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Studies on changes in biochemical attributes during growth and development of ber (*Zizyphus mauritiana* Lamk.) fruit cv. (Narendra ber selection-2)

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Abstract

The Studies on changes in biochemical attributes during growth and development of ber (*Zizyphus mauritiana* Lamk.) fruit cv. (Narendra Ber Selection-2) was conducted during growing season of 2019-20. The fruits on tagged current season shoot were harvested at 21, 36, 51, 66, 81, 96, 111, 126, 141, 156, 171 and 186 days after fruit set. Samples were collected from Main Experiment Station, Horticulture and transported to the post graduate laboratory of Department of Fruit Science, College of Horticulture and Forestry, ANDUA&T, Kumarganj, Ayodhya, Uttar Pradesh. The objective was to probe the pattern of biochemical changes in developing ber fruits. The outcomes reveal that total soluble solids increased from 1.04% to 17.94% during 186 days of fruit growth and development whereas acidity content continuously decreased and recorded 0.39% on 21th day and 0.14% on 186th day of growth and development. Ascorbic acid content increased from 3.29 mg/100g to 90.26 mg /100g of fruit. Reducing, Non-reducing and total sugar content significantly increased from 0.22% to 4.76%, 0.11% to 5.77% and 0.35% to 10.87%, respectively. Moisture content showed decreasing trend and was maximum 71.12% on 21st day and minimum 65.79% on 186th day of observation. An abrupt decrease in chlorophyll content was recorded with growth and development of the fruit.

Keywords: Ber, *Zizyphus mauritiana*, NBS-2, fruit growth and development, arid fruit, dryland horticulture

Introduction

Ber (*Zizyphus mauritiana* Lamk.), the king of arid fruits, is a considerable minor hardy fruit crops symbolizing the production at a modicum cost. There are two major cultivated jujubes- Indian jujube (*Zizyphus mauritiana* Lamk., 2n=48) and Common or Chinese jujube (*Zizyphus jujube* Mill., 2n =24). Genus *Zizyphus* comprises almost fifty species, out of which 18 to 20 are local to India (Pareek, 2001) [8]. It is evergreen, small (up to 15m height), spiny tree with about 30 cm diameter trunk. Fruit is juicy drupe with 2.5cm (diameter) and 4.5cm (wide) and can be round, oval, ovate oblong or elliptical in shape. Ber is a perfect tree for arid as well as semi-arid culture and one of the most nutritious fruit crop having medicinal as well as processing potential. The ber fruit is excellent source of proteins, carbohydrates, fibers, fats, TSS, ascorbic acid, antioxidants, total phenolics, reducing, and non-reducing and total sugars (Kumara *et al.*, 2015) [6]. It can be consumed as fresh or can be used in processed forms such as powder, candies, murrabbah, jams and beverages. It can tolerate salinity, alkalinity and pH as high as 9.2 and even waterlogged condition upto certain extent. This crop requires less water compare to other fruits therefore, suitable for dry land farming. Successful cultivation of ber can be done even in the most marginal ecosystem of tropics and subtropics (Pareek, 2001) [8] and can tolerate extremely high temperature and are grown in region with maximum temperature of 39-42 °C. The area under cultivation of ber is extending because of its unique ability to flourish even on neglected land, specific demand, hardy nature, good return, and Indian Government policies under National Horticulture Mission.

The studies on changes in biochemical attributes during growth and development are essential requirement to determine the maturity and harvesting time in order to maintain high nutritional quality, reduced post-harvest losses as well as better marketability. Therefore, the present investigation has been undertaken to observe the changes in biochemical attributes during growth and development of recent ber variety Narendra Ber Selection-2 (NBS-2).

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Materials and Methods

The present experiment was conducted at the Main Experiment Station of the Department of Fruit Science, Acharya Narendra Deva University of Agriculture & Technology, India during the years 2019-20. The experiment was conducted on 27 years old uniform vigorous ber trees of variety Narendra Ber Selection-2 which received uniform cultural operation throughout the experiment. The trial was laid out with four replications. The four fruits from each replication were randomly picked up for biochemical analysis. The fruits were macerated to extract the juice for Total Soluble Solids (T.S.S.) estimation. The T.S.S. was recorded using 0-32% range ERMA hand refractometer at room temperature and corrected at 20° C with help of reference table (Ranganna, 2010) [14]. The 5g of pulp was macerated with small amount of distilled water and filtered through muslin cloth for acidity estimation. The volume of filtrate was made up to 100 ml with distilled water and 5 ml aliquot was titrated against N/10 sodium hydroxide solution using phenolphthalein as indicator. The appearance of light pink colour was marked as end point. Ascorbic acid content was estimated by grinding 5 g fruit pulp with 3.0 per cent metaphosphoric acid and filtrate volume was made up to 50 ml with 3% metaphosphoric acid. The known amount of aliquot was titrated against 2, 6-dichlorophenol indophenol dye solution till the appearance of light pink color. The ascorbic acid content was calculated with help of formulae and expressed as mg ascorbic acid/100 g of fruit pulp (A.O.A.C., 1975) [1]. To determine the reducing sugars, 5g pulp was crushed with distilled water and volume of filtrate

was made up to 100 ml with distilled water. 5 ml aliquot was mixed with 5 ml of each Fehling's solution 'A' and 'B' (Lane and Eynone, 1923) and titrated against 1.0% glucose solution in boiling condition with few drops of methylene blue indicator upto appearance of light brick colour. The blank sample was also titrated against 1% glucose and reducing sugars content was calculated with help of formulae (Ranganna, 2010) [14]. Then two drops of HCL was added to aliquot and left for overnight to estimate total invert sugars. The reducing sugars were subtracted from total invert sugar and result was multiplied with factor 0.95 to get non-reducing sugar. The sums of reducing and non-reducing sugars were expressed as total sugar.

The green layer of peel was taken from fruit and chopped into fine pieces. Chlorophyll was extracted with 80 per cent acetone following the procedure of Witham *et al.*, (1971). The intensity of color was recorded at 663 nm wave length and calculated chlorophyll content expressed as mg per 100g of peel. To record moisture content in fruit, the fruit were dried into oven at 60 °C to constant weight then moisture content was calculated and expressed in percent.

Statistical analysis

The data on chemical attributes of fruit were recorded and analyzed statistically applying the analysis of variance procedures outlined by Panse and Sukhatme (1967) [9] and the analyzed data and graph were used to interpret the results.

Results and Discussion

Table 1: Changes in biochemical attributes during growth and development of ber fruit cv. NBS-2

Interval (days)	Total Soluble Solids (%)	Acidity (%)	Ascorbic acid (mg/100g)	Reducing sugars (%)	Non-reducing sugar (%)	Total sugars (%)	Moisture (%)	Total chlorophyll (mg/100g peel)
21	1.04	0.39	3.29	0.22	0.11	0.35	71.12	39.01
36	1.43	0.36	3.44	0.27	0.33	0.60	70.20	38.90
51	1.50	0.32	4.30	0.31	0.66	0.99	69.82	38.03
66	2.48	0.30	5.61	0.45	0.96	1.34	69.80	36.06
81	2.98	0.24	5.84	0.76	1.06	2.04	69.36	35.31
96	3.25	0.22	9.90	1.29	1.45	2.74	69.52	31.23
111	4.38	0.18	17.21	1.42	1.50	3.32	69.32	28.48
126	10.10	0.17	23.25	1.67	1.85	3.67	68.76	27.16
141	15.05	0.16	32.75	2.56	2.75	5.70	68.80	23.95
156	15.58	0.15	49.37	3.57	2.93	7.56	67.88	22.08
171	17.29	0.14	70.96	4.19	3.96	9.64	67.49	20.50
186	17.94	0.14	90.26	4.76	5.77	10.87	65.79	12.36
SEm±	0.11	0.00	0.08	0.00	0.01	0.04	0.11	0.01
CD at 5%	0.34	0.01	0.22	0.01	0.01	0.11	0.32	0.05

Total soluble solids

The data pertaining to fruit length of various stages of fruit growth are presented in Table-1 and showed pictorially in Fig. 1.1. Total soluble solids content of ber fruit increased continuously during entire period of growth and development. The hydrolysis of polysaccharides into sugar and synthesis of

other water solubles results an increase of total soluble solids. Patil and Shanmugasundaram, (2015) [10] also reported significant increase in TSS toward progressed developmental stages of banana fruits. Similar observation was reported by Sahu *et al.*, (2018) [16] on fruit growth & development of ber (*Ziziphus mauritiana* Lamk.).

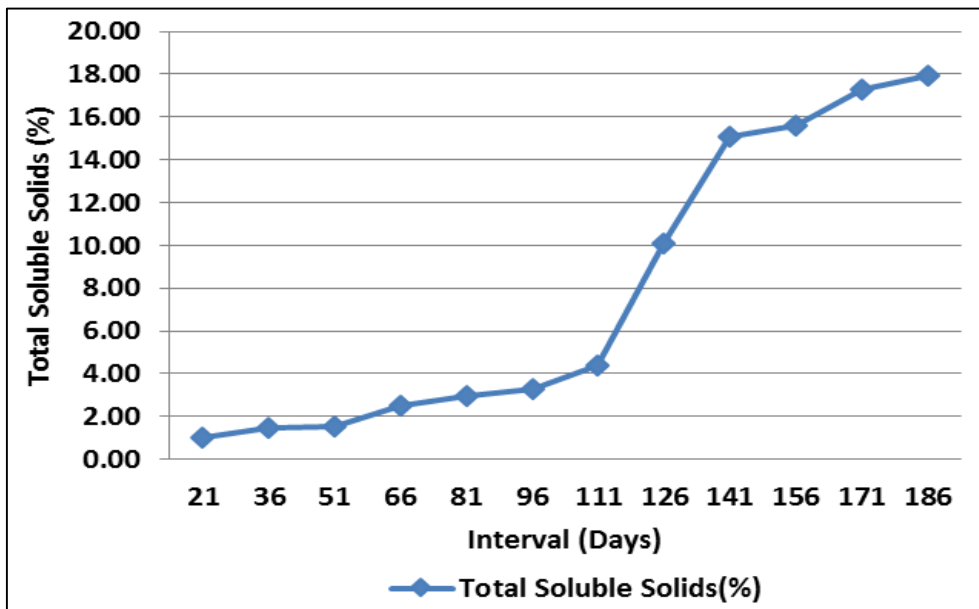


Fig 1: Changes in Total Soluble Solids during growth and development of ber fruit cv. NBS-2

Acidity

Data in Table-1 showed that the acidity content of ber fruit continued to decrease throughout fruit growth and development (Fig. 1.2) after fruit setting, which might be due to the reason that available organic acids utilized at faster rate

during the respiratory process (Bal *et al.*, 1995) [2]. Similar observation was reported by Islam *et al.*, (2015) [5] who reported that total acidity decreased gradually from 90 days to 130 days of ber fruit setting.

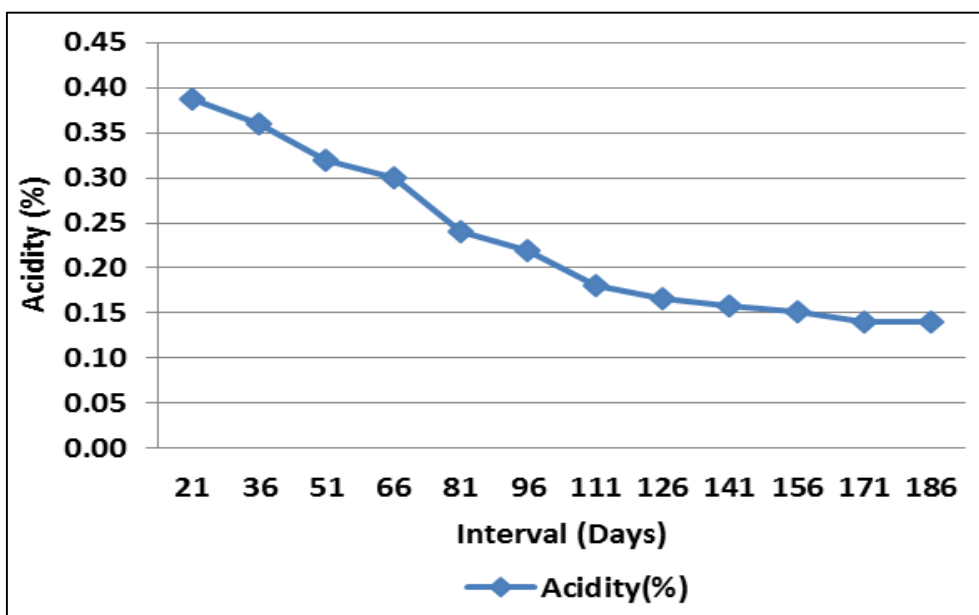


Fig 2: Changes in Acidity content during growth and development of ber fruit cv. NBS-2

Ascorbic acid:

It is clear from data of Table-1 and Fig.1.3 that the ascorbic acid content of fruits was continuously increased during growth and development. The accumulation and synthesis of glucose-6-phosphate reserved as a precursor of ascorbic acid synthesis in fruit (Marton, 1970) might be the reason of

ascorbic acid content increase in the fruits during growth and development. The results were in line with the findings of Pathare *et al.*, (2016) [11] who observed an increasing trend in ascorbic acid content of cultivar Mehrun-khedi, Mehrun and M.P.K.V. ber fruits from its setting till maturity.

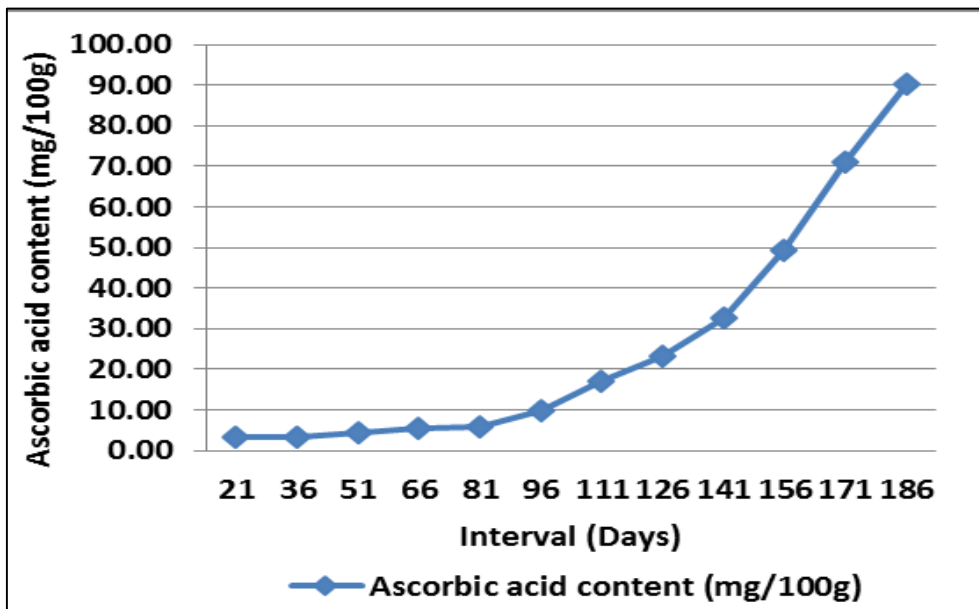


Fig 3: Changes in Ascorbic acid content during growth and development of ber fruit cv. NBS-2

Reducing sugars

The data presented in Table-1 pertaining to reducing sugars content at various stages of fruit growth and development depicted in Fig. 1.4. The gradual increase in reducing sugars was recorded that might be due to conversion of polysaccharides and non-reducing sugar in to reducing sugars

during growth and development of fruit. Sahu *et al.*, (2018) [16] also observed similar trend in reducing sugar during growth and development of ber fruits. They further reported that reducing sugar of ber fruits influenced by different genotypes.

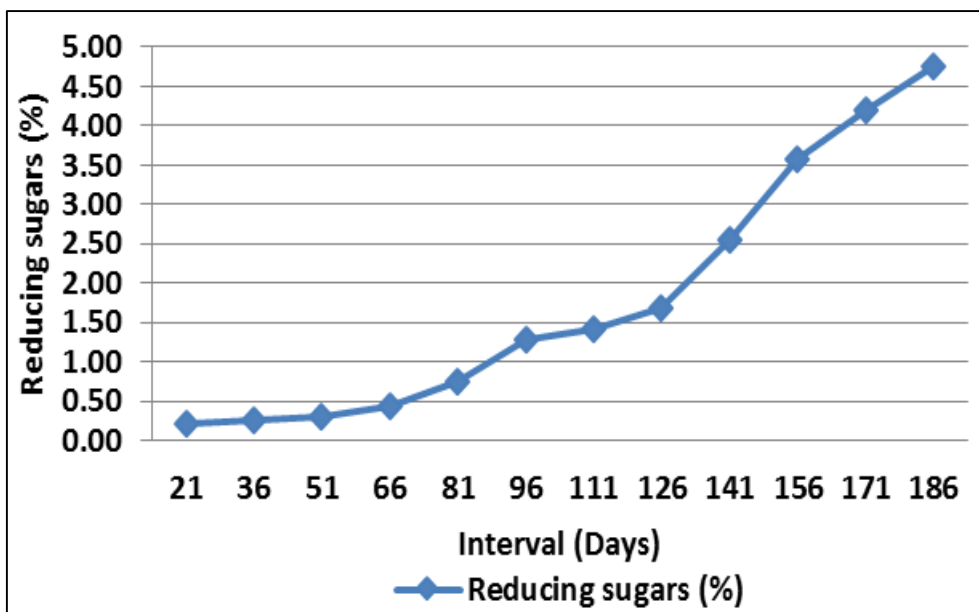


Fig 4: Changes in Reducing sugars during growth and development of ber fruit cv. NBS-2

Non-reducing sugar

It is clear from data of Table-1 that the non-reducing sugar content in ber fruit increased continuously from fruit set till maturity (Fig.1.5) which could be due to hydrolysis of starch

into sucrose when fruit proceeded towards maturity and ripening. The finding agrees with Pandey and Deen (2018) [12].

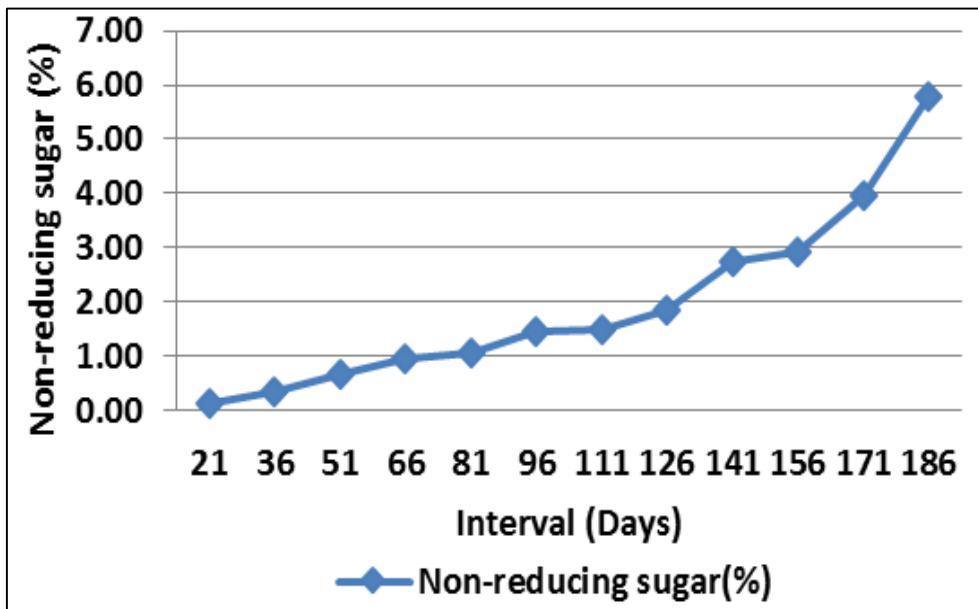


Fig 5: Changes in Non-reducing sugar during growth and development of NBS-2

Total sugars

Continuous significant increase was observed in total sugars content of ber fruit during entire growth and development (Fig.1.6). Conversions of polysaccharides into sugars contribute to total soluble solids and reducing sugars which ultimately increases in total sugar content.

Radha and Rajasekhar (2014) [13] also found increased total sugar content continuously with advancement of growth and maturity in sapota cultivars viz., PKM-1, PKM-3, DSH-1, DSH-2, Pala, Kalipatti, Cricket ball, Singapore, Kirthibarthi and Virudhnagar.

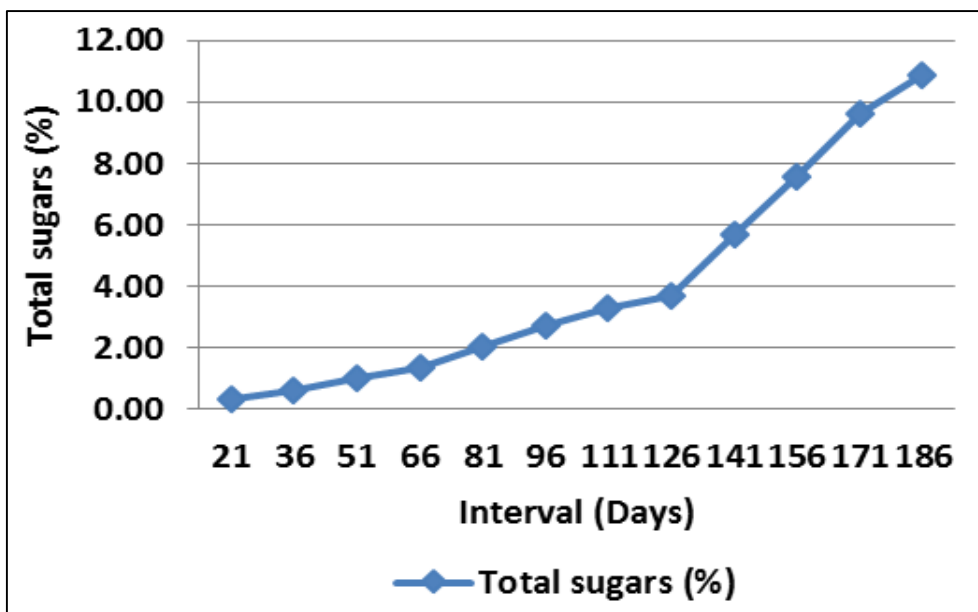


Fig 6: Changes in Total sugars content during growth and development of NBS-2

Moisture

The moisture content continued to decrease (Fig. 1.7) throughout the fruit growth and development which might be because of accumulation of more total solids in fruits. The moisture content was maximum 71.12% on 21st day and

minimum 65.79% on 168th day after fruit setting. Mukesh *et al.*, (2016) reported similar results and observed decreasing trend in percentage of moisture content with advancement of ripening of jujube fruits cvs. Kaithali, Umran and Ponda.

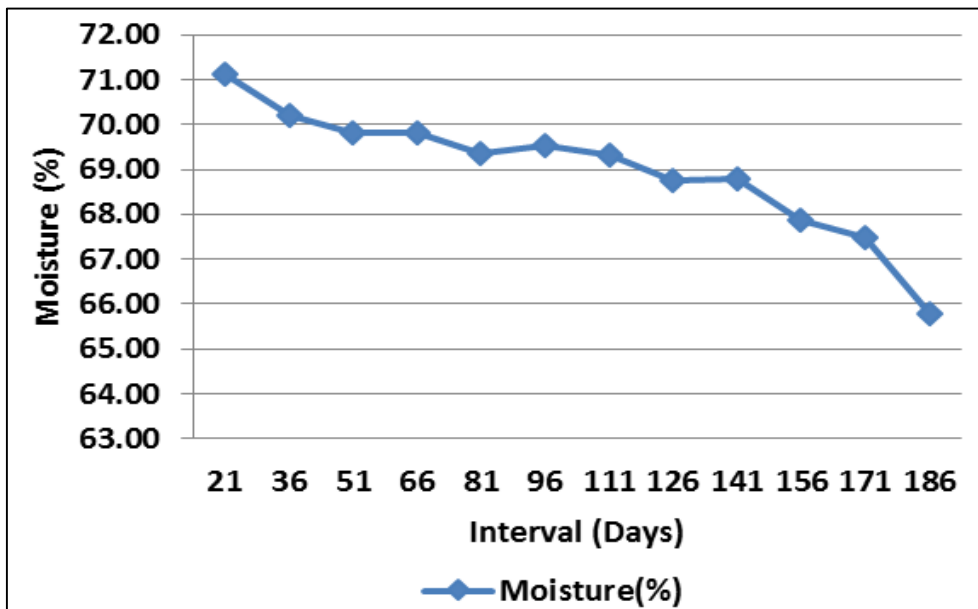


Fig 7: Changes in Moisture content during growth and development of NBS-2

Total Chlorophyll

An abrupt significant decreasing trend (Fig.1.8) in chlorophyll content of fruit was recorded with growth and development. Decrease in chlorophyll content might be result of

degradation of chlorophyll and synthesis of other pigments in the fruit. Sharma *et al.*, (2008) [15] and Ezhilarasi and Tamilmani, (2009) [3] were also reported similar findings which are in support of present result.

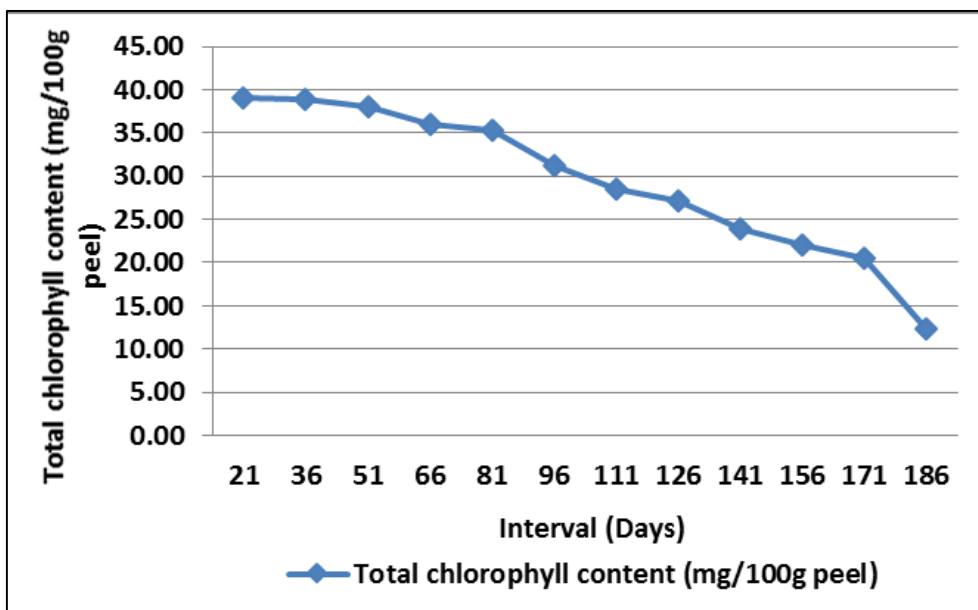


Fig 8: Changes in Total chlorophyll content in ber fruit cv. NBS-2

Conclusion

The various biochemical attributes *viz.* total soluble solids, acidity, ascorbic acid, reducing sugars, non-reducing sugar, total sugars, moisture and total chlorophyll content of Narendra Ber Selection-2 fruits were investigated since 21st October to 15th March under Northern Indian agro-climatic conditions at an interval of 15 days during growth and development period of fruit. The total soluble solids, ascorbic acid, reducing sugars, non-reducing sugar and total sugars contents of fruit were increased with the growth and development whereas titratable acidity, moisture, and total chlorophyll showed decreasing trend throughout growth and development.

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