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Studies of the Changes in Physico-Chemical Parameters during Growth and Development of Fruits of Karonda cv. Konkan Bold

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Aims: To study the changes in physical and chemical parameters of karonda cv. Konkan Bold fruits during growth and development of fruits.
Place and Duration of Study: Fruit and Vegetable Processing Unit Laboratory at the Department of Horticulture, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli during the 2013-2014 period.
Methodology: During the course of investigation, the physico-chemical changes during growth and development were studied. Drying up of the stigmatic surface and swelling of the ovary were the indication of fruit set. Such set fruits were tagged on the selected karonda bush on the farm. The

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physico-chemical changes during growth and development of karonda fruits Cv. Konkan Bold were be recorded at the four growth stages: 1) Fruit set, 2) Half grown, 3) Full grown and 4) Ripe stage.
Results: As the fruit advanced from the set stage through to the full-grown stage, it was observed that attributes such as weight, volume, size, total soluble solids, total sugars, reducing sugars, and iron content of the karonda fruit increased. Conversely, the specific gravity and titratable acidity demonstrated a decrease from the fruit set to the full-grown stage. The days required to reach the full-grown stage from the fruit set was approximately 108.34 days. Furthermore, ripening from the fruit set took around 116.17 days.
Conclusion: physical characteristics such as weight, volume, specific gravity, length, diameter, and the number of days needed for various growth stages and chemical parameters T.S.S., reducing sugars, total sugars, acidity, and iron content can serve as a maturity indices for these fruits.

Keywords: Karonda; fruit set; ripe stage; maturity indices; physical parameters; chemical parameters; growth; development.

1. INTRODUCTION

Karonda (*Carissa conjesta* Linn.), one of the various minor fruit crops, is often overlooked but holds significant importance. Originating from India, it belongs to the Contorate order and the Apocynaceae family. The Carissa genus comprises 32 species, characterized by their closely branched, thorny, upright or climbing shrubs and small trees, predominantly found in the warmer regions of Africa, Australia, and Asia. Among these species, *Carissa conjesta*, *Carissa spinarum*, and *Carissa grandiflora* hold economic value.

The karonda fruit is small and ellipsoid, growing more than 12mm, transitioning from green to red, and ultimately to shiny black when ripe. The unripe fruit has a sour, astringent taste and is used in making preserves, chutneys, and various types of pickles. These fruits are an excellent source of iron. A ripe karonda fruit consists of 73.89% moisture, 20.17 ºB of T.S.S., 11.48% total sugars, 0.34% acidity, and 1.75 mg/100g of ascorbic acid. Known as one of the richest iron sources, it contains 39.1 mg/100g of iron. The sweet ripe fruits are edible in both fresh and processed forms, such as syrup and jam. The fruit also possesses anti-scorbutic properties and is used in tanning and dyeing. Moreover, ripe fruits are used to create high-quality syrup and wine. The ripe fruits are eaten as a dessert or used in creating value-added products like jelly, sauce, Carissa cream, or jellied salad.

Given the growing demand for karonda products and fresh fruits, a large quantity is needed for processing and consumption. This demand could be met by increasing fruit yield, reducing losses due to late fruit maturity, and enhancing fruit shelf life using early bearing and high-yielding varieties. Furthermore, given the potential for karonda cultivation, it is crucial to study the physico-chemical indices of fruit maturity during growth and development. Little work has been done in these areas, indicating the need for further research that could assist farmers in harvesting the necessary quantity of fruits suitable for value addition and fresh consumption in distant markets with suitable packaging to prevent spoilage. Therefore, the present investigation was titled, "Studies of the changes in physico-chemical parameters during growth and development of fruits of karonda cv. Konkan Bold."

2. MATERIALS AND METHODS

The experiment was conducted in the Fruit and Vegetable Processing Unit Laboratory, at Department of Horticulture, College of Agriculture, Dapoli, Dist-Ratnagiri (M.S.) during 2013-2014. During the course of investigation, the physico-chemical changes during growth and development were studied. Drying up of the stigmatic surface and swelling of the ovary were the indication of fruit set. Such set fruits were tagged on the selected karonda bush on the farm. The physico-chemical changes during growth and development of karonda fruits Cv. Konkan Bold were be recorded at the four growth stages: 1) Fruit set, 2) Half grown, 3) Full grown and 4) Ripe stage. The physical parameters studied during the experiment were weight of fruit (g), volume of fruit (ml), specific gravity of fruit, size of fruit (length and diameter) (cm) and days required for different growth stages of fruit. The different chemical parameters studied were total soluble solids (ºbrix), reducing sugars (%), total

sugars (%), titratable acidity (%), moisture (%) and iron (%).

3 RESULTS AND DISCUSSION

3.1 Physical Parameters of Fruits

The data regarding the changes in physical parameters of karonda fruits during different stages of growth and development were presented in Table 1.

3.1.1 Weight of fruit (g)

The weight of the karonda fruit progressively increased from the fruit set stage to the full-grown stage. The fruit weight was initially 0.016 g at the fruit set stage and expanded to 14.070 g when fully grown. Upon reaching the ripe stage, the fruit weight showed a slight rise to 15.530 g. Weight is a key physical indicator of fruit maturity. A similar trend in fruit weight increase was noted in other studies by Naik [1], and Gole [2] on mangoes, Antarkar [3] on cashew apples, Nair [4] on kokum, Paralkar [5] on Sapota, and Garande [6] on jamun.

3.1.2 Volume of fruit (ml)

The volume of karonda fruit exhibited a increasing trend. At fruit set the volume of karonda fruit was minimum (0.015 ml) while it was maximum at the full-grown stage (13.500 ml). An increase in volume from fruit set till maturity was also reported by Kumar et al. [7] in cashew apple and nut, Paralkar [5] in sapota, Nair [4] in kokum, Garande [6] in jamun. On the basis of these findings, volume of the fruit could also be considered as one of the important physical indices of maturity in karonda fruit.

3.1.3 Specific gravity

The specific gravity of karonda fruit was found to decline from fruit set till maturity but remained more than 1.00 at all stages of its development. It ranged from 1.001 at ripe stage to 1.066 at fruit set. A decrease in specific gravity from fruit set till final harvest was also reported by Jawanda and Bal [8] in ber, Nair [4] in kokum and Pawar [9], Salvi [10], Jadhav [11] in karonda.

3.1.4 Size of fruit (Length and Diameter) (cm)

There was an increase in fruit length from fruit set till full grown stage followed by slight increase at ripe stage. The length of karonda fruit was minimum (0.417 cm) at fruit set and maximum (3.125 cm) at full grown stage. An increasing trend observed in length of karonda fruit was also reported by Kumar et al. [7] and Antarkar [3] in cashew apple, Nair [4] in kokum, Pawar [9], Chavan [12] in karonda and Devi [13] in jamun.

The fruit diameter was minimum (0.214 cm) at fruit set and maximum (2.823 cm) at full grown stage. The fruit diameter showed an increasing trend from fruit set to full grown stage. An increasing trend observed in diameter of karonda fruit was also reported by Kumar et al. [7] and Antarkar [3] in cashew apple, Paralkar et al. (1987) in sapota, Pawar [9], Chavan [12] in karonda and Devi [13] in jamun.

3.1.5 Days required at different growth stages of fruit

It could be noticed that karonda fruit took 116.17 days for reaching ripe stage and 108.34 days for reaching full grown stage from fruit set. Further, it took 58.69 days for reaching half grown stage from fruit set. The observations in accordance with this finding were also reported by Pawar [9] and Mukadam [14] in karonda, Meel [15], Neog [16] and Pareek [17] in ber. Based on this study the number of days required from fruit set till maturity could be considered as one of the important indices of maturity.

3.2 Chemical Parameters of Fruits

The data regarding the changes in chemical parameters of karonda fruits during different stages of growth and development were presented in Table 2.

Table 1. Changes in physical parameters of karonda fruit during growth and development

Stages	Weight (g)	Volume (ml)	Specific gravity	Length (cm)	Diameter (cm)	Days required for different growth stages of fruit
Fruit set	0.016	0.015	1.066	0.417	0.214	00
Half grown	7.851	7.400	1.060	2.584	2.368	58.69
Full grown	14.070	13.500	1.042	3.125	2.823	108.34
Ripe	15.530	15.500	1.001	3.262	2.866	116.17

Table 2. Changes in chemical parameters of karonda fruit during growth and development

Stages	TSS (ºB)	Reducing sugars (%)	Total Sugars (%)	Acidity (%)	Iron (mg/100 g)
Fruit set	6.80	1.09	2.56	3.39	19.41
Half grown	7.80	1.94	3.26	2.89	22.47
Full grown	8.90	3.60	4.52	2.03	28.59
Ripe	12.00	4.50	7.20	0.80	35.14

3.2.1 Total soluble solids (ºB)

The total soluble solids content of karonda fruit recorded a continuous increase from fruit set till ripe stage. The Total soluble solids content of karonda fruit was observed varying from 6.80ºB per cent at fruit set to 12.00ºB at ripe stage. This increase in total soluble solids from fruit set till ripe stage in karonda fruit appeared to be due to accumulation of more sugars in the fruit due to hydrolysis of starch. The similar trend had been reported by Pawar [9] and Jadhav [11] in karonda.

3.2.2 Reducing sugars (%)

The reducing sugars increased throughout the growth period from fruit set 1.09 % to ripe stage 4.50 %. An increase in concentration of sugar may be due to conversion of starch into sugars. This similar finding was observed by the Jawanda and Bal [8] in ber, Nair [4] in kokum, Pawar [9], Salvi [10] and Jadhav [11] in karonda.

3.2.3 Total sugars (%)

The total sugars of karonda fruit increased throughout the growth and development. The total sugars increased first gradually and then rapidly from 2.56 % (at fruit set) to 7.20 % (at ripe stage). An increased concentration of sugars from full grown to ripe stage of fruit development could be attributed to strong source (leaf) and sink (fruit) relationship and due to conversion of starch into sugars. Similar findings were observed by the Jawanda and Bal [8] in ber, Nair [4] in kokum, Pawar [9], Salvi [10] and Jadhav [11] in karonda.

3.2.4 Titratable acidity (%)

The titratable acidity showed a decreasing trend throughout the growth and development of the fruit. It decreased from 3.39 % (at fruit set) to 0.80 % (at ripe stage). The decreased in titratable acidity due to conversion of acids into sugars and then utilization as respiratory substrate during growth of the karonda fruit. The similar findings were reported by Nair [4] in kokum, Pawar [9], Bhajipale [18], Gosavi [19] in karonda.

3.2.5 Iron content (mg/100 g)

The iron content of the karonda fruit increased throughout the growth and development and ranged from 19.41 mg/100 g (at fruit set) to 35.14 mg/100 g (at ripe stage). The similar results were reported by Khan [20] in apple and Tosun [21] in blackberry.

4 CONCLUSIONS

Based on the current findings, we can deduce that certain physical characteristics such as weight, volume, specific gravity, length, diameter, and the number of days needed for various growth stages can be viewed as physical indicators of karonda fruit maturity. Similarly, T.S.S., reducing sugars, total sugars, acidity, and iron content can serve as the chemical indicators of maturity for these fruits.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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