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Kokum value-added products and its sensory evaluation

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Abstract
Garcinia indica commonly known as kokum, has lot of medicinal properties and commercial importance, but the crop remains neglected and hence there is a need to concentrate on diversification and popularization of such an underutilized fruits through development of value added products. To take advantage of health promoting properties of Kokum, Kokum fruits used as pulp and powder forms for ten different formulated and standardized value added products like Kokum Jelly (KJ), Kokum Squash (KS), Kokum Carbonated Drink (KCD), Kokum wine (KW), Kokum Diet Powder (KDP), Kokum Chutney Powder (KCP), Kokum Rasam Powder (KRP), Kokum Lassie (KL), Kokum Spray Dried Powder (KSDP) and kokum popsicles (KP). Sensory evaluation was conducted on all the products and the results indicate that, KRP were highly acceptable (8.98 ± 0.32) among all other kokum products followed by KJ, KS, KCD, KW, KDP, KCP, KL, KSDP and KP, with good acceptability scores. Value addition of Kokum fruits will improve the consumption by different communities and also reduce the postharvest losses of the Under-utilised fruit, apart from promoting several health benefits.

Keywords: *Garcinia indica*, kokum pulp, kokum powder, value added products, sensory evaluation

Introduction
Garcinia indica (Kokum) is also known as ‘cool king’ of Indian foods, belongs to the botanical family Clusiaceae. The fruits are generally globular or spherical in appearance, which are green when raw and become red to dark purple when fully ripe with unique flavour weighing about 15-20 grams, enclosing 5 to 8 large seeds (Dembitsky *et al.*, 2011) [2]. Kokum fruits processing is an important activity because raw/ripe fruits need to be processed before their consumption. In the whole fruit, seed portion consists of 20 to 23% fruit weight and is very rich in stearic, oleic and stearic triglycerides (Dushyantha *et al.*, 2010) [3]. Freshly harvested kokum is reddish green in colour and turn into full red-purple colour in two days. The flesh of the fruit is juicy and has a sweetish acid taste. The normal shelf life of fresh fruit is about 5 days.

It exhibits various phytochemical properties like anti-ulcerogenic, cardio protective, anticancer, chemo preventive, free radical scavenging and anti-obesity effects. Garcinia known for medicinal properties is also used for curing piles, dysentery, tumour pains and cardiac problems. Even fat reducing tablets and capsules based on Garcinia are available in the market (Rasha *et al.*, 2015) [15].

Garcinia Kernal accounts to 61% of the seed weight. The kernels of Garcinia seed contain about 33 to 44 per cent oil, which is commercially known as “Kokum butter”, also considered as nutritive, and astringent. Due to high content of di-saturated and mono-saturated glycerides, it is in great demand as a substitute for cocoa, an extender in chocolate and confectionery products preparations. Hydroxy citric acid (HCA) is one of the most important constituents of Garcinia which is used as an anti-obesity agent for keeping fatty acid symbiosis at lower level. Garcinol has antioxidant properties, which includes citric acid, malic acid, polyphenols, carbohydrates, anthocyanin pigment and ascorbic acid. Malic acid is acidic, reddish coloured and gives the pungent sour taste to fruits. Hence it has good demand in confectionery industry (Swami *et al.*, 2014) [16].

Kokum rind contains 2 to 3% anthocyanin pigments and is a promising source of natural colorants for acid foods. The rind contains moisture (80%), protein (1%), fat (1.4%), tannin (1.7%), pectin (0.9%), total sugars (4.1%), organic acids like hydroxyl citric acid, lactone and

citric acid; anthocyanin's, cyanidin-3-glucoside and cyanidin-3-sambubioside and polyiso prenylated phenolics, garcinol and isogarcinol (Jagtap, *et al.,* 2015) [4].

The dried rind is also used to make a peculiar soup and cold drinks in summer. The dried rind is extracted with water to make syrup which is sweetened to make a cold drink (Mishra *et al*., 2006) [7]. In some parts of India, rinds are spiced and sweetened with jaggery for feasts (Patil, 2005, Patil, and Kattimani, 2008) [11, 12]. Aqueous Kokum extract also has 4% sugar, which can be fermented to make excellent quality wine. It can also be used in the manufacture of wine, champagne and liquor. Dried kokum rind pieces are powdered, sieved and stored in airtight containers. Powder is used in coconut and fish curries as an acidulant (Nayak *et al.*, 2010) [8, 9] and also used to impart an acid flavour to curries instead of tamarind (Rasha *et al*., 2015) [15]. The recent research establishes *Garcinia indica* as biochemically one of the most creative plant species.

The fruit rind usually wasted can be utilized for preparation of various value added products, which are of commercial importance from the industrial as well as health point of view so we has taken the objectives to study the development and sensory evaluation of ten different commercially value added kokum products.

Materials and Methods

Kokum fresh fruits were procured from local market at Putter, Karnataka. Other ingredients were purchased from local market to formulate and standardize different products.

Primary processing

Washing and cleaning

The fresh Kokum fruits were collected and washed thoroughly in fresh tap water, followed by double glass-distilled water to remove the adhering dust and drained completely. After primary processing fruits were bifurcate into two groups. One group of fruits were ground after carefully removing the seed. The ground kokum pulp was stored at refrigerated temperature (-4°C) in sterilized glass containers after adding preservative (sodium benzoate 250ppm) for further products development such as jelly, squash, sauce, wine, spray dried powder and Lassie.

Another group of fresh fruits are cut into halves and fleshy portion containing the seed is removed. The residual moisture was evaporated at sun drying (35ºC to 40ºC for 2 to 3 days), on a clean paper with constant turning over (Excess moisture was removed) using dry muslin cloth (Fig; 1). Fruits were powdered by using blender and stored in sterilized glass containers at room temperature for further development of products like diet powder, chutney powder, rasam powder and popsicle. According to Gupta and Prakash, (2011)., Kokum fruits were cut into halves, spread on stainless steel trays for drying at 70 °C for first 3 hours and 60 °C for the next 8 – 10 hours in a pre-heated tray drier. The recent research establishes *Garcinia indica* as biochemically one of the most creative plant species.

Development of value-added kokum products

The Kokum pulp and powder were used for formulating and standardizing ten value added products (Fig:2) like Kokum Jelly (KJ), Kokum Squash (KS), Kokum Carbonated Drink (KCD), Kokum wine (KW), Kokum Diet Powder (KDP), Kokum Chutney Powder (KCP), Kokum Rasam Powder (KRP), Kokum Lassie (KL), Kokum Spray Dried Powder (KSDP) and kokum popsicles (KP). Kokum wine- The Red Kokum juice has about 4 percent sugars and can be feremented to produce wine. Kokum wine is prepared in Goa using the traditional method (Obolskiy *et al*., 2009) [18]

The sensory assessments were conducted in a purpose-built, ten -booth sensory evaluation laboratory. The panel of 30 members consisted of staff and the students of the under Graduate Agriculture college, Hassan. All the products prepared were coded using random three-digit numbers and served in transparent glass bowls. Panelists were provided with a glass of water and instructed to sip in between samples. They were given written instructions and asked to evaluate the products for acceptability based on its colour, flavor, texture, taste and overall acceptability using nine-point hedonic scale (0=Dislike extremely to 9=Like extremely) (Ramya and Anitha., 2020) [13]. The data obtained from sensory evaluation was subjected to analysis of variance (ANOVA).

Fig 1: Value added products from *Garcinia indica*.

Results and Discussion

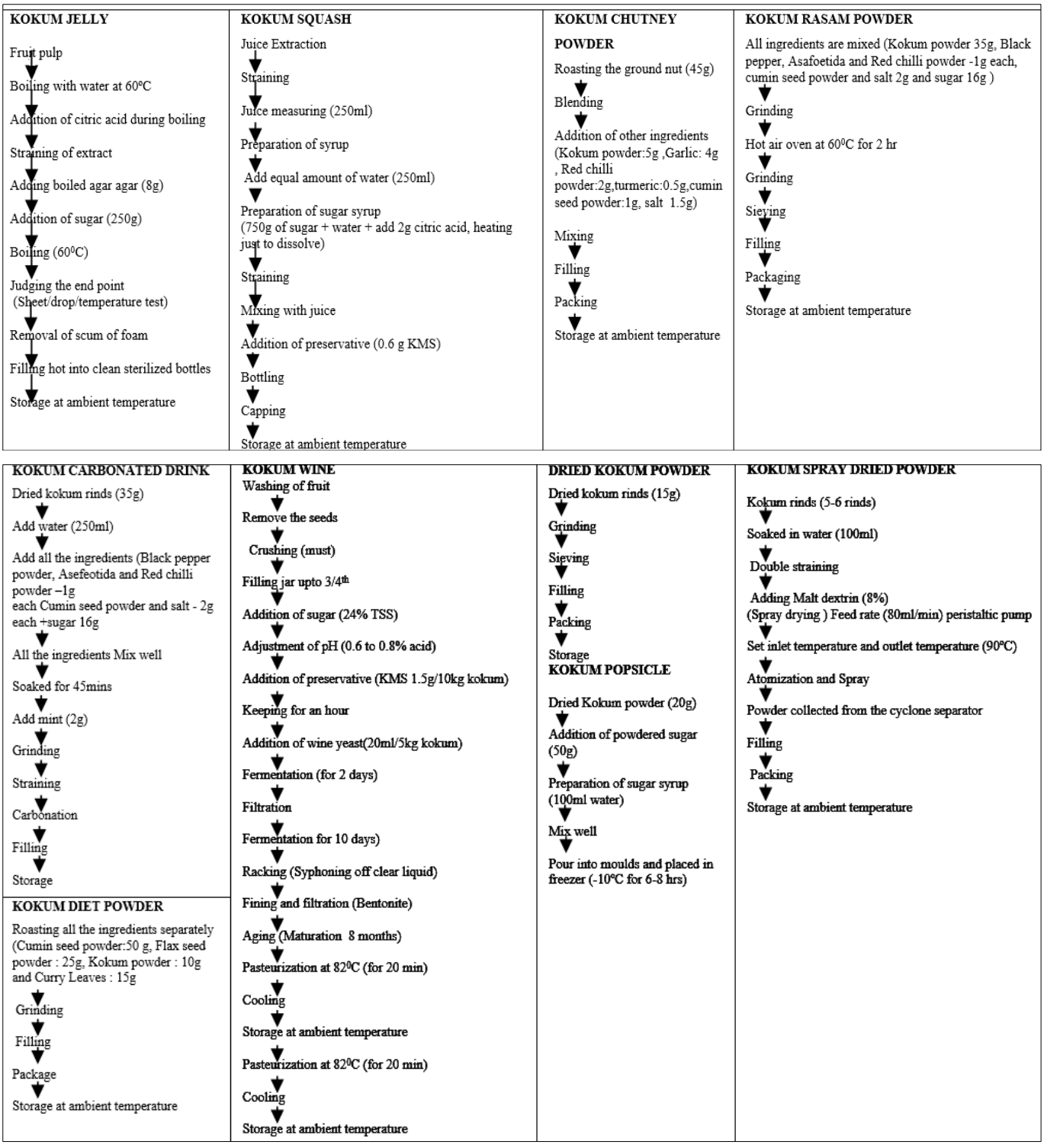

Fig 2: Flow chart for ten different value added products from *Garcinia indica*.

Table 1: Sensory evaluation of products developed with Kokum

S. No.	Products	Colour	Flavour	Texture	Taste	Overall Acceptability
1.	KJ	8.54±0.25	7.93±0.23	8.43±0.32	7.48±0.32	8.65±0.43
2.	KS	8.78±0.23	7.89±0.56	8.22±0.11	7.98±0.54	8.75±0.32
3.	KCD	8.54±0.33	7.98±0.76	7.89±0.44	7.52±0.22	8.54±0.41
4.	KW	8.56±0.11	8.44±0.88	7.56±0.33	8.43±0.32	8.79±0.52
5.	KDP	7.84±0.21	7.65±0.43	8.54±0.23	8.43±0.32	8.01±0.54
6.	KCP	7.54±0.43	8.56±0.56	8.52±0.55	8.78±0.51	8.95±0.33
7.	KRP	8.01±0.21	8.76±0.11	8.79±0.31	8.98±0.21	8.98±0.32
8.	KL	7.84±0.45	7.90±0.32	7.44±0.86	7.97±0.11	7.90±0.22
9.	KSDP	7.02±0.10	7.01±0.44	8.74±0.32	7.11±0.66	7.11±0.21
10.	KP	8.43±0.32	7.86±0.77	8.32±0.21	8.01±0.66	8.56±0.37

Kokum rind was being used because of its highly desirable natural flavour and sour or sweet taste. The blackish red colour of kokum rind is due to the presence antioxidant anthocyanins

Color is an important constituent of any food as every food is associated and identified with certain color. Color is the first characteristic the consumer perceives of a food, which confers expectations of quality and flavour (Chetan *et al*., 2010) [1]. All the products formulated with Kokum pulp and powder had extremely attractive colour (Figure.2). The results of sensory evaluation (Table.1) indicate that, colour of all the products formulated with Kokum pulp and powder were highly acceptable with scores ranging from 7.02 ± 0.10 to 8.78 ± 0.23 on a 9 point scale, with KS receiving highest score and KSDP receiving lowest score. The attractive reddish colour was due to the purplish red anthocyanin pigments present in ripe Kokum fruits. Anthocyanins of Kokum are water soluble and possess antioxidant activity. Two major pigments cyanidin-3glucoside and cyanidin-3-sambubioside are present in the ratio of 4:1 (Nayak *et al.*, 2010) [8, 9]. Flavour of all the products evaluated by sensory testing indicate that KRP flavor (8.76 ± 0.11) was very much liked by the panelists, followed by KSDP (7.01 ± 0.44).

Kokum is used as an acidulant in different curries like traditional fish curries etc, because of its sweetish acidic test and its typical flavour (Patil, 2005) [11]. The acidic and sweet taste went very well in KW, KRP and KCP. Similar sensory scores were obtained for texture of the products with KRP (8.79 ± 0.31) receiving the highest score followed by KSDP (8.74 ± 0.32) and KDP (8.54 ± 0.23) also received good scores, but were rated low compared to the other Kokum products.

Taste of KRP (8.98±0.21) shows the highest scores compared to other products. Results of sensory evaluation indicate that taste of all the Kokum products were very much liked by the sensory panelists with scores ranging between 8.98 ±0.21 and 7.11 ± 0.66 on a 9 point hedonic scale. The scores of taste of products indicate that all the products had very good taste which could be due to the typical flavor of Kokum coupled with the sweetish acidic taste imparted by organic acids like hydroxycitric acid (HCA) (1,2 dihydroxypropane-1,2,3 tricarboxylic acid), citric acid, malic acid and ascorbic acid (Jayaprakasha and Sakariah, 2002) [5].

The overall acceptability of any product is the most important characteristic to ensure consumer acceptability of any product. All the products formulated with Kokum were very well acceptable as indicated by the scores received on a 9 point hedonic scale. As per the sensory score results, KRP were highly acceptable (8.98 ± 0.32) among all other kokum products.

Consumer awareness about health hazards associated with synthetic colors is increasing and thereby the use of natural colorants is increasing. The use of natural pigments as food colorants permitted by the regulatory authorities is very limited. Various studies evaluated different sources of anthocyanins along with the pigment concentration (Chetan *et al*., 2010) [1]. Results indicate that the kokum contains highest concentration (2400 mg/100g of fresh fruit) of anthocyanins as compared to other sources (Nayak *et al*, 2010) [8, 9]. Kokum is a rich source of anthocyanin and natural pigments, which are water soluble and help in scavenging free radicals. Hence, the fruit can be further explored for its use as a natural colourant. Kokum fruit also contains various bioactive compounds and potential compounds such as antioxidant, anti-bacterial (Ranveer and Sahoo, 2017) [14] and antifungal properties.

The fruits are also used to prepare red beverage which has bilious action. Several studies (Kirana, and Srinivasan, 2010) [6] reported many health benefits, but there are very few products made with Garcinia available in the market. Hence value addition of *Garcinia indica* (Kokum) enhances the utilization of fruit to the best possible extent, along with availment of health benefits of the fruit through various product forms.

Conclusion

Kokum is a rich source of anthocyanin, which has a great export potential as naturalcolorant and major source of hydroxy citric acid. Value addition of kokum into processed products will enhance the health benefits of consumers due to several bioactive components present. Further product formulations and process optimization of Kokum value added products can help explore the untapped potential of kokum. Flavour of all the products evaluated by sensory evalution indicate that KRP (kokum Rasam Powder) flavor (8.76 ± 0.11) was very much liked by the panelists, followed by KSDP (Kokum spray dried powder) (7.01 ± 0.44). Rigorous efforts are needed to establish the commercial plantations, value addition, marketing, as well as development of suitable processing technologies. The value-addition initiative allows Garcinia farmer producers to gain better income by promoting utilization of underutilized Garcinia. Hence Garcinia should be extensively promoted for development of various value added products etc for income generation as well as to reduce post-harvest losses.

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