



## Qualitative Analysis of Mango (*Mangifera indica* L.) Fruits at Different Maturity Stages

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### Abstract

Some chemical compositions of mango harvested at 24, 18, 12, 6 days before optimum maturity and at optimum maturity were analyzed. The amount of ascorbic acid,  $\beta$ -carotene and sugars of the harvested mangoes were significantly influenced by the stages of harvest and period of storage. Amount of ascorbic acid of the harvested mango fruits was the highest just after harvest. It was sharply declined with the elapse of time in storage. Fruits harvested before optimum maturity showed the highest amount of ascorbic acid, which decreased in delay of harvest.  $\beta$ -carotene was quite low at harvest but rapidly increased in storage. Fruits harvested before optimum maturity showed minimum  $\beta$ -carotene and it rapidly increased in late harvested fruits. Total sugar, reducing sugar and non reducing sugar were sharply increased at optimum ripe stage, while slightly declined at last edible stage. All the sugars were the lowest at earliest harvests, which increased gradually with delay in harvest.

**Keywords:** Qualitative analysis, mango, ascorbic acid,  $\beta$ -carotene

### 1. Introduction

Mango (*Mangifera indica* L.) is an important fruit of Bangladesh. It occupied an area of 61885 hectare with an annual production of 662100 metric tones (BBS, 2005). It contains appreciable quantity of vitamins, soluble sugars and minerals which are readily available and easily assumable in human body (Singh, 1990). After harvest, fruits undergo many physiological and biochemical changes during storage. Apart from this change, microbial decay contributes to postharvest losses during ripening and storage. The storage life of a fruit could be significantly prolonged through slowing down of the process leading to ripening and controlling of the microbial decay.

Mango manifests high post harvest losses because of its high perishability and climacteric pattern of respiration. Rubbi *et al.* (1985)

reported 35-38% postharvest losses of mango in Bangladesh. Physiological maturity is another important factor regulating different physiological and biochemical changes during storage and ripening of mango. Storage quality of mango is highly dependent upon the stage of harvest. Mango harvested at full maturity had reduced shelf life, while early harvest caused more weight loss but showed better storability (Shahjahan *et al.*, 1994). Nutritional and edible qualities of mango are affected by the application of the postharvest treatments and also by harvesting the fruits at various stages of maturity. Several authors studied the physical characteristics (Uddin *et al.*, 2006; Alam *et al.*, 2007) and physico-chemical changes during ripening and storage of mango (De Leon and De Lime, 1968; Krishnamurthy and Subramanium, 1973; Subramanium *et al.*, 1975; Medlicott and Jager, 1987).

However, there is a lack of established technology regarding harvesting, handling, transportation, storage and ripening of mangoes which often results in high level of wastage, unsynchronized ripening and poor quality fruits. The present study was therefore, undertaken to find out the optimum harvest stage of four commercial mango varieties based on the changes of nutritional qualities of harvested mango fruits.

## 2. Materials and Methods

The experiment was conducted at Chapai Nawabganj during 1998-99 fruiting season. Among the most important mango varieties commercially grown at Chapai Nawabganj, four varieties namely Fazli, Khirsapat, Langra and Gopalbhog were selected for this investigation. Among the selected cultivars Gopalbhog is early, Khirsapat and Langra are mid season, while Fazli is late. Fruits were collected from the Regional Horticulture Research Station farm at Chapai Nawabganj. The fruits were harvested at 5 different maturity stages. The first harvest ( $S_1$ ) was done at 24 days before optimum maturity (DBOM), second harvest ( $S_2$ ) at 18 DBOM, third harvest ( $S_3$ ) at 12 DBOM, fourth harvest ( $S_4$ ) at 6 DBOM, and the final harvest ( $S_5$ ) at optimum maturity. The experiment was done in a factorial completely randomized design using three replications. Thirty fruits of uniform size and shape were harvested from each stages of harvest. The optimum stages of harvest was 88 days for Gopalbhog, 92 days for Khirsapat, 105 days for Langra and 120 days for Fazli after fruit set (Shahjahan *et al.*, 1994). Dates of fruit set were noted down for accurate age of the fruits.

Thirty fruits of uniform size and shape were harvested from each stages of harvest. Harvested fruits were kept in the laboratory (28 - 37°C) for ripening. Ascorbic acid,  $\beta$ -carotene, total sugars, reducing sugars and non-reducing sugars of the mango samples were examined at 3 stages of storage, once just after harvest, once at full ripe and finally at the end of storage period. Chemical composition of the samples was determined at the Biochemistry laboratory of Rajshahi

University. Ascorbic acid content of the flesh was estimated by Bessey's titrimetric method (Bessey and King, 1933).  $\beta$ -carotene was determined using methods of Biochemical analysis (Anonymous, 1967). Total sugar content of flesh was estimated by Anthrone method (Jayarman, 1981). The amount of total sugar was calculated from the standard curve of glucose. The percentage of total sugar present in the mango pulp was determined as:

Percent of total sugar (g/100g pulp)

$$= \frac{\text{Amount of sugar obtained}}{\text{Weight of mango pulp}} \times 100$$

Reducing sugar content was measured following the DNS method (Miller, 1972). Non reducing sugar content was determined by subtracting the reducing sugar content from total sugar content (Banik, 1995). Non-reducing sugar content was determined by using the following formula.

Percent of non-reducing sugar = (% Total sugar - % Reducing sugar) X 0.95

Data were analyzed using analysis of variance (ANOVA) for a completely randomized design and treatment means were compared by DMRT.

## 3. Results and Discussion

### 3.1. Ascorbic acid

Ascorbic acid content of the harvested mango fruits was significantly influenced by the stages of harvest and period of storage (Table 1). It was the highest just after harvest and gradually declined with the passage of time, while it was the lowest at last edible stage. Early harvested fruits showed higher amount of ascorbic acid as compared to the last harvest with the highest amount being recorded at  $S_1$  and the lowest at  $S_5$  harvest stage. The results of the present study agree with that of Shyamamma *et al.* (1995). Mango varieties showed significant differences in ascorbic acid content. At initial stage, Langra contained the highest amount of ascorbic acid, which sharply decreased at full ripe stage. Fazli and Khirsapat had moderate amounts, while it was the minimum in Gopalbhog. At full ripe and

last edible stage, ascorbic acid content was the highest in Fazli and the lowest in Gopalbhog. The results indicated that ascorbic acid content gradually declined in all varieties as they advanced towards the last edible stage.

### 3.2. $\beta$ -carotene

Stages of harvest and storage period had significant effect on  $\beta$ -carotene content of mango fruits. The amount of  $\beta$ -carotene was increased with the progress of storage (Table 1). It was the minimum after harvest and was maximum at last edible stage. Minimum  $\beta$ -carotene was recorded in the fruits harvested first. The amount of  $\beta$ -carotene increased gradually with the delay in harvest and being highest at last harvest. Similar trend was noted in all periods of storage. The findings of the study conformed to those of Absar *et al.* (1993) and Mondal *et al.* (1995). Significant variations in  $\beta$ -carotene content were observed among the mango varieties. It was the highest in Langra and the lowest in Gopalbhog both after harvest and full ripe stage. At last edible stage, the highest amount of  $\beta$ -carotene

was noted in Khirsapat and the lowest in Gopalbhog. It progressively increased with the period of storage in all the varieties. Similar results were reported by Bhatnagar and Subramanyam (1973).

### 3.3. Total sugar

Total sugar content in mango fruits was significantly influenced by stages of harvest and storage (Table 2). It rapidly increased from harvest to ripe stage and then slightly decreased at the last edible stage. It was the minimum in fruits harvested first, gradually increased with the delay in harvest and was the maximum in last harvest ( $S_5$ ). Similar results have been reported by Shyamamma *et al.* (1995) in ripe 'Mallika' mangoes. The mango varieties exhibited significant differences in total sugar content at all stages of storage. The highest total sugar content was recorded in Gopalbhog and the lowest in Fazli at ripe stage. The results revealed that total sugar sharply reached the maximum level at full ripe stage and then fall down slightly at the last edible stage in all the varieties.

**Table 1.** Effect of stage of harvest on ascorbic acid and  $\beta$ -carotene content of mango fruits.

Treatment Stages/var.	Ascorbic acid (mg/100 g) at			$\beta$ -carotene ( $\mu$ g/100 g) at		
	Harvest	Ripening	Last edible stage	Harvest	Ripening	Last edible stage
24 DBOM	37.33a	17.14a	12.50a	320e	1121e	2512e
18 DBOM	36.63b	16.80b	12.55a	650d	1934d	3635d
12 DBOM	35.83c	15.96c	12.21a	1079c	2776c	4609c
6 DBOM	32.99d	15.55d	11.98a	1453b	3856b	6372b
OM	31.34e	15.16e	12.59a	2123a	5049a	7521a
Variety						
Gopalbhog	26.11d	10.68d	9.50d	735d	2056d	3497d
Khirsapat	32.37c	13.38c	11.33c	1235b	2999b	5526a
Langra	46.32a	19.36b	13.27b	13.53a	3956a	5227c
Fazli	34.15b	21.34a	15.37a	1176c	2779c	5469b
CV%	1.21	0.75	9.73	0.43	0.17	0.17

Values followed by the same letter(s) in a column are not significantly different ( $P \leq 0.05$ ) according to DMRT. DBOM= Days before optimum maturity, OM= Optimum maturity.

**Table 2.** Effect of stage of harvest on total, reducing and non-reducing sugars of four mango varieties.

Treatment Stage/var.	Total Sugar (%) at			Reducing sugar (%) at			Non-reducing sugar (%) at		
	Harvest	Ripening	Last edible stage	Harvest	Ripening	Last edible stage	Harvest	Ripening	Last edible stage
24 DBOM	2.46e	5.20e	4.99e	1.41e	1.81e	1.71e	1.00e	3.22e	3.12e
18 DBOM	2.93d	5.44d	5.35d	1.68d	1.88d	1.85d	1.19d	3.39d	3.33d
12 DBOM	3.36c	5.81c	5.66c	1.79c	2.00c	1.98c	1.50c	3.62c	3.50c
6 DBOM	4.11b	6.10b	6.05b	1.88b	2.12b	2.09b	2.12b	3.79b	3.77b
OM	4.42a	6.39a	6.27a	1.95a	2.25a	2.21a	2.35a	3.94a	3.86a
Variety									
Gopalbhog	3.67a	6.12a	5.95a	1.86a	2.29a	2.13a	1.72a	3.64a	3.63a
Khirsapat	3.52b	5.82b	5.68c	1.76b	1.98b	1.98b	1.68a	3.65a	3.52b
Langra	3.34c	5.79b	5.75b	1.70c	1.99b	1.93c	1.56b	3.61a	3.63a
Fazli	3.31c	5.43c	5.33d	1.65d	1.79c	1.88d	1.58b	3.46b	3.28c
CV%	3.89	2.09	1.56	1.42	1.50	2.17	4.55	2.45	2.78

Values followed by the same letter(s) in a column are not significantly different ( $P \leq 0.05$ ) according to DMRT. DBOM = Days before optimum maturity; OM = Optimum maturity.

### 3.5. Non-reducing sugar

Non-reducing sugars (NRS) in mango fruits was influenced by stages of harvest and storage. It increased at ripe stage but slightly reduced at last edible stage. It became the lowest in early harvested fruits and was the highest in the late harvested fruits (Table 2). The gradual increase of NRS towards advancement of maturity conformed to the findings of Shyamamma *et al.* (1995). Among the mango varieties, Gopalbhog and Langra exhibited the highest and lowest NRS, respectively. At full ripe stage, it was the highest and lowest in Khirsapat and Fazli, respectively. The results revealed that NRS rapidly increased from harvest stage and reached the maximum at full ripe stage and then slightly decreased at last edible stage in all varieties. Similar results have been reported by Ali and Mazhar (1960).

### 4. Conclusions

The study revealed that fruits harvested before optimum maturity showed the highest amount of

ascorbic acid which decreased in delay of harvest.  $\beta$ -carotene was quite low at harvest but rapidly increased in storage. The sugar content was the lowest at earliest harvests which increased gradually in late harvested fruits.

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