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Research Article

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Physico-chemical properties, estimation of total sugars and vitamin C content of pomegranate cultivars Arakta and Gansesh: A comparative investigation

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ABSTRACT

The present investigation was carried out in order to find different physico-chemical characteristics of two varieties of pomegranate fruits namely Ganesh and Arakta cultivated around Lonand (Khandala) of Satara district. The study reveals that, the morphological characteristics such as colour of fruit vary from yellowish with pink patches in Ganesh and dark red for Arakta variety. The average weight of fruit found was 270.7g and 258.4g for Ganesh and Arakta cultivars. The edible and waste index was found 61 % and 37% for Ganesh variety while for Arakta variety it was and 59 % and 41 % respectively. The chemical parameters of fruit determined were total soluble solid (TSS) acidity and pH. Efforts were also made to quantify the amount of reducing sugars and vitamin C contents for both varieties. The results indicate that the values are comparable in both the varieties with minor variation.

Keywords: Pomegranate, Physico-chemical, reducing sugars, vitamin C.

INTRODUCTION

Pomegranate (*Punica granatum* L) is grown in tropical and subtropical regions of the world. It is important crop for drought prone areas in India. The total area under cultivation of pomegranate in India is 130.80 thousand ha and production is around 13.45 lakh tons with productivity ratio 10.30 [1]. India is the largest producer of pomegranates in the world. India produces finest varieties of pomegranate having soft seeds, very less acids and very attractive colour of the fruits and grains. Maximum cultivation of pomegranate is in states of Maharashtra and North Western Karnataka which are very close to the western port of Mumbai for exporting to Gulf and European countries. Quality of Indian pomegranate is much superior to Spain and Iran in its edible quality and attractiveness. Maharashtra is the leading producer of pomegranate followed by Karnataka, Andhra Pradesh, Gujarat and Tamil Nadu. Pomegranate varieties namely Ganesh, Bhagwa, Ruby, G-137, Arakta and Mridula are cultivated in Maharashtra.

On commercial scale it is cultivated in Solapur, Sangli, Satara, Pune, Ahmednagar Nasik,Dhule, Aurangabad, Osmanabad and Latur districts of Maharashtra state. Catchment area for wholesale market of pomegranate in Satara district is Mahabaleshwar, Khandala, Wai, Phaltan, Koregaon, Khatav, Patan, Karad, and Vaduj blocks. Agriculture Export Zone for enhancing exports of pomegranate has been established in Maharashtra. There is strong research support for scientific cultivation of pomegranate like National Research Center for Pomegranate, Solapur, MPKV, Rahuri in Maharashtra and IIHR, Bangalore in the state of Karnataka. Pomegranate co-operative societies from Maharashtra state have formed an apex cooperative namely MAHA ANAR. Bhagwa variety has high acceptance in European market. Pomegranate export facility center set up in Baramati area with mechanical handling system. Farmers have been trained for export quality production and have registered with GLOBALGAP documentation.

It is widely used in the food and process industries due to its excellent nutritional health benefits. The fruits are also act as raw material for the manufacture of secondary products such as jellies, cosmetics and dyes. The fruits are

round, oblate or obovate in shape and vary in weight and size. The edible portion contains about 52% of fruit weight and comprising about 78% juice and 22% seeds. The fruit skin may be thick or thin but smooth, leathery and tough with colour varying from pale yellow to crimson-red. The arils inside the fruit are shiny like pearls or jewels which is actually an edible portion of the fruit. The pulp obtained from it is superior quality thick, soft, fleshy and dripping juicy whose colour varies from light pink to crimson-red. The taste of the pulp varies from sweet and aromatic to sour and insipid. The seed portion of the fruit may be hard or soft but edible. The softer varieties are designated as seedless [2].

The fruit is excellent source of sugars, vitamin C and minerals namely iron, potassium and least for calcium. The juice contains amino acids such as glutamic acid, aspartic acid, typtophan, methionine etc. It is rich in phosphorus while seeds are rich source of lipids, proteins, crude fiber and ash which also contains sugars and pectin [3]. The rind contains poyphenols and mineral matter, the water and solvent extract of the peel contains anthocynins, gallic acid, ellagitannins, gallotannins, ellagic acids, catechins, anthocyanins, ferulic acids and quercetins. These polyphenols exhibit various biological activities such as removing free radicals, inhibition of oxidation and microbial growth, decreasing the risk of cardio and cerebrovascular diseases and few cancer cells [4].

The fruit is included under medicinal plants since ancient time and commonly used as folk medicine in the India as antiviral, antifungal, antimicrobial and antibacterial agent.

Vitamin C is an essential nutrient required for maintaining the human health due to its anti-oxidative and free radical scavenger capacities. It has relatively high content of vitamin C, which is around 40-70 mg/ 100 g pomegranate arils. Since L-ascorbic acid (AA) is a water-soluble, thermo labile vitamin which is prone to both chemical and enzymatic oxidation, its concentration can be considered as a quality factor in fruit juices and therefore it is important to monitor during processing and storage.

The present investigation was carried out to determine the variation in the physicochemical values and morphological attributes of the locally grown pomegranate cultivars Bhagwa and Arakta fruits and its juice. Study aims the physical and chemical properties of both cultivars relevant for post harvest handling and processing around Lonand of Khandala tehsil in Satara district.

EXPERIMENTAL SECTION

2.1 Fruit Sampling

Pomegranate fruits of Arakta and Ganesh variety were collected from the pomegranate orchards situated nearby Lonand and adjoining area of Khandala tehsil of Satara district. The fruits of uniform size and nearly same colour and maturity were selected by visual observation and used for the experiment. To reduce variability within a cultivar, fruit of each cultivar were purchased from one farmer. For each cultivar, a sample of 10 fruit of fairly uniform size was used for measurements, giving a total of 20 fruits for the experiments.

2.2 Morphological features

Features like colour, weight of fruit, percent edible portion, percent waste, percent juice were determined for both the varieties of pomegranate.

2.3 Proximate analysis

Pomegranate fruits were analyzed for its total soluble solids (TSS), acidity, PH, carbohydrate and Vitamin-C content by standard methods.

2.4 Physical properties

2.4.1 Fruit and aril colour

Fruit size and skin colour, aril size and colour determinations were performed by visual observation.

2.4.2 Fruit size

Fruit were weighed individually using a Contech make digital balance (±0.001g). By using a Vernier caliper, the following lineal dimensions of each fruit were made (±0.01 mm): length, equatorial diameter, calyx diameter and calyx length. For each size attribute, two measurements (on opposite sides of fruit) were made. After whole fruit size measurements, the arils (with seed) were manually separated from the fruits and the total aril content per fruit was weighed. Replicate measurements of the skin thickness on opposite sides were made using the Vernier caliper. Total number of arils per fruit was estimated by counting the number per 20 g sample.

2.5. Fruit chemical properties

2.5.1 Preparation of juice

Fruit juice content was determined by extracting the contents of replicate samples of 100 g of arils per fruit using a juice extractor (Bajaj Mixer Grinder, GM-550). The juice was filtered through muslin cloth, clarified by addition of bentonite (0.5%) and used to determine the following chemical properties.

2.5.2 Total soluble solids (TSS)

Total soluble solid (^{o}Brix) was determined on pomegranate juice samples per fruit using a temperature compensating hand-held Atago refractometer (RX-5000) using distilled water as calibration reference.

2.5.3 pH and acidity

The pH of pomegranate juice was measured using a digital pH meter (Equiptronics, EQ- 615). Titratable acidity (TA), expressed as percent citric acid, was determined using a 10 ml homogenized juice sample was filtered through Whatmann filter paper1 in a vacuum flask. The juice sample was added to 190 cm^3 distilled water and homogenized for 5 min. Aliquot of 50 cm^3 was titrated with 0.1 M NaOH to an end point of pH 8.2 as indicated by phenolphthalein indicator [5]. Nine homogenized samples per variety were analyzed for titratable acidity.

2.5.4 Reducing sugars

Reducing sugars was estimated according to the method of Lane and Eyon [6] which is expressed as % sugars.

2.5.5 Vitamin C content

Vitamin C concentration in pomegranate juice was determined by a redox titration using iodine. Determination was done on the same day of sampling to counteract the instability of vitamin C. It is estimated using the procedure as per reference [7] and were reported as mg/100cm^3.

RESULTS AND DISCUSSION

3.1 Whole fruit properties

3.1.1. Fruit morphology

Individual fruit mass, length and mid-section diameter of the Bhagwa was significantly higher than Arakta cultivars (Table 1). There were significant differences in fruit skin thickness among both the cultivars, with Arakta having the thickest skin and the Bhagwa cultivar having the thinnest skin.

Table 1: Fruit morphology of two pomegranate cultivars grown around Lonand

Variety	Fruit Property					
	Mass (g)	Diameter (mm)	Length (mm)	Skin thickness (mm)	Calyx width (mm)	Calyx length (mm)
Arakta	399.06± 16.32	92.63± 1.44	83.62± 1.37a	4.70± 0.41a	27.99± 0.74b	12.19± 0.51c
Ganesh	424.30± 25.62	90.97± 0.87	80.07± 1.06b	3.73± 0.21b	33.11± 1.09a	14.17± 0.69b

Means of fruit property along the row followed by the different letters are significantly different at p < 0.001.

The cultivars also differed significantly in the size of the calyx end material where Arakta variety having 27.99 mm and the largest width 33.11 mm for Ganesh variety. This information is mainly relevant in the design or choice of appropriate packaging for fruit handling and storage.

3.1.2 Physical properties of arils and edible index

Colour characteristics, aril colour and edible index for both cultivars were calculated and compared .The results are presented in Table 2.

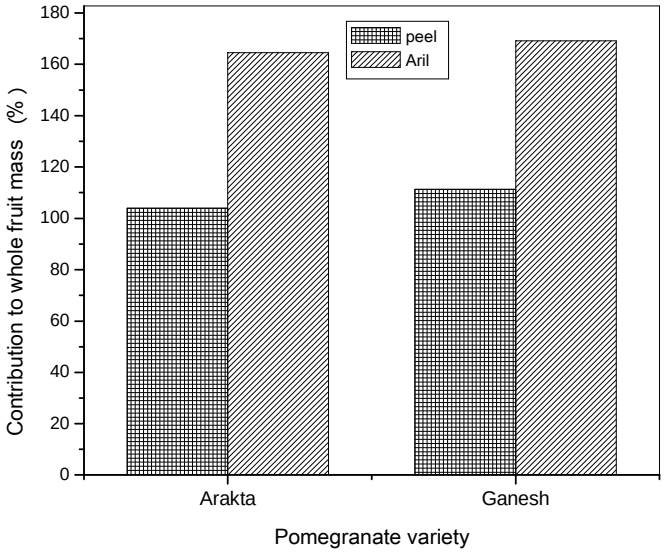
Table 2 Some physical properties of pomegranate arils

Variety	Colour of fruit	Colour of arils	Weight of fruit (g)	Weight of arils (g)	Weight of peel (g)	Edible index (%)	Waste index (%)
Arakta	Dark red	Crimson-red	268.42	164.50	103.92	61.28	38.72
Ganesh	Yellowish with pink patches	Pinkish	280.35	169.15	111.20	60.33	39.66

The data on physical characteristic of pomegranate (Table 2) indicates that the colour of fruit Ganseh cultivars was yellowish with pink patches in comparison with crimson-red for Arakta variety. The fruit aril colour in Arakta was found crimson red while it was pinkish for Ganesh variety. There was marginal average weight for Ganesh variety than Arakta. It has been found that, average weight of Arakta cultivar was 268.52g while weight of Ganesh cultivar

was 280.35g.The edible portion and waste index in Arakta cultivar were 61.28% and 38.72 %, while in Ganesh cultivars these values were 60.33% and 39.66% respectively.

Fig. 1 Relative contributions of skin and arils to the total mass of pomegranate fruit



There were nearly equal proportion of aril and peel mass (Fig.1) for both the varieties. The edible portion was found to more in Arakta cultivar than Ganesh cultivar. Aril content (number of arils and mass) varied noticeably among the cultivars.

Total number of arils and mass per fruit were highest in Bhagwa and significantly lowest in the Arakta variety (Fig.2).

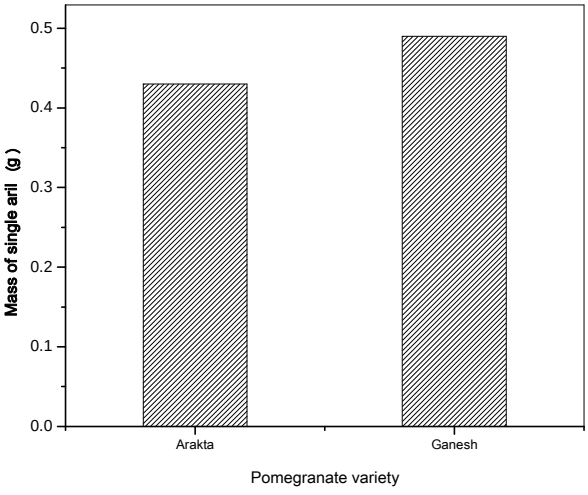


Fig. 2 Mass of single arils of two pomegranate cultivars

The results of present investigation were in good agreement with results reported by Patil *et al* [8].

3.1.2 Chemical parameters of pomegranate juice

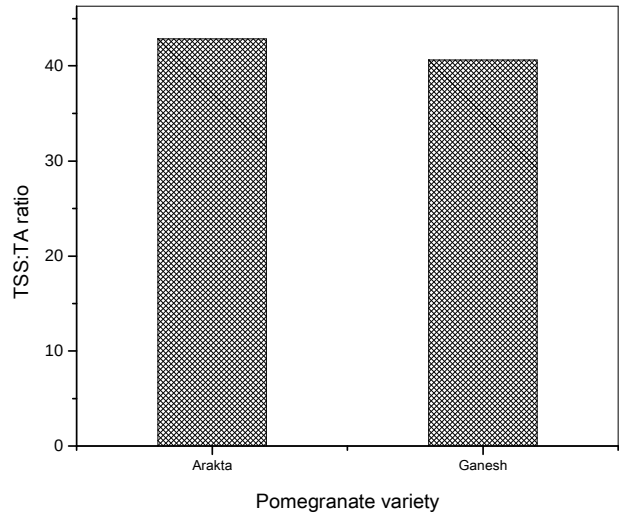
Hand press method was employed for extraction of pomegranate juice where arils were separated manually from the fruit. The juice was extracted by crushing the arils followed by pressing through muslin cloth consisting at least two layers. Juice was clarified and employed for measurement of following chemical properties; results are summarized in Table 3.

Table 3 Juice content and chemical properties of fruit juice of two pomegranate cultivars

Variety	Parameter						
	TSS (^oBx)	Titratable Acidity TA (%)	p^H	Total Sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)	Vitamin-C (mg/100g)
Arakta	15	0.35	3.59	13.50	12.30	1.20	9.5
Ganesh	13	0.32	3.54	12.85	11.15	1.70	9.0

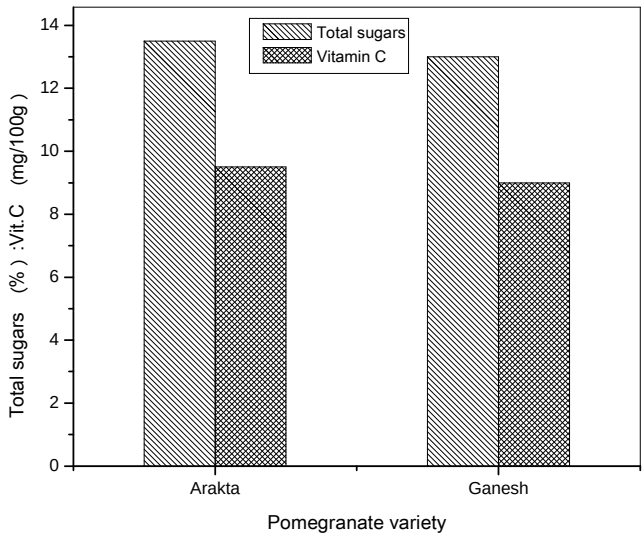
From Table 3 it is clear that the TSS, acidity, pH and total sugars in the juice from Arakta variety has significant values which are higher than Ganesh cultivars. Non-reducing sugars in Ganesh variety shows marginal difference compared to Arakta variety while vitamin-C amount estimated for Arakta is 0.5 mg/100g more than Ganesh cultivars. Arakta cultivar has higher sugar content (TSS,15°Brix) and titratable acidity (0.35) while Ganesh cultivar has TSS,13°Brix and TA 0.32 which is less in comparison where by Brix:acid ratio becomes 42.85 and 40.62 respectively for Arakta and Ganesh cultivars. Fig.3 shows marginal changes in Brix: acid ratio.

Fig.3 Ratio of total soluble solids and titratable acidity of pomegranate cultivars



This very low Brix: acid ratio explains the characteristic 'sweet and sour' taste of the cultivar juice observed when taste test was carried out as usual. The slight acidic taste and related flavor are significant attributes of pomegranate juice, which contribute to its strong appeal in the food and beverage industry.

Fig. 4 Total sugars and vitamin C content of pomegranate cultivars



From estimation of total sugars of the two varieties suggests it has been found that, there is no significant variation in the percentage composition for both cultivars. Juice on storing for the 15 days indicate that there was significant increase in the TSS of juice where °Brix becomes 15.25 for Arakta and 13.30 for Ganesh variety. This increase in TSS values was found associated with increase in sugar contents. Fig.4 suggests cultivars which have lower aril toughness contained more juice per unit mass of aril

Vitamin C content in Ganesh cultivar was 8.5-9 mg/100g and in Arakta cultivar 9.2-9.5mg/100g. The values obtained are in good agreement with the values reported by Kulkarni *et al*. [9].

CONCLUSION

The studies reveal considerable variation in few physical as well as chemical properties of pomegranate cultivars grown around Lonand. Estimation of total reducing sugars and vitamin C indicate that there is little but significant variation in the % composition for both varieties. As the studied cultivars represent major contribution towards pomegranate cultivation, compositional information of fruit varieties such as reducing sugars, vitamin C, titratable acidity etc. highlights that fruits can acts as a good source of nutrients and recommended for commercial utilization. This information could be useful in the early screening of existing cultivars, particularly for juice production which may be useful in preparation of different value added products. The dark red colour of Arakta cultivar had eye appeal effect to the consumers. Further study warrants the physical and chemical relationship among different cultivars grown around the Khandala tehsil.

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