



Effect of Processing on Nutrient Content of Karanda (*Carissa carandas*) Fruit at different Stages of Maturity

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Abstract: The rural India's nutritionally rich fruit Karanda (*Carissa carandas*) is a versatile but under-exploited plant found throughout the dry regions of India. This study was aimed to evaluate the effect of blanching and gamma irradiation at 0.25, 0.5 and 1.00 kGy on nutritional composition of karanda fruit at three maturity stages (raw, ripe and dried). Ripe karanda fruits reported high moisture content and significant reduction of moisture content was from raw to dried fruit. The carbohydrate and fat content were highest in dried fruits. There was a significant decrease from raw to ripe. The dried karanda fruits had highest protein content, crude fiber, ash, ascorbic acid and β - carotene followed ripe and raw. The moisture content was highest in ripe fruits at 0.25kGy followed by 1.0kGy. The carbohydrate content increased significantly from raw to dried stage in fresh blanched and irradiated fruits. The protein content also increased with the advancement of maturity stage i.e. highest at dried stage. Blanched dried karanda fruit had highest fat content. Significant difference was not observed in the fibre content of raw karanda fruit in blanching. Highest fibre content was in irradiated raw karanda fruit at 0.5 kGy. Significantly higher ash content were observed in blanched fruit. Processing treatments had no impact on ascorbic content in ripe fruit. During processing, the β - carotene content decreased significantly, except in raw fruit where, blanching and irradiation at 0.25kGy has higher content.

Keywords: Karanda Fruit, Blanching, Maturity stages, Nutrient content

Tropical fruits, which are at present underutilized, have an important role to play in satisfying the demand for nutritious, delicately flavoured and attractive natural foods of high therapeutic value. The tendency is to avoid chemicals and synthetic foods and preference for nutrition through natural resources. The underutilized fruits like karonda, Indian gooseberry, Aegle marmelos, Malabar plum, passion fruit, phalsa, pomegranate, pumpkin, tamarind, wood apple etc. are the main sources of livelihood for the poor and play an important role in overcoming the problem of malnutrition (Gajanana et al 2010). *Carissa carandas* commonly known as karanda belongs to family Apocynaceae and *carandas* is large dichotomously branched evergreen shrub with short stem and strong thorn in pairs. This species is a rank-growing, straggly, woody, climbing shrub, usually growing to 10 or 15 ft (3–5m) high, sometimes ascending to the tops of tall trees. The plant is native and common throughout India (Kirtikar and Basu 2003).

MATERIAL AND METHODS

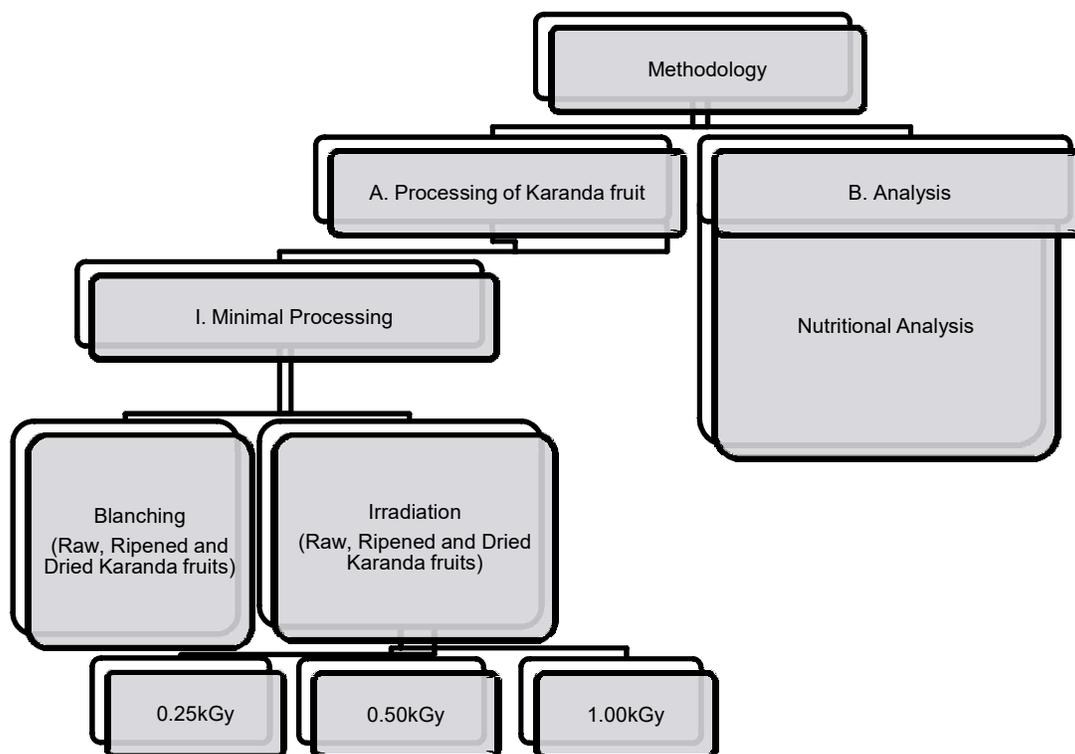
Karanda fruits were procured from Agriculture Research Institute, Rajendranagar and irradiation was done at Gama Radiation Unit, Professor Jayashankar Telangana State Agricultural University, Rajendranagar, Hyderabad. Moisture, protein, carbohydrate, fat and ascorbic acid (AOAC 2000) and crude fibre (AOAC 2005) were analysed. β -

Carotene content was estimated by the method given by Srivastava & Kumar (2003).

RESULTS AND DISCUSSION

Moisture: The moisture content of the karanda fruit was estimated in various stages of maturity of the fruit from raw, ripe and dried stage to study the variation in moisture content. The highest moisture was in ripe fruits (84.76 %). Significant reduction of the moisture content from raw (81.07 %) to dried stage (10.00 %) was observed. Patel and Rao (2013) observed similar trend in the moisture content of *C. carandas* L. fruit which was higher in young stage and a gradual decrease slightly from mature to ripened stage (79.96, 76.63 and 73.23%).

The moisture was also estimated in different minimal processing i.e. in blanching and irradiation at 0.25 kGy, 0.5 kGy and 1.0 kGy. There was a significant increase in moisture content in blanching in raw (83.25%) and ripe (85.20%) stages and reduction in the dried stage (9.54 %). During irradiation process the moisture content was highest in ripe stage at 0.25kGy (85.7%) followed by 1.0kGy (85.25%). In raw karanda fruit the moisture content was higher in irradiation at 0.5kGy followed by 1.00kGy and at 0.25kGy. In contrast in the dried karanda fruit the moisture content was significantly lower in all the treatments: blanching (9.54%) and irradiation (9.22 to 9.54 %) than fresh dried fruit



(10.00%). The moisture content was lowest in irradiation at a dose of 0.5kGy (8.71 %). The reduction in the moisture content on different stages of maturity was also observed by Gopalan et al (2009) in fruits and vegetables and Vendramini and Trugo (2000) in acerola fruit at three different maturity stages.

Carbohydrates: The carbohydrate content was found higher in dried fruits compared to raw and ripe fruits could be attributed to lesser amount of moisture which exhibits the concentration of total solids of the fruit. The carbohydrate content of all the three maturity stages of karanda fruit increased significantly from raw (1.88 g) to dried (61.32 g) stage. The similar trend was also observed in blanching and irradiation at different stages. Anand and Deborah (2016) on nutritional value of a selected fifteen wild edible fruits collected from Boda and Kolli hills of Tamil Nadu reported that the carbohydrate content of 50.41 and 55.8% in *C. carandas* and *C. spinarum* respectively. When the carbohydrate content was compared in different processing in raw and ripe fruit with irradiation at 0.25kGy recorded highest carbohydrate content of 1.92 and 2.06, respectively. Blanched dried fruit recorded highest carbohydrate content of 62.59 g.

Protein: The protein content also increased with the advancement of maturity stage i.e. highest at dried stage, but there was no significant difference between raw and ripe fruits in fresh, blanching and irradiation treatments. Patel and

Rao (2013) reported that the proteins in the fruit of *C. carandas* increased from its young stage (0.28 g) until the fruit ripens (3.37 g).

In the dried fruits, significant difference was observed between fresh, irradiation at 0.25kGy and 1.00 kGy. The protein content during blanching (9.58g) and irradiation at 0.5 kGy (9.38g) of dried fruit showed significantly lower than unprocessed (9.78 g), irradiation at 0.25 kGy (9.88g) and 1.00 kGy (9.94 g). The processing treatments had no influence on protein content of the fruit. Deep red stage of maturity showed highest amount of protein and significant change in later maturity stage due to transition in protein biosynthesis (Opara et al 2011).

Fat: In fresh stage, dried karanda fruit had highest fat content (5.24 g) followed by ripe and raw fruit. Among the maturity stages and processing, blanched dried karanda fruit had highest fat content (5.50 g) followed by dried irradiated fruit at 1.00kGy with significant difference. However, fresh dried (5.24 g) and in irradiated fruit at 0.5kGy (5.29 g) showed no significant difference. Lowest fat content was in dried irradiated fruit at 0.25kGy (5.12 g). Both the fresh raw and ripe fruits recorded highest fat content (2.23 g, 2.31 g respectively), followed by irradiation at 0.25kGy and 0.5kGy with no significant difference, followed by blanching (2.11 g in raw, 2.10 g in ripe) and irradiation at 1.00kGy (1.98 g in raw and 1.90g in ripe fruit). The increase of fat content during maturity and processing can be explained as accumulation of

fat in maturity stage, yields from cuticle and suberin in maturity. Reduced fatty acid yield in blanching due to fatty alcohols (Lenucci et al 2006).

Crude fiber: The crude fibre content increased significantly with the maturity of the fruit i.e. dried fruit with highest fiber content followed by ripe and raw fruit. Same trend was also observed in the processed fruit. In dried fruit the irradiation treatment at 1.00 kGy showed highest fibre content followed by blanching and irradiation at 0.25 kGy with no significant

difference. This was followed by irradiated fruit at 0.5 kGy and fresh unprocessed dried karanda fruit which was significant. The ripe fruit irradiated at 0.5 kGy recorded highest fiber content (2.13 g) followed by irradiated fruit at 0.25kGy then blanching (1.85 g) and irradiated fruit at 1.00kGy (1.83 g) with no significant difference. The lowest fibre content was in unprocessed fruit (1.80 g). Significant difference was not observed in the fibre content of raw karanda fruit in blanching (1.82 g), irradiation at 0.25kGy and at 1.00 kGy. Highest fibre

Table 1. Proximate analysis of the karanda fruit under different treatments (per 100g)

Parameters	Stage of ripening	Fresh	Blanching	Irradiation			CD value
				0.25 kGy	0.5 kGy	1.0 kGy	
Moisture (%)	Raw	81.070.06 ^{b2}	83.250.91 ^{b1}	81.120.02 ^{b2}	81.570.11 ^{b2}	81.170.02 ^{b2}	0.06
	Ripe	84.76 0.03 ^{a3}	85.200.01 ^{a2}	85.770.02 ^{a1}	84.440.05 ^{a4}	85.250.02 ^{a2}	
	Dried	10.000.10 ^{1c}	9.54±0.05 ^{c2}	9.570.01 ^{2c}	8.710.05 ^{c4}	9.220.05 ^{c3}	
CD value				0.04			
Carbohydrates (g)	Raw	1.88±0.01 ^{b2}	1.72±0.01 ^{c4}	1.92±0.02 ^{c1}	1.77±0.01 ^{c3}	1.77±0.02 ^{c3}	0.03
	Ripe	1.89±0.01 ^{b2}	1.87±0.02 ^{b2}	2.06±0.06 ^{b1}	1.82±0.01 ^{b3}	1.87±0.01 ^{b2}	
	Dried	61.32±0.05 ^{a3}	62.59±0.01 ^{a1}	61.01±0.02 ^{a4}	62.09±0.09 ^{a2}	62.06±0.02 ^{a2}	
CD value				0.01			
Protein (g)	Raw	1.59±0.04 ^{b1}	1.61±0.01 ^{b1}	1.60±0.02 ^{c1}	1.70±0.02 ^{b1}	1.71±0.02 ^{b1}	0.12
	Ripe	1.61±0.02 ^{b1}	1.59±0.01 ^{b1}	1.80±0.02 ^{b1}	1.74±0.05 ^{b1}	1.66±0.01 ^{b1}	
	Dried	9.78±0.08 ^{a1}	9.58±0.49 ^{a2}	9.88±0.04 ^{a1}	9.38±0.04 ^{a3}	9.94±0.08 ^{a1}	
CD value				0.07			
Fat (g)	Raw	2.23±0.03 ^{c1}	2.11±0.08 ^{b3}	2.15±0.01 ^{b2}	2.14±0.09 ^{b2}	1.98±0.02 ^{b4}	0.05
	Ripe	2.31±0.06 ^{b1}	2.10±0.07 ^{b3}	2.16±0.12 ^{b2}	2.16±0.04 ^{b2}	1.90±0.08 ^{c4}	
	Dried	5.24±0.05 ^{a3}	5.50±0.02 ^{a1}	5.12±0.03 ^{a4}	5.29±0.01 ^{a3}	5.42±0.01 ^{a2}	
CD value				0.03			
Crude fiber (g)	Raw	1.75±0.01 ^{c3}	1.82±0.01 ^{c2}	1.82±0.03 ^{c2}	1.96±0.02 ^{c1}	1.81±0.02 ^{c2}	0.02
	Ripe	1.80±0.02 ^{b4}	1.85±0.02 ^{b3}	1.91±0.01 ^{b2}	2.13±0.01 ^{b1}	1.83±0.02 ^{b3}	
	Dried	6.95±0.05 ^{a4}	7.06±0.01 ^{a2}	7.04±0.01 ^{a2}	7.01±0.02 ^{a3}	7.18±0.05 ^{a1}	
CD value				0.01			
Ash (%)	Raw	2.95±0.03 ^{c3}	2.85±0.02 ^{c4}	2.93±0.04 ^{c3}	3.03±0.01 ^{c2}	3.06±0.01 ^{c1}	0.02
	Ripe	3.18±0.01 ^{b1}	3.07±0.01 ^{b4}	3.02±0.01 ^{b5}	3.11±0.01 ^{b3}	3.15±0.02 ^{b2}	
	Dried	3.76±0.04 ^{a3}	3.99±0.02 ^{a1}	3.76±0.01 ^{a3}	3.76±0.01 ^{a3}	3.88±0.02 ^{a2}	
CD value				0.01			
Ascorbic acid (mg)	Raw	9.92±0.06 ^{c2}	9.61±0.45 ^{c1}	10.04±0.11 ^{c1}	9.54±0.44 ^{c2}	9.96±0.06 ^{c1}	0.22
	Ripe	10.84±0.16 ^{b1}	11.02±0.09 ^{b1}	11.02±0.24 ^{b1}	10.87±0.30 ^{b1}	10.89±0.18 ^{b1}	
	Dried	9.17±0.06 ^{a3}	9.48±0.22 ^{a1}	9.00±0.33 ^{a2}	9.05±0.03 ^{a2}	9.93±0.16 ^{a1}	
CD value				0.13			
β - carotene (µg)	Raw	9.73±0.39 ^{c3}	10.83±0.23 ^{c2}	11.64±0.39 ^{c1}	8.62±0.17 ^{c5}	9.16±0.31 ^{c4}	0.22
	Ripe	15.65±0.08 ^{b1}	14.39±0.18 ^{b2}	15.53±0.33 ^{b1}	14.09±0.07 ^{b3}	13.49±0.23 ^{b4}	
	Dried	16.33±0.12 ^{a2}	16.59±0.14 ^{a1}	16.62±0.07 ^{a1}	15.28±0.10 ^{a3}	14.54±0.34 ^{a4}	
CD (p=0.05)				0.13			

content was reported in irradiated raw karanda fruit at 0.5 kGy (1.96 g) and lowest in unprocessed raw fruit (1.75 g). Guerrero and Fuentes (2009) found that breaker stage of tomato (cherry pera variety) had higher fibre content.

Ash: The analysis of ash content in different maturity stages and processing showed significant increase in three maturity stages i.e. from raw (2.95 %) to ripe (3.18 %) and dried karanda fruit (3.76 %). Similar trend was also observed in blanching and irradiation at different dosages. The highest ash content during processing and unprocessed conditions was recorded in dried karanda. Significantly higher values were reported in blanched fruit (3.99 %) followed by irradiated fruit at 1.00kGy. Significant difference was not observed in the ash content of irradiated fruit at 0.25 and 0.5kGy when compared with raw and unprocessed fruit.

Ascorbic acid: The ascorbic acid content ranged from 9.61 to 10.84 mg in different maturity stages studied. There was a significant increase in ascorbic acid content from raw to maturity stage and the same trend was also found in blanched and irradiated fruits. The ascorbic acid content in raw fruit when subjected to blanching and irradiation showed significant difference between raw unprocessed (9.92 mg) and irradiated fruit at 0.5kGy (9.54 mg). In the blanched and irradiated fruits at 0.25 and 1.00kGy no significant difference was observed. The processing treatments had no impact on ascorbic content in ripe fruit, as there was no significant difference among the treatments. In dried karanda fruit, the ascorbic acid content was maximum in irradiation at 1.00kGy 9.93 mg followed by blanching and had no significant difference in the treatments between irradiation at 0.25 and 0.5kGy. The blanching and irradiation at 1.00 kGy showed increase in ascorbic acid content whereas the irradiation at 0.25 and 0.5 kGy showed minimal decrease in ascorbic acid compare to unprocessed dried fruit. But in other two maturity stages i.e. raw and ripe karanda fruits, the treatments had no significant impact on the ascorbic acid content. Among the maturity stages ascorbic acid was increased from raw (9.92 mg) to ripe stage (10.84 mg) and decline in dried stage (9.17 mg). The reduction in ascorbic acid with maturity may be due to oxidative destruction by enzymes, mainly ascorbic acid oxidase or due to conversion in acid to sugar (Rahman et al., 2010). Atefeh et al., (2013), observed that several factors including: cultivar, row spacing and different stages of maturity can influence ascorbic acid, soluble solids, β -carotene and lycopene in tomato fruits.

β -Carotene: The β -carotene content was highest in dried karanda fruit (16.33 μ g) compared to raw (9.73 μ g) and ripe stages (15.65 μ g) and the difference was significant in unprocessed fruit. The increase in β - carotene during maturity may be due to conversion of chlorophyll to

carotenoids. During processing in three maturity stages, the β - carotene content decreased significantly, except in raw fruit where, blanching (10.83 μ g) and irradiation at 0.25kGy (11.64 μ g) has higher content than the unprocessed raw fruit (19.73 μ g). Guarte et al (2005) reported that blanching at 80°C will inactivate carotenoid oxidizing enzymes without showing significant carotene degradation. In ripe fruit the β carotene content was significantly higher in unprocessed (15.65 μ g) > irradiated at 0.25kGy > blanched > irradiated at 0.5kGy > and 1.00kGy. In dried fruit, blanching (16.59 μ g) and irradiation at 0.25kGy (16.62 μ g) showed higher content of β carotene than unprocessed dried fruit (16.33 μ g). However, irradiation at 0.5kGy and 1.00kGy showed significantly lower β - carotene when compared with the unprocessed dried fruit. This trend can be attributed to the degradation of carotenoids during processing. The most of the wild fruits were comparable to cultivated fruits in nutritive value and were suggested for commercial cultivation.

CONCLUSION

The karanda (*Carissa carandas*) is important traditional and underutilized fruit crop for arid and semi-arid regions in tropical and sub-tropical regions. It is known for its ability to withstand adverse conditions. It is good source of vitamin C and rich in carotenes. When the fruit was subjected to blanching and irradiation treatments at raw, ripe and dried stages the carbohydrate, fat and ash content was found highest in dried blanched fruits, protein, crude fibre and ascorbic acid in dried irradiated fruit at 1.00kGy, and β -carotene in dried irradiated fruit at 0.25 kGy.

AUTHOR'S CONTRIBUTION

Supraja. T conducted the experiment, did statistical analysis and wrote the first draft of manuscript. K. Uma Maheswari, K. Uma Devi, M. Prasuna and D. Srinivasa Chary guided throughout the study, helped in designing the work, proof reading and critical correction of manuscript. Sujatha. M assisted in analysis and writing the drafts.

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