

Morphological and biochemical changes in avocado (*Persea americana*) during ripening

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ABSTRACT

A study was carried out on the morphological and physiological changes in avocado during ripening at ICAR-IIHR, Bengaluru. A promising genotype (IC-0626510) having a large sized green fruits with yield potential of 281 fruits/year was used. Increased weight loss was induced at different stages of ripening from maturity to ripening showing weight loss (11.13% on 8th day) without any change in size of the fruit (9.15 cm x 8.23 cm). At ripening mean pulp recovery >75%, TSS 4.42 °Brix, 38.5%fat, 79.9% moisture, 30g/100g carbohydrate, 4.4% protein and 22.6% fibre was recorded. However firmness of fruits reduced considerably without change in fruit (light green) and pulp colour (creamy-white). There was no incidence of anthracnose on fruits throughout the period of study indicating that fruits of promising genotype are tolerant to anthracnose disease.

Key Words: Fat content, Fruit quality, Promising genotype, Weight loss

Avocado (*Persea Americana* Mill) is a native of tropical America. It is found growing in home gardens of several states of country. Almost each house is maintaining a few plants of avocado (Chithiraichelvan *et al.*, 2002; Tripathi *et al.*, 2014, Tripathi *et al.*, 2016). The avocados are better stored at relative humidity 90 % - 95 % and temperature 12-13 oC. Grading can be done based on size: small (250 gm), medium (500 gm) and large (1000 gm) for internal and for export markets. Unripe avocados can be stored up to four weeks at 5.5 to 8 °C. Therefore, an experiment was conducted to study its morphological and physiological changes during ripening.

MATERIALS AND METHODS

The experiment was conducted at ICAR-IIHR, Bengaluru, during 2021-22. A promising seedling selection (IC-0626510) was used. The seedlings were raised and planted at IIHR FGB in 2013. Twenty fruits were collected from elite avocado tree. Fruits were harvested at physiological maturity. Data were recorded on variables, viz, fruit length (cm), breadth (cm), weight (g), pulp weight (g), pulp recovery (%), seed weight (g), rind weight (g) rind thickness (mm), cavity length (cm), and cavity diameter (cm). Fruit skin colour, pulp colour were determined

using RHS colour chart. Fruit length and width were measured for using a Vernier calipers. Fruit skin colour changes were evaluated every day using RHS colour chart. Weight loss was measured on 10 fruits every day during 8 days with an electronic scale balance (0.1-1500 g). The fat, moisture, carbohydrate, protein and fibre content were estimated using standard procedures. Pulp firmness of five fruits was determined manually by 0-10 scale. Additionally, descriptive analysis was performed using MS excel.

RESULTS AND DISCUSSION

The fruit evaluation for fruit weight, fruit size, fruit and pulp colour, fruit firmness and seed colour were evaluated from harvesting at full maturity till ripening when fruit reached a soft texture and ripen properly for consumption. The data revealed fruit weight loss was 1.24 % day 1 and weight loss gradually increased till it reached full ripe stage (Table1). At 8 DAH fruit weight loss was 11.13%. The fruit length and breadth remained constant without any change from maturity till ripening. The firmness of fruits showed differences during ripening process. The fruits showed a significant reduction in firmness at 8 days after harvesting (DAH) with average value of 2 (1-10 scale). At 8 DAH, all fruits showed similar firmness (Table 1). The fruit skin color showed no differences during ripening process (144 A Yellow

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green group at harvesting), that remained the same at 8 DAH. The pulp colour was yellow (3 C ;yellow group) that remained same at 8 DAH. Similarly seed colour is greyed orange (164 A + 164 C; greyed orange group) did not undergo change during ripening.

At ripening mean fruit length was 9.15 cm and mean fruit diameter was 8.23 cm with pulp recovery >75%. Mean seed weight was 71 g with TSS 4.42 °Brix. Fruit color is light green and flesh color is creamy white. It is late bearing genotype with pear shaped fruits and fruit is thin skinned (10mm) (Table 2). Fruit shape is obovate, dark green colour with creamish white flesh colour. It is suitable for fresh fruit purpose.

Ripe fruits were analyzed for biochemical parameters (Table 2). The moisture content of avocado pulp was 79.9 %. The fat content ranged from 36.28 - 40.21%. Mean values for carbohydrate, protein were 30.12 g/100g and 4.38% respectively. Crude fibre content accounted for 22.63%.

The weight loss was gradual from maturity to ripening. Adato and Gazit (1974) mentioned that avocado fruits ripen faster when weight

loss is higher; this loss of water is considered the main cause of physical deterioration of fruit quality (Kader,2002). The avocado is considered a climacteric fruit (Bower and Cutting 1988; Osuna-García *et al.*, 2005). Though color and firmness changes are indicative of a ripening process, in our study only changes were observed on firmness and not in fruit colour. Cox *et al.* (2004) reported changes occurred in colour and firmness. Colour alteration of exocarp are result of changes in structure and conformation of thylakoids (Navarro *et al.*, 1999; Bonfiglioli *et al.*, 1994) so, these alterations affect the chlorophyll content in cell, resulting in development of yellowish-white colour symptoms, than later turn into purple and reddish color due to the increase in anthocyanin content (Cox *et al.* 2004; Vallejo-Pérez *et al.*, 2014). The average size of fruit (9.15cm × 8.23 cm) similar without any reduction. However Vallejo-Perez (2015) reported 7-9 % in size reduction.

Saucedo-Carabez *et al.* (2013) also reported yield reduction of 52 -75 % from symptomatic B Hass^ avocado trees. This response is probably due to deterioration of phloem and xylem tissues causes

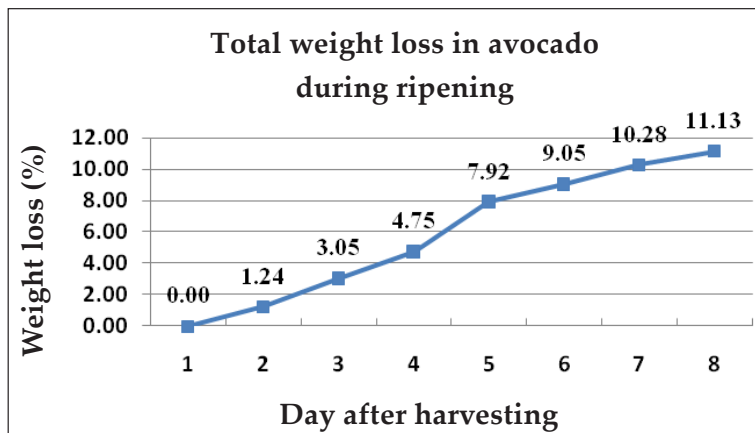


Fig. 1: Weight loss in avocado fruit during ripening

Table 1. Changes in morphological parameters of avocado during ripening

Parameter	Day after storage							
	1	2	3	4	5	6	7	8
Weight loss (%)	0.00	1.24	3.05	4.75	7.92	9.05	10.28	11.13
Fruit length (cm)	10.85	10.85	10.85	10.85	10.85	10.85	10.85	10.85
Fruit diameter(cm)	8.66	8.66	8.66	8.66	8.66	8.66	8.66	8.66
Fruit colour	144 A	144 A	144 A	144 A	144 A	144 A	144 A	144 A
Pulp colour	3 C	3 C	3 C	3 C	3 C	3 C	3 C	3 C
Firmness(scale)	10	10	9	8	6	5	3	2

Fruit colour- 144 A Yellow green group
 Pulp colour -3 C (Yellow group)
 Seed colour: 164 A + 164 C (Greyed orange group)

Table 2. Biochemical parameters in avocado mature fruit

	Fat (%)	Moisture (%)	Carbohydrate (g/100g)	Protein (%)	Crude fiber (%)
Mean	38.49	79.9	30.12	4.38	22.63
Minimum	36.28	78.03	27.31	4.19	21.013
Maximum	40.21	81.81	32.51	4.56	24.26
Standard error	0.86	0.57	1.083	0.19	1.62
Standard deviation	1.73	1.40	2.167	0.27	2.29
CV (%)	4.48	1.75	7.195	7.19	10.13

by ASBVd (Vallejo-Pérez *et al.* 2014). Avocados have the highest energy value (245 cal/100 g) of any fruit besides being a reservoir of several vitamins and minerals (Tripathi *et al.*, 2022). The protein content is 4.38% and fat is 39%. According to Tripathi *et al.* (2022) that the pulp is rich in proteins (up to 4%) and fat (up to 30%), but low in carbohydrates. The fat is similar to olive oil in composition and is widely employed in the preparation of cosmetics as they work well on skin ailments.

According to Mazumdar, (2004) fruits contain less than one per cent sugar and good for diabetics. Dietary fibre which is important in keeping gut health was found to be high in avocado. In adults, emerging evidence suggests that higher daily intake of fiber-rich fruit and vegetable servings is associated with lower incidences of anxiety, greater happiness, higher life satisfaction, and greater social-emotional well-being. Increased fruit fiber such as pectin intake has been suggested to correct gastrointestinal abnormality and promote microbial health to potentially enhance gut-brain communication (Dreher. 2018)

CONCLUSION

There is very little change in weight loss and fruit quality in terms of appearance, size, quality and anthracnose. The selected genotype is promising and fulfils the minimum requirements of fresh market.

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