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Study on Physico-chemical Properties of Kokum Seed (*Garcinia indica*) Full Fat Flour and Defatted Flour

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Authors' contributions

This work was carried out in collaboration among all authors. Author MRC designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

Kokum *(Garcinia Indica)* is an ancient fruit of India which is mostly consumed in the form of sarbat. It is mainly found in the western ghats in the state of Maharashtra, Goa, Karnataka, and Kerala. Kokum fruit is widely used in culinary, pharmaceutical, nutraceuticals uses. Kokum has a long history in Ayurvedic medicine as it was traditionally used to cure sores, dermatitis, diarrhoea, dysentery, ear infection and to facilitate digestion. The present study conducted to study Physico-Chemical Properties of Kokum Seed (*Garcinia indica)* Full Fat Flour and Defatted Flour and it reveals that defatted kokum seed flour is superior in quality in terms of protein, carohydrates, crude fiber and Vitamin B3 contain as compared to kokum seed flour. We can utilise the Kokum seed defatted flour to overcome protein malnutrition problems in developing countries.

Keywords: Kokum (Garcinia indica); kokum seed; kokum seed flour; kokum seed defatted flour (KSDF).

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1. INTRODUCTION

Kokum *(Garcinia indica)* belonging to the family *Guttiferae* is an indigenous tree of India [1,2]. It was originally found only in the western peninsular coastal regions and the Western Ghats in the state of Maharashtra, Goa, Karnataka, and Kerala as well as in some east India states like West Bengal, Assam, and North Eastern Hill region, but now a day's it is growing in other parts of peninsular India. It is an underexploited tree and is known as wild mangosteen, kokum, goa butter tree, kokum butter tree in English; Vrikshamia, Vrikshamla, Amlabija, Raktavikshamla, Amlapura, Amlashaka in Sanskrit; kokum in Hindi; Bheranda in Marathi; Punarpuli in Tulu; Bhiranda , Murgal, Murgal-mala in Tamil; Kaattampi in Malayalam; Goraka in Sinhala; Murgina, Punarpuli, Devana huli in Kannada; Tintali in Oriya; kokum in Gujarati and Bhirind in Konkani [1,3].

Kokum trees yield fruits annually in the summer season during the months of March to May. The fruits are green when raw and red to dark purple after fully ripe. It is used as a major spice in India. They are used to prepare juice, pickles and as acidulant in curries. In the traditional Indian system of medicine the Ayurveda the fruit rinds and leaves are used to treat various inflammatory ailments, rheumatic pain and bowel complaints. The kokum butter prepared from the seed is of both commercial and medicinal use. Chemical studies of kokum rind have shown that it contains protein, tannin, pectin, sugars, fat, organic acids like hydroxycitric acid, hydroxycitric acid lactone and citric acid; the anthocyanins, cyanidin-3-glucoside and cyanidin-3-sambubioside; and the polyisoprenylated phenolics garcinol and isogarcinol. Preclinical studies have shown that kokum or and some of its phytochemicals possess antibacterial, antifungal, anti-ulcerogenic, cardioprotective, anticancer, chemopreventive, free radical scavenging, antioxidant and anti-obesity effects [4].

1.1 Nutritional Composition of Kokum Fruit

Kokum rind contains moisture (80.0 g/100 g), protein (1%), tannin (1.7%), pectin (0.9%), Total sugars (4.1%) and fat [5,6]. Kokum leaves are reported to contain 75% moisture, 2.3 g of protein, 0.5 g of fat, 1.24 g fiber, 17.2 g of carbohydrates, 15.14 mg of iron, 250 mg of calcium, 10 mg of ascorbic acid and 18.10 mg of oxalic acid [7]. The seeds are rich in stearic, oleic and stearic triglycerides [8]. Kokum (Garcinia indica Linn) is a medicinal plant mentioned in Ayurveda has been used for treatment of diseases like liver disorders, dysentery, sunstroke, cancer and heart diseases [9].

2. MATERIALS AND METHODS

Kokum seed were procured from the local market of Chiplun, Dist- Ratnagiri (Maharashtra). The kokum seed were cleaned to remove any unwanted materials, followed by washing and then dried at 60°C for 6 hours in tray drier. The dried seeds were ground into flour using lab grinder (Sujata model). The particle size was further reduced using a sieve of 60 mesh. Finally prepared kokum seed flour was packed in an air tight polythene bag and stored at refrigerated conditions until it was used for further processing in the defatted flour preparation. The process flow chart for the preparation of kokum seed flour was shown in Fig. 1.

2.1 Preparation of Kokum Seed Defatted Flour (KSDF)

Defatting was was carried out using the Soxhlet apparatus extraction method by Hexane using a sample to solvent ratio of 1:10 (w/v), for 9 hours. The defatted flour was air-dried at room temperature (approximately 28°C) and subsequently kept in an air-tight plastic container at 4°C prior to use for further processing in the preparation of protein concentrate.

2.2 Physico-Chemical Analysis of Full Fat Flour and Defatted Flour

Moisture, ash, fat and crude fiber contents of kokum seed flour were determined in accordance with AOAC - Association of Official Analytical Chemists method [10]. Protein and Total carbohydrate (%) , Vitamin B3 were calculated by AOAC - Association of Official Analytical Chemists method [11] and Mineral analysis by atomic absorption spectroscopy [11].

2.3 Physical Properties of Kokum Seed Defatted Flour

2.3.1 Bulk density

In this method, the flour samples were gently filled into 10 ml graduated cylinders, previously

tarred. The bottom of each cylinder was gently tapped on a laboratory bench several times until there was no further diminution of the sample level after filling to the 10 ml mark [12].

Calculation:

$$Bulk\ density\left(\frac{g}{cm^3}\right) = \frac{Wt.of\ sample}{Volume\ of\ sample}$$

2.3.2 Tap density

The tap density of a material can be used to predict both its flow properties and its compressibility. In this method the flour was filled in measuring cylinder of capacity 50 ml and tapped 5-10 times. Weight of this measuring cylinder and tapped sample was taken [13].

Calculation:

$$Tap\ density\left(\frac{g}{cm^3}\right) = \frac{Weight\ of\ sample}{Volume\ of\ sample}$$

2.3.3 True density

True density was calculated by filling 1 gm of ground sample of flours in a burette containing toluene. Toluene level was measured and an average of three readings of true density was calculated as followed [13].

Calculation:

$$True\ density\left(\frac{g}{cm^3}\right) = \frac{Weight\ of\ flour\ sample\ (gm)}{Rise\ toluene\ level\ (cm^3)}$$

2.3.4 Porosity

The porosity of flours was determined by the following equation [14].

Calculation:

$$Porosity\ = 1 - \frac{Bulk\ density}{True\ density}$$

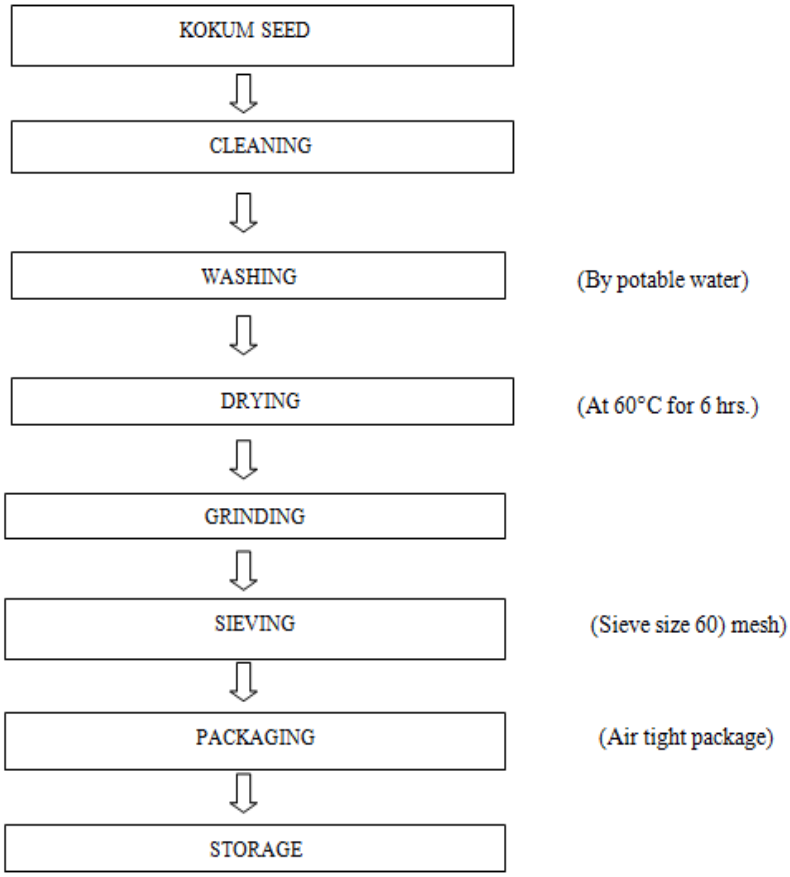

Fig. 1. Preparation of kokum seed flour

3. RESULTS AND DISCUSSION

3.1 Chemical Composition of Full Fat Kokum Seed Flour and Defatted Kokum Seed Flour

The chemical composition of full-fat (FF) and defatted (DF) kokum seed flour (Table 1) showed that kokum seeds were high in fat, carbohydrates and protein. The defatting process resulted in increase in protein, ash, crude fiber and carbohydrate content whereas, fat content was decreased from 43.9% to 6%. Pearson [15] has made similar observations for defatted flour made from soybean. The crude fiber content of full-fat kokum seed flour and defatted kokum seed flour was 4.33% and 7.1% respectively. The ash content of kokum seeds was 2.90% and 4.8% for FF and DF respectively. Carbohydrates content of flour was 29.7% and 58.5% for FF and DF respectively. Vitamin B_3 of kokum seed was estimated as 3.40 mg/100g and 5.50 mg/100g for FF and DF respectively.

3.2 Mineral Composition for Kokum Seed Flour

Mineral composition of kokum seed flour was shown in Table 2. These result showed that, kokum seed flour was high in sodium, calcium, and iron but low in zinc. Because of the high calcium and sodium content of flour, when used to supplement other cereal flours, has the potential of arresting rickets, which is the common minerals deficiency disorder among the children, mostly found in developing countries like India.

3.3 Physical Properties of Kokum Seed Defatted Flour

3.3.1 Bulk density

The bulk density of kokum seed defatted flour was found to be 0.63 g/cm^3 which was higher than bulk density of field pea (0.54 g/cm^3), and pigeon pea (0.47 g/cm^3) as reported by Kaur et al. [12] but lower than bulk density of defatted groundnut seed flour which was found to be 0.71 g/cm^3 [16].

3.4 Tap Density and True Density

The tap density of kokum seed defatted flour was 0.79 g/cm^3 and the true density of flour is 1.25. True density is the density of solid material excluding the volume of any open and closed pore. Depending on the molecular arrangement of the material, the true density can be equal to the theoretical density of the material and therefore be indicative of how close the material is to a crystalline state or the proportion of a binary mixture.

3.5 Porosity

The porosity is a measure of the voids between the solid particles of a material. The porosity of kokum seed defatted flour was 0.50.

Table 1. Chemical composition of full-fat and defatted kokum seed flour

Composition	Full-fat flour (%)	Defatted flour (%)
Moisture	10.2±0.90	8.6±1.35
Protein	9.1±0.36	15±0.45
Fat	43.9±0.57	6±0.23
Ash	2.90±0.29	4.8±0.54
Crude fiber	4.33±0.73	7.1±0.79
Carbohydrates	29.7±1.02	58.5±0.96
Vitamin B_3 (mg/100 g)	3.40±0.42	5.50±0.12

(Note - Values are mean ± standard deviation of triplicate determination)

Table 2. Mineral composition for kokum seed flour

Component (mg/kg)	Kokum seed flour
Sodium	348.27±0.95
Calcium	241.32±1.48
Iron	87.79 ±1.23
Zinc	0.993±0.13

Values are mean ± standard deviation of triplicate determination

Table 3. Physical properties of kokum seed defatted flour

Parameter	Kokum seed defatted Flour
Bulk density (g/cm3)	0.63 ±0.09
Tap density(g/cm3)	0.79 ±0.05
True density (g/cm3)	1.25 ±0.05
Porosity	0.50 ±0.02

Values are mean ± standard deviation of triplicate determination

4. CONCLUSION

Kokum seed defatted flour showed good chemical and physical properties and could be used in protein, vitamin and minerals supplementation in various food systems

particularly in developing countries where protein deficiencies remain a major health issue for children.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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