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Efficacy of Plant Hormone on the Extension of Shelf Life, Postharvest Behaviour and Quality of Kishanbhog Mango (*Mangifera indica* L.)

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Abstract: ***Freshly harvested and uniformly ripe mango cultivar of kishanbhog was collected from the experimental mango research garden of BCSIR Laboratories, Rajshahi, Bangladesh during June – July, 2011 and 2012. The application of plant hormone (IAA, NAA and 2,4-D) at various concentration (10, 20 and 30 ppm) for the extension of storage life (i.e. shelf life), reduction of postharvest weight loss and quality characteristics of mango cultivar of kishanbhog was studied. The storage life of treated mangoes was prolonged 26.67 % as compared to that from control one and the hormone treatments with 10 and 30 ppm IAA, 10 ppm NAA and 30 ppm 2,4-D concentrations were found to be more effective in prolonging 4 days of storage life of this cultivar. But at the last edible stage the weight loss of hormone treated mangoes with NAA 30 ppm concentration was the lowest (16.01 %) as compared to that of control one (22.65). The nutritional value of mango was also affected remarkably after treatment with plant hormone. The quality of hormone treated mangoes might be superior in terms of vitamin C, total soluble solids, total sugar, reducing sugar, non reducing sugar content of its pulp which were higher than those of control one. At the last edible stage chemical analysis of hormone treated mango pulp showed the increased amount of total sugar (25.49 %), reducing sugar (25.31 %), non-reducing sugar (22.49 %), total soluble solids (24.22 %) and vitamin C (23.12 %) while the amount of titrable acidity (18.76 %) was decreased as compared to that from control mango.***

Keywords: Plant Hormone, Mango, Shelf life, Quality and Kishanbhog.

1. Introduction

Mango is now recognized as one of the best fruits of all indigenous fruits due to its excellent flavour, attractive fragrance, beautiful shades of colour, delicious taste and high nutritive value and also economic potentiality in fruit base crop (Ibrahim *et al.*, 2011 and Prasad & Nalini, 1988). Besides being consumed as fresh fruits, both ripe and green fruits are used to make varieties of products such as juice, jam, jelly, pickle, chutney, nectar, squash, powder etc (Gofur *et al.*,1997; Shalunkhe and Kadam, 1995.)

For this reason mango is acknowledges as the King of fruits in Bangladesh as well as in other South- East Asian countries (Ibrahim, 2001; Molla and Miyan, 1974). Nutritionally mango is very important because it contains appreciable quantity of vitamin C, sugar and minerals, which readily available and easily assimilable in human body and therefore is capable to prevent many deficiency diseases (Kalam, 2001 and Litz, 1997). Mango has got a unique position among fruits grown in Bangladesh in respect of nutritional value, taste and consumers acceptability (Salunkhe and Kadam, 1995).

In recent years the total production of mango in Bangladesh is 8,89,176 MT (BBS, 2012) Approximately 2,66,752 - 3,11,211 MT fruits go waste during postharvest handling, storage and ripening (Lashley, 1984 and Meah, 1992). Among the fruits mango manifested the highest postharvest losses because of its high perishability and climacteric pattern and is closely linked with the development of suitable technology which reduces the losses at different stages of harvesting, packaging and storage. Quality mangoes are produced in the north–western part of Bangladesh, of which about 35-38 % post harvest losses are caused due to inefficient handling, improper transportation, storage and marketing (Rubbi *et al.*,1985). Hence the development of technologies for reducing postharvest losses is a necessary prerequisite for the promotion of the fruit industry. It is very important not only to produce more but also to save whatever is grown at production cost.

The shelf life of any fruit consists of ripening and senescence. After harvest, fruits undergo many physiological and biochemical changes during storage. The shelf life of fruits could be prolonged significantly through slowing down the process leading to ripening and controlling the microbial decay (Bose *et al*., 1999; Gofur *et al*., 1997). Information regarding the extension of storage life of mango through the treatment of plant hormones in Bangladesh is very scanty. The present study has been undertaken to extend the storage life (shelf life) and to reduce the spoilage of mango as caused by various factors without changing the original fruit quality.

2. Materials and Methods

Freshly harvested and uniformly ripe mango cultivar of kishanbhog were collected from the experimental mango research garden of BCSIR Laboratories, Rajshahi,

Bangladesh during June–July, 2011 and 2012. During the period of study the ambient temperature and relative humidity in the laboratory ranged between 30-35°C and 75-80 % respectively. The physical and chemical composition of fresh mango were analyzed and the data were recorded in Table 1. Only sound and firm ripe 150 mangoes of averagely uniform size, shape and colour were undertaken in this experiment. The mangoes were divided in 10 lots, containing 15 mangoes in each lot and the treatments were made with three different plant hormones IAA, NAA and 2,4-D at three different concentrations (i.e. 10, 20 and 30 ppm). So there were altogether 10 treatments including the control. The lots of mangoes under experiments were marked and designed. The lots of mangoes were dipped for 5 minutes in plant hormone solutions of 10, 20 and 30 ppm Indole acetic acid (IAA), Naphthalene acetic acid (NAA) and 2,4-dichlorophenoxy acetic acid (2,4-D). One lot was dipped only in one solution .The control mango was dipped in water for the same duration and kept at ambient temperature (30-35° C) in identical condition. For determining the postharvest weight losses, the initial weight was recorded just after the treatment. Subsequently, their weights were recorded at two days interval and the loss in weight was expressed as the percentage over the initial weight. The biochemical changes were also determined by the standard methods. The sugar content was determined by spectrophotometric method (Miller, 1959), the reducing sugar was estimated by the same method (Jayaraman, 1981) and vitamin C was estimated by titrimetric method (Mohadevan and Sridhar, 1982) using 2,6-dichlorophenol indophenol, TSS was determined by refractometric method (Gofur *et al.*,1997) and pH was determined by a standard pH meter (Gofur *et al*.,1998). Acidity was estimated by acid–base titrimetric method (Rangana, 1986) using standard sodium hydroxide solution. The preserved mango was analyzed periodically and the results were recorded in tables (Table 2 & 3). Organoleptic test (Begum *et al.*, 2007) of the control and hormone treated mangoes at the last edible stage was performed by a panel of ten Judges and the mangoes were classified as follows on the basis of their scoring, excellent- 80 % or above, good 70-80 % and below 70 % fair depending on general appearance, colour, flavour, taste and texture (Table 4). Microbiological (Morshed *et al.*,2008) and Toxicological (Yesmin *et al.*, 2014) studies of plant hormones (IAA, NAA and 2,4-D) were carried out in Microbiology Laboratory, Department of Pharmacy, Rajshahi University, Rajshahi, Bangladesh and Department of Pharmacology and Therapeutics, Rajshahi Medical College, Rajshahi, Bangladesh. The recorded data were statistically analyzed and means of different parameters were compared by least significant difference (LSD) test (Karim, 1976).

3. Results and Discussions

The table 1 shows that the pulp percentage (74.20%) of kishanbhog variety is higher than those of well known variety of mang in Bangladesh on the other hand the percentage of skin and stone is lower than those variety (Shafique *et al.*, 2006). It is clear from table 1 that the total soluble solids content in the fresh mango pulp is 16.50 % where as in the case of control, it is 14.7% and in the case of hormone trated mangoes are 18.3-19.5 % in all cases, the acidity (% as citric acid) varied from 0.14-0.16 % and the total sugar content ranged from 11.25-12.70 %. As regards taste, flavor and colour of the pulp under study (Table 4) were found to be overall similar except vitamin C (ascorbic acid) content.

Table 1: Proximate composition of fresh mango pulp determined by standard methods

Nutrients	Quantity	Nutrients	Quantity
Moisture (%)	79.65	Carotene (µg/100g)	4823
Total solid (%)	20.35	pH	03.85
Total soluble solids (%)	16.50	Ash (%)	00.27
Total sugar (%)	10.35	Fibre (%)	00.46
Reducing sugar (%)	03.76	Pulp content (%)	74.20
Non reducing sugar (%)	06.59	Skin (Peel) content(%)	13.70
Acidity as citric acid (%)	00.17	Stone content (%)	12.10
Vitamin C (mg/100g)	13.65		

It is reveled form the fig. 1 that the storage life of mango was significantly influenced by different treatments of plant hormones. The storage life was longer (15 days) in 30 ppm IAA and 30 ppm NAA treated fruits followed by 10 ppm NAA 20 ppm IAA and 30 ppm 2,4-D (13 days) treated fruits compared to that of control (11 days). The foregoing results clearly indicate the efficacy of plant hormone to prolong the storage life of mango 2 to 4 days with IAA, NAA, and 2,4-D treatments. The findings of Chattopadhaya *et al.*,1992 and Singh *et al.*,1987 in this respect support the results obtained in this study. A significant variation was found among the treatments in respect of postharvest loss in weight during the storage period up to last edible stage. But the effect was more pronounced in 30 ppm NAA and 30 ppm IAA treated fruits (Table 2). The loss in weight was increased with the increase of storage period. There was a lowest weight loss in 30 ppm NAA treated fruits (16.01 %) and lower weight loss in 30 ppm IAA (17.33 %) and 20 ppm IAA (17.39 %) compared to control (22.65 %). Literature in relevant to plant hormones as preservative to control weight loss in stored mango is scanty. However, it is reported that the weight loss (%) in fruits increase with increasing of storage period regardless method of ripening (Wasker and Masalkar 1997). From the results (Table 3) it is evident that the treatments of different plant hormones significantly differ from one another in respect of TSS content of mangoes. However, the control mango showed lower TSS value (14.3 %) compared to treated mangoes (18.3% - 19.5%). Increased TSS in treated fruits might be attributed to the conversion of starch into sugars occurred during ripening (Bauna, 1976). Increased TSS value with IAA, NAA and 2,4-D was also reported by Tang *et at.*, (1997). The total sugar content of the fruits in different treatments varied from 11.25 % - 12.70 %. The treatments of different growth regulators significantly differ in this aspect compared to control and also reducing sugar and non–reducing sugar (Tang *et al.*,1997). pH, acidity and vitamin C (Ascorbic acid) content of mangoes subjected to treatment of different plant hormones showed significant variation. Similar results were also reported by Chattopadhyay *et al.*, (1992). Studies of biochemical, hematological and histopathological parameters of hormone (IAA, NAA and 2,4-D) treated mice indicated that IAA, NAA and 2,4-D are safe for application on fruits (Morshed, 2005 and 2006). It is evident from Table 4 the physical characters of control and hormone treated

mangoes were compared by the judges on the basis of appearance, colour, flavour, taste and texture. It can be showed from their suggestions that the treated mangoes are quite superior to that from control mango (Ibrahim,2001).

Conclusion: Hormone treated mangoes are singnificantly improved in all respect i.e. lower postharvest weight loss, better quality, more storage life and more acceptable in physical characters than those of control one.

Table 2: Postharvest weight loss of hormone treated and control mango (%) at two days interval during the storage period

Treatments	pH	TSS (%)	Total sugar (%)	Reducing sugar (%)	Non reducing sugar(%)	Acidity (%)as citric acid	Vitamin C (mg/100g)
10 ppm IAA	4.76	19.3	11.30	3.65	7.65	0.15	9.21
20 ppm IAA	4.75	19.2	12.70	3.92	8.15	0.15	9.30
30 ppm IAA	4.63	18.3	11.50	3.95	7.55	0.16	9.50
10 ppmNAA	4.75	18.5	11.55	3.60	7.95	0.14	9.35
20 ppmNAA	4.74	18.7	11.25	3.45	7.80	0.14	9.29
30 ppmNAA	4.65	19.5	12.52	4.36	8.24	0.16	9.56
10 ppm2,4-D	4.74	19.3	12.30	3.85	8.45	0.15	9.20
20 ppm2,4-D	4.73	19.5	12.25	3.50	8.25	0.15	9.25
30 ppm2,4-D	4.73	18.7	11.40	3.38	8.20	0.14	9.30
Control	4.90	14.7	9.50	2.95	6.55	0.12	7.35
LSD(0.01)	0.01	0.01	0.01	0.00	0.00	0.00	0.00

IAA: Indole acetic acid; NAA: Naphthalene acetic acid; 2,4-D: 2,4-Dichlorophenoxy acetic acid; TSS : Total soluble solids

Table 3: The nutritional value of mango pulp from control and hormone treated mango at the last edible stage during the storage period

Treatments	pH	TSS (%)	Total sugar (%)	Reducing Sugar (%)	Non reducing Sugar (%)	Acidity (%) as citric acid	Vitamin C (mg/100g)
10 ppm IAA	4.76	19.3	11.30	3.65	7.65	0.15	9.21
20 ppm IAA	4.75	19.2	12.70	3.92	8.15	0.15	9.30
30 ppm IAA	4.63	18.3	11.50	3.95	7.55	0.16	9.50
10 ppmNAA	4.75	18.5	11.55	3.60	7.95	0.14	9.35
20 ppmNAA	4.74	18.7	11.25	3.45	7.80	0.14	9.29
30 ppmNAA	4.65	19.5	12.52	4.36	8.24	0.16	9.56
10 ppm2,4-D	4.74	19.3	12.30	3.85	8.45	0.15	9.20
20 ppm2,4-D	4.73	19.5	12.25	3.50	8.25	0.15	9.25
30 ppm2,4-D	4.73	18.7	11.40	3.38	8.20	0.14	9.30
Control	4.90	14.7	9.50	2.95	6.55	0.12	7.35
LSD(0.01)	0.01	0.01	0.01	0.00	0.00	0.00	0.00

Table 4: The grading of control and hormone treated mango as judged by the panel of judges based of general qualities of mango

General qualities	*Treatments*	*Scoring by individual judges (last edible stage)*										*Total score*	*Mean score*	*Order of rating*
		01	02	03	04	05	06	07	08	09	10			
Appearance	Treated	84	81	86	85	82	78	85	83	72	86	822	82.2	Excellent
	control	71	72	62	75	74	70	64	79	68	74	709	70.9	Good
Colour	Treated	85	79	80	81	78	85	84	80	80	83	815	8.15	Excellent
	control	70	55	55	52	45	40	60	55	60	50	542	54.2	Fair
Flavour	Treated	85	79	82	86	75	78	85	75	75	81	801	80.1	Excellent
	control	60	53	55	59	45	40	42	45	65	72	536	53.6	Fair
Taste	Treated	86	81	85	84	85	86	80	82	75	83	827	82.7	Excellent
	control	65	56	52	66	75	76	84	86	75	82	717	71.7	Good
Texture	Treated	89	83	85	76	80	88	75	77	81	91	735	83.5	Excellent
	control	55	61	71	80	84	78	69	73	75	69	715	71.5	Good

*Control **:** Dipped in water only, *Treated**:** Dipped in solution of hormone treatment

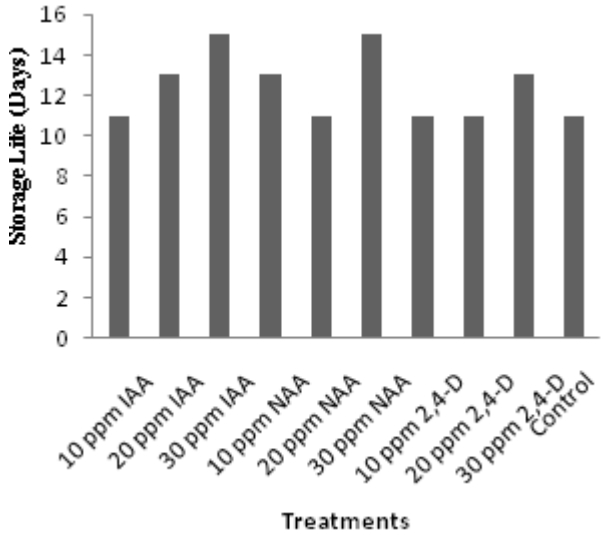

Figure 1: Storage life of mango cultivar of kishanbhog treated with 10 ppm, 20 ppm & 30 ppm of IAA, NAA & 2,4-D and control during the storage period

References

[1] Anonymous. **(**2012). Bangladesh bureau of statistics, Statistic & informatic division, Ministry of planning, Government of the People's Republic of Bangladesh, Dhaka, Bangladesh. P 138

[2] Bauna, G. (1976). Effect of ethephon on ripening of banana. Egypt Journal of Horticulture. 3 (1)**:** 111-114.

[3] Begum, S., Ibrahim, M., Samad, A., Khan, M. R., Khaleda, S., Alam, A. K. M. S. and Chowdhury, A. N. (2007). Effect of pre harvest application of some growth regulators on the yield and quality characteristics of grape(*Vitis vinifera* L.). Bangladesh Journal of Scientfic and Indutrial Research. 42(1): 59-66.

[4] Bose,T. K., Som, M. G. and Kabir, J. (1999). Vegetable crops. Naya prokash, 206 Bidhan sarani, Calcutta 700 006 India. 929 pp.

[5] Chattopadhyay , N., Hore, J. K. and Sen, S. K. (1992). Extension of storage life of sweet orange (*Citrus sinensis* Osbeek) CV Jaffa. Indian Journal of Plant Physiology. 35 (3): 245-251.

[6] Gofur , A., Shafique, M. Z., Helali, M O. H., Ibrahim, M. Rahman, M. M. and Alam, M. S. (1997). Studies on extension of postharvest storage life of mango (*Mangifera indica* L). Bangladesh Journal of Scientfic and Indutrial Research. 32 (1)**:** 148-152

[7] Gofur, M. A., Shafique, M. Z., Helali, M. O. H., Ibrahim, M. and Rahman, M. M. (1998). Effect of application of plant hormone on the control of fruit drop, yield and quality characteristies of mango (*Mangifera indica* L). Bangladesh Journal of Scientfic and Indutrial Research.

[8] Ibrahim, M., Helali, M.O.H., Shafique, M. Z, Samad, A. and Alam, A. K. M. S. (2011). Studies on the shelf life and physiological weight loss of langra mango cultivar (*Mangifera indica* L). and also its quality characteristics as affected by plant hormone. Journal of Subtropical Agricultural Research and Development. 9 (4): 907-912

[9] Ibrahim, M. (2001). Application on plant hormone of the control of anthracnose disease, yield and quality characteristics of mango. Ph D Thesis. Institute of Biological Sciences, University of Rajshahi, Rajshahi, Bangladesh. Ace . No. 0034: 181 pp.

[10] Jayaraman, J. (1981). Laboratory manual in biochemistry. New age International Lit, New Delhi. 180 pp.

[11] Kalam, A. (2001). Reduction of postharvest losses and extension of shelf life of mango. Ph D Thesis, Bangladesh Agricultural University. pp. 134-137.

[12] Karim, K. N. S. (1996). Biometry or Bio-Statistics, Eureka Book Agency, No-9, New Market, Rajshahi-6100, Bangladesh. 188 pp.

[13] Lashley, D. (1984). Advances in postharvest technology and new technology in food production. Proc. Seminar, Sl. Augustine (Trinidad Tobago). pp. 173-183.

[14] Litz, R. E. (1997). The mango, botany, production and uses. Library of congress publication, London, U K. 587 pp.

[15] Meah, M. B . (1992). Postharvest handling affecting mango quality and marketing in Bangladesh.4th International Mango Symposium. Florida, USA. Abstract: p. 106.

[16] Miler, G. L. (1959). Use of dinitrosalicylic acid reagent for determination of reducing sugar. Analytical. Chemistry. 31 (3): 426-428

[17] Morshed, M. H., Hossain , M. S., Ibrahim, M., Helali, O. H., Shafique, M. Z., Samad, A., Islam , M. S. and Islam, M. A. (2005). Bacteria killing kinetics of the four plant hormones. Pakistan Journal of Biological Sciences. 8 (7)**:** 1025-1029.

[18] Morshed, M. H., Hossaim , M. S., Habib, M. A., Ahmed, M. M. M., Ibrahim, M., Ali, M. U., and Islam, M. A. (2006). The effect of plant hormne indole acetic acid (IAA) hematological and biochemical parameters in mice. Bangladesh Journal of Physiology ana Pharmacology. 21(1&2): 05-08.

[19] Morshed, M. H ., Hossaim, M. S., Habib, M. A., Ahmed, M. M. M., Ibrahim, M., Ali, M. U., and Islam, M. A. (2008). Sub acute toxicity study of plant hormone 2,4-Dichlorophenoxy acetic acid in swiss albino mice. Banglasdesh Medical Journal (Khulna) 41: 15-17.

[20] Mohadevan, A. and Sridhar, R. (1982). Methods in physiological plant pathology. Sivakami Publications, Indira Nagar, Madras 600 020, India. 171 pp.

[21] Molla, M. R. I. and Miyan, M. A. (1974). An overview of commercial mango marketing in Bangladesh. Bangladesh Journal of Agricultural Sciences. 1 (2)**:** 90-98

[22] Prasad, A. Z. and Nalini, K. (1988). Investigation on postharvest physiological changes and quality parameters in mango varieties. Indian Journal of Horticultur. 45 (3-4)**:** 235-240.

[23] Ranganna, S. (1986). Handbook of analysis and quality control for fruit & vegetable products. Tata Mc Graw-Hill Publishing Company Lit. New Delhi. 1101 pp.

[24] Rubbi, S. F., Rahman, M. A. and Rahman, K. Q. 1985. Studies on the processing and preservation of mango. Proc. 4th Natn. Symp of Bangladesh Soc. Hort. Sci, pp. 138-148.

[25] Salunkhe, D. K. and Kadam., S. S. (1995). Handbook of fruit science and technology. production

composition, storage and processing. Published by Library of Congress. 270, Madison Avenue, New York, USA. pp. 123-169.

[26] Shafique, M. Z., Ibrahim, M., Helali, M. O. H. and Biswas, S. K. (2006). Studies on the physiological and biochemical composition of different mango cultivars at various maturity levels. Bangladesh Journal of Scientfic and Indutrial Research. 41(1&2): 101-108

[27] Singh, R. N., Singh, G., Mishra, J. S., Rao, O. P. and Singh, G. (1987). Studies on the effect of pre-and postharvest treatments of calcium nitrate and calcium chloride on the storage life of amropali mango. Progressive Horticulture. 19 (1-2)**:** 1-9.

[28] Tang, Y. L., Zhou, Y.C. and Pan, X. P. (1997). Effect of plant growth regulator and prochloraz on postharvest diseases of Zihua mango fruits. Acta Phytophyl Sinica. 24 (1)**:** 70-74.

[29] Wasker, D. P. and Masalkar, S. D. (1997). Effect of hydro-cooling and bavistin dip on the shelf life and quality of mango during storage under various environments. Acta Horticulture. 455**:** 687-695.

[30] Yesmin, F., Morshed, M. H., Ibrahim, M. and Islam, M. A. (2014). Toxicological study of plant hormone naphthalene acetic acid in swiss albino mice. Journal of Engineering Science. 05(1): 81-84.