RESEARCH PAPER

FOOD SCIENCE
RESEARCH JOURNAL

e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 8 | Issue 2 | October, 2017 | 260-265
DOI : 10.15740/HAS/FSRJ/8.2/260-265

Effect of traditional and modern drying methods on nutrients, total polyphenol and anthocyanin content of *Garcinia indica* rinds

SONI TILARA AND MONALISA GUHATHAKURTA

Drying is one of the methods that are used to preserve fruits and vegetables. The aim of the present research was to estimate the nutritional, total anthocyanin and total polyphenol content in dried kokum (*Garcinia indica*) rind powders using 4 drying treatments *i.e.* sun drying, microwave drying, tray drying and osmotic drying. Results for proximate analysis indicated that sun dried samples had highest and significant retention ($p<0.05$) in crude protein, crude fat and crude fibre followed by microwave dried samples. Carbohydrate content was retained ($p<0.05$) in all the drying techniques, where in osmotically dried samples were found to contain the highest carbohydrate content (63.505±0.336) as compared to other three samples. Regarding Anthocyanin content, the highest and the lowest content was found in sundried (2.259±0.122g/100g) and microwave dried samples (0.142±0.001g/100g), respectively. Further, total polyphenol content was found highest in sundried sample (76.266±0.053mg/100g), followed by tray dried (54.845mg/100g), osmotic dried (51.750±0.210mg/100g) and microwave dried samples (24.890mg/100g). Thus, in the present study sun drying was found as best drying method for preservation of kokum/ *Garcinia indica* as it showed highest retention of nutrients and minimum loss in anthocyanin and polyphenol contents as compared to microwave drying, tray drying and osmotic drying.

Key Words : Anthocyanin, Polyphenol, Osmotic drying, Tray drying, Microwave drying, Sundrying

How to cite this article : Tilara, Soni and Guhathakurta, Monalisa (2017). Effect of traditional and modern drying methods on nutrients, total polyphenol and anthocyanin content of *Garcinia indica* rinds. *Food Sci. Res. J.,* **8**(2): 260-265, **DOI : 10.15740/HAS/FSRJ/8.2/260-265**.

INTRODUCTION

Kokum (*Garcinia indica*) is an extremely important tree that is underexploited in India. It belongs to the family *Clusiaceae/Guttiferae*. In India, kokum is found along the western coasts of India such as Konkan in Maharashtra, Gujarat, Goa, Karnataka, Kerala and stretches to North-eastern states like Assam, Meghalaya and West Bengal. Kokum is widely used by the native locales in their cuisines as it imparts sour taste and works as a perfect substitute for tamarind. Its medicinal properties too are well known.

Kokum is mostly available as value added products such as amsul, syrups, ready to serve drinks, solkadi mix etc. These products are made after various types of heat treatments and drying techniques. Kokum fruit rinds are mostly dried using traditional methods like Sun drying and air drying. However, these methods being time consuming, modern drying methods such as perforated tray drying

MEMBERS OF RESEARCH FORUM

Author for correspondence :
SONI TILARA, Department of Foods and Nutrition, College of Home Science, G.B. Pant University of Agriculture and Technology, Pantnagar, U.S. NAGAR (UTTARAKHAND) INDIA
Email : drsonitilara@gmail.com

Associate Authors' :
MONALISA GUHATHAKURTA, Department of Foods Nutrition and Dietetics College of Home Science, Nirmala Niketan, New Marine Lines, MUMBAI (M.S.) INDIA

are also put into use by the manufacturing companies (Camire *et al.*, 2007). The major phytoconstituents present in *Garcinia indica* are fatty acids, hydroxycitric acid, garcinol, iso-garcinol, citric acid and polyphenols (Jena *et al.*, 2002). Antioxidant activity of *Garcinia indica* has been measured before by different methods such as ORAC, ABTS, FRAP etc. (Hande *et al.*, 2016). Anthocyanins are well known for their antioxidant, anti-inflammatory and anti-carcinogenic activity. Kokum contains 2 to 3 % of red colour pigment. Anthocyanins of kokum are water soluble and possess antioxidant activity (Swami *et al.*, 2014). Kokum also has high concentration of anthocyanin pigments which suggests its use as a colorant and it has been proved to be a rich source of color due to the anthocyanin pigments present in it (Parle and Dhamija, 2014). Many therapeutic effects of the fruit have been described in traditional medicine based on Ayurveda. These includes its usefulness as an infusion in skin ailments such as rashes caused by allergies; treatments of burns, scalds and chaffed skin; to relieve sunstroke; remedy for dysentery and mucous diarrhoea; an appetizer and good liver tonic; to improve appetite and to allay thirst; as a cardiotonic and for bleeding, plies, dysetry, tumours and heat diseases (Thakor *et al.*, 2012) Sun drying is a continuous process with changes in moisture content, air and crop drying and the humidty of air, all occurring simultaneously. Heat is transferred from surrounding air from the sun to the surface of crop in different models of heat transfer (Delgado-Vargas *et al.*, 2000). The high sugar and acid content of fruits make them safe to dry out-of-doors when conditions are favorable for drying. To dry fruits out-of-doors hot, dry, breezy days are best. A minimum temperature of 85ºF is needed with higher temperatures being better. It takes several days to dry foods out-of-doors. Because the weather is uncontrollable, drying fruits out-of-doors can be risky (*http://nchfp.uga.edu/how/dry/sun.html*).

Microwave drying offers opportunities to shorten the drying time and improves the final quality of the dried products. Micro wave related drying can meet the four major requirements in drying of foods: speed of operation, energy efficiency, cost of operation, and quality of dried products (Gunasekaran, 1999). Further, Apart from microwave drying in tray drying, the food is spread out, generally quite thinly, on trays in which the drying takes place. Heating may be by an air current sweeping across the trays, by conduction from heated trays or heated shelves on which the trays lie, or by radiation from heated surfaces. Most tray dryers are heated by air, which also removes the moist vapours.

On the other side osmotic dehydration is the phenomenon of removal of water from lower concentration of solute to higher concentration through semi permeable membrane results in the equilibrium condition in both sides of membrane (Tiwari, 2005). Osmotic dehydration found wide application in the preservation of food-materials since it lowers the water activity of fruits and vegetables. Osmotic dehydration is preferred over other methods due to their color, aroma, nutritional constituents and flavor compound retention value.

Total phenolics and anthocyanin content in kokum after processing has not been evaluated and needs to be studied. Present study was also an endeavour to find the best method for drying kokum rinds. Therefore, It was planned to prepare kokum rind powder and evaluate the nutritional quality, total phenolic content and anthocyanin content of dried *Garcinia indica* powder using 4 drying techniques *viz.*, sun drying, osmotic drying, tray drying and microwave drying.

METHODOLOGY

Procurement of sample:

Ripe Kokum fruits (*Garcinia indica*) were purchased from local Borivili market in Mumbai in bulk and were stored in HDPE bags in refrigerator until they were used for the research work. The samples were subjected to different drying techniques after preparation.

Locale of the study:

The study was carried out in the research laboratory, College of Home Science, Nirmala Niketan, New Marine Lines, Mumbai (M.S.).

Procedures:

Proximate analysis:

Moisture, total ash, crude protein, crude fat, crude fibre and total carbohydrates were analysed using methods of AOAC (2010).

Anthocyanin content:

It was done by using method of AOAC (2005).

Reagents:

– pH 1.0 Buffer (potassium chloride, 0.025 M)

Table A: Drying of samples using different methods

Drying technique	Method
Sundrying	The fruits were washed, cleaned, cut into flesh was removed and the rinds were allowed to sundry for 14 days on an aluminum tray covered with mesh. After drying, powdered in electrically operated grinder. The powder was then sieved through 1 mm mesh sieve and then packed in polythene bags and kept in a cool and dry place at ambient temperature conditions.
Osmotic drying	Fresh and ripe kokum fruits were washed and split opened longitudinally to remove seeds along with pulp. 1 per cent w/w common salt was added to the seeds along with pulp for juice extraction. The rind pieces were then dipped in this juice solution for 14 hours and tray dried for approximately 24 hours at 50-55°C. After drying, powdered in electrically operated grinder. The powder was then sieved through 1 mm mesh sieve and then packed in polythene bags and kept in a cool and dry place at ambient temperature conditions.
Tray drying	Ripe, fresh and sound Kokum fruits were selected. The fruits were cut into ¼ slices. Inner pulp and seeds were removed. The pieces were dried in cabinet drier at 50- 55°C for 24 hours and after drying, powdered in electrically operated grinder. The powder was then sieved through 1 mm mesh sieve and then packed in polythene bags and kept in a cool and dry place at ambient temperature conditions.
Microwave drying	Fruits were washed, cleaned, cut into ¼ slices and the flesh was removed. Fruit rinds were kept in the microwave oven, where the rinds were turned and checked for complete dryness for every 20 mins intervals until dried. After drying, rinds were powdered in electrically operated grinder. The powder was then sieved through 1 mm mesh sieve and then packed in polythene bags and kept in a cool and dry place at ambient temperature conditions.

– pH 4.5 Buffer (sodium acetate, 0.4 M)

Preparation of test solution:

Determine appropriate dilution factor by diluting the test portion with pH 1.0 buffer, until absorbance at 520 nm is within the linear range of the spectrophotometer. (0.2 and 1.4 AU).

Using this dilution factor, prepare 2 dilutions of the test sample, one with pH 1.0 buffer and the other with pH 4.5 buffer.

Determination:

Determine absorbance of test portion diluted with pH 1.0 buffer and pH 4.5 buffer, at both 520 nm and 700 nm. The diluted test portions are read versus a blank (D/W). Measure the absorbance within 20 – 50 minutes of preparation

Formula:

$$\text{Anthocyanin pigment (mg/L)} = \frac{A \times MW \times DF \times 10^3}{\epsilon \times 1}$$

where:

$A = (A_{520\ nm} - A_{700\ nm})$ pH 1.0 - $(A_{520nm} - A_{700\ nm})$ pH 4.5

MW (Molecular weight) = 449.2 g/mol for cyanidine-3- glucoside

DF = Dilution factor

l = Pathlength in cm

€ = 26900 molar extinction co-efficient, in L x mol^{-1} x cm^{-1} for cyanidine-3- glucoside

10^3 = Factor for conversion from "g" to "mg"

Determination of total phenolic content:

Total phenolic content of kokum rind powders was determined using method given by Singleton *et al.* (1999), using gallic acid as standard. Known aliquot of sample was taken and volume made upto 1.5 ml with distilled water. To this 0.5 ml of folin ciocalteau reagent was added. After that 10 ml of 7.5 per cent Na_2CO_3 was added and incubation was done at 37º C for 60 minutes. Readings for resulting blue colour complex at 750 nm were taken and expressed as mg gallic acid equivalents (GAE)/100g. Gallic acid (5-20 µg) was used as standard.

Statistical analysis:

Simple statistical tools like mean and standard deviation were used. One way ANOVA test was applied using IBM SPSS statistics version 20 programme to observe any difference among the samples regarding different nutrients and total phenolic content. Paired t test was applied to observe any difference between raw and dried samples regarding anthocyanin content.

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Proximate analysis:

The Proximate composition of the dried samples using different drying techniques are can be summarized as follows:

After comparing the different drying techniques, Sun dried powder was found to have highest total moisture (8.828 ± 0.003g/100g), total ash (3.820 ± 0.036g/100g), crude protein (4.347 ± 0.113g/100g), crude fat(16.770 ± 0.219) and crude fibre (16.667 ± 0.082) followed by microwave dried kokum rind powder for nutrients like crude protein, crude fat and crude fibre (Table 1).Total carbohydrates was found highest (63.505 ± 0.336) in osmotic dried kokum rind powder. Therefore it is clear from the results of proximate analysis, sundried samples had the highest nutrients. Hande *et al.* (2016) reported the increased values of protein, carbohydrates, total ash and decreased values of crude fat in sundried kokum rind powder in comparison to fresh rinds.

Estimation of anthocyanin content:

The results are represented on dry weight basis (dwb) as follows:

The anthocyanin content in microwave dried sample, osmotic dried sample, sun dried sample and tray dried sample was observed to be 0.142±0.001g/100g, 1.804g/100g, 2.259±0.122g/100g and 1.866g/100g, respectively (Table 2). It is observed that the anthocyanin content decreased significantly (p=0.000) in all the drying techniques except for sun drying. The reduction in the anthocyanin content may be due to the nature and sensitivity of the nutrient to the level of heat during the drying process. Fresh rind samples had anthocyanin contents of 2.4+0.08g/100g. However, sundried samples did not show any considerable loss in the anthocyanin content (p=0.938).Thus, sun drying showed the least influence on the anthocyanin content. Anthocyanins constitute approximately 2.4 per cent of the total fruit biomass. These pigments can scavenge free radicals and are water soluble. They can be extracted from the fruit rind by hydraulic press using 1 per cent acidified water as a solvent (Nayak *et al.*, 2010). Anthocyanins have been shown to possess strong antioxidant activity. Given their wide distribution in nature, daily intake of anthocyanins is 25 to 215 mg/person depending upon gender and age (Delgado-Vargas *et al.*, 2000).

Total phenolic content :

On comparing the total phenolic content of different

Table 1 : Effect of drying methods on the proximate composition of dried Kokum rind powders

Nutrient	Microwave dried (g / 100g)	Osmotic dried (g / 100g)	Sun dried (g / 100g)	Tray dried (g / 100g)
Total moisture	* 7.327 ± 0.527	* 7.895 ± 0.060	* 8.828 ± 0.003	* 8.421 ± 0.220
Total ash	2.775 ± 0.527	2.675 ± 0.196	3.820 ± 0.036	3.089 ± 0.200
Crude protein	* 3.147 ± 0.024	2.913 ± 0.068	* 4.347 ± 0.113	2.68 ± 0.160
Crude fat	* 14.390 ± 0.030	10.730 ± 0.094	* 16.770 ± 0.219	10.366 ± 0.174
Crude fibre	* 15.823 ± 0.907	14.095 ± 0.083	* 16.667 ± 0.082	14.763 ± 0.089
Carbohydrates	* 60.802 ± 0.178	* 63.505 ± 0.336	* 42.781 ± 0.120	* 63.102 ± 0.201

* indicates mean values that are significantly different (p<0.05)

Table 2 : Anthocyanin content (g/100g) (on dry weight basis) in dried kokum rind powders

Fresh sample	Dried sample	Mean ± SD	P value
2.400	Microwave dried	*0.142 ± 0.001	0.000
	Osmotic dried	*1.804 ± 0.000	0.000
	Sun dried	2.259 ± 0.122	0.938
	Tray dried	*1.866 ± 0.000	0.000

* indicates mean values that are significantly different (p<0.05) from the fresh rind sample

Table 3 : Total phenolic content in dried kokum rind powders

Samples	Mean ± SD
Microwave dried	24.890* ± 0.000
Osmotic dried	51.750* ± 0.210
Sun dried	76.266* ± 0.052
Tray dried	54.845* ± 0.000

dried samples, it was observed that sun dried sample had the highest phenolic content (76.266±0.052mg GAE/100g), followed by tray drying (54.845mgGAE/100g), osmotic drying (51.750±0.210mgGAE/100g) and microwave drying (24.890mgGAE/100g). Sailaja *et al.* (2014) revealed that fresh fruit showed highest concentration of phenols *i.e.* 0.714 GAE/mg of sample as compared to dry rind and whole dry fruit.Similarly Bomayya *et al.* (2011) revealed the high phenolic content than the present study in fresh fruit *i.e.* 2207 mg GAE/100g (Table 3). Promjiam *et al.* (2011) reported 0.457±0.030g GAE/100g DW phenolic content in dried Garcinia powder.

Conclusion :

In the present study therefore it can be concluded that in terms of nutrients, retention of anthocyanin and total phenolic content sun drying showed the highest results. Except for sun drying, other 3 drying treatments showed significant loss in anthocyanin content as compared to fresh rind values. Microwave drying showed the significant highest loss in anthocyanin content.

It was also revealed that the sundried sample of *Garcinia indica* exhibits the highest phenolic content followed by tray dried, osmotic dried and microwave dried samples.

LITERATURE CITED

AOAC Official Method (2005.02). Total Monomeric Anthocyanin Pigment Content of Fruit Juices, Beverages, Natural Colorants, and Wines.pH Differential Method First Action 2005.

AOAC (2010). *Official methods of analysis*, 18th Edn. Association of Official Analytical Chemists

Bommayya, H., Kusum, R. and Ramachandran, H.D. (2011). Antioxidant capacities of fruit extracts of *Garcinia indica* with different assays and maturity stages. *VEGETOS*, **24** (2) : 86-90.

Camire, M.E., Dougherty, M.P. and Briggs, J.L. (2007). Functionality of fruit powders in extruded corn breakfast cereals. *Food Chem.*, **101**: 765-770.

Delgado-Vargas, F., Jiménez, A.R. and Paredes-López, O. (2000). Natural pigments: Carotenoids, anthocyanins and betalains - characteristics, biosynthesis, processing, and stability. *Critical Rev. Food Sci. & Nutr.*, **40**(3): 173-289.

Gunasekaran, S. (1999). Pulsed microwave-vacuum drying of food materials. *Drying Technol*., **17**(3) : 395-412.

Hande, A.R. , Swami, S.B. and Thakor, N.S.J. (2016). Open-air sun drying of Kokum (*Garcinia indica*) rind and its quality evaluation. *Agric Res.* DOI 10.1007/s40003-016-0229-3.

Ici Turk To Grul (2005). Convective heat transfer coefficient of some fruits under open sundrying conditions. *J. Food Technol.*, **3**(1):10-14.

Jena, B.S., Jayaprakasha, G.K., Singh, R. and Sakariah, K.K. (2002). Chemistry and biochemistry of (-)-hydroxycitric acid from Garcinia. J. Agric. & Food Chem., **50**: 10-22.

Joshi, G.D. (2012). Traditional methods of Kokum fruits processing. Resource book on kokum (*Garcinia indica* Choisy) by Western Ghats Kokum Foundation, Panaji-Goa, pp. 75.

Lee, J., Durst, R.W. and Wrolstad, R.E. (2005). Determination of total monomeric anthocyanin pigment content of fruit juices, beverages, natural colorants, and wines by the pH differential method: Collaborative study. *J. AOAC Internat.*, **88**(5) : 1269-1278.

Nayak, C.A., Rastogi, N.K. and Raghavarao, K.S.M.S. (2010). Bioactive constituents present in *Garcinia indica* Choisy and its potential food applications: A review. *Internat. J. Food Properties*, **13**(3): 441-453.

Padhye, S., Ahmad, A., Oswal, N. and Sarkar, F.H. (2009). Emerging role of Garcinol, the antioxidant chalcone from *Garcinia indica* Choisy and its synthetic analogs. *J. Hematology & Oncol.*, **2**(38): 1-13.

Parle, M. and Dhamija, I. (2013). Golden benefits of drinking Kokam Kola. *Internat. Res. J. Pharmacy*, **4**(5) : 5-6.

Promjiam P., Siripongvutikorn, S., Wichienchot, S. and Usawakesmanee, W. (2011). Total phenolic compound content, antioxidant property and quality changes of the southern sour curry paste, keanghleung, as affected of garcinia, Garcinia atroviridis, salt during storage. Proceedings of The 2nd Annual International Conference Syiah Kuala University 2012 & The 8th IMT-GT Uninet Biosciences Conference Banda Aceh, 22-24 November 2012.

Sailaja, P., Malpani, Kejal, Kudalkar, Sonali and Pore, Tushar (2014). Investigation of adsorption effectiveness of kokum (*Garcinia indica*) rind residue on synthetic dyes and determination of best extraction procedure for kokum phenols. *Internat. J. Adv. Res. Sci. & Engg.*, **3**(9):449-466.

Singleton, V.L., Orthofer, R. and Lamuela Raventus, R.M. (1999). nalysis of total phenols and other oxidation substrates and antioxidants by means of *Folin ciocalteu* reagent. *Methods Enzymol.*, **299**:152-178.

Swami, S.B., Thakor, N.J. and Patil, S.C. (2014). Kokum

(*Garcinia indica*) and its many functional components as related to the human health: A Review. *J. Food Res. & Technol.,* **2** (4): 130-142.

Thakor, N.J., Swami, S.B.and Haldankar, P.M. (2012). Need of standardization and advances in value addition of Kokum processing. Resource book on kokum (*Garcinia indica* Choisy) by Western Ghats Kokum Foundation, Panaji-Goa,.pp67.

Tiwari, R.B. (2005). Application of osmo-air dehydration for processing of tropical fruits in rural areas. *Indian Food Ind.,* **24**(6):62–69.

Tsushima, M., Fujiwara, Y. and Matsuno, T. (1996). Novel marine di-Z-carotenoids: cucumariaxanthins A, B and C from the sea cucumber *Cucumaria japonica*. *J. Natural Products*, **59** : 30-34.

■ WEBLIOGRAPHY

http://nchfp.uga.edu/how/dry/sun.html

Received : *23.03.2017;* **Revised:** *11.08.2017;* **Accepted :** *26.08.2017*