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Determination of fruit maturity indices in apricot (*Prunus armeniaca* L.) cv. New Castle

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Abstract

Maturity indices of "New Castle" apricot were studied to standardized maturity standard based on different physico-chemical attributes at different stages of fruit growth and development. The findings obtained revealed that picking of "New Castle" apricot fruits should be done at 71 days after full bloom for distant transportation and marketing when the fruits are sufficiently firm (2.25 kg cm^{-2}) and have developed orange buff colour with blood red tinge under Ranichauri conditions. The fruits for local market should be harvested at 73 days when fruit is soft (2.05 kg cm^{-2}) and fully blended with colour (cadmium orange tinged with jasper red) and flavor.

Key words: *Prunus armeniaca*, maturity indices, ripening, physico-chemical attributes, fruit growth.

Introduction

Among stone fruits, apricot (*Prunus armeniaca* L.), a member of family Rosacae, is one of the most important and delicious fruits of temperate region due to its lucious taste and captivating flavour. Fruits are highly nutritious and contain adequate amount of vitamins, proteins, carbohydrates and minerals (Teskey and Shoemaker, 1972). Apricots being a non-climacteric fruit develops maximum flavor and attain deliciousness when ripened on tree. But being perishable in nature, such fruits can not be transported to distant market to sustain transit losses (Sharma and Sharma, 1990). Lack of proper information in ascertaining physico-chemical changes for the determination of fruit maturity index and untimely harvesting adversely affect the quality and storage life of the fruits. Realizing the importance of the problem, the present investigation was carried out with a view to determine the physical and biochemical changes taking place during maturity, and to fix maturity indices on these basis for appropriate harvesting stage in case of early maturing apricot Cv. New Castle.

Materials and methods

The present studies were conducted at Horticultural Research Block of G.B. Pant University of Agriculture and Technooogy, Hill campus, Ranichauri (Tehri Garhwal), during Feb. to June, 1999. The experimental site falls under mid hill agro-climatic conditions of Garhwal region, situated at an altitude of 2000m above MSL. Seventeen-year-old "New Castle" trees with uniform vigour and bearing potential, grafted on wild apricot rootstocks, were selected as experimental material. The experiment was arranged in R.B.D. with altogether eight treatments (dates of harvesting) and three replications. The physico-chemical analysis of the fruits was carried out at five days interval starting from 45 days to 65 days and at three days interval from 65 days to 71 days and finally after two days interval up to 73 days after full bloom. A random sample comprising 25 uniformly ripe fruits were collected for physico-chemical studies and analyzed as per standard method (A.O.A.C, 1984). The colour of fruits at different stages was matched with R.H.S. colour chart (1966).

Results and discussion

Fruit growth: Critical examination of data presented in Table 1 depicted a continuous increase in fruit length and diameter, however, the increase in both these parameters was found significant only up to 60 days after full bloom. Maximum fruit length (3.58cm) and diameter (3.52cm) was recorded at final harvesting. A similar trend in growth in terms of fruit length and diameter was obtained by Sharma and Sharma (1990) and Sharma and Nigam (1994). This increase in length and width may be probably due to increase in cell size, *i.e.,* both cell enlargement and amount of intercellular spaces.

Fruit weight, volume and specific gravity: The results obtained during present study revealed a continuous increase in fruit weight throughout the course of investigation, and the maximum fruit weight of 19.78g was recorded at final harvest, however the fruit volume showed a continuous increase only up to 2nd last sampling date (Table 1). The increase in fruit weight and volume might have probably been again due to the increase in cell size and intercellular spaces of the flesh. Carbohydrate accumulation during the stage has also resulted in increase in fruit weight and volume. The specific gravity was recorded to decrease up to 50 days and thereafter increased, which is similar to the findings of Gangwar and Tripathi (1972) who recorded the same trend in specific gravity in case of peaches.

Pulp and stone weight: A progressive and significant increase in pulp weight was observed till final harvest, while stone weight showed a diminishing trend through out the course of study (Table 1). These results are in conformity with the findings of Sud *et al.* (1979). A marked increase in fruit pulp with the advancement of maturity may attributed to accumulation of metabolites, thus increasing its weight, whereas, reduction in

seed weight resulted from the strong competition for assimilates between pericarp and stone in which stone was weaker competitor.

Firmness and colour: A gradual decrease in fruit firmness was noticed with the advancement of maturity. Firmness of fruits has been reported to decline as the fruits mature (Sugar and Powers, 1994). Flesh softening is primarily attributed to break down of insoluble protopectines, a major component of cell wall, into soluble pectic compounds and shortening of the polymer chain length, dimethylation of carboxylic group and diactylation of hydorxy group, which ultimately affects the cell wall consistency through cell wall constituents namely cellulose and hemicellulose. The flesh as well as skin colour gradually changed from green to yellow and finally turned orange at ripening (Table 3). Dramatic changes in fruit colour were observed due to replacement of chloroplast by chromoplast and carotenoids (Leopold and Kriedmann, 1983).

Maturity Period: Fruits of New Castle apricot took 71 days for harvesting for distant market, whereas, the fruits for local consumption took 73 days from full bloom to picking maturity (Table 1), when they attained good size and cadmium orange colour tinged with Jasper red (Table 3). However, Sud *et al.* (1979) found optimum time of harvesting the New Castle apricot, 64 days after full bloom under mid hills of Himachal Pradesh, while Nigam and Sharma (1986) reported a period of 70 days from full bloom under similar conditions. The difference in number of days for attainment of picking maturity can be attributed to the differences in microclimatic conditions and environmental factors.

Table 3. Colour of fruits during various stages of growth, development, maturity and ripening

Days[z]	Fruit skin colour	Mesocarp colour
45	Scheele's green	Agathia green
50	Pea green	Sap green
55	Sap green	Primerose yellow
60	Chartreuse green with current red blushes	Naples yellow
65	Prime rose yellow with orange blushes	Straw yellow with orange buff tinge
68	Naples yellow with red blushes	Tangerine orange
71	Orange buff with blood red tinge	Orange buff
*73	Cadmium orange tinged with Jesper red	Amber yellow

z Days after full bloom, *Date of final harvest

Total soluble solids and dry matter contents: T.S.S. present in the pericarp tissue of fruit increased markedly upto final harvest and recorded maximum of 16.34° Brix at last picking (Table 2). These findings are in agreement with the results obtained by Bajwa and Mishra (1970). The increased level of T.S.S. at maturity may be due to higher level of sugar since T.S.S. is a function of several factors of which sugars constitute the major component. The variation in dry matter content showed

Table 1. Physical traits of apricot cv. New Castle at different maturity stages

Days	Length (cm)	Diameter (cm)	Length/ diameter	Fruit weight (g)	Fruit volume (cm^3)	Specific gravity	Pulp weight (g)	Stone weight (g)	Pulp:Stone ratio	Firmness (kg cm^{-2})
45	2.45	2.28	1.07	6.88	6.78	1.01	4.80	2.08	2.37	-
50	2.76	2.62	1.05	8.86	8.77	0.01	6.81	2.05	3.32	-
55	2.81	2.75	0.01	12.02	12.25	0.98	10.06	1.96	5.13	13.20
60	3.03	2.90	1.04	13.44	13.88	0.96	11.49	1.95	5.89	9.16
65	3.31	3.28	1.00	15.82	18.31	0.86	13.88	1.94	7.15	4.95
68	3.40	3.40	1.00	17.30	19.88	0.87	15.38	1.92	8.01	3.05
71	3.51	3.43	1.02	18.81	20.62	0.91	17.01	1.80	9.45	2.25
73*	3.58	3.52	1.01	19.78	20.16	0.98	18.02	1.76	10.24	2.05
SE(m) ±	0.04	0.09	-	0.16	0.16	-	0.10	-	0.07	0.06
CD (5%)	0.11	0.26	-	0.48	0.48	-	0.30	-	0.20	0.19
CV (%)	2.06	4.91	-	1.63	1.80	-	1.41	-	1.77	1.84

Table 2. Biochemical traits of apricot cv. New Castle at different maturity stages

Days	TSS (°Brix)	Titrable acidity	Ascorbic acid mg/100 g	Chlorophyll mg/100 . fresh wt	Dry matter (%)	Reducing sugars (%)	Non reducing sugars (%)	Total sugars (%)	Starch (mg/100g)	Protein (mg/100g)
45	8.51	40.27	15.48	0.61	14.75	3.00	0.54	3.54	2.07	15.54
50	8.89	36.71	15.18	0.46	16.20	2.72	0.98	3.70	1.89	16.20
55	9.41	31.11	13.82	0.29	15.32	2.59	1.80	4.39	1.68	16.02
60	10.31	22.82	12.25	0.19	16.23	2.40	2.39	4.78	1.47	16.98
65	14.01	18.86	11.64	0.17	13.35	2.38	3.47	5.85	1.07	17.52
68	14.71	17.10	11.16	0.12	12.95	2.37	3.41	6.28	0.52	17.64
71	15.67	15.34	10.68	0.10	12.76	2.48	4.36	6.84	0.28	17.76
73*	16.34	14.91	10.35	0.07	12.38	2.52	4.69	7.21	0.02	17.85
SE(m) ±	19.62	0.22	0.35	0.03	0.08	0.05	0.05	0.15	0.03	0.12
C.D. (5%)	0.19	0.67	0.80	0.10	0.23	0.16	0.14	0.46	0.10	0.37
C.V. (%)	1.89	1.54	3.63	22.09	0.92	3.49	2.81	4.88	5.05	3.71

z Days after full bloom, *Date of final harvest

an erratic pattern during entire study period. Similar results were obtained by Sharma and Nigam (1994) in apricot. Hence dry matter is not a good criteria for determining maturity indices.

Sugars and starch: There was a gradual and steady increase in the total sugar content (3.54 to 7.21%) throughout the growth and maturation period (Table 2). Almost similar observations were recorded by Sud *et al.* (1979) in apricot fruits. The reducing and non-reducing fractions of the total sugars exhibited almost similar trend as was observed for total sugars. Accumulation of non-reducing sugars starts at later stages in the season and is speeded up during maturation and ripening as a result it dominates over reducing sugars. The increase in sugar levels is due to abundance of chloroplast in young fruits which help in synthesis of sugars. On the other hand starch content showed a declining pattern due to the fact that starch was hydrolyzed into component sugars during maturation and ripening (Malik and Srivastava, 1985).

Acidity and ascorbic acid content: A perusal of Table 2 indicated that titrable acidity in terms of malic acid contents decreased gradually from first sampling (40.27mg/100gm.) till final picking (14.91mg/100gm.) and almost in line with the results obtained by Sharma and Nigam (1994). Sourness of fruit is basically attributed to the presence of organic acids in fruit pulp and taste of fruit is determined by ratio of sugars and acids. The ascorbic acid content also exhibited similar trend like acidity and recorded a minimum of 10.35 mg/100 g at final harvest. Srivastava *et al.* (1970) reported ascorbic acid contents ranging from 6.37 mg to 14.52 mg/100 g in different varieties of apricot grown in U.P. hills.

Chlorophyll and protein: A gradual decrease in chlorophyll content of fruits was noticed upto 60 days after full bloom and, thereafter marginal change was observed till maturity (Table 2). Similar trend was observed by Singh (1997) in peach cvs Saharanpur Prabhat and Flordasun. Replacement of chloroplast by chromoplast and carotenoids caused reduction in chlorophyll level during maturation and ripening stages (Leopold and Kriedmann, 1983). The total protein content of the pericarp tissue of developing New Castle apricot fruits increased gradually from Ist sampling to final harvest (15.54 to 17.85mg/g) however, this increase was not found to be significant between any two sampling dates (Table 2). The low protein content in fruits as compared to seed, leaf and other plant parts have also been reported by Hensan (1970).

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