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Dynamics of Physico-Chemical Values in *Sohshang* (*Elaegnus latifolia* L.) across Maturity

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ABSTRACT

Sohshang (*Elaegnus latifolia* L.) is a large evergreen spreading type woody shrub mostly grown in semi-wild condition in the backyard garden throughout Northeast India. It is harvested during February-April when most of the major fruits are not available in the market. However, a bulk quantity of the fruit gets damaged during the process of handling and marketing due to harvesting of fruits at improper stage. Therefore, standardization of harvest maturity is required to reduce post harvest loss. Dynamics of physico-chemical values like fruit colour, pulp: seed ratio, moisture content, specific gravity, fibre, texture, total soluble sugar (TSS), ascorbic acid, total carotenoids, ß-carotene, tannins, etc. were analyzed at different stages of maturity to determine the harvest maturity of *Sohshang*. The present study indicated that the right stage of fruit harvesting is 75-80 days after fruit setting when the fruits develop deep orange colour and attain optimum fruit weight (11.55-61 g), TSS (>11.0 ^{0}Brix) and TSS: Acidity ratio (>3). Moreover, the fruits harvested at this stage had all the desirable qualities with a better shelf life.

Keywords: Sohshang, *Elaegnus latifolia* L., fruit maturity, specific gravity, TSS, ascorbic acid, ß-Carotene, sensory quality

INTRODUCTION

Sohshang (*Elaegnus latifolia* L.) is an important indigenous fruit of Meghalaya that grows in Khasi and Jaintia hills besides other places in Assam and Nagaland. It is a large evergreen spreading type woody shrub that is mostly grown in semi-wild condition in the backyard garden throughout the region. It is being consumed to a great extent by the rural and tribal masses of the Northeast India for their congenial taste. The fruits of Sohshang are very delicious with an attractive pink colour. However, the fruits must be fully ripe before it could be eaten raw, as it is very astringent in taste at immature and half ripe stage. At full ripe stage, the fruits are acidic in taste and are pleasantly refreshing. It also possesses specific medicinal properties. In Sind and Punjab, its flowers are considered cardiac and astringent, whereas the fruits are used in Kashmir as an astringent (Kirtikar et al. 1975). They can be used for making jam, chutney and pickles, etc. Its leaves are used as fodder for goats and cows and its woods can be used as a good fuel (Sundriyal and Sundriyal 2003).

Sohshang is normally harvested during February to April when most of the major fruits are not available in a sufficient amount in Northeast India. Thus, the fruits may partly meet the demand of vitamins and minerals of the people in these months. The added advantage of cultivation of Sohshang is a relatively wider phenological and soil adaptability, higher degree of pest and disease resistance and minimal demand for intensive production care as compared to the many major fruits.

It is known that physico-chemical qualities depend on various physiological and biological

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changes that occur during fruit growth, development and maturity (Harding and Hatoon 1967). Maturity at harvest is an important factor affecting quality perception and the rate of change of quality during post harvest handling. The information pertaining to the dynamics of physico-chemical properties of Sohshang at different stages of maturity is very scanty since no systematic study has so far been reported. Such information is required because physico-chemical changes during maturity can be used as important criteria for determining the optimum stage of harvesting for best quality and extended shelf life. Keeping these facts in view, a comprehensive study was carried out on various physico-chemical changes in different stages of fruit maturity to determine the appropriate time of harvesting of Sohshang for better quality and desirable shelf life.

MATERIALS AND METHODS

Fruits of *Sohshang* were harvested from the experimental field of the division of Horticulture, ICAR Research complex for NEH Region, Barapani at 15-day interval from fruit set to mature green stage and then at five-day interval from mature green stage to full ripe stage and analyzed for different physico-chemical parameters. Fruit, pulp and seed weight was measured at each stage using the standard method. Fruits and seed size (length and breadth) were measured using vernier calipers. A TA-XT-plus texture analyzer measured the textural property of the fruit. A panel consisting of five untrained members based on visual observation evaluated the visual colour of the fruit at different stages of maturity. Specific gravity was measured by water displacement method and sensory evaluation was done by a panel of five untrained members based on nine-point hedonic scale rating (Amerme et al. 1965). Moisture content was determined as per the method of AOAC (1980)

The total soluble solids (TSS) content was determined by Erma Hand Refractometer (0-32^{o}B). Titratable acidity and fibre content were estimated as per AOAC (1980) and total carotenoids were determined according to the methods described by Ranganna (1997). Ascorbic acid was determined by 2,6 di-chlorophenol-indophenol dye visual titration method of Freed (1966). Ash and ß-Carotene were determined as per the method described by Srivastava and Kumar (2002). Chlorophyll content of the fruit was determined by using the colorimetric method of Singh (1997).

The experiment was carried out in completely randomized design, and each treatment was replicated thrice. The data were subjected to statistical analysis following the Fisher's method of "Analysis of Variance" (Snedecor and Cochran 1967). Critical difference at 5% level of significance was used for finding the significant differences if any, between the treatments means.

RESULTS AND DISCUSSION

Fruit growth of Sohshang in terms of fruit length and fruit breadth followed a single sigmoid growth curve (Fig. 1). The fruits attained maximum length (35.55 mm) and breadth (23.96 mm) on 75 days after fruit set (DAF) after which, they remained almost constant up to 85 DAF. The increase in fruit length (14.57-35.55 mm) and breadth (5.37-23.96 mm) might be due to an increase in cell size because of cell division and cell elongation, which enabled the maximum accumulation of food materials. The present result was in conformity with the findings of Gowda and Huddar (2001) in mango. A linear increase in fruit weight (Fig. 2) was observed up to 75 DAF after which it remained almost constant

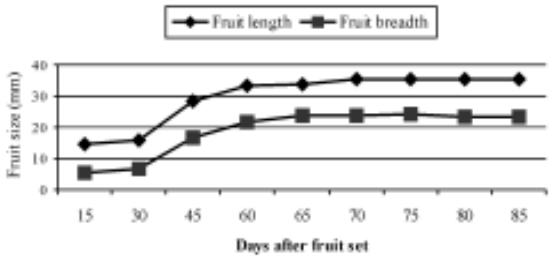

Fig. 1: Changes in fruit length and fruit breadth of *Sohshang* at different stages of maturity

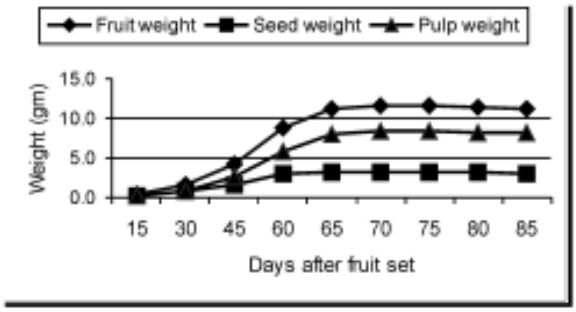

Fig. 2: Changes in fruit weight (g), seed weight (g) and pulp weight (g) of *Sohshang* at different stages of maturity

up to 85 DAF. The increase in fruit weight (0.37-11.61 g) could be attributed to an increase in the size of the cells and accumulation of food substances in the intercellular spaces in fruit. Similar findings were also reported by Kishore et al. (2006) in passion fruit. Pulp weight and seed weight followed the same pattern as that of fruit weight where the highest pulp weight (8.38g) and seed weight (3.233g) was observed in the fruits harvested at 75 DAF (Fig. 2).

A linear increase in seed length (13.00-32.41 mm) and seed breadth (2.67-13.90 mm) of Sohshang was observed up to 85 DAF (Table 1). These findings were comparable to those obtained by Sahni and Khurdiya (1984) in mango and Lilien-Kipnis and Lavee (1971) in peach. The data presented in Table 1 showed a significant increase in pulp: seed ratio (1.29-2.69) with the advancement of maturity and ripening of the fruits. Increase in this ratio might be due to accumulation of the metabolites, thus increasing the fruit weight. Similar results were also reported by Dhillon et al. (2007) in pear.

The immature fruits were firmer than the completely matured fruits due to decline in fruit texture (13.46-0.85 kg) with the progress of maturity and ripening (Fig. 3). This might be a result of progressive decline in cell wall strength and loss of cell-to-cell adhesion. Similar findings were also reported by Heyes et al. (1994) in pepino. Specific gravity (Table 1) was found to increase up to 75 DAF (0.26-1.84), and thereafter, it decreased until the last date of observation. Increase in specific gravity might be due to higher rate of accumulation or synthesis of food materials. Similar results were also reported by Sema and Sanyal (2003) in lemon. A gradual change in colour (Table 1) from dark green to deep pink was observed with the advancement of maturity and ripening. This could be attributed to a gradual decrease in the content of chlorophyll and increase in carotenoids (Kramer and Smith 1947; Deka et al. 2006) in *Khasi* mandarin. Increase in moisture content (Table 1) of the fruit was observed upto 60 DAF (80.20-91.47 %) which was followed by a decline up to 85 DAF (91.47–86.17 %). The reduction in fruit moisture at later stages might be due to dehydration of the fruit as well as due to low relative humidity during the period. Similar results were also reported in peach by Chapman et al. (1991). Fruits harvested between 75 and 80 DAF attained the best taste, optimum texture, attractive colour, good aroma and best appearance, thereby, recorded the highest score for sensory quality (Table 2). Similar observation was also reported by Deka et al. (2007) in pineapple.

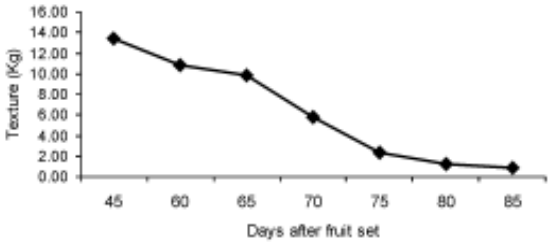

Fig. 3: Change in texture (kg) of *Sohshang* at different stage of maturity

A gradual increase in TSS contents (8.57-12.23°B) of the fruit was observed with the advancement of maturity (Table 2). The increase in TSS content might be the result of degradation of starch during later stage of harvest maturity. Similar results were also reported by Candir et al. (2009) in persimmon. Acidity of the fruit increased gradually (Table 2) and was at its maximum on 70

Table 1: Changes in fruit characters of *Sohshang* at different stages of maturity

Days after fruit set	Seed length (mm)	Seed breadth (mm)	Pulp: seed ratio	Specific gravity	Fruit Colour content (%)	Moisture
15	13.00	2.67	1.29	0.26	Dark green	80.20
30	13.67	5.07	1.01	1.09	Dark green	84.36
45	26.31	11.32	1.55	1.18	Dark green	87.90
60	31.13	12.67	1.86	1.31	Mature green	91.47
65	31.15	12.74	2.50	1.42	Light yellow	88.32
70	31.81	13.01	2.58	1.62	Yellowish orange	88.00
75	31.88	13.17	2.60	1.84	Deep orange	87.80
80	31.98	13.69	2.58	1.23	Pink	86.62
85	32.41	13.90	2.69	1.06	Deep pink	86.17
$CD_{0.05}$	1.51	0.91	0.08	0.24	-	1.40

Table 2: Changes in chemical properties of *Sohshang* at different stages of maturity

Days after fruit set	TSS (°B)	Titratable acidity (%)	TSS: Acidity	Reducing sugar (%)	Total sugar (%)	Fibre (%)	Sensory score
60	8.57	2.90	2.98	0.92	2.25	2.40	-
65	10.53	3.33	3.18	2.14	2.48	2.30	6
70	11.07	4.05	2.70	2.59	3.92	2.10	7
75	11.33	3.16	3.59	2.76	7.62	1.90	8
80	12.23	2.60	4.28	3.01	8.21	1.80	8
85	12.23	2.86	4.70	3.10	9.04	1.60	7
$CD_{0.05}$	1.35	0.69	0.37	NS	0.21	0.08	0.17

DAF (4.05 %) followed by a decreasing trend (4.05–2.86 %) as the fruit approached maturity and ripening stage. The increase in acidity might be attributed to an increased biosynthesis of organic acid during the growth period. The decrease at later stages was due to conversion of organic acid into sugar. Similar results were also observed by Deka et al. (2006) in *Khasi* Mandarin and by Sakamura and Sugaa (1987) in oleaster. There was a fluctuation in TSS: Acidity ratio up to 70 DAF (Table 2), after which it increased gradually until maturity (3.59– 4.70). Decrease in the concentration of acid with a gradual increase in total sugar during development resulted into an increase in the TSS: Acidity ratio. This finding was in conformity with those of Singh et al. (2004) in banana and Deka et al. (2006) in *Khasi* Mandarin.

Both reducing (0.92-3.10%) and total sugars (2.25-9.04%) were found to increase linearly up to 85 DAF (Table 2). The increase in sugar was due to an increase in TSS and accumulation of glucose, fructose and sucrose. Similar trend was also reported by Selvaraj et al. (1996) in grapes. A significant decrease in fibre content (2.40–1.60 %) was observed with the advancement in maturity and ripening. A decrease in fibre content during fruit development was also reported by Venu et al. (2005) in fig fruits. Ascorbic acid (Table 3) content was found to decrease from 19.04 to 8.16 mg / 100 g at mature green stage to full ripe stage. The decline in ascorbic acid content might be attributed to an oxidation of ascorbic acid. Similar results were also reported by Bal et al. (1981) in plum and Sakamura and Sugaa (1987) in oleaster and Dubey et al. (2003) in Khasi Mandarin.

Total carotenoid contents of Sohshang (Table 3) fruits increased with the advancement of maturity and ripening (12.82–67.54 µg/g). Gradual increase in carotenoids during ripening was also reported by Kumar (1982) in grape and Hamid et al. (1990) in fig. A significant increase in ß-carotene (Table 3) of Sohshang fruit was observed with the increase in maturity and ripening of the fruits (0.51-4.88 µg/ 100 g). Similar finding was also reported by Aggarwal and Sandhu (2003) in Kinnow Mandarin. Ash content (Table 3) of the fruit was found to increase upto 75 DAF (0.93 -1.76 %) and thereafter, it decreased upto 85 DAF. Similar finding was also reported by Ting and Attaway (1971) in orange. A gradual decrease in chlorophyll content (Table 3) of the fruit was observed with the advancement of maturity and ripening of fruits. This finding was in

Table 3: Changes in nutritional parameters of *Sohshang* at different stages of maturity

Days after fruit set	Ascorbic acid (mg/100g)	Total carotenoids (µg/g)	β-carotene (µg/100g)	Ash (%)	Tannin (%)
60	19.04	12.82	0.51	0.93	0.27
65	12.80	14.08	1.27	1.04	0.28
70	12.72	23.21	2.39	1.17	0.06
75	12.24	57.32	2.84	1.76	0.04
80	10.20	67.13	3.01	0.62	0.04
85	8.16	67.54	4.88	0.26	0.04
$CD_{0.05}$	7.41	3.19	0.31	0.55	NS

close conformity with the observation made by Gowda and Huddar (2001) in mango and Ishak et al. (2005) in *Ambarella*. Tannin content (Table 3) of Sohshang was found to diminish as the fruit entered maturity and ripening stage (0.27-0.04%). A decrease in tannin content with the advancement in maturity was also reported by Sakamura and Sugaa (1987) in oleaster fruits and Candir et al. (2009) in Persimmon.

REFERENCES

Aggarwal P, Sandhu KS (2003). Effect of harvesting time on physico-chemical properties of juice and non juice components of 'Kinnow'. J Food Sci Technol 40(6): 666-668

Amerine MA, Pangborn RM, Roessler EB (1965). Principles of sensory evaluation of food. Academic Press, New York, London

AOAC (1980). Official method of analysis. Association of the Official Analytical Chemists. 13th Edn., A.O.A.C. Washington, DC

Bal JS, Chohan GS, Josan JS (1981). Studies on growth and development of plum. J Hort PAU 21: 83-88

Candir EE, Ozdemira AE, Kaplankirana M, Tophia C (2009). Physico-chemical changes during growth of persimmon fruits in the east Mediterranean climate region. Sci Hort 121(1): 42-48

Chapman GW, Horvat RJ, Forbur WF (1991). Physical and chemical changes during the maturation of peaches cv 'Majestic'. J Agril Food Chem 39: 867-870

Deka BC, Sharma S, Borah SC (2006). Post-harvest management practices of mandarin. Indian J Hort 63(3): 251-255

Deka BC, Saikia , Pal RK (2007). Physico-chemical changes of pineapple at different stages of maturity. Indian J Hort 64(4): 464-466

Dhillon WS, Singh A, Singh R (2007). Biochemical changes in developing semi soft pear fruits. Indian J Hort 64(1): 81-83

Dubey AK, Patel RK, Singh AK (2003). Standardization of fruit maturity indices in Khasi mandarin (*Citrus reticulata* Blanco.) under Meghalaya. Ann Agric Res 24(3): 559-562

Freed M (1966). Method of vitamin assay. Interscience Publication Inc., New York

Gowda IND, Huddar AG (2001). Studies on ripening changes in mango (*Mangifera indica* L.) fruits. J Food Sci Technol 38(2): 135-137

Hamid L, Zainon MA, Halmah, AS (1990). Tropical fruit in international trade. Acta Hort 269: 359-360

Harding PL, Hatoon TT (1967). Mangoes at their best. Proc. Int. Symp Subtrop and Trop Hort, Horticultural Society of India, Bangalore, pp 137-145

Heyes JA, Blaikiea FH, Downsa CG, Sealeya DF (1994). Textural and physiological changes during Pepino (*Solanum muricatum* Ait.) ripening. Sci Hort 58(1-2): 1-15

Ishak SA, Ismail N, Noor MAM, Ahmad H (2005). Some physical and chemical properties of Ambarella (*Spondias cytherea* Sonn) at three different stages of maturity. J Food Composition and Analysis 18(8): 819-827

Kirtikar KR, Basu BD (1975). Indian Medicinal plants. Volume III, Periodical Experts, Delhi. pp. 2175-2176

Kishore K, Bharali R, Pathak KA, Yadav DS (2006). Studies on ripening changes in purple passion fruit (*Passiflora edulis* Sims). J Food Sci Technol 43(6): 599-602

Kramer A, Smith HR (1947). Electrophotometric methods for measuring ripeness and colour of canned peaches and apricots. Food Tech 1: 527-539

Kumar R (1982). Studies on the storage in grapes (*Vitis vinifera* L.). Ph.D. Thesis, Haryana Agric. Univ. Hissar, India

Lilien- Kipnis H, Lavee S (1971). Anatomical changes during the development of 'Ventura' peach fruits. J Hort Sci 46: 103-110

Ranganna S (1997). Manual of analysis of fruits and vegetable products. Tata McGraw Hill Publishing Company Limited, New Delhi

Sahni CK, Khurdiya DS (1984). Physico-chemical changes during ripening in 'Chausa', 'Neelum' and 'Amrapalli' mango. Indian Food Packer 43(1): 36-41

Sakamura F, Sugaa T (1987). Changes in chemical components of ripening oleaster fruits. Phytochemistry, 26(9): 2481-2484

Selveraj Y, Pal DK, Shikhamany SD (1996). Changes in chemical composition and enzyme activity of grape during growth and development. Indian J Hort 53: 81-88

Sema A, Sanyal D (2003). Developmental physiology of lemon fruits. I. Physical characteristics. Crop Res 26(3): 446-451

Singh UR (1977). Growth and maturity indices of banana. Indian J Hort, pp 19-25

Singh SP, Bhatt L, Prasad M. (2004). Physico-quality changes associated with growth and development of banana (*Musa* sp.) fruit cv. Dwarf Cavendish. Agric Sci Digest 24 (3): 197-199

Snedecor GW, Cochran WG (1967). Statistical methods, Oxford and IBH Publishing Co., New Delhi

Srivastava RP, Kumar S (2002). Fruits and vegetables preservation- Principles and Practices, International book Distributing Co., pp 353-363

Sundriyal M, Sundriyal RC (2003). Underutilized edible plants of the Sikkim Himalaya: Need for domestication. Curr Sci 85(6): 731-736

Ting SV, Attaway JA (1971). Citrus fruits. In: AC Hulme (ed) The biochemistry of fruits and their products. Academic Press, INC. London, NWI, p 128

Venu DK, Munjal SV, Waskar DP, Patil SR, Kale AA (2005). Biochemical changes during growth and development of fig (*Ficus carica* L.) fruits. J Food Sci Technol 42(3): 279-282