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Influence of storage treatments on the changes of some physicochemical constituents of the postharvest mango (*Mangifera indica* L.)

Md. Khairul Islam
Department of Crop Science and Technology, University of Rajshahi, Rajshahi 6205, Bangladesh
E-mail: mki_crop@yahoo.com

Abstract: The influence of six storage treatment viz. control, paraffin coating, perforated polyethylene cover, unperforated polyethylene cover, hot water (55±1 0C) and low temperature (4±1 0C) on the behavioral pattern of physicochemical constituents of the two postharvest mango varieties *viz., the* Langra and the Khirshapat showed a significant effects in respect of most of the characters investigated in the laboratory situation. The Langra predominately accumulated a greater amount of crude fiber, lipid, WSP and potassium content over the Khirshapat. The constituents were increased with the progress of storage period except lipid content where it was decreased. A good amount of lipid, WSP and potassium content were gradually increased whereas crude fiber decreased with the advance of storage time from control and a lower changing trend was found from low temperature. So, low temperature impeded the changes. The Langra with control proficiently increased lipid and WSP; slightly increased potassium and progressively decreased crude fiber. The Langra using low temperature (4±1 ^{0}C) also exhibited lower diminishing trend of crude fibre. Therefore, low temperature (4±1 ^{0}C) was found suitable for retarding the physiological process of the postharvest mango.
Keywords*:* *Mangifera indica* L*;* physicochemical constituents; storage treatment, varieties**.**

Introduction

The mango (*Mangifera indica L.*) is being a major fruit crop cultivated in tropical and subtropical region of the world (Benitez *et al*., 2006). Nutritionally, it contains appreciable amount of crude fibre, lipid, and water soluble protein (Pal, 1998), and mineral elements which are used for good sources of nutrition for the human body (Muy *et al.*, 2004). It is efficient to prevent many deficiency diseases and possesses antioxidant activities (Samad *et al*., 1975). Crude fibre is a very important constituent for man and animals. It protects the human body from catastrophic diseases like colon cancer. It is not assimilated by human body. But it usually helps in digestion and formulated stool in intestine (Purohit, 1985). Lipid, water soluble protein and potassium element are also very important compositions for all of the living being. Potassium acts as the development of brain cell (Islam *et al*., 2011). The mango contains a very little amount of these compositions. Malnutrition is a serious problem of the people of the third world countries. Vitamin and mineral deficiencies are the most serious nutritional disorder in low income groups (Fonseca *et al.*, 2004). The minimum dietary requirement of fruit per day per individual is 115 g, but our availability is only 30-35 g (Siddiqui and Scanlan, 1995). The per capita availability of fruits is being come down by the high magnitude of postharvest losses (Mondal *et al*., 1995). The postharvest decay of fresh mango fruit is one the major problems in the tropic for its high perishability in nature and climacteric pattern in respiration. Postharvest changes deteriorate the nutritional qualities of the fresh mango. Approximately 30-50% fruits go waste during postharvest handling, storage and ripening (Lashley, 1984). The postharvest decay of physiological constituents of the mango can be substantially reduced by applying improved storage methods. Implication of postharvest treatments *viz*., paraffin coating, perforated polyethylene cover, unperforated polyethylene cover, hot water treatment and low temperature are very effective to retard the normal respiration of mango fruits. These treatments strongly impede in ethylene synthesis that resulted in low respiration and delay ripening. These materials also reduced the decay of mango (Tefera *et al.* 2007; Fawaz, 2006). Postharvest decay causes a huge amount of economic loss that hampers the total GDP in a country. Therefore, the present study was undertaken with a view to minimize the decay and to determine the status of the physicochemical constituents of the postharvest mango.

Materials and Methods

Experimental material and design: Two mango varieties namely, the Langra and the Khirshapath were used as experimental materials and collected from the mango grower of Kansart, Shibgonj Upazila of Chapai Nowabgonj and Chirghat Upazila of Rajshahi district, and other material used as storage treatments *viz*., paraffin coating and polyethylene cover were assembled from Royal Scientific shop at cooperative market of Rajshahi city. The mango varieties were treated with different storage treatments *viz.,* control, paraffin coating (PC), perforated polyethylene cover (PPC), unperforated polyethylene cover (UPC), hot water (HW) (55±2 ^{0}C) and low temperature (LT) (4±1 ^{0}C). The experiment comprised of two factors and laid out in randomized complete block design with three replicates. The postharvest treated fruits were assigned at random in each block and refrigerator for low temperature effect. The fruits were carefully selected during harvest. The skin of fruits was cleared with the help of a cloth just after harvesting.

Preparation of storage treatments: Solid paraffin wax was made liquid by heating it with the help of an electric heater in a large aluminum pot. Eighteen fruits from both the varieties were taken for wax coating individually. The fruits were treated as per treatment and dipped in it quickly. Care was taken to ensure a uniform coating on all the fruits and kept on brown paper for observation. The 19 cm x 15 cm sized polyethylene cover was taken at laboratory room and these were perforated with a scissor in nine equal positions of the bags. Individual fruit was taken into polyethylene cover and the open portion of the bag was sealed with burning. Eighteen fruits of each variety were bagged in this system and then placed on brown paper for next observation. Unperforated 19 cm x 15 cm sized polyethylene cover was used for this purpose and fruits were kept in it as perforated polyethylene cover. Tap water was heated in a hot water bath at (55 ± 2 ^{0}C). Fruits were individually dipped into hot water for a period of 5 minutes and then stored at ambient condition on brown paper. Fruits were stored in a refrigerated incubator at (4±1 ^{0}C). The temperature of the refrigerated incubator was maintained by adjusting the button on the incubator.

Application of storage treatments: The storage treatments used in the experiment were sequentially induced to the assembled mango fruits. Thereafter, the fruits were kept on a brown paper and placed on the laboratory floor at ambient condition. For each treatment of blocks, there were six fruits, of which five fruits were preserved in a deep refrigerator (-85^0 C) at Protein and Enzyme Laboratory in the Department of Biochemistry and Molecular Biology, University of Rajshahi for recording the data periodically at five different dates (at 3 days interval). Five fruits from each treatment combination of every replicate were chemically analyzed for the determination of the changes in crude fibre, total lipid, water soluble protein, potassium.

Physicochemical **parameters:** Crude fibre of the mango pulp was estimated following the procedures as given in the Biochemical Methods for Agricultural Sciences as stated by Sadasivam and Manickam (1992). Total lipid content of fruit pulp was determined using the method as narrated by Bligh and Dyer (1959). Water soluble protein content of mango pulp was determined following the method as described by Lowry *et al.* (1951). Potassium content of mango pulps was determined following the procedure as mentioned by Petersen (2002).

Statistical analysis: The assembled data obtained from the chemical analysis were statistically analyzed by analysis of variance method. The means of different parameters were compared using DMRT and LSD as described by Gomez and Gomez (1984).

Results and Discussion

Effects of varieties on physicochemical properties of mango: The postharvest Langra significantly produced a greater amount of crude fibre, total lipid, water soluble protein and potassium content as compared to the Khirshapat at different days of storage as shown in Figs.1-4. Initially, the Langra accumulated sufficient amount of crude fiber (1.30%) as compared to the Khirshapat (1.18%). The amount of crude fiber decreased gradually from the initial to the last day of edible stage. At 12th day, the highest (0.75%) was noted from the Langra whereas; the lowest (0.65%) was noted from the Khirshapat. A greater amount of crude fiber recorded in the Langra is in partially supported by the report of Mathooko (2000).The postharvest Langra gradually accumulated total lipid content up to the last edible stage. At 12th day, a bulky amount of lipid (0.72%) was obtained from the Langra and lower (0.65%) was obtained from the Khirshapat (Fig. 1). The phenomena might be due to the genetically dissimilarities between two varieties It was also found that the Langra enriched an adequate amount of water soluble protein (WSP) and potassium from the initial to the last stage of storage followed by the Khirshapat. At 12th day, a considerable amount of WSP (1.20%) was accumulated to the Langra whereas lower amount (1.08%) was accumulated to the Khirshapat. The event might be possible due to the seed protein of mango was extended to pulp during ripening. At 9th day of storage, a greater amount of potassium (0.30%) was enriche in the Langra and a minor amount (0.27%) was accumulated to the Khirshapat (Fig. 2). The phenomena might be probably due to rottening and transmission of potassium from the stone and peel of mango to the pulp of mango. The results of the increased behavior of total lipid, water soluble protein and potassium in the Langra are in agreement with the findings of Islam *et al. (*2011)

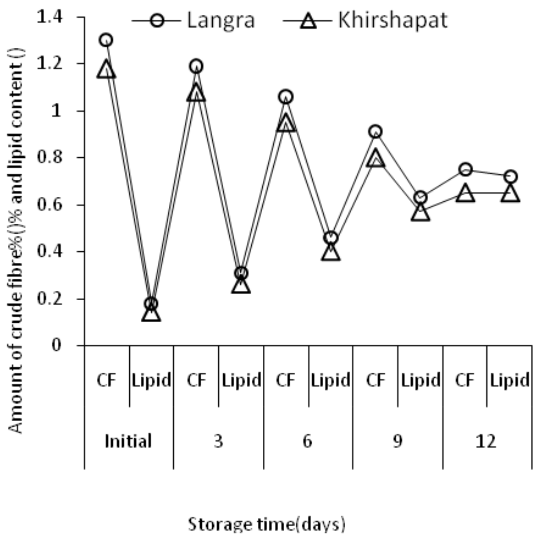

Fig. 1. Quantitative status of crude fibre and lipid content of pulp of the two postharvest mango varieties at different days of storage

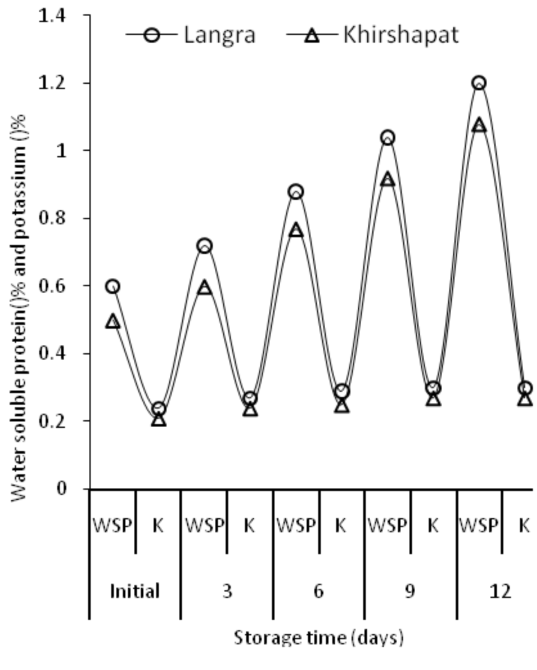

Fig. 2. Quantity of WSP and potassium content of pulp of the two postharvest mango varieties at different days of storage

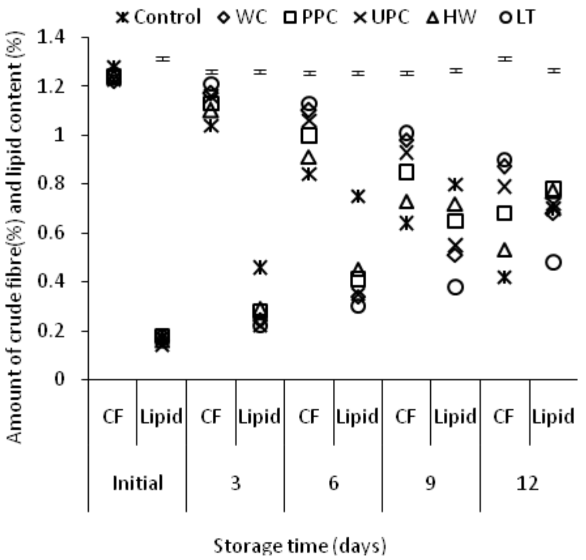

Fig. 3. Amount of crude fibre and lipid content of pulp of the postharvest mango influenced by different storage treatments at different days of storage. Vertical bars represent LSD at 0.05 levels

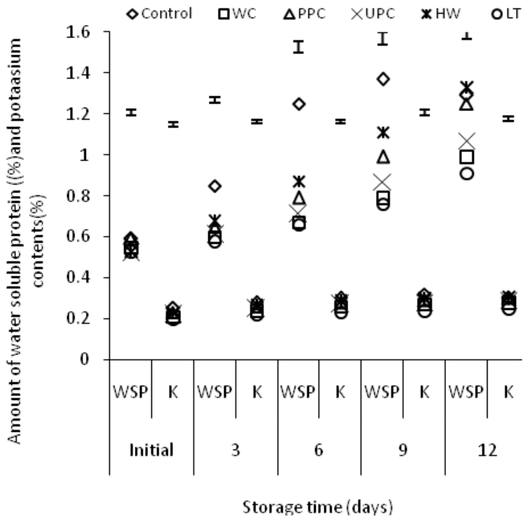

Fig. 4. Amount of WSP and potassium content of pulp of the postharvest mango influenced by different storage treatments at different days of storage. Vertical bars represent LSD at 0.05 levels

Table 1. Combined effects of varieties and different storage treatments on crude fibre of the postharvest mango

Treatments combination	Crude fibre (%) at different days				
Varieties × Treatments	Initial	3	6	9	12
V_1T_0	1.34 a	1.13 de	0.93 f	0.72 g	0.48 h
V_1T_1	1.25 cd	1.23 ab	1.15 ab	1.03 ab	0.92 b
V_1T_2	1.28 bc	1.17 b-d	1.04 d	0.88 de	0.71 e
V_1T_3	1.30 a-c	1.21 bc	1.11 bc	0.98 bc	0.84 c
V_1T_4	1.32 ab	1.15 c-e	0.96 ef	0.78 f	0.58 g
V_1T_5	1.33 ab	1.28 a	1.18 a	1.06 a	0.96 a
V_2T_0	1.21 de	0.96 g	0.76 h	0.56 h	0.36 i
V_2T_1	1.18 e	1.10 ef	1.05 cd	0.93 cd	0.81 c
V_2T_2	1.19 e	1.09 ef	0.96 ef	0.82 ef	0.65 f
V_2T_3	1.16 e	1.11 d-f	1.01 de	0.88 de	0.74 d
V_2T_4	1.15 e	1.05 f	0.85 g	0.67 g	0.47 h
V_2T_5	1.16 e	1.14 de	1.07 cd	0.96 c	0.84 c
Level of significance	**	*	*	***	***
CV%	1.87	1.84	2.07	1.33	1.50

Table 2. Combined effects of varieties and different storage treatments on WSP content of postharvest mango

Treatments combination	WSP content (%) at different days				
Varieties × Treatments	Initial	3	6	9	12
V_1T_0	0.65 a	0.92 a	1.31 a	1.45 a	1.36 ab
V_1T_1	0.62 ab	0.65 de	0.72 ef	0.84 f	1.04 g
V_1T_2	0.66 a	0.72 c	0.85 d	1.05 d	1.32 bc
V_1T_3	0.55 cd	0.66 d	0.76 e	0.92 e	1.12 f
V_1T_4	0.58 bc	0.74 c	0.92 c	1.17 c	1.40 a
V_1T_5	0.55 cd	0.62 f	0.69 fg	0.79 fg	0.94 h
V_2T_0	0.52 c-e	0.78 b	1.18 b	1.28 b	1.22 de
V_2T_1	0.48 e	0.54 h	0.62 h	0.74 gh	0.94 h
V_2T_2	0.52 c-e	0.58 g	0.73 ef	0.93 e	1.18 ef
V_2T_3	0.49 de	0.56 gh	0.66 gh	0.82 f	1.02 g
V_2T_4	0.48 e	0.62 ef	0.82 d	1.05 d	1.26 cd
V_2T_5	0.51 de	0.53 h	0.62 h	0.72 h	0.87 i
Level of significance	***	**	*	***	*
CV%	1.83	1.58	1.70	1.19	1.83

In a column values having the same letter(s) do not differ significantly as per DMRT at 5% level

Effects of storage treatments on the physicochemical properties of mango: Storage treatments induced to the mangoes exhibited a profound influence on the physicochemical constituents of mango pulp at different times of storage (Figs. 3-4). Crude fiber content decreased gradually with the increase of storage period. A greater reduction of crude fiber appeared from the fruits at control whereas a lower reduction was observed at low temperature. In all the cases, low temperature was more efficient for the reduction of the loss of crude fibre than other storage treatments (Fig. 3). Similar findings are noticed to be in the report of Islam, (2008). Crude fiber decreased in the mango pulp with the advance of storage period as reported by Mathooko (2000). An increasing trend of lipid (Fig. 3), WSP and potassium content (Fig. 4) were demonstrated with the passing of different storage periods. A higher rising trend was observed from control whereas a lower rising trend was observed from low temperature. The increasing trend was not resumed with advanced time and it dropped down in a certain stage. These occurrences might be due to the influence of low temperature in refrigerator caused delay ripening resulting in lower production of physicochemical constituents. The results of the present studies were supported by the findings of Gomez-lim (1997) and Anon (1962). Potassium element increased in the postharvest mango during storage as reported by Peter *et al*. (2007)

Table 3. Combined effects of varieties and different storage treatments on lipid content of the postharvest mango

Treatments combination	Lipid content (%) at different days				
Varieties × Treatments	Initial	3	6	9	12
V_1T_0	0.18 a-c	0.47 a	0.77 a	0.83 a	0.72 cd
V_1T_1	0.17 b-d	0.25 cd	0.35 d-f	0.53 de	0.71 cd
V_1T_2	0.19 a-c	0.29 bc	0.42 c	0.67 c	0.80 ab
V_1T_3	0.15 d-f	0.24 c-e	0.36 c-f	0.56 d	0.74 c
V_1T_4	0.20 ab	0.33 b	0.49 b	0.76 b	0.81 a
V_1T_5	0.21 a	0.26 cd	0.34 d-f	0.42 f	0.52 f
V_2T_0	0.15 d-f	0.45 a	0.72 a	0.77 b	0.67 de
V_2T_1	0.14 d-g	0.22 de	0.32 f	0.49 e	0.64 e
V_2T_2	0.16 c-e	0.26 cd	0.39 c-e	0.63 c	0.75 bc
V_2T_3	0.13 e-g	0.20 de	0.33 ef	0.53 de	0.69 c-e
V_2T_4	0.11 g	0.24 c-e	0.40 cd	0.67 c	0.72 cd
V_2T_5	0.12 fg	0.18 e	0.25 g	0.33 g	0.43 g
Level of significance	***	***	***	***	**
CV%	6.90	3.71	2.40	1.76	1.42

Table 4. Combined effects of varieties and different storage treatments on potassium content of postharvest mango

Treatments combination	Potassium content (%) at different days				
Varieties × Treatments	Initial	3	6	9	12
V_1T_0	0.27 a	0.30 a	0.32 a	0.33 a	0.31 ab
V_1T_1	0.23 b-d	0.25 d-f	0.27 d-f	0.28 cd	0.29 bc
V_1T_2	0.24 bc	0.28 a-c	0.30 a-c	0.31 ab	0.32 a
V_1T_3	0.22 cd	0.27 b-d	0.29 b-d	0.30 bc	0.31 ab
V_1T_4	0.25 b	0.29 ab	0.31 ab	0.32 ab	0.33 a
V_1T_5	0.22 cd	0.23 f-h	0.24 gh	0.25 ef	0.26 de
V_2T_0	0.23 cd	0.26 c-e	0.28 c-e	0.30 bc	0.28 cd
V_2T_1	0.19 e	0.22 gh	0.24 gh	0.25 ef	0.26 de
V_2T_2	0.22 cd	0.24 e-g	0.26 e-g	0.27 de	0.28 cd
V_2T_3	0.21 d	0.23 f-h	0.25 fg	0.26 de	0.27 cd
V_2T_4	0.21 d	0.25 d-f	0.27 d-f	0.28 cd	0.28 cd
V_2T_5	0.18 e	0.21 h	0.22 h	0.23 f	0.24 e
Level of significance	NS	NS	NS	NS	NS
CV%	4.72	4.12	3.84	3.70	3.64

In a column values having the same letter(s) do not differ significantly as per DMRT at 5% level

Combined effect of varieties and storage treatments on physicochemical properties of mango: Combined effects of varieties and storage treatments on crude fiber, lipid, water soluble protein and potassium content of mango pulp at different days of storage period are shown in Table 1- 4. Crude fiber of mango pulp decreased gradually with the progress of storage period. The Langra using low temperature showed better performance in producing a higher amount of crude fiber from all the storage times except initial day. At 12^{th} day, the highest (0.96%) quantity of crude fiber was synthesized from the Langra using low temperature and the lowest (0.36%) was synthesized from the Khirshapat using control (Table 1). A higher increasing pattern of lipid (Table 2) and WSP (Table 3), and slightly increasing trend of potassium content (Table 4) in the postharvest mango pulp were perceived with the advance of storage times. The constituents were produced more quantities from the treatment combination of the Langra with control whereas a lower increasing pattern was followed by the Khirshapat using low temperature. The results of the present investigation are strongly supported by findings as stated by Islam *et al.* (2011).

References

Anonymous . 1962. Wealth of India, Raw Materials, C.S.I.R., New Delhi.

Benitez, M.M., Acedo, A.L. Jitareerat P. and Kanlavanarat S. 2006. Mango fruit softening response to postharvest treatments. Acta Hort., 712 (2):811-816.

Bligh, E.G. and Dyer, W. 1959. Total lipid extraction and purification. Can. J. Biochem. Physiol. 37. p. 911.

Fawaz, S. A. 2006. Effect of postharvest treatments on physicochemical characters of mango fruits (cv. Bullock's heart) during storage. Ann. Agril. Sci. Moshtohor. 44 (2):705-716.

Fonseca, M.J.O., Cecon, P.R., Salomao L.C.C. and Pushmann, R. 2004. Fungicides and wax in postharvest preservation of mango haden. Acta Hort. 645: 557-563.

Gomez, K.A. and Gomez, A.A. 1984. Statistical Procedures for Agricultural Research. John Weley and Sons. Inc. New York. pp. 67-215.

Gomez-Lim M.A. 1997. Postharvest Physiology. In: The Mango: Botany, Production, and Uses (Edited by Litz R E) CAB International. pp. 425 - 446.

Islam, M. K., Islam, A. K. M. R and Absar, N. 2011. Postharvest Storage and Shelf Life of Mango, LAP LAMBERT Academy Publishing, GmbH & Co. Germany. (https://www.lap-publishing.com/catalog/details/store/gb/book/978-3-8465-0195-5/postharvest-storage-and-shelf-life-of-mango?search=synthesis).

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

Lowry, O.H., Rosebrough, N.J., Farr A.L., and Randall, R.J. 1951. Protein measurement with the Folin- Ciocalteau's Reagent., J. Biol. Chem. 193: 265- 275

Mathooko, F.M. 2000. Manual of Third Country Group Training Programme in Applied Food Analysis: Postharvest Physiology- JKUAT KENYA.

Mondal, M.F., Rahman M.A. and Pramanik M.A.J. 1995. Effects of different postharvest treatments on physico-chemical changes and shelf life of mango. Bangladesh Hort. 23 (1& 2): 1-5.

Muy, R.D., Siller, J.C., Diaz J.P. and Valdez, B.T. 2004. Storage condition and waxing affect water status and quality of mango. Revista Fitotcnia-Mexicana. 27 (2): 201-209.

Pal, R.K. 1998. Ripening and physiological properties of mango as influenced by ethereal and carbide. J. Food Sci. Technol. 35 (4): 358-360

Peter, M., Fweja, L., Chove, B., Kinabo, J., George, V. and Mtebe, K. 2007. Physical and chemical characteristics of off vine ripened mango (*Mangifera indica L.)* fruit (Dodo). African J. Biotech. 6 (21): 2477-2483.

Petersen, L. 2002. Analytical Methods- Soil, Water, Plant material, Fertilizer. Soil Resources Management and Analytical Services, Soil Resource Dev., Inst. Danida, Dhaka. pp. 61-70.

Purohit, A.G. 1985. Fruit trees for social forestry. Indian Hort., 30 (3):3.

Sadasivam, and Manickam. 1992. Biochemical Methods for Agricultural Sciences. Wiley Eastern Ltd. New Delhi, pp. 20 - 21.

Samad, M.A., Farruque, A.M.M. and MaleK, A. 1975. A Study on the Biochemical Characteristic of the fruit of some mango variety of Bangladesh. Bangladesh J. Sci. Res., 12 (2): 28-32.

Siddiqui, A.B. and Scanlan, F.M. 1995. Nutritive value of fruits. In: Fruit Production Manual. Hort. Res. Dev. Proj. (FAO/UNDP/ADB Project: BGD/87/ 025), pp. 1-286.

Tefera, A., Seyoum, T. and Worldetsadik, K. 2007. Effect of disinfection, packaging and storage environment on the shelf life of mango. Biosystem Engineering. 96 (2): 201-212.