



ISSN (E): 2277-7695  
ISSN (P): 2349-8242  
NAAS Rating: 5.23  
TPI 2023; 12(11): 384-388  
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[www.thepharmajournal.com](http://www.thepharmajournal.com)  
Received: 07-08-2023  
Accepted: 22-09-2023

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## Quality attributes and nutrient composition of acid lime varieties

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DOI: <https://doi.org/10.22271/tpi.2023.v12.i11e.23870>

### Abstract

Six acid lime varieties grown in Horticulture Research and Extension Station, Tidgundi (UHS, Bagalkot) and farmer's fields around Vijaypur Taluka were selected and they were analyzed for quality attributes and fruit characteristics. Fruits were bright yellow in colour, round and oval in shape with smooth to uneven surface. Fruit length was ranging from 4.15cm to 4.64 cm and fruit breadth between 3.99cm to 4.23cm. Fruit weight ranged between 37.73 to 48.05g. While fruit peel ranging from 7.66 to 10.01g. Flavedo weight ranged from 24.30g to 21.10g. The highest juice content was observed in Pule sharbatti (22.70g) and lowest in Vikram (14.20g). fruit volume range between 37.90ml to 48.50ml. Among all varieties Pule sharabatti had significantly maximum length, breadth, fruit weight, fruit volume, fruit peel, albedo, flavedo and juice content. Significantly higher ascorbic acid content was found in Vikram (39.68mg/100ml), total soluble solids were ranging between 7.24 to 7.96 °brix, high content was in Vikram and low in Pule sharabatti.

**Keywords:** Acid lime, antioxidant, antibacterial, anticarcinogenic, flavonoids

### Introduction

Acid lime (*Citrus aurantifolia* Swingle) belongs to Family Rutaceae, is one of the four commercially important citrus fruits grown in the country, besides sweet orange, mandarin and lemon. Lime is a versatile tropical fruit with multiple health benefits and give relief from numerous diseases. It is not only used in households but also in many industrial applications like cosmetics, pharmaceuticals and food processing industries.

Karnataka ranks 5<sup>th</sup> in acid lime production with 2,83,470 tonnes and first in productivity with 23.33 t/ha and a trade of worth 4,92,027 lakhs (Anon, 2014) [2]. Among different horticulture crops, acid lime is one of the remunerative fruit which is grown on commercial scale in Vijaypur district in an area of 6499 ha, with a production of 1,62,475 tonnes (Anon., 2014) [2]. Acid lime exhibits cyclical growth flushes throughout the year. Wherein three blooming seasons are Mrig Bahar (June-July), Hasta bahar (September–October) and Ambe bahar (January to February). Out of three bahars, Hasta Bahar fruits fetch high price in the market. Acid lime starts yielding from the 5<sup>th</sup> year with 50-60 fruits per tree and from 10<sup>th</sup> year the yield stabilizes with 1000 to 1500 fruits per tree. The economic life of acid lime is about 25 to 30 years. Kagzi lime is one of the important variety grown extensively in Karnataka (Vijaypur, Bagalkot, Koppal and Gularga districts) and is exported to United Arab Emirates, Saudi Arabia and Bangladesh ([www.apeda.gov.in](http://www.apeda.gov.in)).

Acid lime fruit is nutritionally very rich and have acidic property (light) that possesses natural antioxidants, antibacterial, anticarcinogenic properties and boosts immune system in human body. It is an essential ingredient of cuisine used worldwide because of its fragrance astringent and acidic taste and also as preservative. Lime is rich in vitamin C, excellent source of phosphorous and iron. Besides high nutritive value it has excellent medicinal properties because it contains unique flavonoid compounds that have antioxidant and anticancer properties. It is a digestive stimulant and improves both digestion and appetite.

The fresh lime juice is being used in medicine from ancient times of India. In Vedas lime has been mentioned as a sacred fruit *Charaka* and *Sharangdhara* the two famous physicians of ancient India, have mentioned about the therapeutic value of acid lime in various disease of bones and joints. The vitamin 'C' content in lime increases the body resistance to diseases, aids to the healing of wounds and prevents damage to eyes. Vitamin-C is also helpful in maintaining the health of teeth and other bones of the body. It prevents decay and loosing of the teeth, dental caries, toothache, bleeding of the gums and fragility of bones.

Acid lime has good commercial potential and cultivation area is gradually increasing because of high returns on the other hand, processing units are not available in growing area is one of the back drop under value addition sector. That is causing post harvest loss. Hence, the present study was undertaken with the following objective to assess the quality attributes and fruit characteristics of acid lime varieties.

### Materials and Methods

The present study was undertaken in Department of food science and nutrition, College of community science, University of agricultural sciences, Dharwad. Six acid lime varieties cultivated in Horticulture Research and Extension Station, Tidgundi (UHS, Bagalkot) and farmer's fields around Vijaypur taluka were selected. The varieties studied were Pule sharabatti, Sai sharabatti, Balaji, Vikram, Pramalini and Kagzi lime. Fresh acid lime fruits were selected randomly for assessment of fruit characteristics and yield characteristics such as colour, shape, size (weight and volume) and seed number. Quality attributes like juice content, albedo content, flvedo content and peel content weight by using standard AOAC methods (Anon., 2005) [1]. Total soluble solids were analysed using hand refractometer and pH by using digital pH meter. Titrable acidity, Ascorbic acid and proximate composition were analysed using standard AOAC methods (Anon., 2005) [1]. The results were statistically analyzed by one way ANOVA using SPSS software.

### Results and Discussion

The six acid lime varieties namely Pule sharabatti, Sai sharabatti, Vikram, Pramalini, Balaji and Kagzi lime were selected for analysis. The fruits were harvested at mature yellow stage and analysis was carried out immediately. The data were presented in the table 1. Physical characteristics of six acid lime varieties were studied for colour, shape, surface, fruit weight and the study revealed that the Pule sharabatti, Kagzi and Vikram varieties had smooth surface, while Balaji, Sai sharabatti and Pramalini variety had rough surface. Similarly Singh *et al.* (2009) [10] observed smooth, rough, semi smooth and very smooth texture in different varieties of acid lime fruits.

Pule sharabatti, Balaji, Sai sharabatti varieties were round in shape whereas Kagzi lime, Vikram, Pramalini varieties were in oval shape. Similar observations were made by Yadlod *et al.* (2018) [12] who noticed oval and round shaped fruits with rough and smooth surface fruits.

The length of acid lime fruits was ranging from 4.15cm to 4.64 cm, these findings were in the range of observations were made by Tirthakar *et al.* (2004) [11] ranging between 3.52cm to 5.20 cm. and Yadlod *et al.* (2018) [12] between 3.75 cm to 4.95 cm.

The fruit breadth varied significantly among the selected varieties which breadth ranged between 3.99cm to 4.23cm. These findings were in the range of Yadlod *et al.* (2018) [12] who noticed breadth of fruit ranging from 3.70 to 4.70 cm.

Weight of fruit varied significantly among the acid lime varieties. The fruit weight ranged between 37.73g to 48.05g. The findings were on par with the observation made by Pawar *et al.* (2015) [7].

Volume of fruit varied significantly among acid lime varieties, which ranged between 37.90ml to 48.50ml. These findings were in the range of Tirthakar *et al.* (2004) [11] and Athani *et al.* (2009) [3]. Less number of seeds per fruit is a

desirable character in acid lime varieties. There was a significant difference observed in bulk density, varied between 0.10g/ml to 1.00g/ml. Least found in Sai sharabatti(0.10g/ml) and highest found in Vikran (1.00g/ml).

There was no significant difference observed among the variety except Kagzi lime variety (10.5) has the maximum number of seeds followed by Sai sharabatti (8.20) and Pule sharabatti (7.20). The lowest number of seeds were observed in Pramalini variety (6.00), followed by Balaji (6.20) & Vikram (6.40).

There was significant difference among the acid lime variety (Fig.1). The variety Pule sharabatti has the maximum fruit peel weight (10.01g) followed by Vikram (9.60g) and Balaji (8.70g). The minimum fruit peel was observed in Kagzi lime (7.66g) followed by Pramalini (7.80g) and Sai sharabatti (7.94g).

Figure 2 indicates the flavedo content of acid lime varieties. The variety Pule sharabatti has the maximum flavedo weight (24.30g), followed by Vikram (22.80g) and Sai sharabatti (22.30g). The minimum flavedo weight was observed in Pramalini variety (21.10g), followed by Kagzi lime (21.50g) and Balaji (21.70g). Significant difference was observed among the varieties (Fig.3). The maximum albedo weight was observed in Pule sharabatti (14.80g), followed by Sai sharabatti (14.40g), Balaji (13.10g) and Vikram (13.10g). The minimum albedo weight was observed in Pramalini (11.60g), followed by Kagzi lime (11.80g).

Significant difference was observed among the acid lime varieties (Fig.4). The fruit juice content ranged from 14.20 to 22.70g. Similarly Shinde *et al.* (2004) [8] found highest juice percent in Pramalini (57.72%) and Deshmukh *et al.* (2015) [4]. Physico-chemical parameters were analyzed and results were represented in Table 3. Significant difference was not observed among the acid lime varieties. The maximum total soluble solids were found in Vikram (7.96%), followed by Pramalini (7.83%) and Kagzi lime (7.44%). The minimum total soluble solids were found in Balaji variety (7.24%) which was at par with variety Pule sharabatti (7.27%) and Sai sharabatti (7.40%). The Titrable Acidity varied significantly among the varieties of acid lime. The lowest titrable acidity (7.13%) was observed in variety Pramalini, followed by Vikram (7.39%), Balaji (7.50%) and Sai sharabatti (7.60%). The highest titrable acidity was found in Pule sharabatti (8.22%), followed by Kagzi lime (7.97%). Significant difference was not observed in pH of fruit. The highest pH was observed in variety Pramalini (3.25), which was followed by Balaji and Sai sharabatti (3.20). The lowest pH was recorded in Pule sharabatti and Vikram (3.05), which followed by Kagzi lime (3.10). The highest content of Ascorbic acid (39.68mg/100ml) content was found in variety Vikram, followed by Pramalini (30.61mg/100ml) & Sai sharabatti (30.12 mg/100ml). The lowest ascorbic acid content was recorded in variety Pule sharabatti (25.14mg/100ml), followed by Kagzi lime and Balaji (26.24mg/100ml) each.

Proximate composition of acid lime varieties was analyzed and results are given in Table 4. Significant difference was not noticed between the varieties for moisture content. Moisture content ranged from 82.05 to 85.45g%, highest moisture content was observed in Sai sharabatti variety (85.45g%) followed by Pramalini (84.31g%), Kagzi lime (84.16g%) and Pule sharabatti (84.02g%). The lowest moisture content was observed in the Vikram (82.05g%)

which was as par with Balaji (82.90g%). Acid lime fruit contains very less amount of fat content. The highest fat content observed in Kagzi lime variety (2.17g%) which was as par with Balaji (2.15g%) followed by Pramalini (1.90g%) and Pule sharabatti (1.82g%). The lowest fat content observed in Sai sharabatti (1.07g%), followed by Vikram (1.25g%).

There is no significant difference is observed in the acid lime fruit varieties. The highest crude fibre content was observed in Vikram (10.13g%), followed by Sai sharabatti (9.58g%). The lowest crude fibre content was found in Pule sharabatti (8.66g%), which was as par with Pramalini (8.81g%), Kagzi lime (8.86g%) and Balaji (8.98g%).

Significant variation was observed among the acid lime varieties. The maximum ash content was observed in Kagzi lime (7.75g%) followed by Sai sharabatti (7.15g%), Pule sharabatti (7.09g%) and Vikram (7.09g%). The minimum ash content was observed in Pramalini (6.99g%) followed by

balaji (7.00g%) were on par with each other and were having significantly lower ash content. In general, significant variation was noticed among the selected acid lime varieties for physical and chemical composition. These variations could be due to environmental factors such as variety, maturity, soil, climate as reported by Kumar *et al.* (2011) [5]. Titrable acidity varied significantly among the varieties of acid lime fruit. It ranged between 7.13 to 8.22 percent. These findings were in the line of observations made by Deshmukh *et al.* (2015) [4] (7.13% and 8.23%) and Tirthakar *et al.* (2004) [11] (7.14% to 11.93%).

The ascorbic acid content varied significantly between varieties which ranged from 25.14mg/100g to 39.68mg/100g. Similarly Deshmukh *et al.* (2011) documented significant variation ranging from 27.17 to 33 mg/100 g among acid lime varieties.

**Table 1:** Visual observation of acid lime varieties

Variety	Colour	Shape	Surface
Pramalini	Bright yellow	Oval	Uneven
Kagzi lime	Bright yellow	Oval	Smooth
Balaji	Bright yellow	Round	Uneven
Sai sharbatti	Bright yellow	Round	Uneven
Vikram	Bright yellow	Oval	Smooth
Pule sharbatti	Bright yellow	Round	Smooth

**Table 2:** Fruit characteristics of acid lime varieties

Varieties	Fruit characteristics (per fruit)						
	Length (cm)	Breadth (cm)	Shape index of fruit (L/B)	Fruit weight (g)	Volume (ml)	Bulk density (g/ml)	Number of seeds
Pramalini	4.42 ± 3.19	3.99 ± 2.46	1.10 ± 0.06	38.76 ± 6.23	39.0 ± 7.97	0.99±0.01	6.00 ± 2.22
Kagzi lime	4.46 ± 1.37	4.17 ± 1.39	1.07 ± 0.03	44.93 ± 3.6	46.7 ± 6.67	0.96±0.03	10.5 ± 2.78
Balaji	4.55 ± 3.30	4.15 ± 1.89	1.09 ± 0.06	43.65 ± 6.10	44.0 ± 3.19	0.99±0.01	6.20 ± 3.20
Sai sharbatti	4.15 ± 1.94	4.03 ± 2.21	1.03 ± 0.05	37.73 ± 4.79	37.9 ± 6.18	0.10±0.01	8.20 ± 1.68
Vikram	4.45 ± 3.04	4.05 ± 2.61	1.10 ± 0.04	40.95 ± 7.62	40.9 ± 4.79	1.00±0.01	6.40 ± 1.81
Pule sharbatti	4.64 ± 1.96	4.24 ± 2.44	1.09 ± 0.04	48.05 ± 6.43	48.5 ± 6.73	0.99±0.02	7.20 ± 0.52
Mean	4.44 ± 2.89	4.10 ± 2.30	1.08 ± 0.05	42.34 ± 6.97	42.83 ± 6.12	0.99±0.02	7.40 ± 1.3
S.Em	0.81	-	0.06	1.88	0.60	0.03	0.72
CD	2.31	-	0.0	5.32	1.70	0.11	2.03
F value	4.09**	2.01 <sup>NS</sup>	3.17**	4.35**	5.03**	7.14**	5.71***

Note- values are average of ten fruits; Mean ± S.D; CD - Critical Difference; S. E m ± Standard Error of mean ; NS- non significant

\*\*-significant at 1 percent \*\*\*- significant at 0.1 percent

**Table 3:** Physico-Chemical parameters of acid lime varieties

Varieties	TSS (° Brix)	Titration acidity (%)	pH	Ascorbic acid (mg/100ml)
Pramalini	7.83 ± 0.49	7.13 ± 0.02	3.25 ± 0.07	30.61 ± 1.89
Kagzi lime	7.44 ± 0.46	7.97 ± 0.08	3.10 ± 0.14	26.24 ± 1.10
Balaji	7.24 ± 0.28	7.50 ± 0.01	3.20 ± 0.00	26.24 ± 2.21
Sai sharbatti	7.40 ± 0.46	7.60 ± 0.02	3.20 ± 0.00	30.12 ± 0.97
Vikram	7.96 ± 0.59	7.39 ± 0.03	3.05 ± 0.07	39.68 ± 4.83
Pule sharbatti	7.27 ± 0.76	8.22 ± 0.02	3.05 ± 0.07	25.14 ± 2.50
Mean	7.56 ± 0.52	7.63 ± 0.37	3.14 ± 0.09	29.67 ± 5.51
SEM	-	0.022	-	1.49
CD	-	0.077	-	4.61
F value	4.18 <sup>NS</sup>	474.61***	2.54 <sup>NS</sup>	12.98***

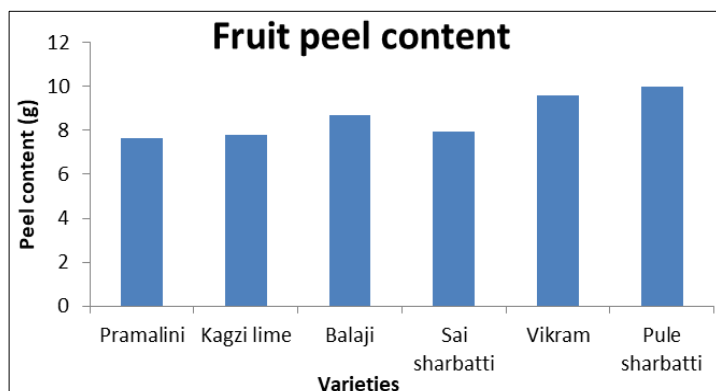
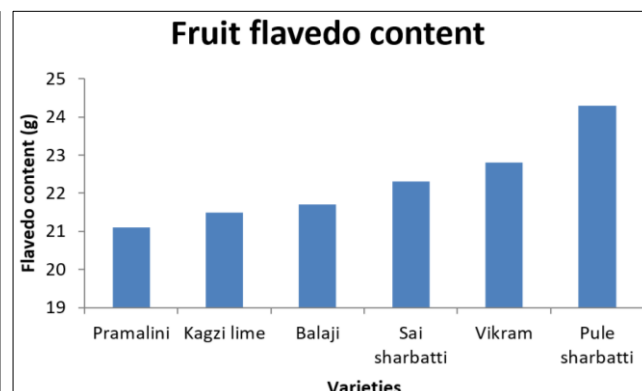
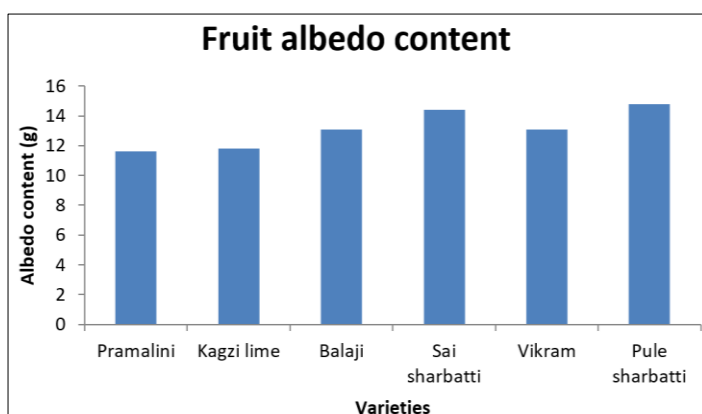
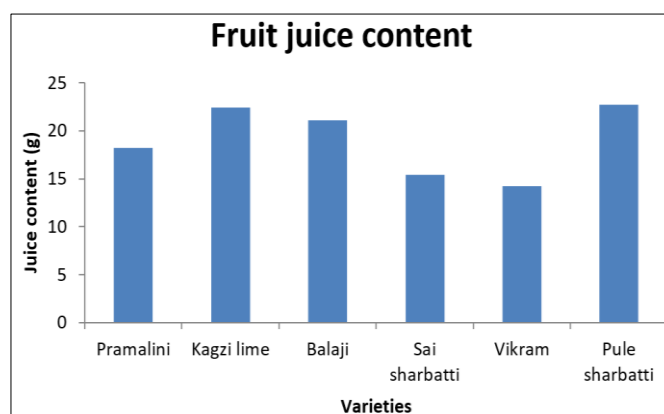
Note: Mean ± S.D; CD - Critical Difference; S. E m ± Standard Error of mean;

NS-Non significant \*\*\*- Significant at 0.1 percent

**Table 4:** Proximate composition of acid lime varieties

Varieties	Moisture (g/100g)	Fat (g/100g)	Crude fibre (g/100g)	Ash (g/100g)
Pramalini	84.31 ± 1.14	1.90 ± 0.49	8.81 ± 1.62	6.99 ± 0.02
Kagzi lime	84.16 ± 1.77	2.17 ± 0.67	8.86 ± 0.04	7.75 ± 0.04
Balaji	82.90 ± 0.06	2.15 ± 0.14	8.98 ± 0.21	7.00 ± 0.03
Sai sharbatti	85.45 ± 1.14	1.07 ± 0.10	9.58 ± 1.10	7.15 ± 0.05
Vikram	82.05 ± 0.01	1.25 ± 0.28	10.13 ± 2.07	7.09 ± 0.06
Pule sharbatti	84.02 ± 1.64	1.82 ± 0.03	8.66 ± 0.79	7.09 ± 0.04
Mean	83.81 ± 1.49	1.72 ± 0.51	9.17 ± 1.04	7.18 ± 0.27
SEM	-	-	-	0.03
CD	-	-	-	0.11
F value	2.98 <sup>NS</sup>	3.18 <sup>NS</sup>	0.43 <sup>NS</sup>	72.08 <sup>***</sup>

Note -Dry Weight basis ; Mean ± S.D; CD - Critical Difference; S. E m ± Standard Error of mean ; NS- Non significant \*\*\*- Significant at 0.1 percent

**Fig 1:** Peel content of acid lime varieties**Fig 2:** Flavedo content of acid lime varieties**Fig 3:** Albedo content of acid lime varieties**Fig 4:** Juice content of acid lime varieties

## Conclusions

Physico-chemical composition of six acid lime varieties showed that the fruits were bright yellow in colour, round and oval in shape with smooth to uneven surface. Among all varieties Pule sharabatti had significantly maximum length (4.64 cm), breadth (4.24 cm), fruit weight (48.05g), fruit volume (48.50ml), fruit peel (10.01g), Albedo (14.80g), flavedo (24.30g) and juice content (22.70g). Total soluble solids were ranging between 7.24 to 7.96 °brix, high content was in Vikram and low in Pule sharabtti. The titrable acidity was between 7.13 to 8.22% high in Pule sharabatti and low in Pramalini. pH content ranging from 3.05 to 3.25, high in Pramalini and low in Vikram and Pule sharabatti. Significantly higher ascorbic acid content was found in Vikram (39.68mg/100ml) and lowest in Pule sharabatti (25.14mg/100ml). Moisture content of acid lime varied from 82.05 to 85.45g%, maximum was seen in Sai sharabtti and

minimum in Vikram. Fat content varied from 1.07 to 2.17g%, high content was seen in Kagzi lime and low in Sai sharabatti. With regard to crude fibre, high content was found in Vikram and low in pule sharabatti and it was ranging from 8.66 to 10.13g%. Ash content was varied from 6.99 to 7.75g%, highest being found in Kagzi lime and lowest in Pramalini. These fruit characteristics helps in processing the acid lime fruit products in its peak production time. Acid lime fruit has the so many health benefits and it can be utilized, preserved and can be made available throughout the year.

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