



POSTHARVEST LOSSES OF MANGOES AT DIFFERENT STAGES FROM HARVESTING TO CONSUMPTION

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Abstract

A study was conducted to estimate the postharvest losses of seven mango varieties. A survey was carried out in Rajshahi, Meherpur, Satkhira, Chapinawabgonj and Chuadanga districts during three consecutive mango growing year from 2017 to 2019. The data were collected from 160 respondents randomly selected from the study area, and seven popular varieties of mangoes were considered for assessment of postharvest loss. The data was elicited through questionnaire and personal interview method. Postharvest losses were estimated at grower level, during transportation, storage, wholesale and retail trader level. The mango grower had grown Khirsapat, Langra, Gutí, Amropali, Fazli, Harivanga and Ashwina varieties. It was observed the highest postharvest losses at farm level were quantified to be about 7.04%. Losses at wholesale market including transportation accounted for about 4.70%. Losses at retailing market, at storage unit and at consumer level accounted for about 3.66%, 3.50% and 3.50%, respectively. It was also studied that the post-harvest losses of processing 3.11%. Overall post-harvest losses in mango at different stages from harvesting to consumption were quantified which accounted for about 25.51%.

Key words: Mango varieties, harvesting, growers, traders, retailers, postharvest losses.

Introduction

Mango (*Mangifera indica* L.) is one of the choicest fruits in the world (Joshi and Roy, 1999). It belongs to the family of Anacardiaceae, one of the most important species of the family and one of the most preferential fruit crops of the tropical and subtropical regions of the world for human consumption (Upadhyay and Tripathi, 2000). Due to its popularity and importance, *M. indica* is often named “King of fruits” for its luscious flavor, taste and high nutritive value (Moula *et al.*, 2017). Its social and economic impact are most relevant in developing and emerging countries, where mango is a high-valued component in diet, rich in vitamins and minerals. *Mangifera indica* has been an important component of the Ayurvedic and indigenous medical systems for over 4000 years (Singh, 1999; Joshi and Roy, 1999).

Mango fruit pulp may be used to make juices, mango nectar, squash or flavoring as a major ingredient in ice cream and sorbets (Mukherjee, 1997). In Bangladesh, it occupies an area of 37,830 hectares of land with an annual production of 11,61,685 metric ton (MT) (BBS, 2016). The leading mango growing districts of the country are Rajshahi, Chapainawabgonj and greater Dinajpur. It is a seasonal cash crop of North-Western region of Bangladesh which dominates the economy of Rajshahi and Chapainawabgonj district. Chapainawabgonj alone produces almost 1,52,285 MT of mangoes on 44,430 hectares of land (BBS, 2015). The main parts of the mango production area are Shibgonj, Bholahat and Gomastapur upazilla (sub-district). Mango is the second most produced fruit in Bangladesh contributing 19.25% of total fruits and 50,000 number of commercial growers are involved in mango production (Sikder, 1999). Bangladesh started exporting mango since 2014, and exported 800 MT of mango mainly in European market in 2015. Mango ranks third among the tropical fruits grown in the world with a total production of 9.5 lakh MT around seventy thousand hector land in Bangladesh (BBS, 2015). Nutritionally mango is very important because it contains appreciable quantity of vitamin A, vitamin C, total soluble sugars and minerals which are readily available and easily assimilable in human body (Singh, 1999) and therefore is capable to prevent many deficiency diseases (Samad and Faruque, 2002; Pruthi, 1992). Approximately 30-35% fruits go waste during postharvest handling, storage and ripening (Lashley, 1999). Besides, these perishable characteristics of the horticultural produce, inadequate arrangements for post-harvest management like storage, processing, preservation and marketing facilities lead to problem of postharvest losses (Mitrannavar, 2012). The postharvest losses of fruits and vegetables in developing countries have been reported to vary between 20-40% at different stages of marketing (Theodosy *et al.*, 2011). Studies on the extent of losses of mangoes during postharvest handling is inadequate, especially in Bangladesh. Hence, the present investigation was carried out to find out the extent of postharvest losses of some selected commercial varieties of mangoes in Bangladesh.

Materials and Methods

Major mango growing area of Bangladesh were selected to conduct study for estimating the postharvest

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losses of mango fruits from harvesting to consumption. Five districts namely Rajshahi, Chapainawabgonj, Chuadanga, Meherpur and Satkhira were selected to conduct survey and data collection using structured questionnaire. For this study, data was collected during March to April 2017-2019 to investigate the present situation of mango cultivation in selected districts. To get information as per objectives, a total number of 160 respondents were selected randomly among four districts in each forty number of responds (4x40=160) local mango growers of the selected areas. Structured interview was carefully prepared in questionnaire, keeping the objectives of the study in view. Data were collected by the structured questionnaire interview form directly field visit were conducted in Shibpur and Banassor (market) upazila in the Rajshahi district, Cansert market in Chapinawabgonj. Data were also collected on the area of mango cultivation, types of mango varieties, number of mango plants, diseases and insect infestation, uses of chemicals and yield of mango to determine the present status of mango cultivation. Appropriate scaling was used for measuring characters in mango cultivation. Also, problem confronted by farmers in mango cultivation was also measured.

Postharvest losses were determined using mango cultivars grown in small scale farmers’ orchards at selected area. Fruits were picked from tree using thusy (bamboo made), bag and kept into a plastic cartons which was carefully descended to the ground on the using a rope. The fruits were sorted and to avoid bruise, spoilage, shriveling, mechanical injury, microbial decay and damage fruits. Then to find out the loss at farm level.

The collected data were analyzed using appropriate statistical tools. The fruits were then transported of different zila Khulna, Mymensingh, Gazipur, Sylhet, Dhaka etc. After arrival at the urban market, the fruits cartons were kept on the ground under the sun for two to three days to stimulate wholesale marketing during high and low demand seasons. The assessment of mango fruits deterioration was carried out during the harvest, transport and wholesale market stages. The experiment layout was completely randomized design with two treatment.

The transported fruits were then stored at room temperature. Data for experiment which were scored based on the number of damaged (postharvest losses). On the other hand another losses can be determined at the different stages of retail, consumer and processing. The loss was calculated using the following equation:

$$\% \text{ Postharvest loss} = \frac{\text{Initial weight} - \text{Spoiled portion weight}}{\text{Initial weight}} \times 100$$

experiment layout was completely randomized design with two treatments. Total postharvest loss was estimated by addition of losses from each stage using the following equation:

$$\text{Total loss} = \text{Loss at farm level} + \text{loss due to transportation} + \text{loss at whole sale level} + \text{loss during storage} + \text{loss at retail level} + \text{loss at consumer level} + \text{loss during processing}$$

Results and Discussion

Maturity indices used by mango growers

Only 21.87% of the growers harvested mangoes by “first dropping of ripe mangoes” and 26.25% by “age of fruit”. The maturity indices characteristics are the highest number 45% of “external color observation” and the lowest of “smell” and “presence of birds” are 3.12 % and 3.75% respectively (Table 1).

Table 1. Distribution of mango growers/traders according to their judgment towards maturity indices of mango harvesting

Indicator of maturity indices	Number	Percent
1. First dropping of ripe mango	35	21.87
2. External color observation	72	45.00
3. Age of fruit	42	26.25
4. Smell/odor	05	3.12
5. Presence of birds	06	3.75
Total	160	100

Methods of harvesting of mango fruits



Fig. 1. Convenient method of mango harvesting and transportation (left: harvesting, middle: basketing, right: transportation)

Methods of harvesting a considerable bearing on the postharvest losses of the mango fruit. From the mentioned, the overwhelming majority (80%) of the traders/growers harvested mango fruits with the help of a “Thushy”, other methods used were: “Thushy and gunny bag” (8.75%) and “Hand collection” (11.87%) and “branches shaking” (7.5%) (Table 2). The findings indicated that “Thushy and rope basket” was the most widely used method.

Table 2. Distribution of mango traders/growers according to their methods of harvesting of mango of selective districts

Harvesting equipments	Frequency	Percent growers/ traders
‘Thushy’ and ‘rope basket’	115	71.87
‘Thushy’ and gunny bag	14	8.75
Hand collection	19	11.87
Branches shaking	12	7.50
Total	160	100

Spoilage of mango during transportation

A total quantity of 9933 MT of mango were traded by the respondents, out of which 1366 MT were rotten due to diseases and inadequate postharvest handling, constituting a mean loss of 13.75%. In Chapainawabganj (production area), the volume of mango traded by the respondent was 2765 MT out of which the loss was about 157 MT. In Rajshahi, Khulna, Mymensingh, Dhaka and Chittagong, the total quantities of mango traded by the respondents were 1408, 565, 1191 and 2085 MT respectively. The maximal quantity of rotten mangoes was found in Chittagong (19.64%), followed by Dhaka (19%) and Mymensingh (18%). On the other hand, the loss of mangoes was minimal in Chapainawabganj (5.56%). The results showed that postharvest loss increased with increasing distance travelled (Table 3).

From table 4 it showed that the postharvest loss of Langra (15.18%) and the lower post harvest loss Harivanga (10.66%). Otherwise the post harvest losses of mango cultivars are almost same. So there no significantly. According to Sreenivasa *et al.*, (2002) founded that the Khirsapat is the higher post harvest loss (15.66%) but almost same with our studied loss. It only dependent upon the long distances.

Table 3. Spoilage of mangoes caused by distance, mode of transport and time taken for transportation to different district towns from the production area

Location	Distance from Chapainawabganj (km)	Mode of transport used	Time required	% Fruit loss
Chapai	5-30	Boat, rickshaw van	30 min	5.56
Nawabganj				
Rajshahi	50	Truck, train, bus	1hr 10 min	9.30
Khulna	318	Truck, train	7 hr 30 min	12.72
Mymensingh	292	Truck	6 hr 52 min	18.22
Dhaka	294	Truck, bus	6 hr 40 min	19.10
Chittagong	538	Truck	11 hr 20 min	19.64
Average loss				13.75

Table 4. Loss occurred due to rotting of mangoes in Chapainawabganj and Rajshahi district of Bangladesh at retailers and wholesalers level (seven varieties)

Sl. No.	Mango varieties	Percent loss
1	Guti amm	14.10
2	Khirsapat	15.22
3	Harivanga	10.66
4	Langra	15.18
5	Amropali	13.24
6	Fazli	14.10
7	Ashwina	11.62
	Average	13.44

Source: Field survey, 2017-2019 at Rajshahi and Chapainawabganj

Postharvest loss at farm level

Postharvest loss at farm level in Rajshahi (Shibgonj) and Chapainawabganj (Canshart) district most of mango growing farmers follow manual harvesting, where laborers harvest the fruits using bamboo wooden stick with hook at the end with which the fruits are pulled down from the tree. Some laborers shake the branches during the harvesting. After harvesting the entire orchard, the fruits are collected with the help of baskets and heaped temporarily in a common place. At the time of harvesting, the damaged, over ripened and spoiled fruits are discarded (Figure 2). It was observed that in case a total quantity of cultivars of 2500 kg harvested in the samples, about 176 kg were lost, which accounted for about 7.04% due to various reasons (Table 5). The highest loss was found in farm operations like insect and disease attack (1.55%), sorting & grading (1.00%), harvesting injury (1.45%), cracks (1.10%) and natural disaster (0.88%) etc.

Murthy *et al.*, (2012) assessed the postharvest losses in Banganapalli mango at different stages of marketing in Andhra Pradesh. The average post-harvest loss at the farm level was 15.6%.

Table 5. Post-harvest losses at farm level

Losses due to	Percent loss*
Insect and disease attack	1.55
Harvesting injury	1.45
Cracks	1.10
Sorting and grading	1.00
Over ripe	0.95
Natural disaster (Rain hail stone)	0.88
Rat, birds and other animal damage	0.09
Other	0.02
Total loss	7.04

*Loss indicated the average value from four farms.



Fig. 2. Harvesting loss a) anthracnose, b) cracking, c) fungal infection loss when it is spreading

Postharvest losses at wholesale market including transportation

After harvesting, most of the farmers transport the fruits to the markets in trucks and van. Loading in trucks the fruits are transported plastic crates and other packaging. At the time of unloading the fruits in the wholesale market, the damaged, over ripened, immature and unmarketable size fruits are separated out. Losses in the wholesale market including transportation were quantified in both upazila Bannessar and Kansert wholesale markets. The total quantity transported was 3,225 kg, out of which 151.57 kg (4.70%) was the loss (Table 6). The major loss of 64.50 kg (2.00%) was due to mechanical damage, followed by Immature and unmarketable size 38.70 kg (1.20%), over ripening, 32.25 kg (1.00%) and spoilage 16.12 kg (0.50%).

Postharvest losses during storage

The fruits are stored in the market yard or sometimes in rooms, when fruits are arranged in several layers on the ground spread with paddy straw and the top of the lot is also covered with straw. Fruits are kept for about four weeks for uniform ripening. Then the fruits are distributed to retailers. Retailers purchase the fruits directly from the wholesale agent. They classify the fruits into different sizes and sell within two or three days. The data collected on storage losses in different varieties are presented in Table 6. For a sampled quantity of 2500.00 kg stored, 87.50 kg fruits were lost amounting to 3.50 % of fruits loss. The major loss was due to spoilage which contributed to a loss of about 50.00 kg (2.00%) (Table 6). The loss due to over ripening and shriveling was about 25.00kg (1.00%). Murthy *et al.*, (2012) assessed the postharvest losses in Banganapalli mango at different stages of marketing in Andhra Pradesh and reported that post-harvest losses during storage and ripening were estimated as 5.80 %.

Postharvest losses at the retail level

When data was collected at the retail level, it was found that the losses were about 3.66 % i.e., out of 1500 kg sampled nearly about 54.90 kg were wasted (Table 6). The major loss was due to spoilage accounting to about 1.90%. The loss due to over ripening and shriveling was about 1.50% and pilferage accounted for 0.26%. The results are in line with the results obtained by Murthy *et al.*, (2012) who reported that the loss at the retail marketing was found to be 5.25% and also reported a physical postharvest loss of 5.25% at the retail level.

Postharvest losses at consumer level

The data was collected at the consumer level, reveals that the losses were about 3.50% i.e., out of 50 kg sampled nearly about 1.75 kg were wasted (Table 6). The major loss was due to physical injury including cutting accounted to 2.00%. The loss due to over ripening and shriveling was about 0.50% and spoilage due to disease accounted for 1.00%.

Table 6. Postharvest losses at wholesale, storage, retailer and consumer level

Losses due to	Percent loss			
	Wholesale level ^a	Retailer level ^b	Storage level ^c	Consumer level ^d
Mechanical damage or breakage (loading/unloading)	2.00	1.90	-	2.00
Over ripening and shriveling	1.20	1.50	1.00	0.50
Immature and unmarketable size	1.00	0.26	-	-
Spoilage due to disease	0.50	-	2.00	1.00
Variation in temperature and bedding material			0.50	-
Total	4.70	3.66	3.50	3.50

^aLoss indicated the average value from two traders; ^bLoss indicated the average value from ten retailers; ^cLoss indicated the average value from four wholesale markets; ^dLoss indicated the average value from four consumers.

Post-harvest losses at processing units

The post-harvest losses of mango fruits during processing units were estimated and the details are given in Table 7. The total quantity of fruit handled was 80 kg from two seasonal analytical works in Agro-processing (AGP) Laboratory, BSMRAU, out of which 3.11 kg was lost. The major loss was due to over ripening and immature (1.12% and 1.10%, respectively) followed by cutting and pulp extraction (0.34% and 0.31%, respectively).

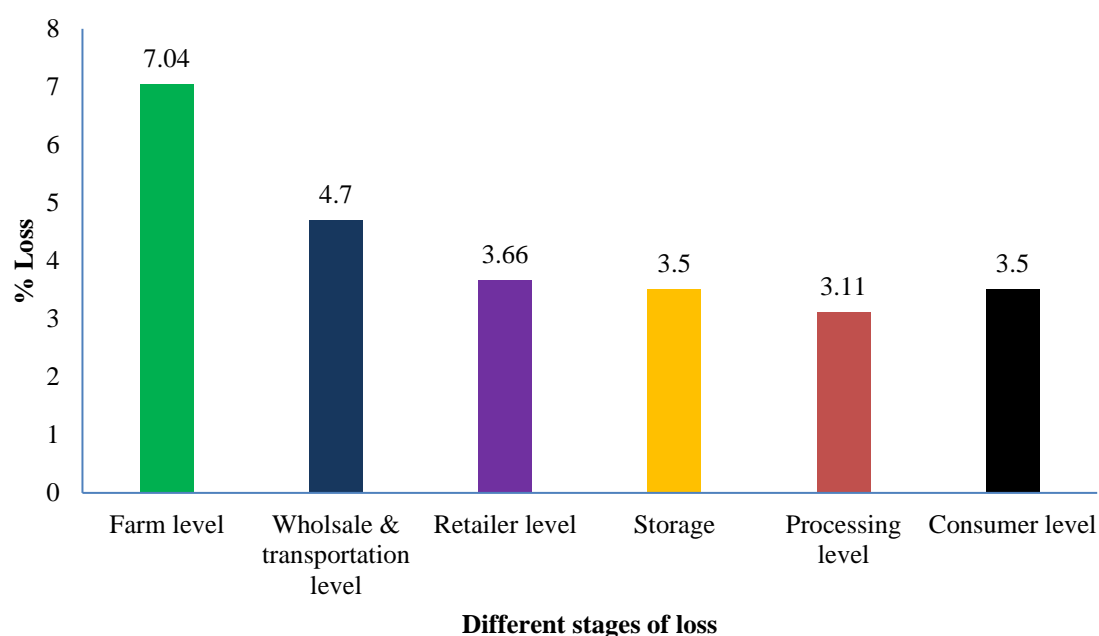
Table 7. Postharvest losses at processing units

Losses due to	Percent loss
Immature sorted out	1.12
Over ripening	1.10
Cutting	0.34
Pulp extraction	0.31
Fruit washing	0.24
Total post-harvest losses	3.11

*Loss indicated the average value from two processing in the laboratory of AGP

Overall postharvest losses

Six important stages were identified in the post-harvest handling chain and losses were estimated at each stage (Figure 3). The stages were at farm level, transporting and marketing, storage, retail, processing unit and consumer level. The overall loss accounted was 25.51% (7.04 % at field level, 4.70 % wholesale market, 3.66 % in retailing market, 3.50 % in storage unit, 3.11 % in processing and 3.50 % in consumer level. The studies conducted by Murthy *et al.*, (2002) reported that, the total post-harvest loss in mango was found to 17.90 and 29.65% respectively.

**Fig. 3.** Overall post-harvest losses in mango at different stages from grower to consumer

Conclusion

It is clear from the results of the study that, post-harvest losses in mango at different levels was found to 7.04% at farm level, 4.70% at market level, 3.50% at during storage, 3.66% at retailer level, 3.11% at processing and 3.50% at consumer level. Total postharvest loss of mango was estimated to be 25.51%. Hence it can be concluded for the study that, there is a need to provide better infrastructural facilities like proper harvesting techniques, better transportation, marketing and cold storage facilities in order to avoid the postharvest losses at different levels. There is a need to create awareness among the farmers regarding measures to control the post-harvest losses of mango at different levels through intensive extension educational activities.

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