fruits of Bhagwa variety were most attractive on the basis of outer appearance. Fruits appeared most attractive at 3<sup>rd</sup> stage. The fruits were blood red in color, with symmetrical size and shape which enhances its attractiveness to consumer’s eyes.

**Taste****Table 7. Taste of pomegranate fruits of four varieties at three physiological stages.**

<b>Variety Stages</b>	<b>Fulle arkta (FA)</b>	<b>Ganesh (G)</b>	<b>Mridula (M)</b>	<b>Bhagwa (B)</b>
<b>Stage 1</b>	7.0	6.9	7.2	7.0
<b>Stage 2</b>	7.5	7.2	7.5	7.7
<b>Stage 3</b>	7.9	7.5	8.3	8.5

The rating was done on the basis of taste of pulp and seed also. The maximum palatability was found in Mridula variety. The taste was perfect according to a standard pomegranate with maximum juice content. The sweetness was mild. The taste enhances with advancement of maturity.



**Aril appearance****Table 8. Aril appearance of pomegranate fruits of four varieties at three physiological stages.**

Variety Stages	Fulle arkta (FA)	Ganesh (G)	Mridula (M)	Bhagwa (B)
Stage 1	7.0	6.7	7.2	7.2
Stage 2	7.9	7.4	7.6	8.0
Stage 3	8.2	7.7	8.4	8.5

The rating was recorded on the basis of seed appearance and maximum palatability was found in Bhagwa variety. The blood red seeds enhance its attractiveness.

**CHEMICAL CHARACTERS****Total soluble solids (TSS)****Table 9. Total soluble solids (° Brix) of pomegranate fruits of four varieties at three physiological stages.**

Variety Stages	Fullearkta	Ganesh	Mridula	Bhagwa
Stage 1	12.9	12.8	12.0	11.3
Stage 2	14.0	15.1	13.0	14.0
Stage 3	15.1	16.1	14.8	14.0

From the above table 6, the maximum TSS had been observed in Ganesh variety 14.7 ° Brix. The increase in TSS indicates the increase in sweetness of fruit which may be due to more hydrolyzing of sugar content in fruits or decrease in the acidity of fruits. More TSS indicates good feature for harvesting. Similarly, Tapre and Jain (2013) studied the maturity stages of Banana. He observed that TSS of pulp showed increasing trend from stage 5 to stage 7.

**Titrateable acidity percentage****Table 10. Titrateable acidity (%) of pomegranate fruits of four varieties at three physiological stages.**

Variety Stages	Fulle arkta (FA)	Ganesh (G)	Mridula (M)	Bhagwa (B)
<b>Stage 1</b>	0.4087	0.4004	0.4433	0.4757
<b>Stage 2</b>	0.4371	0.3337	0.5195	0.4839
<b>Stage 3</b>	0.4955	0.6667	0.5527	0.4020

It was recorded that Titrateable acidity percentage increases from 1<sup>st</sup> to 3<sup>rd</sup> stage of fruit maturity. It was recorded highest in Ganesh variety 0.6667% over the Fulle arkta, Mridula and Bhagwa variety in which Titrateable acidity percentage was found to be 0.4955 %, 0.5527 % and 0.4020 % respectively. Similar results have been recorded by Gunduz (2014) where several characteristics of Jujube fruit harvested at four maturity stages were studied. The maturation stages were classified by degree (%) of dark color formation on the fruit surface [Stage (S1), 1–10% (S2), 11–50% (S3), 51–100% (S4)] and observed that Titrateable acidity increases with maturation.

**TSS: Acid Ratio****Table 11. TSS: acid ratio of different varieties of pomegranate fruits at three physiological stages.**

Variety Stages	Fulle arkta (FA)	Ganesh (G)	Mridula (M)	Bhagwa (B)
<b>Stage 1</b>	29.612	31.900	27.120	23.910
<b>Stage 2</b>	32.782	34.848	26.551	32.399
<b>Stage 3</b>	33.987	46.292	27.052	35.840

From the above data, it was concluded that sugar to acid ratio increases from 1<sup>st</sup> to 3<sup>rd</sup> stage and was found maximum in Ganesh variety 37.620 over the other three varieties. Similarly Brito and Narain (2002) studied the physical and chemical characteristics of sapota fruit at different stages of maturation and observed that TSS: TA increase from green to half ripe stage whereas decrease from half ripe to full ripe stage.

## CONCLUSIONS

Results concluded from the above result is that maximum fruit size, fruit volume (316.8cc), aril weight (266.35g), titratable acidity(0.6667%), TSS:TA(46.292) and TSS (16.1° Brix) was obtained in Ganesh variety at 3<sup>rd</sup> stage of maturity. However fruits of Bhagwa variety were most desirable for their outer appearance, taste and aril appearance.

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