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Fruit development and maturity of mrig bahar Nagpur mandarin fruits

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ABSTRACT : Maturation is the most important stage of fruit development which is most active phase, involving high metabolic activity and cellular changes which lead to changes in colour, aroma, flavour and texture of fruits. The knowledge of these changes may be widely used to evaluate fruit maturity period of Nagpur mandarin. A change in peel colour is one of the indices used for maturity. Considering this, an experiment was carried out during 2010-11 at College of Horticulture; Dr. P.D.K.V., Akola comprising four stages of maturity in Randomized Block Design with five replications. The chlorophyll, carotenoid pigments and physico-chemical analysis of Nagpur mandarin fruits of mrig bahar was done. The significant difference was found in all characters recorded at different stages. The maximum fruit weight, volume and size were recorded in matured deep orange colour stage. Chlorophyll 'a' decreased from 0.0855 mg/g fruit weight in fully developed green stage to 0.0224 mg/g (fruit weight) in matured deep orange colour stage. The decreasing rate of chlorophyll 'a' content was very rapid in fruit sample between fully developed green stage 0.0855 mg/g to colour break stage 0.0399 mg/g. Similar results were recorded in chlorophyll 'b' and total chlorophyll content in fruits. The progressive increase in carotenoid content was observed during advancement of fruit maturation.

KEY WORDS : Nagpur mandarin, Maturation, Physico-chemical status

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Citrus fruit is botanically classified as a hesperidium containing juice vesicles within segments. The development of citrus fruit comprises of three major stages. According to Brain (1958) the first stage - cell division, second stage-cell enlargement and third stage - fruit maturation. Maturation is the most important stage of fruit development which is most active phase, involving high metabolic activity and cellular changes which leads to change in colour, aroma, flavour and texture of fruits. The knowledge of the changes may be widely used to evaluate fruit maturity period of Nagpur mandarin. A change in peel colour is one of the indices used for maturity. The study regarding changes during

maturity due to pigments accumulation in the fruits so far has not been undertaken and hence, the present work has been carried out.

RESEARCH METHODS

Twelve year old Nagpur mandarin orchard on jamberi rootstock was used for this experiment. Freshly harvested matured fruit sample were collected at four stages of maturity viz., Stage I-Fully developed green colour, Stage II- Colour break stage, Stage III-50 per cent colour break stage and Stage IV- Deep orange colour fruits. The experiment were laid out in Randomized Block Design with five replications. These fruits were

mixed thoroughly (Stage wise) for analysis of physico-chemical parameters and estimation of chlorophyll and carotenoid pigments by acetone method. The data were statistically analyzed by using the methods described by Panse and Sukhatme (1985).

RESEARCH FINDINGS AND DISCUSSION

The significant differences were found in fruit weight, fruit volume, fruit height at different stages of fruit maturity. The maximum fruit weight, volume and height was found in matured deep orange stage (Stage IV) whereas minimum was recorded in (Stage I) fully developed green fruits. The non significant difference was recorded in juice per cent. Numerically the juice was more in fully developed green fruits (Stage I).

Total soluble solids and reducing sugar were significantly influenced by different stages of fruit maturity. TSS in the fruit juice increased with the different stages of maturity. The maximum TSS (10.28%) was recorded in stage IV *i.e.* deep orange colour stage. This may be due to hydrolysis of starch leading to accumulation of more sugars in the fruits. There was no significant difference in respect of different stages of fruit maturation of Nagpur mandarin. The maximum acidity was recorded in stage IV *i.e.* deep orange colour stage. The reducing sugar was significantly influenced by different stages of maturity. The reducing sugar increased from 3.85 per cent in fully developed green

stage to 4.75 per cent in mature deep orange colour stage. The increasing trend was significantly found between fully developed green stage (stage -I) and colour break down (stage II) (Table 1).

Chlorophyll 'a', chlorophyll 'b' and total chlorophyll content decreased significantly during the advancement of fruit maturation. The chlorophyll 'a' decreased from 0.0885 mg/g fresh weight in fully developed green stage to 0.0339 mg/g fresh weight in mature deep orange colour stage. The decreasing rate of chlorophyll content was significantly raised in fruit stages between fully developed green stage and colour break stage (stage-II). While it was lower down in the fruits harvested in colour break stage to 50 per cent colour break stage and again subsequently lower the rate at maturity orange colour stage. The chlorophyll 'b' content decreased significantly from 0.1202 mg per g in fully developed green fruit to 0.0538 mg per g in colour break stage. The rate of degradation of chlorophyll 'b' decreased gradually from colour break stage (II) to matured stage-deep orange colour stage (II). Ram and Godara (2003) reported similar results.

Similarly total chlorophyll content decreased significantly during the advancement of fruit maturation. The fruit harvested at fully developed green stage (stage I) accumulated higher amount of total chlorophyll 0.2057 mg per g on fresh weight basis which very rapidly decreased on subsequent stages and attended the

Table 1 : Physico-chemical status of mrig bahar fruits of Nagpur mandarin

Stages	Fruit weight (g)	Fruit volume (cc)	Fruit size		Juice (%)	TSS (%)	Acidity (%)	Reducing sugar (%)
			Length (cm)	Diameter (cm)				
I	185.8	176	4.60	5.51	48.98	8.48	0.74	3.85
II	192.2	182	4.57	5.74	46.79	9.80	0.70	4.74
III	196.0	210	4.83	6.09	44.50	9.76	0.70	4.22
IV	222.0	243	5.54	6.43	46.66	10.28	0.67	4.75
S.E. \pm	7.4	7.8	0.12	0.09	1.41	0.17	0.03	0.22
C.D. (P=0.05)	22.8	24.0	0.37	0.28	NS	0.52	NS	0.69

NS=Non-significant

Table 2 : Chlorophyll, carotenoids status of mrig bahar fruits of Nagpur mandarin

Stages	Chlorophyll 'a' (mg/g)	Chlorophyll 'b' (mg/g)	Total chlorophyll (mg/g)	Carotenoids (mg/g)
I	0.0855	0.1202	0.2057	0.0888
II	0.0399	0.0538	0.0928	0.1006
III	0.0303	0.0370	0.0493	0.1028
IV	0.0224	0.0144	0.0369	0.1075
S.E. \pm	0.0108	0.0090	0.0027	0.0078
C.D. (P=0.05)	0.0334	0.0277	0.0084	NS

NS=Non-significant

minimum total chlorophyll content of 0.0369 mg per g fresh weight basis at mature deep orange stage. The chlorophyll 'a', chlorophyll 'b' and total chlorophyll decreased significantly from fully developed green fruit stage to deep orange colour fruit stage. These results are in accordance with the results of Ram and Godara (2003) in Kinnow mandarin. The loss in chlorophyll content was mainly due to the increase in the activity of chlorophyll degrading enzymes *i.e.* chlorophyllase and chlorophyll degrading peroxidases (Yamauchi and Hashinaga, 1992; Yamauchi *et al.*, 1991). The activity of chlorophyllase (Barmore, 1975) and Sapira *et al.* (1987) and chlorophyll degrading peroxidases enzymes increased with degreening of the peel on free fruit maturation was reported by Yamauchi *et al.* (1997).

The carotenoid content progressively increased during the advancement of fruit maturation. The carotenoid increased from 0.0888 mg per g fresh weight in fully developed green fruits to 0.1075 mg per g fresh weight in deep orange colour fruit stage. The rate of carotenoid synthesis was higher in the fruits of mature stage than those fruits at fully developed green stage. The increasing trend in carotenoid content due to break in colour which was apparent from a corresponding decrease in chlorophyll 'a' and chlorophyll 'b'. Stewart and Wheaton (1973); Mehta and Bajaj (1984) and Singh *et al.* (1998) recorded that with maturation of citrus fruit (Kinnow), the chlorophyll started disappearing as well as amount of lutein and neoxanthin decreased. New carotenoids appeared and decreased drastically to impart colour to the peel. Continuous chlorophyll degradation and carotenoids synthesis exhibited by fruits with the advancement of fruit maturity (Table 2).

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