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EFFECT OF FOLIAR APPLICATION AND TIME OF HARVESTING ON QUALITY ATTRIBUTES OF AONLA (*EMBLICA OFFICINALIS* GARTEN.) CV. CHAKAIYA

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Abstract

Present investigations were carried out in the year 2015-2016 & 2016-17. During the experimentation foliar application of different concentrations of Borax, Planofix, Bayleton, Calcium Nimbicidine and control were made. Fresh aonla fruits of cultivar chakaiya from all sampling dates were stored under ambient conditions to check changes in physico-chemical properties of the fruits at weekly intervals.

It was observed that the first full bloom was recorded on 1st April in Cv. Chakaiya. The days from full bloom to harvest for the sampling durations of fruits in the cultivar ranged between 228 to 288 days. The average fruit length and diameter increased gradually with the advancement in maturity but became static at later stages of development. There was increases in fruit length and diameter up to the 4th sampling date (272 DFFB). Fruit size, length and diameter increased appreciably till the 3rd sampling date (259 CFFB). Fruit weight, specific gravity, Pulp:stone ratio increased in the cultivars upto the 3rd sampling date. Moisture content exhibited a non-significant decrease with a progressive increase from the first to the last sampling date in the cultivar. The juice yield increased significantly with maturity of fruits. Total soluble solids (TSS) contents increased throughout the sampling period. The increase was rapid and significant till the 3rd sampling date in the cvs. Chakaiya (12.0°B). A substantial increase in titratable acid (T A) content was observed upto the 3rd picking dates (1.65%). Delay in harvesting of fruits beyond these periods caused a reduction in the reducing sugar content of fruits. Ascorbic acid content increased significantly till the 4th sampling date. significant increases in tannin content occurred in the cultivar under study with a progressive increase in storage duration from 7 to 28 days. The trends of increase in tannin contents during storage were also not affected by harvest dates as highest and lowest tannin contents were recorded in fruits from the first and last harvests, respectively in the cultivars at the time of harvest and after storage. Fruit spoilage increased significantly with the advancement of storage duration of 28 days. The lowest fruit spoilage after storage was recorded (20.43%) harvested on the 3rd sampling date. In general the average scores for overall acceptability decreased significantly during the entire 28 day storage period. The decrease was observed 8.05 to 2.53 in the stored aonla fruits. The maximum mean scores after storage were recorded in fruits of Chakaiya, recording a mean rating of 6.28, when they were harvested on the 3rd sampling date.

Key words : Chakaiya, Days from full bloom, fruiting, foliar spray, time of harvest, Physiological quality, Storage life.

Introduction

Aonla {*Emblica officinalis* (L). *Gaertn*} is an important indigenous emerging fruit crop owing to its hardiness and ability to withstand adverse soil and climatic conditions and belongs to the family Euphorbiceae sub-family Phyllanthoideae (Arun *et al.,* 2009). It is originated in tropical South East Asia particularly South India (Virendra Singh *et al.,* 2009) and (Jain and Khurdiya, 2004). Aonla is commercially cultivated in Mayanmar, Bangladesh, Sri Lanka, Iran and Iraq (Kondhare, 2000). India ranks first in area and production of aonla crops (Priya and Khatkar, 2013) in the world. In India, it occupied an area of 108 thousand hectare, production of 1266 thousand tonnes with 11722.20 kg/ha productivity (Anonymous, 2014) and (NHB, 2014).

The major aonla growing states in India are Uttar Pradesh, Maharashtra, Gujarat, Rajasthan, Andhra Pradesh, Tamil Nadu, Karnataka, Punjab and Himachal Pradesh. Uttar Pradesh, Gujarat and Tamil Nadu,

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contributing over 55 per cent to the total area and production of aonla in the country (Singh *et al.,* 2010). In Tamil Nadu Salem, Tuticorin and Dindigul are the major aonla cultivated areas. The average productivity of aonla in Tamil Nadu is 19 tonnes per hectare with traditional way of cultivation against the Indian average productivity of 11.71 tonnes per hectare (NHB, 2014). In Rajasthan it occupied an area of 1687 hectare with the production of 10675 MT with 6521 kg/ha productivity (Anonymous, 2014). The tree is also common in the mixed deciduous forests of India ascending to 1,350 meters on the hills.

The aonla fruit is a potent antioxidant, hypolipidemic and antibacterial, it also has antiviral and antacid properties. Aonla has been reported to be hepato-protective and possesses expectorant, purgative, spasmolytic, antibacterial, hypoglycemic and hypolipidemic activities (Mishra *et al.*, 2010). However, owing to its highly acidic and astringent taste, low total soluble solids (TSS), poor flavor and colour, it is not popular as a table fruit (Jain and Khurdiya, 2004).

Aonla becomes ready for harvesting from mid November to first week of February. The produce remains in market for a very short span. Huge harvest of produce during peak harvesting season create glut and the growers are compelled to sell their produce at distress prices. Appropriate storage and processing methods can curtail the post harvest losses to 30 per cent (Goyal *et al.,* 2008) and make the fruit available for longer period. Plant growth regulators, certain chemicals and fungicides play a great role in increasing the storage life (Dhumal *et al.,* 2008).

At present, number of processed products such as murrabba, candy, pickles, dehydrated aonlashreds are being prepared through traditional methods. As a result the quality of product is not so good and cause heavy losses of nutrients during cooking and processing. Calcium, as a constituent of the cell wall, plays an important role in forming cross-bridges, which influence cell wall strength and regarded as the last barrier before cell separation (Fry, 2004). Pre-harvest calcium application is one of the most important practices of new strategies applied in the integrated fruit production systems, improving fruit characteristics and minimizing fungicides sprays towards the end of the harvest period. Bakshi *et al*., (2005) reported that the role played by Ca in cell wall integrity is an established fact. Its application retains fruit firmness, which is an important quality parameter during storage.

Foliar application of calcium nitrate, fungicides, planofix, borax increases the yield and quality of aonla. simultaneously, surface coating and proper packing of aonla inceases the duration and quality of aonla.

Materials and Methods

During the experimentation foliar application of different chemicals in different concentrations of Borax, Planofix, Bayleton, Calcium Nimbicidine and control were made. One hundred and twenty fruits comprising twelve units samples of ten fruits from each tree were harvested randomly at fortnightly intervals. All the trees from which fruits were taken were maintained under a strictly uniform schedule of cultural operations throughout the season.

Fruits were harvested at five fortnightly intervals which were spread over a period of two months. Sampling was started one month before and continued upto one month after the expected date of harvest. Harvesting of the fruits and Chakaiya were started on Jan 6th to March 6th,. The fruits were hand picked or plucked by climbing on the trees with the help of bamboo ladder. Six different harvesting dates were chosen to record different physic-chemical studies of the fruits. The chemicals were weighed and dissolved in water before spraying which applied 15-20 days before the expected date of harvest. Fresh fruits from all sampling dates were stored under ambient conditions for physico-chemical study at weekly intervals. Fruits kept in LDPE pouches/ bag at ambient temperature. Fruit size, length and width were recorded with the help of vernier calipers. The specific gravity of aonla fruit was determined by method given by AOAC, 2000. After weighing the whole fruit stone weight was worked out by separating and weighing the stones of the fruit. Pulp weight was calculated by subtracting the stone weight from the whole fruit weight and the pulp:stone ratio was worked out (AOAC, 2000). Oven drying method was used to determine the moisture content from aonla (Ranganna, 1986). Fruit juice was extracted with the help of a juice extractor (B. San Barry and company, New Delhi). Fruit skin and seed colours were determined by matching with the Charts published by the Royal Horticulture Society, London. Total soluble solids (TSS) was recorded with the help of an Erma hand refractometer. The reading was expressed as ^{0}Brix. Acidity was estimated by simple acid-alkali titration method as described in A.O.A.C. 2000. Total sugars content was determined by using Anthrone reagents method (Dubois *et al.,* 1951). Reducing sugar content was measured as suggested by Miller (1959) using di-nitrosalicylic acid. The ascorbic acid content was determined by as per method A.O.A.C., 2000. Tannins (as per cent gallotannic acid) were estimated by determining their oxidisability by potas siurn permanganate solution as per the method described by Ranganna (1986).

Physiologycal loss in weight was measured by Pre-weighed fruit samples were weighed on a physical

balance after each storage interval. The loss in weight during storage was expressed as per cent of initial weight on each sampling date. Moisture content was determined by the method given by Ranganna, 1986. Percentage of spoilage was recorded by eye estimation from the numbered fruits of each experimental lot at each date observation and the Disease Reduction Index (DRI) was calculated as suggested by Gutter (1969). The organoleptic qualities of the beverages were carried out using 09 points hedonic scale (Amerine *et al.,*1965). Sensory evaluation for each experiment analyzed by RBD. The effect of harvest maturity in relation to storage of aonla cultivars analyzed by completely randomized design (CRD) as per standard methods while effects of pre harvest treatments on physico chemical characteristics of fruit analyzed by Randomized Block Design (RBD) as described by Cochran and Cox (1967) and Gomez and Gomez (1984).

Results and Discussion

It is clear from the table 2 that the fruit size (length and diameter) and weight (17.50-31.36) increased substantially during long period and ultimately became non-significant towards the close of sampling. Gradual increase in the fruit size and weight on successive harvest dates can be expected as the fruits get more time for the accumulations of photosynthates, nutrients, water, mineral nutrition etc. which are primarily responsible for increase in fruit size and weight. Such increases in the constituents are conducive for growth and enlargement of cells of mesocarp and their tissue which are responsible for increase in fruit size (Garg, 2007). Table 1 indicating that the significant increases in fruit size and weight were generally observed upto the 3rd sampling date, corresponding to 258 DFFB in Chakaiya. Subsequent increases in these parameters were lesser and non-significant. Aonla fruits are reported to follow a double sigmoidal growth pattern and therefore decrease in rates of increases in size and weight of fruit with approaching maturity is on expected lines. Similar results have also been reported by by Gupta *et al*., (2003) and Singh *et al*., (2006). It was observed that the specific gravity tended

Table 1: Different dates of harvesting and the corresponding days from full bloom (DFFB) of aonla cv. Chakaiya.

2015-16		2016-17		Mean	
Harvest dates	DFFB	Harvest dates	DFFB	Harvest dates	DFFB
Jan-6th	227	Jan-6th	229	Jan-6th	228
Jan-20th	241	Jan-20th	245	Jan-20th	243
Feb-6th	259	Feb-6th	257	Feb-6th	258
Feb-20	272	Feb-20th	274	Feb-20	273
March-6th	286	March-6th	290	March-6th	288

Table 2: Effect of harvest maturity on the different physical characteristics of aonla fruit cv. Chakaiya.

Sampling dates (DFFB)	Length (cm)	Diameter (cm)	Weight (g)	Specific gravity	Pulp-stone ratio	Moisture (%)	Juice*yield (%)	Fruit Colour	Seed Colour
2015 – 16									
Jan-6th (228)	2.80	2.93	18.03	1.03	17.00	84.58	24.72	149A’	159
Jan-20th (243)	3.21	3.56	24.93	1.04	20.64	84.30	33.99	149B	159C
Feb-6th (258)	3.54	3.83	32.27	1.07	21.97	84.05	41.20	149C	159B
Feb-20th (273)	3.55	3.85	32.29	1.08	22.00	84.02	41.46	149C	206C***
March-6th (288)	3.56	3.85	32.30	1.08	22.01	83.96	41.51	149C	206B
CD (P=05)	0.06	0.06	2.73	NS	0.86	NS	0.19	-	-
2016 – 17									
Jan-6th (228)	2.64	2.75	16.98	0.97	16.01	79.66	23.28	141A’	149
Jan-20th (243)	3.03	3.36	23.47	0.98	19.44	79.38	32.01	141B	149C
Feb-6th (258)	3.34	3.61	30.39	1.01	20.69	79.15	38.80	141C	149B
Feb-20th (273)	3.35	3.63	30.41	1.02	20.72	79.12	39.04	141C	194C***
March-6th (288)	3.36	3.63	30.42	1.02	20.73	79.06	39.09	141C	194B
CD (P=05)	0.08	0.08	2.71	NS	0.84	NS	0.19	-	-
Mean									
Jan-6th (228)	2.72	2.84	17.50	1.00	16.50	82.12	24.00	145A’	154
Jan-20th (243)	3.12	3.46	24.20	1.01	20.04	81.84	33.00	145B	154C
Feb-6th (258)	3.44	3.72	31.33	1.04	21.33	81.60	40.00	145C	154B
Feb-20th (273)	3.45	3.74	31.35	1.05	21.36	81.57	40.25	145C	200C***
March-6th (288)	3.46	3.74	31.36	1.05	21.37	81.51	40.30	145C	200B
CD (P=05)	0.07	0.07	2.72	NS	0.85	NS	0.19	-	-

to increase (10-10.5) as the fruits coursed through maturity with the values stabilizing towards the close of sampling. The moisture content remained almost unaffected showing only light but non-signficant decreases with each subsequent sampling date. The increase specific gravity and decreased in moisture content might be due to the additional inflow of photosynthates into the fruit with each passing sampling dates resulting in an increase in the dry matter. Content constituting total soluble solids, sugars and organic acids (Pathak, 2003). Garg (2007) also observed similar trends in changes in specific gravity of fruits with advancing maturity. Juice yield was also observed to be affected by fruit maturity with the differences becoming smaller between progressive sampling dates. Juice yield were also prominent with yields. In having higher moisture content lower juice yield during the initial sampling dates may be due to the difficulty in breaking of cells to release their juice. With maturity the cell size in the mesocarp tissue increases (Gupta *et al.,* 2003) which is accompanied by a decrease in the pectin content, therefore, making it easier to break the cells, enabling sample extraction of juice from more number of cells and hence resulting in juice yields. Changes in fruit colour from green to yellowish green, with a subsequent increase in its intensity was observed. Such a pattern is generally degraded during maturation of most fruits exposing the underlying pigments. Similarly seed colour from creamy white to brown black occurred after 288 DFFB in the cv. Chakaiya. Similar changes in the fruit and seed colour have been reported by Pathak (2003). The present study reveal that pulp: stone ratio increased gradually upto 3rd sampling dates and thereafter the increase was not significant. Maximum significant pulp: stone ratio was recorded pulp-stone ratio of 21.33. The present findings are substantiated to the observation of Gupta *et al*., (2003) who also recorded increase in pulp: stone ratio of Chakiya.

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