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Studies on physical and chemical composition of lime (*Citrus aurantifolia* L.)

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Abstract
In this present investigation, study was carried out to determine physical and chemical composition of lime (*Citrus aurantifolia* L.). The freshly collected lime selected for evaluation of physical, chemical and mineral composition. Results obtained showed that color of lime was yellow, length was 5.19cm, diameter was 4.43cm and mass was observed to be 35.38 g. Further chemical and mineral composition was reported and results showed that moisture content found to be 83.88%, carbohydrate 9.96%, protein 1.5%, Fat 1.0% and ascorbic acid content found to be 12.2mg/100g. The other parameters such as acidity and pH of lime juice were indicated 7.0% and 2.2 respectively. The mineral composition of lime showed iron 4.0mg, zinc 0.4mg, copper 5.56mg and manganese 1.90mg/100g respectively.

Keywords: lime, *Citrus aurantifolia,* physical properties, chemical properties.

Introduction
Kagzi lime (*citrus aurantifolia* L.) belongs to family *Rutaceae*, originated in India. It is commercially grown in tropical and subtropical region of India. Kagzi lime is the third most important fruit after mandarin and sweet orange and India ranks fifth among major lime producing countries (Anonymous, 2001) [4]. One of the most important citrus fruit as a major source of vitamin "C" and acetic acid, grown throughout the world.

In 2015-2016 India produced 2438 MT of lime/lemon from an area of 245 MT ha. Maharashtra produces 11% of total production of lime/lemon in the country and is the fourth largest producer in the country. State produces 0.31 m MT of lime/lemon from an area of 0.045 m ha with productivity of 6.8 MT/ha. Maharashtra state is leading in acid lime cultivation. Kagzi lime is principle citrus fruits grown commercially in Vidarbha and Marathwada regions. The major lime producing belts in the State are Akola, Ahmednagar and Solapur. And also In Maharashtra, lime is grown in various districts such as Pune, Satara, Wardha, Nagpur, Beed and Aurangabad (Anonymous, 2010) [5].

Many polymethoxylated flavones have several important bioactivities, which are very rare in other plants (Ahmad *et al*., 2006) [3]. In addition the fiber of citrus fruit also contains bioactive compounds, such as polyphenols, the most important being vitamin C (or ascorbic acid), and they certainly prevent and cure vitamin C deficiency-the cause of scurvy (Aronson, 2001) [6].

The health benefits of lime include weight loss, skin care, good digestion, relief from constipation, eye care, and treatment of scurvy, piles, peptic ulcer, respiratory disorders, gout, gums, urinary disorders, etc. It is used in curing giddiness, vomiting, nausea, thirst, scurvy and in febrile and inflammatory conditions. (Mohanapriya *et al.,* 2013) [10].

The fruits are extensively used for squashes, pickles, syrups and cordials, manufacture of citric acid and for table purpose in daily life of Indians (Cheema *et al.* 1954) [7]. Lime is being acidic generally consumed as fresh but mostly used for flavouring vegetable dishes, fish, meat and salads. It also makes delicious and refreshing cold drinks. The fruits are valued not only for its nutritional qualities but also for medicinal purposes. In India kagzi lime 'sharbat' is commonly used during summer. Kagzi lime produces better quality juices and beverages compared to other lime fruits. Besides having nutritional importance, citrus consists of a number of species and varieties, which are made available throughout the year, making their cultivation remunerative.

Mandarins, sweet oranges, pummelos and grape fruits are consumed in fresh form. While Limes, mandarins and oranges are mainly used for making cool drinks, syrup, crush and squash. Orange, lime, lemon and grape fruit juice are bottled and canned in large scale. Orange

marmalade, cordial and squashes are very important products (Ladaniya and Shyamsingh, 2001) [8].

Materials and Methods

The present investigation was carried out in Department of Food Engineering with collaboration of Department of Food Science and Technology and Department of Food Chemistry and Nutrition, College of Food Technology, VNMKV, Parbhani during year 2017-18.

Materials

Raw materials

Fresh limes were obtained from the central nursery of VNMKV, Parbhani. The experiments were generally performed immediately after procurement.

Chemicals and glasswares

The chemicals of analytical grade and glasswares required during investigation were used in the department of Food Engineering.

Methods

Physico-chemical properties

Physical properties such as titrable acidity, pH, proximate analysis.

pH: The pH of lime juice was determined using digital pH meter. Twenty (20ml) of the juice was transferred into a beaker and the pH was determined after the meter was calibrated using standard buffer of pH 4.0 and 7.0, sufficient time was allowed for stabilization before readings were taken.

Total soluble solid (TSS)

The TSS content of juice was determined with the help of Erma hand refractometer of 0-32 range in duplicate (A.O.A.C., 2005) [2]. The sugar content percentage (soluble sugar) was read from the scale of the refractometer when held close to the eye.

Titratable acidity

The titratable acidity was determined by the procedure as reported by Ranganna (1986) [13].

Ascorbic acid

Ascorbic acid content will be determined as per AOAC (2004) [1] using dichlorophenol Indophenol dye.

Proximate composition:

Different chemical properties of samples were analysed for moisture content, ash, fat, protein and total carbohydrate. All the determinations were done in triplicate and the results were expressed as the average value.

Moisture content:

Moisture content was determined adopting AOAC (2005) [2] method as following:

$$\% \text{ moisture} = \frac{\text{Wt.of fresh sample} - \text{Wt.of dry sample}}{\text{Weight of fresh sample}} \times 100$$

Fat

AOAC (2005) [2] method using Soxhlet apparatus was used to determined crude fat content of the sample. The percent of crude fat was expressed as follows:

$$\% \text{ Crude Fat} = \frac{\text{Weight of dried ether soluble material}}{\text{Weight of sample}} \times 100$$

Protein

Protein content was determined using AOAC (2005) [2] method. Percentage of nitrogen and protein calculated by the following equation:

$$\% \text{ Nitrogen} = \frac{\text{TS - TB} \times \text{Normality of acid} \times 0.014}{\text{Weight of sample}} \times 100$$

Where, Ts = Titre volume of the sample (ml), TB = Titre volume of Blank (ml), 0.014= M eq. of N2.

% Protein = Nitrogen × 6.25

Total carbohydrate

Total carbohydrate content of the samples was determined as total carbohydrate by difference that is by subtracting the measured protein, fat, ash and moisture from 100 phenol sulphuric acid method as given by AOAC (2005) [2].

Ash

Drying the sample at 100℃ and charned over an electric heater. It was then ashed in muffle furnace at 5500 C for 5 hrs by AOAC (2005) [2]. It was calculated using the following formula:

$$\% \text{ Ash content} = \frac{\text{AW}}{\text{IW}} \times 100$$

Where, AW = Weight of Ash and IW= Initial weight of dry matter

Results and Discussion

The extracted lime juice were evaluated for various physicochemical properties are presented as follows:

Physical properties

The data pertaining to various physical properties like mass, length, colour, diameter, shape, edible index and waste index were determined and the average values are presented in table 1.

Table 1: Physical properties of lime

Physical parameters	Average value
Mass	35.38gm
Length	5.19cm
Colour	Yellow
Diameter	4.43cm
Shape	Round
Juice recovery	48.86%

*Each value is average of three determinations

The physical properties of lime were measured and results reported that mass was found 35.38 (g), length 5.19cm, diameter 4.43cm, round in shape. Property like juice recovery was noted as 48.86%

Chemical properties and mineral composition of lime

The data pertaining to various chemical and mineral composition such as moisture, fat, carbohydrates, protein, ash and crude fiber were determined and results obtained are illustrated in Table. 2 and Table. 3

Table 2: Proximate composition of lime

Nutrients	Average Value
Moisture	83.88%
Fat	1.0±0.01%
Protein	1.5±0.02%
Carbohydrate	9.96±0.12%
Dietary fibre	1.3±0.20%
Ash	0.7±0.2%

Results given in the table. 2 indicated that the moisture content was 83.88%, fat 1.0%, protein 1.5%, carbohydrates 9.96%, crude fiber 1.3%, and ash 1.18%. The results found to be similar with book of Nutritive Value of Indian foods revised and updated by (Narasingarao *et al*., 2014) [11].

Table 3: Mineral composition of lime juice

Minerals	Average value mg/100g
Iron	4.0
Zinc	0.4
Copper	5.56
Mangnese	1.90

The mineral composition of lime were analyzed and results revealed that iron was 4.0, zinc 0.4, copper 5.56 and zinc 0.4 mg/100gm) respectively. Results reported are in close agreement with the data reported by (Masniza *et al*., 2004 and Hossain *et al*., 2015) [9].

Table 4: Chemical properties of lime

Chemical parameters	Average value
TSS	7.0
P^H	2.2
Titrable acidity	7.0
Ascorbic acid (mg/100g)	12.2

The chemical composition of lime were analyzed and results revealed that TSS was 7.0, pH 2.4, acidity was 7.0%. The ascorbic acid content of lime observed to be 12.2 mg/100g respectively. The observations for T.S.S are in close accordance with findings reported by Ramarao *et al*., (1979) [12].

Conclusion

In the present investigation it could be finally concluded that lime is good source of protein, carbohydrate and dietary fiber. Lime is good source of copper mineral. The lime is excellent source of ascorbic acid which makes it potential source for exploration and value addition in food products in combination with various fruits.

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