RESEARCH ARTICLE

ESTIMATION OF POST-HARVEST LOSSES OF POTATO IN MARKETS OF SOME SELECTED DISTRICTS IN BANGLADESH

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ABSTRACT

A survey was carried out following questionnaire to estimate the status of post-harvest losses of potato from potato retailers in different markets of Comilla, Dinajpur, Mymensingh and Rangpur district. Basic information of potato retailers such as age, gender, educational qualification, marketing experience, ownership and their basic knowledge of stored variety, problems associated in stored potato, storage conditions, causes of losses of stored potato, common storage diseases of potato, possible reasons for rotting of potato in storage, primary source of potato, care of stored potato, most favorable and unfavorable period for potato storage were assessed by direct interview. The average incidence of soft rot, dry rot and scab was found 2.54%, 4.44% and 1.85%, respectively in November, 2019. The total losses due to post-harvest diseases in these markets were found 8.83%. Meanwhile, the total loss of potato due to physical abnormalities was recorded 13.78%. The highest physical abnormalities were observed green potato (6.20%) followed by cut potato (4.27%) and pitted potato (2.10%). This study was a preliminary step for the investigation of the idea of the retailers of the selected districts about the status, problems they faced for potato storage in markets. This was the first time survey from potato retailers of different districts in Bangladesh and estimation of potato loss in the market of Bangladesh.

KEYWORDS

Post-harvest losses, potato, Retail market, Post-harvest diseases of potato.

1. INTRODUCTION

The potato (*Solanum tuberosum*) belongs to the solanaceae family of flowering plants. It originated and was first domesticated in the Andes Mountains of South America. It was introduced to the Indian Subcontinent some time during the first half of the 17th century (Hashem, 1999). The potato is the third most important food crop in the world after rice and wheat in terms of human consumption. More than a billion people worldwide eat potato and global total crop production exceeds 300 million metric tons. In 2013, more than 368 million tons of potato was produced through the world (FAO, 2015). Bangladesh is mainly an agro-based country. Considering the trend of potato cultivation, it is now one of the major foods as well as vegetables in Bangladesh. Potato production covers more than 0.51% of total land in Bangladesh (BBS, 2014). It contributes alone as much as 64% of the total annual production of Bangladesh (BBS, 2014). In the year 2013-14, potato was grown in an area of 4,62,151 hectares and the production was 89,50,000 metric tons (BBS, 2014). But thousands of tons of potatoes are going to loss in markets due to lack of adequate cold storage and marketing facility. If this loss can be minimized, it will reduce the food shortage of Bangladesh to a great extent. Hence, potato may prove to be a useful tool to achieve the nutritional security of the nation. Among the cultivars, maximum loss within the three months namely July, August and September was found in cultivar Cardinal (5.55%)

Rifat *et al.* (2014). The economic importance of losses caused by soft rot bacteria can be very great, depending upon the value of the crop and the severity of the attack during storage. In England 70% of ware crops and 100% of seed stocks were affected by the disease and that the disease itself was present on as many as 1% of tubers (Bradshaw *et al.* 2001).

In Bangladesh considerable efforts have been given by the researchers of BAU and BARI on different aspects of diseases of potato but no systematic work has been done on the market diseases of this crop, except recording the occurrence of a few diseases and only limited research work in the lab. Therefore, the present research was undertaken with the following objectives:

- To survey the status of post-harvest potato diseases of different markets of Comilla, Dinajpur, Mymensingh and Rangpur.
- To estimate post-harvest losses of potato.

2. MATERIALS AND METHODS

2.1 Location and time

The survey was carried out in the district of Comilla, Dinajpur, Mymensingh and Rangpur in the month of November, 2019. The

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laboratory experiment was carried out at MS Laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh.

2.2 Survey

For surveying the post-harvest losses of potato in different markets of Comilla, Dinajpur, Mymensingh and Rangpur, ten retailers from each districts were selected. A questionnaire mentioning problems in post-harvest potato were prepared. Questionnaire was filled up by face to face interview of these selected retailers. The selected markets were puritan bahadur bazar in Dinajpur, City bazar in Rangpur, Mechuya bazar in Mymensingh and Chawkbazar in Comilla.

The parameters of the survey were:

1. Basic information

- i. Name / Retailer's name
- ii. Gender
- iii. Age
- iv. Educational qualification
- v. Marketing experience
- vi. No. of shop and
- vii. Ownership.

2. Stored variety

3. Problems in stored potato

- i. Small potato
- ii. Cut potato
- iii. Lesion potato
- iv. Greenish potato
- v. Rotten potato
- vi. Other variety/Varietal mixture.

4. Stored conditions

- i. Dark room
- ii. Bright room
- iii. Woody Floor
- iv. Concrete floor
- v. Ground floor
- vi. Others.

5. Cause of loss

- i. Insects
- ii. Diseases of potato
- iii. Rats
- iv. During transport
- v. During storage and
- vi. Others.

6. Idea about post-harvest diseases.

- i. Soft rot
- ii. Dry rot
- iii. Scab and
- iv. Other Lesions.

7. Possible reasons for rotting of potato in storage

- i. Cut potato
- ii. Injured potato
- iii. Mixture with rotten potato and
- iv. Wet potato

8. Primary source old potato.

9. Care of stored potato during storage.

10. Most favorable season for potato storage.

11. Most unfavorable season for potato storage

2.3 Record of the market diseases

For the experiment of diseases of potato in markets, three different retailers from each districts of Comilla, Dinajpur, Mymensingh and Rangpur were selected. From each retailer, 40 kg of potato tubers were collected. The collected tubers were stored in gunny bags. The tubers were spread over the floor and the diseased potatoes were sorted out and weight were taken. The data were collected for the following parameters:

1. Weight of potato (kg)
2. Weight of healthy potato (kg)
3. Weight of green potato (kg)
4. Weight of cut potato (kg)
5. Weight of pitted potato (kg) and
6. Weight of diseased potato (kg).

3. RESULT

3.1 Basic information

Total ten retailers from each district were selected for questionnaire (Table 1). They collected potato from primary sources (farmer, cold storage) and supply to the local retailers. All the potato retailers gave related information and ideas about different problems they are facing.

Table 1: List of selected retailers of different districts				
Sl No.	Comilla	Dinajpur	Mymensingh	Rangpur
R1	Mainuddin Ahmed	Md. Shahid Amin	Nasiruddin	Md. Shahinur Islam
	Chawdhury Store	M/S Al Amin Traders	Mayer Doya Sobji	Shahin Banijyaloy
R2	Hazi Md. Abu taher	Bishal Das	Gaurango Saha	Md. Kaysar Hossain
	Polli Store	M/S Bishal Traders	Saha Enterprise	Kaysar Banijyaloy
R3	Md. Habib Sheikh	Md. Mokhesur Rahman	A.K.M. azad Selim	Md. Kamalur Rahman
	M/S Shanti Traders	Sujon Khalasi Ghar	Selim Enterprise	Selim Banijyaloy
R4	Md. Sekandar Ali	Md Liakat Ali	Md. Dulal Mia	Rafiqul Islam
	Molla Store	M/S Likhon Vandar	Dulal Enterprise	Swadesh Banijyaloy
R5	Razab Mia	Md. Rabiul Islam	Ismail Hossain	Sirajul Haque Siru
	Ali store	Rabiul Banijyaloy	Ismail Enterprise	Jamjam Banijyaloy
R6	Abdul Motaleb	Shafiqul Islam	Abdul Jalil	Abdul Kader
	Amena Bitan	Sadia Banijyaloy	Jalin Banijyaloy	Bismillah Vandar
R7	Abul Kamal Azad	Saddam Hossain Babla	Md. Joynal Sheikh	Md. Azad Rahman
	M/S Moni Traders	Saddam Khalasi Ghar	Mayer Doya Sobji	Rangpur Khadyo Vandar
R8	Karim Sheikh	Mona Sawdagar Mona	Md. Jalaluddin	Md. Abul Hossain
	Karim Store	M/S Mona Traders	Jalal Banijyaloy	Modina Vandar
R9	Mehedi Hasan	Abdul Gaffar	Masud Sikdar	Rejaul Karim Rizu
	Sahara Store	Sahara Banijyaloy	Jony Enterprise	Bandhu Banijyaloy
R10	Sajib Molla	Azgar Ali	Milon Das	Shahidul Islam
	Sajib Khalasi Ghar	M/S Moni Traders	Mamoni Banijyaloy	Abadan Banijyaloy

3.2 Gender, age, educational qualification, marketing experience and ownership of retailers of all surveyed districts

According to the survey, all the retailers in all surveyed districts were observed male. Age and educational qualification of the retailers of the district Comilla ranged from 26 to 58 and primary to B.Com, respectively. At the same time, the information of this study indicates that age of the retailers of the districts Dinajpur, Mymensingh and Rangpur ranged from 26 to 58 years, 38 to 54 years and 30 to 65 years, respectively. Similarly, educational qualification of the retailers of the district of Dinajpur, Mymensingh were observed in the range of 8th class to B. Com., primary to H.S.C. and primary to H.S.C., respectively. All of the retailers of the district of Comilla, Dinajpur, Mymensingh and Rangpur had trading experience ranged from 4 to 29 years, 2 to 42 years, 2 to 26 years and 15 to 35 years, respectively. None of the retailers of the district of Comilla, Dinajpur, Mymensingh and Rangpur had more than one shop. Only very few retailers of Mymensingh and Rangpur had ownership of their shop.

3.3. Stored variety

There were several varieties of potato stored in Comilla city including Diamant, Cardinal, Lalita, Granola, Petoniz. Mostly stored variety of potato in Comilla was Diamant. In the district of Dinajpur, the most stored potato variety was Asterix. They also store potato of the variety of Diamant, Cardinal, Granola and Deshi guti. Similarly in the district of Mymensingh the most stored variety was found Diamant. Granola, Deshi guti, Lal guti variety was also found as stored variety in the district of Mymensingh. Meanwhile, retailers of the district of Rangpur mostly stored potato of the variety was Shilbilati, Cardinal, Diamant, Granola, Deshi guti etc.

3.4 Problems in stored potato

Retailers were asked to assess the problems of potato in their storage (Fig. 1 and 2). In Comilla, highest problem in stored potato was injured potato followed by cut potato, small potato, rotten potato, greenish potato and mixed potato. In the district of Dinajpur, highest problem in stored potato was cut potato followed by greenish potato, mixed potato, small potato, rotten potato and injured potato. Similarly, In Mymensingh, highest problem in stored potato was injured potato followed by cut potato, greenish potato, small potato, rotten potato and mixed potato. In the district of Rangpur, highest problem in stored potato was rotten potato followed by injured potato, small potato, cut potato, greenish potato and mixed potato.

Figure 1: Categories of problems associated in storage potatoes in retailer's storage A. Comilla, B. Dinajpur.

*R=retailers.

Figure 2: Categories of problems associated in storage potatoes in retailer's storage A. Mymensingh, B. Rangpur.

*R means retailers.

3.5 Retailer's storage condition

Types of storages of retailers of different districts of Bangladesh were recorded in the survey (Table 2). All potato retailers from all districts store potato on concrete floor having natural light.

Table 2: Types of storages of retailers of different districts of Bangladesh	
District	Storage Condition/ Types
Comilla	Concrete floor with natural light.
Dinajpur	Concrete floor with natural light.
Mymensingh	Concrete floor with natural light.
Rangpur	Concrete floor with natural light.

3.6 Causes of losses of potato in storage

Categories of causes of losses of storage potatoes in retailer's storage were recorded (Fig. 3). In Comilla maximum losses were found in during storage followed by during transport, rats & diseases of potato, insects and other causes like warm weather. In the district of Dinajpur maximum losses were found in during transport followed by rats, during storage, diseases of potato and other causes. Similarly, in Mymensingh, maximum losses were found in during transport followed by rats, during storage, diseases of potato, insects and other causes like warm weather. In Rangpur, maximum losses were found in during storage followed by during transport, rats & diseases of potato, insects and other causes like warm weather.

Figure 3a: Categories causes of potato losses in retailer's storage A. Comilla, B. Dinajpur.

*R means retailers.

Figure 3b: Categories causes of potato losses in retailer's storage A. Mymensingh, B. Rangpur.

*R means retailers.

3.7 Idea about post-harvest disease of potato

Retailer's basic ideas on common post-harvest diseases of potato were surveyed in the study (Table 3). In Comilla, the retailers had clear idea about soft rot of potato followed by dry rot, scab and other lesions. In the district of Dinajpur, the retailers had clear idea about dry rot of potato followed by soft rot, scab and other lesions. Similarly in both of the district of Mymensingh and Rangpur, the retailers had clear idea about dry rot of potato followed by soft rot, scab and other lesions.

Table 3: Retailers basic ideas on common storage diseases of potato

Sl. No.	Comilla				Dinajpur				Mymensingh				Rangpur			
	Dry rot	Soft rot	Scab	Others	Dry rot	Soft rot	Scab	Others	Dry rot	Soft rot	Scab	Others	Dry rot	Soft rot	Scab	Others
R1	4	3	2	1	3	4	2	1	4	3	2	1	3	1	4	2
R2	3	4	2	1	4	3	2	1	4	3	1	2	4	3	2	1
R3	3	4	2	1	4	2	3	1	4	3	1	2	2	1	-	-
R4	3	4	1	2	4	3	2	1	4	3	1	2	4	3	1	2
R5	3	4	2	1	4	3	2	1	3	4	2	1	3	2	1	-
R6	4	3	2	1	3	4	1	2	3	4	2	1	2	3	1	-
R7	3	4	2	1	3	2	4	1	4	3	2	1	3	2	1	-
R8	4	3	1	2	4	3	2	1	3	4	2	1	3	4	1	2
R9	3	4	2	1	3	2	4	1	4	3	2	1	3	2	1	-
R10	4	3	2	1	4	3	2	1	4	3	2	1	3	2	1	-

R1~10=Ten retailers

1 to 4 indicate frequently of a particular disease

1=Minimum / frequently observed

2,3 & 4 = Gradually more observed

'-'= no idea

3.8 Possible reasons for rotting of potato during storage

Retailer's View on categories of possible reasons for rotting of potato during storage was assessed in this survey (Fig. 4). In Comilla, the most common possible reason for rotting potato during storage was found mix with rotten potato followed by injured potato, cut potato and wet potato. In the district of Dinajpur, the most common possible reason for rotting potato during storage was found cut potato followed by injured potato, mix with rotten potato and wet potato. In Mymensingh, the most common possible reason for rotting potato during storage was found mix with rotten potato followed by injured potato, wet potato and cut potato. Similarly, in Rangpur, the most common possible reason for rotting potato during storage was found mix with rotten potato followed by wet potato, injured potato and cut potato.

Figure 4a: Categories of possible reasons for rotting potato during storage.

A. Comilla, B. Dinajpur.

Figure 4b: Categories of possible reasons for rotting potato during storage.

A. Mymensingh, B. Rangpur.

*R means retailer.

3.9 Primary source of potato

Potato collection sources of retailers of different districts were assessed in this survey (Table 4). In Comilla, Dinajpur and Rangpur, primary sources of potato were cold storage and farmers. But in Mymensingh, retailers collected potato from dealer.

Table 4: Potato collection sources of retailers of different districts

District	Potato collection sources
Comilla	Cold storage, Farmers
Dinajpur	Cold storage, Farmers
Mymensingh	Dealer
Rangpur	Cold storage, Farmers

3.10 Care of stored potato during storage

In this study care of stored potato by retailers of different districts during storage were assessed (Table 5). In all selected districts, the retailers provide fan for providing good aeration facility in their storage. They also applied sorting of potato before storage for avoiding contamination and gaining good market price.

Table 5: Care of stored potato by retailers of different districts during storage

District	Caring measures
Comilla	Provide fan, Grading
Dinajpur	Provide fan, Grading
Mymensingh	Provide fan, Grading
Rangpur	Provide fan, Grading

3.11 Most favorable period for potato storage

Retailer's knowledge on most favorable period for potato storage were assessed in this study (table 6). Retailers in Comilla and Dinajpur districts, replied on the survey that most favorable (good) period for potato storage was February to April. Retailers from Rangpur said it was March to May. But retailers from Mymensingh gave different answer from the others. Most of them answered that most favorable period for storage was August to December. Some of them said it was April to May. Some of them said they had no clear idea about the most favorable period for potato storage.

3.12 Most unfavorable period for potato storage

Retailer's knowledge on most unfavorable period for potato storage were assessed in this study (Table 7). The findings are also slightly different from districts to districts. In Comilla, most of the retailers answered that most unfavorable period for potato storage was April to June. Few retailers mentioned October & January as unfavorable period for potato storage. In Dinajpur, Almost all the retailer said it was July to December. Meanwhile, in the district of Mymensingh, most of the retailers said unfavorable period for potato storage was November to January. Some of them said it was June to July. In Rangpur, the retailers told that the most unfavorable period for potato storage was May to July.

Table 6: Retailers knowledge on most favorable period for potato storage

Sl. No.	Comilla	Dinajpur	Mymensingh	Rangpur
1	February-April	March-April	August-September	April-November
2	March	March	April-May	April-May
3	March-April	February-March	September-December	March-May
4	Mid March-mid April	Mid March-April	August-September	April-May
5	March-April	February-April	June-July	April
6	April-November	March	September-December	April-May
7	April-May	March-April	March-April	April-May
8	March-May	Mid March-mid April	August-September	April
9	April-May	March-April	April-May	April-May
10	April	April	September-December	April

Table 7: Retailers knowledge on most unfavorable period for potato storage

Sl. No.	Comilla	Dinajpur	Mymensingh	Rangpur
1	April-May	Mid April-mid July	December-January	April-May
2	June-July	November-December	November-December	June-July
3	May-July	May-June	November-December	May-July
4	June-July	January-March	June-July	June-July
5	June-October	July-August	April-May	June-October
6	May-June	June-July	June-July	May-June
7	November-December	July-November	November-December	June-July
8	May-June	May-July	November-December	June-July
9	January-March	June-July	November-December	July-August
10	July-August	November-December	June-August	June-July

3.13 Survey on Physical abnormalities of potato collected from retailers of different districts in Bangladesh

Prevalence of Physical abnormalities of Potato collected from different retailers in Comilla, Dinajpur, Mymensingh and Rangpur were recorded and are presented in table 8, 9, 10 and 11. In the Table 8, Prevalence of Physical abnormalities of Potato collected from three selected retailers of Comilla district are presented. The average physical abnormalities occurrence of the retailers of Comilla was found as 13.80% (green potato 7.81%, cut potato 3.55%, pitted potato 2.44%). The highest observation of green potato was recorded from Polli store (11.07%) followed by Chawdhury store (7.06%) and M/ S Shanti Retailers (5.29%). Similarly, the highest observation of cut potato was recorded from Chawdhury Store (6.30%) followed by M/S Shanti Retailers (3.15%) and Polli store (1.20%). The highest Observation of pitted potato was recorded from Chawdhury Store (3.32%) followed by M/S Shanti Retailers (2.29%) and Polli Store (1.70%). Average percentage of healthy potato was found 86.20 in the district of Comilla.

In Table 9, Prevalence of Physical abnormalities of Potato collected from three selected retailers of Dinajpur district are presented. The average Physical abnormalities found in the retailers storage of Dinajpur was found as 14.63% (green potato 6.21%, cut potato 6.18%, pitted potato 2.24%). The highest observation of green potato was recorded from Sujon

Khalasi Ghar (7.04%) followed by M/S Bishal Retailers (6.53%) and M/S Al Amin Retailers (5.07%). Similarly, the highest observation of cut potato was recorded from M/S Bishal Retailers (7.35%) followed by M/S Al Amin Retailers (5.60%) and Sujon Khalasi Ghar (5.58%). The highest observation of pitted potato was recorded from M/S Bishal Retailers (3.52%) followed by Shujon Khalasi Ghar (2.54%) and M/S Al Amin Retailers (0.67%). Average percentage of healthy potato was found 85.37 in the district of Dinajpur.

Table 8: Prevalence of Physical abnormalities of Potato collected from different retailers in Comilla in the month of November, 2015

Shop Name	Green Potato (%)	Cut Potato (%)	Pitted Potato (%)	Total Devalued Potato (%)	Healthy Potato (%)
1. Chawdhury Store	7.06b	6.30a	3.32a	16.68a	83.32b
2. Polli Store	11.07a	1.20c	1.70c	13.97b	86.03ab
3. M/S Shanti Traders	5.29c	3.15b	2.29b	10.73c	89.27a
Average	7.81	3.55	2.44	13.80	86.20
LSD _{0.05}	1.27	0.405	0.446	1.65	3.84
Level of significant	**	**	**	**	*

**= Significant at 1% level of probability, *= Significant at 5% level of probability

Table 9: Prevalence of Physical abnormalities of Potato collected from different retailers in Dinajpur in the month of November, 2015

Shop Name	Green Potato (%)	Cut Potato (%)	Pitted Potato (%)	Total Devalued Potato (%)	Healthy Potato (%)
1. M/S Al Amin Traders	5.07b	5.60b	0.67c	11.34c	88.66a
2. M/S Bishal Traders	6.53a	7.35a	3.52a	17.40a	82.60b
3. Sujon Khalasi Ghar	7.04a	5.58b	2.54b	15.16b	84.84ab
Average	6.21	6.18	2.24	11.63	85.37
LSD _{0.05}	1.27	0.619	0.357	1.62	3.87
Level of significant	*	**	**	**	*

**= Significant at 1% level of probability, *= Significant at 5% level of probability

Prevalence of Physical abnormalities of Potato collected from three selected retailers of Mymensingh district are presented in the Table 10. The average Physical abnormalities observation of the retailers of Mymensingh was found as 13.41% (green potato 6.12%, cut potato 5.57%, pitted potato 1.71 %). The highest observation of green potato was recorded from Mayer Doya Sobuj Bitan (7.39%) followed by Selim Enterprise (5.75%) and Shaha Enterprise (5.23%). Similarly, the highest observation of cut potato was recorded from Mayer Doya Sobuj Bitan (6.75%) followed by Saha Enterprise (5.72%) and Selim Enterprise (4.23%). The highest observation of pitted potato was recorded from Saha Enterprise (2.01%) followed by Selim Enterprise (1.70%) and Mayer Doya Sobuj Bitan (1.44%). Average percentage of healthy potato was found 86.59 in the district of Mymensingh.

Prevalence of Physical abnormalities of Potato collected from three selected retailers of Rangpur district are presented in the Table 11. The average Physical abnormalities in potatoes of the retailers storage of Rangpur was found as 89.8% (green potato 4.64%, cut potato 1.79%, pitted potato 1.99%). The highest observation of green potato was recorded from Kaysar Banijyaloy (5.53%) followed by Selim Banijyaloy (4.86%) and Shahin Banijyaloy (3.52%). Similarly, the highest observation of cut potato was recorded from Selim Banijyaloy (3.55%) followed by Kayser Banijyaloy (2.04%) and Shahin Banijyaloy (1.47%). The highest observation of pitted potato was recorded from Selim Banijyaloy (2.36%) by Kaysar Banijyaloy (1.86%) and Shahin Banijyaloy (1.76%) of healthy potato was found 91.02 in the district of Rangpur.

Table 10: Prevalence of Physical abnormalities of Potato collected from different retailers in Mymensingh in the month of November, 2019

Shop Name	Green Potato (%)	Cut Potato (%)	Pitted Potato (%)	Total Devalued Potato (%)	Healthy Potato (%)
1.Mayer Doya Sobji Bitan	7.39a	6.75a	1.44c	15.58a	84.42b
2. Saha Enterprise	5.23b	5.72b	2.01a	12.96b	87.04a
3.Selim Enterprise	5.75b	4.23c	1.70b	11.68c	88.32a
Average	6.12	5.57	1.71	13.41	86.59
LSD _{0.05}	0.524	0.389	0.167	0.857	2.23
Level of significant	**	**	**	**	**

**= Significant at 1% level of probability, *= Significant at 5% level of probability

Table 11: Prevalence of Physical abnormalities of Potato collected from different traders in Rangpur in the month of November, 2019

Shop Name	Green Potato (%)	Cut Potato (%)	Pitted Potato (%)	Total Devalued Potato (%)	Healthy Potato (%)
1.Shahin Baniyaloy	3.52b	1.47c	1.76b	6.75c	93.25a
2. Kaysar Baniyaloy	5.53a	2.04b	1.86b	9.43b	90.57ab
3. Selim Baniyaloy	4.86a	3.55a	2.36a	10.77a	89.23b
Average	4.64	1.79	1.99	8.98	91.02
LSD _{0.05}	1.04	0.261	0.245	0.752	2.84
Level of significant	**	**	**	**	*

**= Significant at 1% level of probability, *= Significant at 5% level of probability

Prevalence of Physical abnormalities of Potato collected from different retailers of districts of Comilla, Dinajpur, Mymensingh and Rangpur are presented in the Table 12. The average Physical abnormalities found in the retailers storage of Comilla, Dinajpur, Mymensingh and Rangpur was found as 13.78% (green potato 6.20%, cut potato 4.27%, pitted potato 3.31%). The highest observation of green potato was recorded from Comilla (7.81%) followed by Dinajpur (6.21%), Mymensingh (6.12%) and Rangpur (4.64%). Similarly, the highest observation of cut potato was recorded from Dinajpur (6.18%) followed by Mymensingh (5.57%), Comilla (3.55%) and Rangpur (1.79%). The highest observation of pitted potato was recorded from Comilla (2.44%) followed by Dinajpur (2.24%), Rangpur (1.99%) and Mymensingh (1.71%).

Table 12: Loss estimation of Physical abnormalities of potato collected from different districts of Bangladesh

District	Green potato (%)	Cut Potato (%)	Pitted Potato (%)	Total
Comilla	7.81a	3.55b	2.44 a	13.79a
Dinajpur	6.21b	6.18a	2.24 ab	14.63a
Mymensingh	6.12b	5.57a	1.71 c	13.41a
Rangpur	4.64c	1.79c	1.99 bc	8.98b
Average	6.20	4.27	2.10	13.78
LSD _{0.05}	1.16	1.13	0.347	2.51
Level of significant	**	**	**	**

**= Significant at 1% level of probability, *= Significant at 5% level of probability

Figure 5: Retailers opinion to physical abnormalities of potato collected from different districts of Bangladesh.

3. DISCUSSION

Potato is a valuable source of carbohydrates to most people in Bangladesh as well as in the world. The availability of potato in the market for a considerable part of the year helps to prevent food shortages, particularly in the urban communities because of its relatively longer shelf life, compared with other root crops. Potato has huge storage losses from farmers home to market of which dry rot, soft rot, potato scab are the important causes. A report describing damage and loss occurring channels of potato value chain stated that, around 25% potatoes were damaged in supermarkets due to post-harvest quality reduction for assessing post-harvest losses in markets (Kaguongo *et al.* 2014). That is why preliminary survey was performed in different markets of Comilla, Dinajpur, Mymensingh and Rangpur district for assessing market diseases and losses in the storage of retailers. A total of 40 retailers were randomly selected for collecting primary data and information. Questionnaire contained the basic information of retailers such as age, gender, educational qualification, marketing experience, ownership and their basic knowledge of stored variety, problems associated in stored potato, storage conditions, causes of losses of stored potato, common storage diseases of potato, possible reasons for rotting of potato in storage, primary source of potato, care of stored potato, most favorable and unfavorable period for potato storage. In overall view, all the selected retailers mentioned cut potato, injured potato, small potato, rotten potato, greenish potato and varietal mixture as most common problems in stored potato. They also mentioned that most common causes of post-harvest losses are rats, insects, during transport and during storage. They mentioned mixture with rotten potato, injured potato, cut potato and wet potato as most common reasons for rotting of stored potato during storage in this questionnaire survey. This result reflects the findings of Hossain and Miah (2009), who conducted a survey and found that average harvesting loss comprised of insect damage (1.21%), rotten loss (1.40%), culling loss (1.14%), potato remained under soil during harvesting (0.89%), and other losses (1.02%) such as off size, green potato etc. A survey conducted by Kaguongo *et al.* (2014) also reported that according to the opinion of retailers, cut tubers, bruised tuber, potted potatoes and greening potatoes are the main causes of post-harvest losses in markets. Under bad handling and storage conditions post-harvest losses may reach to 100% (CIP, 1987). Rahman (1969) and Kamaluddin (1970) claimed that 2-9% total losses occur due to storage disease every year in cold storage condition.

5. CONCLUSION

For surveying the post-harvest losses of potato in different markets of Mymensingh, Rangpur, Dinajpur and Comilla, ten retailers from each district were selected. A questionnaire mentioning problems of post-harvest potato in storage developed. Questionnaire was filled up by face to face interview of these selected retailers. They were selected from puratan bahadur bazar in Dinajpur, City bazar in Rangpur, Mechuya bazar in Mymensingh and Chawkbazar in Comilla. The most stored variety of potato in was Diamant, Asterix, Diamant, Cardinal, Granula, Shilbilati etc. The retailers focused on injured potato followed by cut potato, small potato, rotten potato, greenish potato and mixed potato as main problem of stored potato. The major problems of stored potato were cut potato, injured potato and rotten potato. All of the retailers stored potato on concrete floor. Maximum losses were found in during storage followed by during transport, rats and diseases of potato, insects and other causes like warm weather. Rats were also responsible for some losses in all these areas. Soft rot, dry rot, scab are found as the most common diseases in markets, The most common causes of rotting potato injured potato, cut

potato, potato etc. The causes varied with different varieties of potato. The most common primary source of potato were farmers and cold storage, in these elected districts. The most common care about stored potato during storage was providing aeration and grading. The most favorable seasons for potato storage found February to April. The most unfavorable seasons for potato storage was found July to December. Post-harvest loss estimation of potato in markets was done. This study was a preliminary step for the investigation the idea of the retailers of the selected districts about the status and problems they faced for potato storage in markets. The study revealed the fact that potatoes were subjected to various diseases in the markets of Bangladesh. A thorough and wide scale investigation is needed to gather a clear idea regarding the causes, problems and factors involved in disease or rots of potato in the markets in Bangladesh.

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