STUDY ON PROCESSING QUALITY OF SOME POTATO VARIETIES AS INFLUENCED BY GROWING ENVIRONMENT

RAJASREE SARKER

DEPARTMENT OF AGRONOMY

SHER-E-BANGLA AGRICULTURAL UNIVERSITY

DHAKA -1207

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STUDY ON PROCESSING QUALITY OF SOME POTATO VARIETIES AS INFLUENCED BY GROWING ENVIRONMENT

By

RAJASREE SARKER
Reg. No.: 12-05093

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APPROVED BY

_____	_____
(Prof. Dr. Tuhin Suvra Roy)	**(Associate Prof. Anisur Rahman, PhD)**
Supervisor	Co-supervisor
Department of Agronomy	Department of Agronomy
SAU, Dhaka	SAU, Dhaka

_____
(Prof. Dr. Md. Shahidul Islam)
Chairman
Examination Committee

DEPARTMENT OF AGRONOMY

Sher-e-Bangla Agricultural University
Sher-e-Bangla Nagar, Dhaka-1207

CERTIFICATE

This is to certify that the thesis entitled **"Study on Processing Quality of Some Potato Varieties as Influenced by Growing Environment"** submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfillment of the requirements for the degree of **Master of Science (MS)** in **Agronomy**, embodies the results of a piece of *bona fide* research work carried out by **Rajasree Sarker**, Reg. No. **12-05093** under my supervision and guidance. No part of this thesis has been submitted for any other degree or diploma.

I, further, certify that such help or source of information as has been availed of during the course of this investigation has duly been acknowledged.

Dated:
Dhaka, Bangladesh

(Prof. Dr. Tuhin Suvra Roy)
Supervisor
Depatment of Agronomy
Sher-e-Bangla Agricultural University
Dhaka-1207

DEDICATED

TO

MY BELOVED PARENTS

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The Author

STUDY ON PROCESSING QUALITY OF SOME POTATO VARIETIES AS INFLUENCED BY GROWING ENVIRONMENT

ABSTRACT

A study was conducted to investigate the influence of growing environment on processing quality of five potato (*Solanum tuberosum* L.) varieties (Asterix, Courage, Lady Rosetta, Felsina and Dura) grown at Panchagarh, Dhaka and Munshiganj in Bangladesh during 2017-2018. The experiment consisted of 2 factors: Factor A : Location (3 locations) as - P: Panchagarh, D: Dhaka, M: Munshiganj; Factor B : Potato variety (5 varieties) as-V_1: Asterix, V_2: Courage, V_3: Lady Rosetta, V_4: Felsina, V_5: Dura. Each varieties from each locations were collected and stored at ambient conditions for 60 days in the laboratory of Sher-e- Bangla Agricultural University, Dhaka-1207. The quality of tubers *viz*., dry matter percentage, total soluble solids, firmness, weight loss percentage, specific gravity, starch percentage, fleshcolor, chipscolor and chips were made from them was evaluated at varying storage periods. Tubers from Lady Rosetta variety had a high specific gravity (1.0840 g cm^{-3}) and dry matter percentage (22.7%) when grown in Panchagarh and a lower specific gravity (1.0413 g cm^{-3}) and dry matter percentage (20.8%) when grown in Munshiganj. There was a progressive reduction in specific gravity, dry matter percentage, firmness, crispness with increasing of storage time and increasement in total soluble solid with advancing storage period. Variety with higher dry matter concentration maintained a better quality than variety with a lower dry matter content. It is reasonable to conclude that Lady Rosetta variety can produce tubers with a high dry matter percentage under Panchagarh conditions. In ambient storage the result revealed that the quality parameter of potato such as dry matter percentage, firmness, weight loss percentage, specific gravity slowly decreased upto 40 days after storage (DAS) and thereafter sharply lost this values. So it may be concluded that farmers of Bangladesh can store their potato upto 40 DAS without sacrificing its quality.

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LIST OF ACRONYMS

Acronyms	Full word
Agril.	Agricultural
BARI	Bangladesh Agricultural Research Institute
BBS	Bangladesh Bureau of Statistics
cm	Centimeter
CV	Coefficient of Variation
DAS	Days After Storage
et al.	And others (*et alibi*)
FAO	Food and Agriculture organization
g	Gram
J.	Journal
K cal	Kilo calorie
LSD	Least Significance Difference
MT	Matric Ton
N	Nitrogen
NS	Non-Significant
%	Percent
pH	Hydrogen ion concentration
RS	Reducing Sugars
SAU	Sher-e- Bangla Agricultural University
TCRC	Tuber Crop Research Centre
TSP	Triple Superphosphate
viz.	*videlicet* (L.), Namely

CHAPTER 1
INTRODUCTION

Potato (*Solanum tuberosum* L.) is extensively grown in 150 countries ranging from 65^{o} N to 50^{o} S latitude. It is world's fourth most important food crop after wheat, maize and rice. Bangladesh is the 7th potato producing country in the world and in Bangladesh, it ranks second after rice in production. The total area, production and yield of Bangladesh is 0.496 million hectares, 0.94 crore MT and 19.03 t ha^{-1}, respectively (FAOSTAT, 2014). It produces more ratio of protein to calories (17 g protein: 1000 K Cal), which is higher than the most of other root, cereal and plantation crops (Adhikari *et al*., 2008). As compared to many cereal crops, potato gives an exceptionally high yield, fits well into multiple cropping systems prevalent in tropical and sub-tropical agro-climatic conditions and provides employment.

Processing is an important value addition function of marketing and is considered as a major source of income and employment in Asia, Africa and Latin America. Processed potato products have high demand in the markets (Khurana, 2005) and market value of processed products is far better than the value of raw products (Abbas, 2011). In the most developed and developing countries, an increasing proportion of potato crop is being processed prior to consumption. More than 50% potato crop is processed in USA and nearly 30% in the United Kingdom (Pandey *et al.,* 2000).

For chips making purpose, potato should have round to oval shape, shallow eyes, high dry matter and specific gravity and low reducing sugars. Genotypes and environment have major role on dry matter, glucose content and chips colour of potato (Amoros *et al.,* 2000). Varieties recommended for one location and management conditions may not be the same for other locations for production and processing.

Crisp quality of potato is composed of many characters.Colors is one of the most important characters of potato crisps (Stevenson *et al*., 1964) and represents the crisp industry with the greatest problem (Talburt and Smith, 1967).Crisp quality is influenced by both genotype and environment (Stevenson *et al.,* 1964). Factors that influence potato tuber composition also control potato crisp color (Talburt and Smith, 1967).

Processing varieties differed with table varieties with respect to numbers of characters like shape and size of tubers, carbohydrate composition, dry matter (DM), specific gravity (SG), reducing sugars (RS) and shelf life. Mineral nutrients especially nitrogen (N) and potash (K_2O) play very important role for economic yield and quality of processing potato. Nitrogen is an essential constituent of protein and chlorophyll that influences growth, yield and the quality of potatoes than other nutrients. However, its excess application suppresses tuber initiation, reduces yield, decreases specific gravity, dry matter, poor skin set, poor quality and storability in some cultivars (Lisinka and Leszczynski, 1989; Mikkelsen, 2006). Potash has crucial role for many metabolic functions such as synthesis of photosynthates and their transport from the leaves to the tubers and their conversion into starch. It controls the plant water status and internal ionic concentration of the plant tissues. It helps to maintain cell turgid, enhances shipping quality, extends shelf life and improves chip colour and decreases storage losses (Marschner, 1995). Potato tubers remove 1.5 times more K_2O than N and 4 - 5 times more than phosphorus from soil (Perrenoud, 1993). However, it's over dose reduces tuber specific gravity (Chapman *et al.,* 1992; Panique *et al.,* 1997) which may influences the processing quality. Storage of potato plays an important role to minimize the price fluctuation and continue supply in the market. Storage at high temperature and relative humidity causes heavy losses both in quantity and quality. These losses are mainly caused by high transpiration, respiration, sprouting, changes in chemical composition of tubers and spread of diseases. In the developing countries of the tropics and sub tropics, the post harvest handling and storage losses of potatoes have been estimated about 20 - 30% (Prasad *et al.,* 1989; Satter *et al.,* 2002; Karki, 2003).

Potato can be successfully stored in cold store. cold stored potatoes become sweet due to accumulation of higher levels of reducing sugars and turn dark brown while frying at high temperature due to Millard's reaction (Kumar *et al.,* 2005; Gautam and Bhattarai, 2006; Ezekiel *et al.,* 2007). On-farm storage structures like; heap and pit storage have been developed and utilized for storing potatoes, especially the varieties having long shelf-life in them. Storing of potatoes in such structures also helps to maintain good processing quality due to low accumulation of reducing sugars (Uppal, 1999; Marwaha, 2001).

The dry matter concentration of tubers is an important measure of quality to assess suitability for processing purposes as it influences process efficiency, product yield and oil absorption (Stevenson *et al*., 1964). Tubers with high dry matter concentration require less energy input during frying or dehydration to remove water, they have greater product yield per unit fresh weight than tubers with lower solid concentration and absorb less oil during frying (Burton *et al*., 1992). Potatoes with dry matter concentrations of 20-24% are acceptable for making French fries and crisps while those with dry matter concentration upto 24% are ideal for preparing crisps (Kabira and Berga, 2003). Specific gravity of raw potatoes is widely accepted by the potato processing industry as a measure of total solids, starch concentration and other qualities (Fitzpatrick *et al.,* 1969). High and medium specific gravity tubers have better quality and lower oil absorption when utilized for crisps (Kunkel *et al*., 1951; Lana *et al.,* 1970).

In Bangladesh, most farmers cannot store potato at home in large quantities for long period. They sell out major part of potato immediately after harvest with low price. Harvesting period can play important role on processing quality of potato. In Bangladesh, potato is stored in three ways such as (i) in cold stores under controlled environment (ii) in the houses under normal room conditions. The present cold storage capacity in Bangladesh is about 25% of the total potato productions (BBS, 2010). Potato can be stored under normal room conditions for a longer period but proper knowledge of storage environment can help to maintain the quality, extend the storage period and increase the value of stored potato.

The present research work was undertaken with following objectives-

1. To find out the suitable location for processing quality of potato
2. To screen out the suitable variety for better processing purpose

CHAPTER 2

REVIEW OF LITERATURE

Potato is a perishable commodity and three variables determine storage losses in potatoes: quality of the tuber at the beginning of the storage, storage conditions and duration of storage (Burton *et al.*, 1992). Storage losses are often specified as weight losses and losses in quality of potatoes which are caused by respiration (Basker, 1975); sprouting (Amaros *et al*., 2000); evaporation of water from the tubers (Kabira and Berga, 2003); changes in chemical composition and physical properties of the tuber (Cronk *et al.,* 1974; Maga, 1980) and damage by extreme temperatures (Linnemann *et al,*. 1985). Quality of potato tuber is one of the most important quality attributes (Brown, 2005) for consumers and industrial demand. Processing quality of potato tubers is determined by high dry matter, high starch (Kadam *et al*.,1991; Abong *et al*., 2009). Some of the important experiment reports considering processing qualiy of potato have been reviewed in this chapter.

A study was conducted by Elfnesh *et al*. (2011) to investigate the influence of growing environment and blanching on chips quality of five improved potato cultivars (Chiro, Zemen, Bedassa, Gabissa and Harchassa). The cultivars were grown at Langaie, Kulubi and Haramaya, all in the eastern part of Ethiopia. The highest tuber dry matter content (27.33%) and specific gravity (1.110 gcm-3) were produced by cultivar Harchassa while the lowest dry matter content (20.33%) and specific gravity (1.078 g cm-3) were by cultivar Zemen both grown at Haramaya condition. All the cultivars at all locations produced tubers with a dry matter content greater than 20.0% and a specific gravity of 1.070 gcm-3 which are within the acceptable range for chip processing. The tuber pH value ranged from 6.18 to 6.37 for the cultivars regardless of the growing environment. Location did not significantly affect tuber reducing sugar content and the cultivars produced tubers with low reducing sugar content that ranged from 0.036 to 0.051 g 100 g-1 fresh weight (FW). For chips making, peeled potatoes were sliced to 2.0 mm thickness, washed and surface-dried. In the blanching treatment, sliced potatoes were blanched at 90°C for about 5 min. Both blanched and unblanched slices were fried at 175°C for about 5 min using vegetable oil. The interaction effect of genotype and growing environment significantly influenced texture, bitterness, sweetness, crispiness and overall acceptability of potato chips.

Blanching improved chips color, texture, sweetness, and crispness while reducing sourness and bitterness, ultimately increased the overall acceptability. In all cases, blanching resulted in a better acceptability of potato chips. The study indicated that the tested cultivars can be potentially be used for chips making. However, a comprehensive study under wide frying and blanching condition would be necessary to optimize the best operating conditions. The potato breeders should give emphasis for genotype × environment interaction while developing varieties suitable for processing.

In Ethiopia, potato sub-sector is expanding, with more value added products, such as potato chips, mainly due to increasing demands associated with growth of population and urbanization. Processing industry is very dependent on the quality parameters of tuber to satisfy the increasing demand of customers. Thus, this experiment was conducted by Bekele and Haile (2019) with the objective to evaluate the quality of some improved potato varieties at Shebench district of Bench-Maji Zone. The study comprised of nine improved potato varieties laid out in randomized complete block design (RCBD) with three replications. The tuber size distribution and proximate quality data were collected and analyzed by using SAS Version 9.2 statistical software. The results of the study revealed that all of the variables considered were significantly ($P<0.01$) affected by varieties except pH. Accordingly, considering tuber size distribution,the highest percentage of medium tuber was observed for Gudanie (77.4) followed by Belete (72.18). Whereas the highest percentage of large tuber was observed for variety Belete (17.35) followed by Shenkola (14.03). On the other hand, the least percentage of small tuber size was observed for variety Belete (10.47) followed by Gudanie (13.59). With regard to physicochemical qualities, the highest value of dry mater content (21.67%), specific gravity (1.08) and starch content (14.69%) were observed for Gudanie variety whereas Degemegn (3.28%) and Gudanie (3.27%) varieties showed the highest protein contents. Therefore, considering majority of the tested marketable and processing quality attributes, variety Gudanie can be considered as superior and recommended for the study area. In addition to this, growers in the study area can also use variety Belete for its good marketable tubers and varieties Gera, Gorebela and Chala for their acceptable processing quality.

This work was conducted by Freitas *et al*. (2012) to access processing quality of potato clones (*Solanum tuberosum*) Asterix, SMINIA793101-3, and Missaukee cultivated during spring and autumn growing seasons and stored at 4, 8, 12, or 25ºC. Clones grown in spring had shorter dormancy than clones grown in autumn. Potato tubers grown in spring and autumn and stored at 4ºC, as well as tubers grown in autumn and stored at 8ºC had no sprouting for six months. Among clones grown in autumn, the longest dormancy period during storage at 12ºC was observed in the clone SMINIA793101-3, and at 25ºC was in the clone Asterix. In potato tubers grown in spring, the longest dormancy period during storage at 8ºC was observed in the clones SMINIA793101-3 and Missaukee, at 12ºC was in the clone SMINIA793101-3, and at 25ºC was in the clones Asterix and Missaukee. Potato tubers grown in spring had higher dry matter (Asterix 19.9 ,SMINIA793101-3 20.1, Missaukee 19.2) starch content (Asterix 500.0, SMINIA793101-3 526.9, Missaukee 429.3) and respiration rates (Asterix 5.8, SMINIA793101-3 7.1, Missaukee 6.6) and lower reducing sugar (Asterix 32.1, SMINIA793101-3 26.4, Missaukee 26.6) and total polyphenol content (Asreix 1.9, SMINIA793101-3 1.7, Missaukee 1.6). The only exception was the Missaukee (Spring 19.2, Autumn 19.1) that had similar dry matter content in both growing seasons. In general, storage at 4ºC and 8ºC were more effective in reducing respiration rates and maintaining higher dry mater content of potato tubers. Chip darkening, reducing sugars, and total polyphenol content increased during storage of potato tubers. Darker chip color, higher reducing sugars and polyphenol content were obtained during storage at temperatures of 4ºC and 8ºC. These results suggest that the best storage temperature depends on genotype, tuber physiological age, and growing conditions.

The highland of Bale South Eastern Ethiopia is known with potato production, but post harvest quality of the crop is not emphasized yet. Therefore, this study was conducted by Soboka *et al.* (2017) to evaluate six potato varieties with the objective of assessing the effect of varieties and growing on tuber nutritional and process quality of potato grown in Sinana and Dinsho highlands of Bale. The experiment was laid out in randomized complete block design with three replications. The varieties showed highly significant ($P < 0.05$) differences for all the parameters studied across the locations. The highest specific gravity, dry matter content and starch content (1.107, 26.61 and 19.19) were recorded from Dinsho location for Guddene variety while the lowest specific gravity, dry matter content and starch content (1.084, 19.41 and 14.61)

were recorded from Sinana location for Ararsa variety. Most of the varieties were recorded as the highest values of specific gravity, dry matter and starch content at Dinsho indicating that it is an ideal location for potato production to be used for processing while Sinana is suitable for the production for home consumption. However, it is necessary to evaluate these varieties for a number of seasons and locations to recommend with high post harvest quality parameters required by the processors.

Specific gravity (SG) is the measure of choice for estimating dry matter (DMC) and starch content (SC) and ultimately for determining the processing quality of potato varieties. A study was conducted by Tesfaye Abebe *et al.* (2013). Evaluation of the SG of 25 potato varieties was carried out at three distinct locations in the Amhara region of Ethiopia with the main objectives of determining their culinary quality and most suitable areas of production. The varieties were planted in a 5 × 5 balanced lattice design of six replications during the 2011 rainy season. The results of the data analysis showed highly significant ($P < 0.01$) genotypic and location differences and significant ($P < 0.05$) genotype × environment interactions. The pooled SG values ranged from 1.058 to 1.102. The SG of tubers of the improved variety Belete was the highest while that of Menagesha was the lowest. Furthermore, the SG values for varieties grown at Debretabor were higher than those for the corresponding varieties grown at Adet and Merawi. The DMC and SC were computed based on the SG and showed significant ($P < 0.01$) genotypic variability. The highest DMC and SC were also obtained at Debretabor; thus, it is an ideal location to grow potatoes for high DMC and starch accumulation. Additive main effects and multiplicative interaction analysis identified CIP392640.524, Zengena, Jalenie and Belete as stable genotypes with SG values above average.

Marwaha and Sandhu (2002) conducted an experiment. Five potato cultivars, belonging to early and medium maturing groups, grown under short (min.5-21^0 C, max. 15-34^0 C, day length 11.5-9.75 hr) and long day (min. 6-25^0 C, max.17-41^0 C, day length 11-13.5 hr) conditions in autumn and spring, respectively, were evaluated for important crop characteristics, contents of chemical compounds and indices of tuber quality at different stages of growth. Mean tuber yield, tuber specific gravity and dry matter content, tuber dry matter production and starch yield increased upto the last stage of harvest in both the crop

seasons, but were significantly higher in autumn. Mature tubers grown in autumn displayed a significantly higher content of reducing sugars and produced darker chips, while those grown in spring showed higher level of sucrose and polyphenols. 'Kufri Lauvkar' was most suitable for the preparation of chips during autumn, while all five cultivars produced chips of acceptable color quality during spring. The yield of fried products from tuber grown during spring was expected to be much lower due to less tuber dry matter production, but these tubers can be used to prolong the period of processing. 'Kufri Jyoti' produced the highest starch yield per unit area in both seasons and was the most suitable for the production of starch and dehydrated products.

In 2016, trials were conducted by Senkumba *et al.* (2017) over two seasons to evaluate varieties already registered in Uganda and clones from the International Potato Center's breeding program for suitability for postharvest storage. These varieties were studied for their storage behavior, physical and chemical properties with special reference to their potential in chip processing and consumer acceptability in ambient stores made of rice straw for insulation, cement plaster on the walls with ventilation. The stores were located in Kapchorwa Town council (1,800 masl), Bennet (2,300 masl), and Mbale Town Council (1,200 masl). Varieties and clones with short dormancy are not suitable for storage, with Shangi, having the shortest dormancy periods. All other clones have dormancy periods of 2 months or greater, making them suitable to store provided they meet variety-specific requirements for specific outlets. The highest dry matter content was recorded in 398208.704 and 393385.4, averaging of 21.9 and 20.8%, respectively, making them appropriate for processing, while the lowest dry matter content was recorded in Rwanshaka and Victoria, averaging 19.2 and 18.5% respectively, making them more suitable for table use. Clone 392797.22 was the most overall acceptable, followed by Rwangume, Kinigi, Rwanshaka. Clone 393385.39 had the lowest consumer acceptability score overall followed by 393079.4. Therefore all clones tested in this trial are suitable for storage with the exception of clones 393385.39, 393079.4 and Shangi.

Present research was designed by Mahamud *et al*. (2015) to evaluate the dry matter yield and biochemical constituents of twenty two potato accession of USA in comparison with two Bangladeshi varieties. Studied biochemical constituents were starch, protein and vitamin C

contents. Analyses were performed from November 2014 to April 2015 in different laboratories of Bangladesh Agricultural University, Mymensingh. Potato accessions differed significantly with respect to dry matter content and biochemical parameters. Dry mater content was found highest in accession AC 10110. Considering biochemical constituent, the accession AC 10062 showed highest protein and vitamin C contents. On the other hand, accession AC 10081 had the highest starch content. Significant positive correlation was observed between dry matter and starch content while significant negative correlation was observed between starch and protein contents. Considering both dry matter yield and biochemical parameters AC 10081 was found as the best USA potato accession for cultivation in Bangladesh.

Processing quality of potatoes for French fries is partially determined by reducing sugar content of the tuber. Much of the potato crop is processed after a storage period when sugar content can change and affect processing quality. By the study of Affleck *et al.* (2012), the stability of sugar levels in eight potato genotypes was studied over four environments (i.e., two locations over 2 yr). The GGE biplot analysis was used to measure the stability of, and the association between, quality traits and sugar content. Quality and sugar content were measured 105 and 120 days after planting and 60 and 120 days after storage. The biplots indicated a change in French fry colour scores and stability between the 105 and 120 d after planting harvest dates. Genotypic differences were noted for French fry colour scores and glucose content. Genotypes were identified that were stable for French fry colour during the two storage periods indicating low genotype by environment interaction. The GGE biplot identified mega-environments that encompassed a group of environments with similar attributes. Based on this finding potatoes from only one environment within the mega environment would need to be stored for quality evaluations.

The acceptability of potatoes for processing as french fries is largely dependent on the quality of the end products. Processing industry is totally dependent on the quality parameters of tuber to satisfy the increasing demand of customers. Thirty two potato genotypes for processing and yield quality traits were assessed for screening by Abbas *et al.* (2012). Significant differences in all the quality parameters and various characteristics were found, while the genotypes; 394021-120, 9625, Kiran, NARC 2002- 1, NARC 1-2006/1 and VR 90-217 gave the highest results regarding

yield and quality of potato tubers except kiran, which has a high yield but low quality characters. The tuber sizes and weight was also significantly different among genotypes except weight of big size tubers. Variations existed among genotypes in tuber characteristics (skin color, tuber shape, eye depth, flesh color and general appearance). The results regarding correlation studies indicated that french fry color exhibited negative correlation with reducing sugar (r = -0.7046), total sugars (r = -0.6659) and positive correlation with dry matter (r = 0.5013).This screening is helpful to the ongoing efforts to select the best genotype for the emerging processing industry of Pakistan.

The varieties Kufri Chipsona-l and Kufri Chipsona-2 have been developed by Gaur *et al.* (1999) in a record time to meet enormous demand for good processing potatoes. These varieties possess high tuber dry matter, low reducing sugars and produce excellent light colour chips of international standards. North western plains are known to produce potatoes of low dry matter and high reducing sugars which result in dark colour of fried products. The produce of this region is, therefore, not considered suitable for processing. The trials conducted in this region at Modipuram for six consecutive years (during 1993-94 to 1998-99) showed that Kufri Chipsona-l and Kufri Chipsona-2 always produced 2-4 percent higher tuber dry matter than the standard processing variety Kufri Jyoti. The level of dry matter in these varieties, which in most cases was above 20 per cent, was in acceptable range for processing. The chip colour in these varieties was also assessed for 4 consecutive years (1995-96 to 1998-99). Both Kufri Chipsona-1 and Kufri Chipsona2 always produced chips in the range of 1-3 when measured on a scale of 1-10 where 1 is white and 10 the dark brown colour. The chip colour in the range of 1-3 has high acceptance in the market. In trials, both Kufri Chipsona-l and Kufri Chipsona-2 gave yields equal to or more than that of Kufri Jyoti. Both of these varieties also showed advantage of having resistance to late blight disease. During 1996-97 potato crop season, severe frost occurred in North western plains and the variety Kufri Chipsona-2 showed high tolerance to frost as well. Both the varieties are resistant to late blight disease with Kufri Chipsona-2 also being tolerant to frost. Kufri Chipsona-l and Kufri Chipsona-2 varieties can be conveniently planted at optimum time or late in the season after harvesting paddy, or even in the spring crop season in North western Indo-Gangetic plains. These also provide a flexibility in the time of harvest and can be lifted at 90, 100 or 110 days to fit in various cropping systems in the plains. Wide adaptability of these

varieties has made the entire Indo-Gangetic plains and the central Indian plains suitable for production of excellent potatoes for processing. The Chipsona varieties will help in improving the quality and boost the export of value added processed products.

A study was done by Rahman *et al*. (2017) . A total of 40 potato varieties grown in Bangladesh were evaluated for different physical and other quality attributes for processing industry. Seventeen varieties were oval shaped and 12 varieties were round shaped tubers. Twenty nine varieties were white coloured and 11 varieties were red coloured skin. Sixteen potato varieties were cream colour flesh. Number of eyes was less in most of the cultivars with shallow eye depth, without scars and green tint. Omega showed the highest average tuber weight (138.6 g) and longest diameter (6.58 cm) while Steffi recorded significantly the highest volume (130.20 ml). The specific gravity was determined to clarify their processing quality. The specific gravity of different potato varieties ranged from 1.053 to 1.123 with the highest in Ludmila and Tomensa (1.123) and the lowest in Espirit, Almerah and Connect (1.053).

By Abu-Zinada and Mousa (2015) four potato cultivars were evaluated for their vegetative growth and tuber production.. Results revealed that plant length of Spunta and Mondial, number of main stems in Mondial and Alaska and leaf area in Alaska cultivar significantly increased. Yield as tubers weight plant-1 and number of tubers plant-1 in Mondial and larger tubers > 60 mm in Mondial and Alaska significantly increased. Tuber properties as tuber weight of Spunta (188g), Alaska (188g) and Mondial (179g), tuber length of Spunta (11cm.) and Mondial (10.3), tuber diameter of Alaska, Spunta (6cm.) and Mondial (5.9cm.), tuber dry weight % and starch % in Lady Rosetta (23.63 and 11.137) and ash % in Mondial (5.06) and Spunta (4.78) showed significant higher increases. It could be recommended to substitute Spunta by Mondial cultivar for home consumption and Lady Rosetta for processing.

Hassanpanah *et al.* (2011) conducted an experiment. For determination of cooking quality characteristics of advanced clones and potato cultivars, this experiment was conducted to determine the quality characteristics on the three advanced clones (397009-3, 397082-2 and 396156-6) and three potato cultivars (Agria, Marfona and Savalan) under *in vitro* condition in Ardabil, Iran in 2009. Experimental design was completely randomized with three replications.

In the study some of characters were measured such as dry matter and starch percent, specific gravity, french-fry and chips color and quality, cooking type, texture firmness and flavor. Analysis of variance showed that significant differences between cultivars and clones for tuber yield, dry matter and starch percent, specific gravity, french-fry and chips color and quality and reducing sugars amount. The 397082-2, 396156-6, 397009-3 clones and Savalan cultivar had the highest yield. The highest dry matter, starch and specific gravity belonged to 396156-6 and 397009-3 clones and Savalan cultivar. These cultivars had C cooking type. Therefore, the 396156-6 clone and Savalan cultivar are recommended for chips production, 397009-3 clone for french-fry, chips and starch production. The Marfona cultivar had a lower dry matter and B cooking type. Potatoes of this type are suitable for eating boiled, mashing and fresh and conserve potato consumption.

Cooking quality of mature tubers was assessed by Cacace *et al.* (1994) for ten Argentine pota- to cultivars, two cultivars of foreign origin and three advanced clones. Specific gravity, dry matter and starch content, as well as quality of boiled potatoes and chips were determined. Pampeana INTA had the highest dry matter content with 21.8 percent and would appear to be a very good cultivar for dehydrated products. The lowest dry matter values were obtained for three of the four most widely planted cultivars: Spunta (17.7), Bonaerense La Ballenera (18.8) and Kennebec(18.8). Kennebec demonstrated its good quality for chipping with a score of 6.9 points. Primicia INTA (20.4) and Surefia INTA (19.0) with high dry matter content and good features for chipping can also be used to produce chips. Breeding under high temperatures during tuberizafion has proven to be a successful strategy in developing cultivars that are superior in dry matter contents to the culfivars currently imported from the northern hemi- sphere.

Evaluation and screening of a wide range of potato germplasm is necessary to identify cultivars that are adapted to the locality, high yielding, consistently resistant to late blight and have good processing quality. By Simongo *et al*. (2011) Five potato entries grown and selected from previous trials were evaluated under different ecological zones/elevations from low mountain zone (1350 masl); mid-mountain zone (below 2000 masl) and high mountain zone (2000 and above masl) during the wet season. In summary, entries CIP 380241.17, PHIL 2.21.6.2, CIP 676070 and PHIL 5.19.2.2 significantly out yielded the check varieties Igorota (processing type),

Ganza (newly approved variety), and Granola (table type/ farmers variety). Furthermore, PHIL 2.21.6.2 and the check variety Igorota have good fry quality based on high dry matter content (20%) and high fry yield (35g). Both entries produced fries which were liked much by the panelists.

A study conducted by Kyle Rak *et al.* (2013). Potato (*Solanum tuberosum* L.) genotypes exhibit significant variation for chip color across different storage regimes. Lines that maintain light chip color after long postharvest storage durations and low storage temperatures are desirable to the potato industry. Since storage regimes vary among growers and processors, lines that exhibit stable chip performance across various storage regimes have a high probability of commercial success. The objective was to test if treating storage regimes as "environments," analyzing genotype × storage environment interactions, and applying stability statistics can help identify desirable chip processing lines. To examine this, chip color of 47 breeding clones and six standard varieties was evaluated across eight storage environments. Chip color data was analyzed using stability metrics as well as stability-adjusted selection indices. The effects of genotype, storage environment, and genotype × environment on chip color were significant, explaining 47, 24, and 17% of total variance, respectively. Types I, II, and III stable lines were identified through stability analyses. Type I stability was significantly correlated with mean chip color. The most desirable lines were identified under long and cold storage environments. Using Type I stability and stability-adjusted indices, this study identified breeding clones for advancement, including W5840-4, W6484-5, and W6929-1, which outperformed standard chipping varieties for chip quality and stability.

CHAPTER 3

MATERIALS AND METHODS

The experiment was conducted during the period from November 2017 to April 2018 to study the influence of variety and location of harvesting on post harvest physiology of potato at ambient storage condition. The materials and methods describes a short description of the experimental site, climate condition of the storage room, experimental materials, experimental treatments and design, methods of the study, data collection procedure and procedure of data analysis. The detailed materials and methods that were used to conduct the study is presented below under the following heading :

3.1 Location of the experimental site

The experiment was conducted at the Laboratory of the Department of Agronomy, Sher-e-Bangla Agricultural University (SAU) , Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh. It was located in 24.09^0 N latitude and 90.26^0 E longitudes.

3.2 Conditions of storage room

The temperature and relative humidity of the storage room were recorded daily basis during the study period with a digital thermo hygrometer (TERMO, TFA, Germany). The minimum and maximum temperature during the study period of storage room was 26.4^0 C to 33.6^0 C, respectively. Details of the meterological data during the period of the experiment were presented in Appendix I.

3.3 Experimental materials

The tubers of Asterix, Courage, Lady Rosetta, Felsina and Dura which were collected from Panchagarh (Breeders Seed Production Farm, Tuber Crop Research Centre (TCRC), Bangladesh Agricultural Research Institute (BARI), Dhaka (TCRC, BARI, Gazipur) and Munshiganj (Tuber Crops Sub-centre) to maintain same cultivation procedure as per TCRC recommendation. The collected tubers were free of any visible defects, disease symptoms and insect infestations and transported to the Laboratory of the Department of Agronomy, SAU, Dhaka with careful handling to avoid disease and injury.

3.4 Experimental treatments and design

The experiment consisted of 2 factors:

Factor A : Location (3 locations) as

i. P: Panchagarh
ii. D: Dhaka
iii. M: Munshiganj

Factor B : Potato variety (5 varieties) as

i. V_1: Asterix
ii. V_2: Courage
iii. V_3: Lady Rosatta
iv. V_4: Felsina
v. V_5: Dura

There were 15 treatment combinations viz., PV_1, PV_2 , PV_3, PV_4, PV_5, DV_1, DV_2, DV_3, DV_4, DV_5, MV_1, MV_2, MV_3, MV_4 and MV_5 . The experiment was laid out in a 2 factors Randomized Complete Block Design (RCBD) with 3 replications in all locations.

3.5 Methods of the study

There were 15 (3×5) treatment combination of the collected potato tubers. The selected tubers of each combination with 3 replication were kept in netted bags and were stored in a well ventilated room under diffused light condition. Tubers were observed at every alternate day for recording rotted tubers and sprouting. Weighing of tubers was continued upto 60 days after storage (DAS) at 10 days interval.

3.6 Parameter studies

The following parameters were studied and data were recorded following the procedure described below:

3.6.1 Dry matter percentage of potato

Dry matter percentage of potato was recorded at 10, 20, 30, 40, 50 and 60 DAS. After chopping the tubers the samples were dried in oven at 72^0 C for 72 hours and then the dry matter percentage of potato was recorded. Dry matter content was calculated as the ratio between dry and fresh weight and expressed as a percentage (Barton, 1989). Dry matter percentage of tuber was calculated with the following formula (Tekalign, 2011)-

$$\text{Dry matter content (\%)} = (DW \div FW) \times 100$$

Where, FW= Fresh Weight and DW= Dry Weight

3.6.2 Weight loss

Potato was stored as per treatment and their initial weight was taken. Weight loss percentage was recorded at 10, 20, 30, 40, 50 and 60 DAS from the stored potato. Weight loss was calculated using the following formula:

$$WL = \{(IW - FW) \div IW\} \times 100$$

Where,

WL= Percent total weight loss

IW= Initial weight of tubers (g)

FW= Final weight of tubers (g)

3.6.3 Total soluble solids (TSS)

TSS of harvested tubers was determined in a drop of potato juice by using Hand Sugar Refractometer “ERMA” Japan, Range : 0-32% according to (AOAC, 1990) and recorded as % Brix from direct reading of the instrument.

3.6.4 Firmness (N)

The fresh potato tubers were washed and dried in fan. Then it was cut longitudinally and firmness was measured by a Texture Analyzer , Sun Rheometer Compac 100 (Sun scientific co. Ltd, Japan) as per treatment.

3.6.5 Crispness (N)

The fresh potato tubers were washed and dried in fan. Then the tubers were cut by using chips maker maintaining 2 mm. (breadth). After that, they were deep fried in hot soybean oil maintaining 185^0C temperature for 2 minutes. After frying the crispness was measured by a Texture Analyzer , Sun Rheometer Compac 100 (Sun scientific co. Ltd, Japan).

3.6.6 Specific gravity (g cm-3)

Specific gravity was measured by using the following formula (Gould, 1995)-

Specific gravity = Weight of tuber in air÷ Weight of tuber in fresh water at 4^0 C

3.6.7 Color measurements

Color is an important quality attribute which influences the acceptability of fried products (Nourian *et al*., 2003). Color was measured with a color spectrophotometer NF333 (Nippon Denshoku, Japan) using the CIE Lab L*.a* and b* color scale.The 'L*' value is the lightness parameter indicating degree of lightness of the sample; it varies from 0 = black (dark) to 100 = white (light). The 'a*' which is the chromatic redness parameter ,whose value means tending to red color when positive (+) and green color when negative (-) . The 'b*' is yellowness chromatic parameter corresponding to yellow color when it is positive (+) and blue color when it is negative (-).

3.6.8 Measurement of starch content

Starch content percentage was measured by Somogyi-Nelson method (Nelson, 1944). The Phosphate buffer solution was prepared through diluted 0.74g $NaH_2PO_4.2H_2O$ and 0.09g $Na_2HPO_4.12H_2O$ into 100 ml Distilled water. 0.1 g Enzyme (Amyloglucosidase) was added and mixed well. Then it was kept for the preservation at -20^0C.After extraction for sugar the remaining residue was washed for several times with water to ensure that there was no more soluble sugar in the residues. Then by using water it was marked upto 250 ml beaker. It was stirred well on a magnetic stirrer. Then 0.5 ml solution was taken from the beaker during stirring into 3 test tubes. After that the test tubes were boiled for 10 minutes at 100^0C. 1 ml

Amyloglucosidase solution was added, mixed and heated at 50-60^{0}C for 2 hours in hot water. After cooling,0.5 ml Copper solution was added, mixed well, heated at 100^{0}C for 10 minutes, cooled in tap water,0.5 ml Nelson solution was added, mixed well, 7 ml distilled water was added, mixed well (Final volume= 9.5 ml) and the absorbance was measured at 600 nm (Abs). Starch content was calculated by using the glucose standard curve. Calculated value was expressed as mg per g Fresh Weight (mg g^{-1} FW).

Calculation of starch content:

Starch= Abs × 0.9

3.7 Statistical Analysis

The data obtained for different characters were statistically analyzed following the analysis of variance (ANOVA) techniques by using Statistix 10 (2013) computer package program to find out the significant variances of the recorded parameters for tubers derived from different variety of potato tubers. The significant differences among the treatment means were compared by Least Significant Differences (LSD) at 5% level of probability (Gomez and Gomez, 1984) .

CHAPTER 4

RESULTS AND DISCUSSION

The experiment was conducted to study the processing quality of some potato (*Solanum tuberosum* L.) as influenced by growing environment. Data were recorded at different days after storage (DAS) on different physical and chemical characteristics were recorded. The analyses of variance (ANOVA) of the data on different physical and chemical characteristics are presented in Appendix II-VIII. The results have been presented and discussed with the help of table and graphs and possible interpretations given under the following headings:

4.1 Dry matter percentage

4.1.1 Effect of location

Significant variation was found for dry matter content in different potato varieties (Asterix, Courage, Lady Rosetta, Felsina and Dura) collected from Panchagarh, Dhaka and Munshiganj at 0 DAS (Appendix II) . At the time of harvesting the maximum dry matter (21.496 %) was obtained from Panchagarh and the minimum (21.113 %) was obtained from Munshiganj (Figure 1). At 10 DAS due to different locations was found significant. The maximum dry matter (20.980 %) was found in Panchagarh followed by Dhaka (20.827%) and Munshiganj (20.763 %) (Figure 1). At 20 DAS due to different locations was found non significant. Numerically the maximum dry matter (20.505 %) was found in Munshiganj whereas the minimum (20.462 %) was found in Panchagarh (Figure 1). At 30 DAS due to different locations was found significant. The maximum dry matter (20.296 %) was found in Munshiganj and the minimum (19.934 %) was found in Panchagarh (Figure 1). At 40 DAS due to different locations was found significant .The maximium dry matter (19.942 %) was found in Munshiganj and the minimum (19.334%) was found in Panchagarh. At 50 DAS due to different locations was found significant .The maximum dry matter (18.411 %) was found in Dhaka while the minimum (17.774 %) was found in Panchagarh (Figure 1). At 60 DAS due to different locations was found significant.The maximium dry matter (16.461%) was found in Dhaka and the minimum (15.814 %) was found in Panchagarh (Figure 1). The results demonstrated that the dry matter content of potato decrease with increasing storage period irrespective of locations.

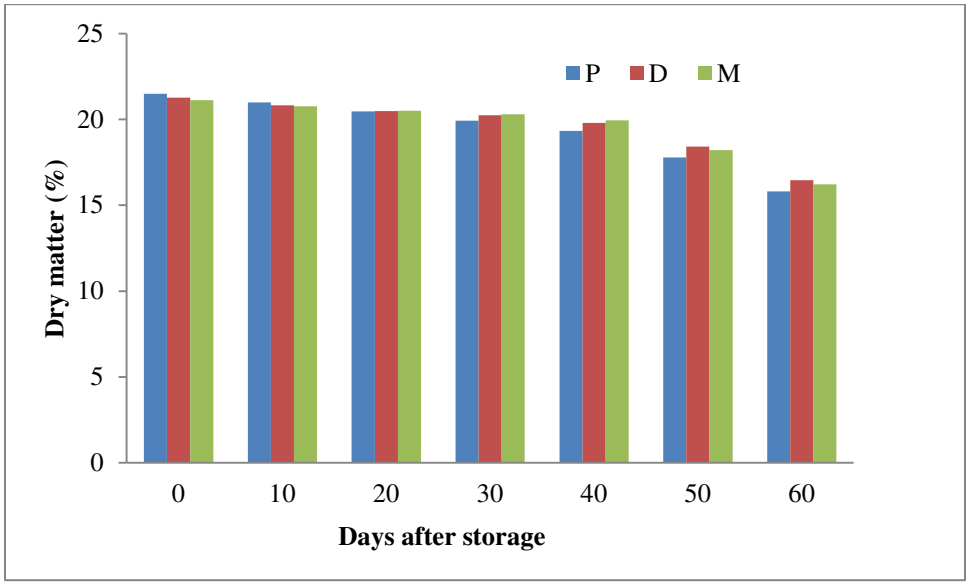

Figure 1. Response of different locations to dry matter (%) of different potato varieties at different days after storage (LSD values 0.2326, 0.1607, 0.2393, 0.2402, 0.5808, 0.5799 for 0 DAS, 10 DAS , 30 DAS, 40 DAS, 50 DAS and 60 DAS respectively).
P-Panchagarh, D-Dhaka. M-Munshiganj

4.1.2 Effect of variety

Significant variation was found among different varieties to dry matter content at 0 DAS (Appendix II). The maximum dry matter (21.733 %) was obtained by Lady Rosetta which is statistically similar to Courage and the lowest (20.934 %) was obtained by Dura (Figure 2). At 10 DAS due to different varieties was found statistically significant. The maximum dry matter (21.273 %) was found in Lady Rosetta and the minimum (20.621 %) was found in Dura which was staristically similar to Asterix and Felsina (Figure 2). At 20 DAS due to different varieties was found significant .The maximium dry matter (20.863 %) was found in Lady Rosetta and the dry matter (20.278 %) was found in Dura (Figure 2). At 30 DAS due to different varieties was found numerically significant (Appendix II). The maximum dry matter (20.553 %) was found in Lady Rosetta and the minimum (19.775 %) was found in Asterix (Figure 2). At 40 DAS due to different varieties was found statistically significant .The maximum dry matter (20.093 %) was found in Lady Rosetta and the minimum (19.518 %) was found in Dura which was staistically similar to V_1 and V_4 (Figure 2).

At 50 DAS due to different varieties was found significant. The maximum dry matter (18.627 %) was found in Lady Rosetta and the minimum dry matter (17.702 %) was found in Asterix (Figure 2). At 60 DAS due to different varieties was found numerically significant (Appendix II). The maximum dry matter (16.727 %) was found in Lady Rosetta and the minimum (15.702%) was found in Asterix (Figure 2). The results revealed that the dry matter content of different potato varieties decreased with advancing storage period irrespective of varieties. Among the varieties , Lady Rosetta exhibited best performance along the storage period whereas Asterix showed the worst one.

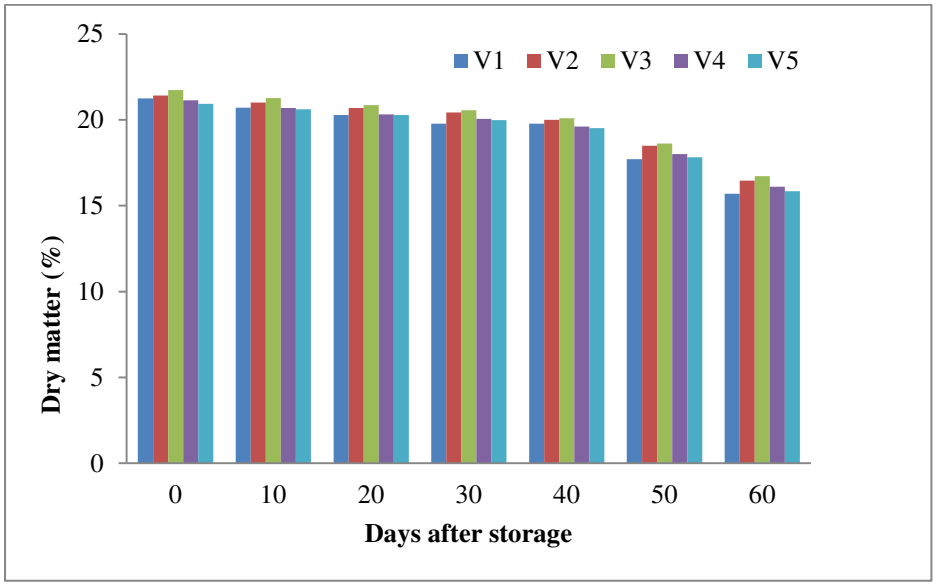

Figure 2. Response of different potato varieties to dry matter (%) of different potato at different days after storage (LSD values 0.3551, 0.2442, 0.2442, 0.3636, 0.3650, 0.8827, 0.8813 for 0 DAS, 10 DAS ,20 DAS, 30 DAS, 40 DAS, 50 DAS and 60 DAS respectively).

V_1-Asterix, V_2-Courage, V_3- Lady Rosetta, V_4-Felsina, V_5-Dura

4.1.3 Combined effect of location and variety

Profound dissimilarity was found among different locations and varieties on tuber dry matter content at 0 DAS (Appendix II).The maximum dry matter (22.700 %) was obtained by PV_3 and the minimum dry matter content (20.678 %) was found in PV_5 (Table 1).At 10 DAS due to different combination of location and varieties was found significant. The maximum dry matter

(22.100 %) was obtained by PV_3 followed by PV_5 (20.440%) (Table 1). At 20 DAS due to different combination of location and varieties was found significant. The maximum dry matter (21.550 %) was obtained by PV_3 whereas the minimum (19.900 %) was found in PV_5 (Table 1). At 30 DAS due to different combination of location and varieties was found numerically significant. The maximum dry matter (21.160 %) was obtained by PV_3 which is statistically similar to DV_2 (20.560 %) and MV_2 (20.521 %) and the minimum (19.072 %) was found in PV_1 (Table 1).At 40 DAS due to different combination of location and varieties was found significant .The maximum dry matter (20.560 %) was obtained by PV_3 which is statistically similar to DV_2 (20.160%), DV_3 (19.780%), DV_5(19.921 %), MV_1(19.760 %), MV_2(20.161%), MV_3(19.940%), MV_4(19.973%),MV_5(19.873%) and the minimum (18.412 %) was found in PV_1 (Table 1).At 50 DAS due to different combination of location and varieties was found non significant . Numerically the maximum dry matter (19.060%) was obtained by PV_3 which is statistically similar to PV_2(18.159%), PV_4 (17.780%), DV_1 (18.233%), DV_2 (18.760%) , DV_3(18.560%), DV_4(18.060%), DV_5(18.421%), MV_1(17.960%), MV_2(18.561%), MV_3(18.240%), MV_4(18.173%), MV_5 (18.073%)and the minimum (16.960 %) was found in PV_5 (Table 1). At 60 DAS due to different combination of location and varieties was found non significant. Numerically the maximum dry matter (17.260 %) was obtained by PV_3 which is statistically similar to DV_1(16.233%), DV_2(16.630%), DV_3(16.680%), DV_4 (16.260%), DV_5 (16.501%), MV_1 (15.860%), MV_2 (16.561%), MV_3 (16.240%), MV_4 (16.273%), MV_5 (16.173%) and the minimum dry matter content (14.861 %) was found in PV_5 (Table 1). The results reveal that the dry matter content of all treatment combination decreased with advancing storage period (Table 1). Among the treatment combination, PV_3 showed the best performance all over the storage period.

Loss of dry matter of tuber during storage period may be due to respiration (Burton *et al*., 1992). Sprouting is a physiological process at which resting buds break their dormancy and resume growth by utilizing stored food (Salisbury and Ross , 1992).

Table 1. Combined effect of location and variety on dry matter (%) of different potato varieties

Combinations	Dry matter (%) at						
	0 DAS	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
PV_1	21.321 b-d	20.661 b-d	20.121de	19.072 d	18.412 e	16.912	15.012
PV_2	21.579 bc	21.039 bc	20.559 b-d	20.199 bc	19.659 bc	18.159	16.159
PV_3	22.700 a	22.100 a	21.550 a	21.160 a	20.560 a	19.060	17.260
PV_4	21.200 b-d	20.660 b-d	20.180 c-e	19.820 b-d	19.280 cd	17.780	15.780
PV_5	20.678 d	20.440 d	19.900 e	19.420 cd	18.760 de	16.960	14.861
DV_1	21.093 b-d	20.613 b-d	20.253 b-e	20.013 bc	19.547 b-d	18.233	16.233
DV_2	21.360 b-d	21.000 bc	20.760 b	20.560 ab	20.160 ab	18.760	16.630
DV_3	21.700 b	21.160 b	20.680 bc	20.320 b	19.780 a-c	18.580	16.680
DV_4	21.120 b-d	20.640 b-d	20.280 b-e	20.040 bc	19.560 b-d	18.060	16.260
DV_5	21.081 b-d	20.721 b-d	20.481 b-d	20.281 b	19.921 a-c	18.421	16.501
MV_1	21.320 b-d	20.840 b-d	20.480 b-d	20.240 b	19.760 a-c	17.960	15.860
MV_2	21.321 b-d	20.961 b-d	20.721 b	20.521 ab	20.161 ab	18.561	16.561
MV_3	20.800 cd	20.560 cd	20.360 b-e	20.180 bc	19.940 a-c	18.240	16.240
MV_4	21.080 b-d	20.750 cd	20.510 b-d	20.303 b	19.973 a-c	18.173	16.273
MV_5	21.043 b-d	20.703 b-d	20.453 b-d	20.233 b	19.873 a-c	18.073	16.173
CV%	1.21	0.85	0.87	1.31	1.35	3.55	3.97
$LSD_{0.05}$	0.7821	0.5378	0.5378	0.8009	0.8040	--	--
Level of Significance	**	**	**	**	**	NS	NS

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly

** and *= Significant at 1% & 5 % level of probability, respectively

P-Panchagarh, D-Dhaka, M-Munshiganj

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.2 Total soluble solid (TSS)

4.2.1 Response to location

Profound dissimilarity was found among different locations on total soluble solid of potato at 0 DAS (Appendix III).The minimum total soluble solid (4.5^0 Brix) was obtained by Panchagarh and the maximum (5.58^0 Brix) was found in Munshiganj (Figure 3). At 10 DAS due to different locations was found significant .The lowest total soluble solid (4.7^0 Brix) was found in Panchagarh whereas the highest (5.8803^0 Brix) was found in Munshiganj (Figure 3). At 20 DAS due to different locations was found significant. The minimum total soluble solid (4.98^0 Brix) was found in Panchagarh while the maximum (6.18^0 Brix) was found in Munshiganj (Figure 3). At 30 DAS due to different locations was found significant. The maximum total soluble solid (6.5^0 Brix) was found in Munshiganj followed by Dhaka (5.84^0 Brix) and Panchagarh (5.24^0 Brix) (Figure 3). At 40 DAS due to different locations was found significant. The maximum total soluble solid (6.84^0 Brix) was found in Munshiganj and the minimum total soluble solid (5.46^0 Brix) was found in Panchagarh (Figure 3). At 50 DAS due to different locations was found significant .The maximum total soluble solid (7.2^0 Brix) was found in Munshiganj and the minimum total soluble solid (5.64^0 Brix) was found in Panchagarh (Figure 3). At 60 DAS due to different locations was found significant. The maximum total soluble solid (7.55^0 Brix) was found in Munshiganj and the minimum total soluble solid (5.91^0 Brix) was found in Panchagarh (Figure 3).

The result exhibited that TSS increased with increasing storage period. The TSS of tuber grown in Panchagarh showed minimum values irrespective of storage period followed by Dhaka and Munshiganj.

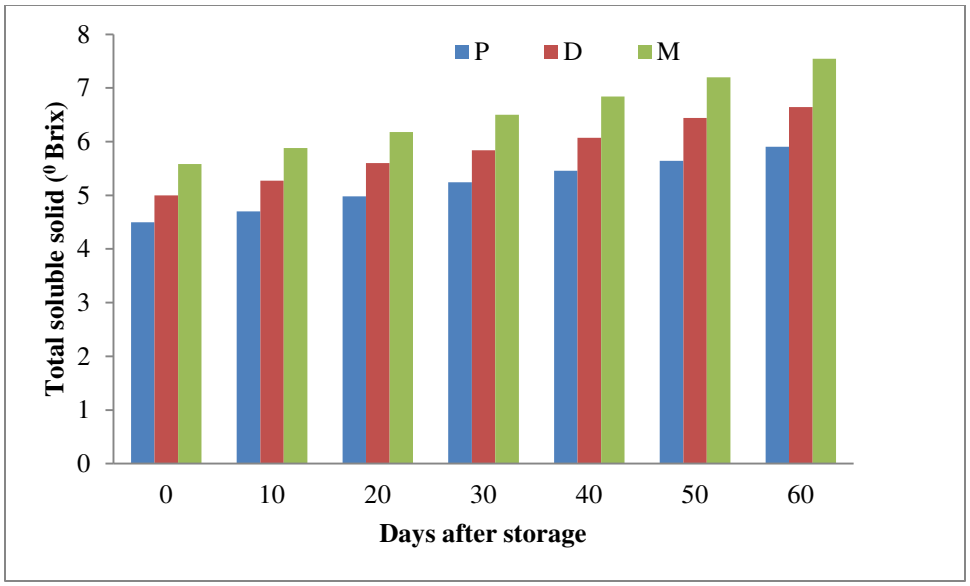

Figure 3. Response of different locations to total soluble solid (TSS) of different potato varieties at different days after storage (LSD values 0.0648, 0.0779, 0.0773, 0.0783, 0.1322,0.0734, 0.0918 for 0 DAS, 10 DAS , 20DAS, 30 DAS, 40 DAS, 50 DAS and 60 DAS respectively)

P-Panchagarh, D-Dhaka. M-Munshiganj

4.2.2 Effect of varieties

Significant variation was found among different varieties to total soluble solid of potato at 0 DAS (Appendix III). The maximum total soluble solid of potato (5.5^0 Brix) was obtained by Lady Rosetta and the lowest (4.57^0 Brix) was obtained by Courage (Figure 4). At 10 DAS due to different varieties was found significant. The lowest total soluble solid (4.83^0 Brix) was found in Courage and the highest (5.73^0 Brix) was found in Lady Rosetta (Figure 4). At 20 DAS due to different varieties was found significant. The lowest total soluble solid (5.1^0 Brix) was found in Courage and the highest total soluble solid (5.97^0 Brix) was found in Lady Rosetta (Figure 4). At 30 DAS due to different varieties was found significant. The lowest total soluble solid (5.33^0 Brix) was found in Courage whereas the highest (6.2^0 Brix) was found in Lady Rosetta and (Figure 4). At 40 DAS due to different varieties was found significant .The lowest total soluble solid (5.6^0 Brix) was found in Courage while the highest (6.43^0 Brix) was found in Lady Rosetta which is statistically similar to Dura (Figure 4). At 50 DAS due to different varieties was found significant . The lowest total soluble solid (5.90^0 Brix) was found in Courage whereas the

highest (6.8^0 Brix) was found in Lady Rosetta (Figure 4).At 60 DAS due to different varieties was found significant . The lowest total soluble solid (6.18^0 Brix) was found in Courage followed by the highest (7.07^0 Brix) in Lady Rosetta (Figure 4).

The result showed that the value of TSS increased with advancing storage period irrespective of varieties. From the above results it reveal that Lady Rosetta showed minimum TSS content all over.

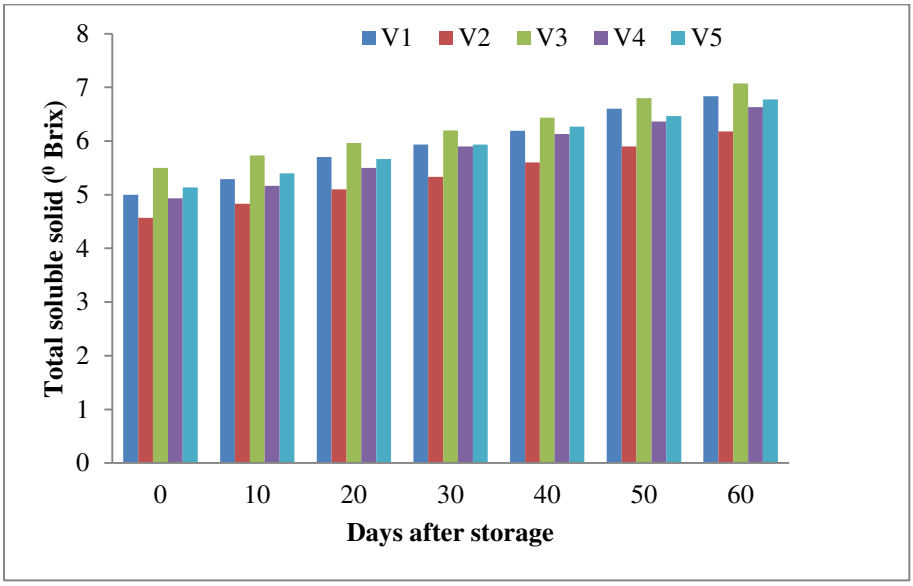

Figure 4. Response of different potato varieties to TSS at different days after storage (LSD values 0.0984, 0.1184, 0.1175, 0.1191, 0.2009, 0.1116, 0.1396 for 0 DAS, 10 DAS , 20 DAS, 30 DAS, 40 DAS, 50 DAS and 60 DAS respectively).

V_1-Asterix, V_2-Courage, V_3- Lady Rosetta, V_4-Felsina, V_5-Dura

4.2.3 Combined effect of locations and varieties

Profound dissimilarity was found among different locations and varieties on total soluble solid of potato at 0 DAS (Appendix III). The minimum total soluble solid (4.0^0 Brix) was found in PV_1 which is statistically similar to PV_2 (4.2^0 Brix) and the maximum (6.0^0 Brix) was obtained by MV_1 (6^0 Brix) and MV_3 (6^0 Brix) (Table 2). At 10 DAS due to different varieties was found significant. The minimum total soluble solid (4.2^0 Brix) was found in PV_1 which is statistically similar to PV_2 (4.4^0 Brix) and the maximum (6.4^0 Brix) was showed by MV_1 (Table 2). At 20

DAS due to different varieties was found significant. The minimum total soluble solid (4.5^0 Brix) was found in PV_1 and the maximum (6.8^0 Brix) was showed by MV_1 (Table 2).At 30 DAS due to different varieties was found significant. The minimum total soluble solid (4.8^0 Brix) was found in PV_1 which is statistically similar to PV_2 (4.8^0 Brix) and DV_2(5^0 Brix) whereas the maximum (7.0^0 Brix) was showed by MV_1 (Table 2). At 40 DAS due to different varieties was found significant. The minimum total soluble solid (5.0^0 Brix) was found in PV_1 which is statistically similar to PV_2 (5.2^0 Brix) , PV_4 (5.6^0 Brix) and DV_2 (5.5^0 Brix) and the maximum (7.4^0 Brix) was showed by MV_1 (Table 2). At 50 DAS due to different varieties was found significant. The minimum total soluble solid (5.2^0 Brix) was found in PV_1 which is statistically similar to PV_2 (5.2^0 Brix) while the maximum (7.8^0 Brix) was showed by MV_1 (Table 2). At 60 DAS due to different varieties was found significant. The minimum total soluble solid (5.5^0 Brix) was found in PV_1 which is statistically similar to PV_2 (5.533^0 Brix) and the maximum (8.0^0 Brix) was showed by MV_1 (Table 2).

The trend of TSS content of al treatment combination increased with increasing storage period. From the above discussion of 15 treatment combination PV_1 showed the minimum TSS level irrespective of different storage period compared to those of other combinations. Though PV_2 showed similar TSS value at 10, 30, 40, 50 and 60 DAS.

Table 2. Combined effect of location and variety on TSS of different potato varieties

Combinations	Total soluble solid (^{0}Brix) at						
	0 DAS	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
PV_1	4.0000 g	4.1980 i	4.5000 i	4.8000 j	5.0000 j	5.2000 h	5.5000 g
PV_2	4.2000 g	4.4000 i	4.8000 h	5.0000 ij	5.2000 ij	5.4000 h	5.5333 g
PV_3	5.0000 de	5.2000 ef	5.4000 ef	5.6000 fg	5.8000 e-h	6.0000 fg	6.4000 e
PV_4	4.5000 f	4.7013 h	5.0000 gh	5.4000 gh	5.6000 g-i	5.8000 g	6.0000 f
PV_5	4.8000 e	5.0000 fg	5.2000 fg	5.4000 gh	5.7000 f-h	5.8000 g	6.1000 ef
DV_1	5.0000 de	5.2667 de	5.8000 d	6.0000 de	6.1667 de	6.8000 d	7.0000 d
DV_2	4.5000 f	4.8000 gh	5.0000 gh	5.2000 hi	5.5000 hi	5.8000 g	6.0000 f
DV_3	5.5000 b	5.8000 b	6.0000 cd	6.2000 cd	6.5000 cd	6.9000 cd	7.0133 d
DV_4	4.8000 e	5.0000 fg	5.4000 ef	5.8000 ef	6.0000 e-g	6.2000 f	6.4000 e
DV_5	5.2000 cd	5.5000 cd	5.8000 d	6.0000 de	6.1973 de	6.5000 e	6.8000 d
MV_1	6.0000 a	6.4000 a	6.8000 a	7.0000 a	7.4000 a	7.8000 a	8.0000 a
MV_2	5.0000 de	5.3000 de	5.5000 e	5.8000 ef	6.1000 d-f	6.5000 e	7.0000 d
MV_3	6.0000 a	6.2000 a	6.5000 b	6.8000 a	7.0000 ab	7.5000 b	7.8000 ab
MV_4	5.5000 b	5.8013 b	6.1000 c	6.5000 b	6.8000 bc	7.1000 c	7.5000 bc
MV_5	5.4000 bc	5.7000 bc	6.0000 cd	6.4000 bc	6.9000 bc	7.1000 c	7.4333 c
CV%	1.43	1.63	1.53	1.48	2.39	1.26	1.52
$LSD_{0.05}$	0.2168	0.2607	0.2589	0.2622	0.4425	0.02458	0.3074
Level of Significance	**	**	**	**	**	**	**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

P-Panchagarh, D-Dhaka, M-Munshiganj

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.3 Crispness

4.3.1 Effect of location

Profound dissimilarity was found among different locations on Crispness of potato at 0 DAS (Appendix IV).The maximum Crispness (6.34) was obtained by Panchagarh and the minimum (4.13) was found in Munshiganj (Figure 5). At 10 DAS due to different locations was found significant . The highest Crispness (5.89) was found in Panchagarh and the lowest (3.59) was found in Munshiganj (Figure 5). At 20 DAS due to different locations was found significant.The highest Crispness (5.40) was found in Panchagarh while the lowest (3.13) was found in Munshiganj (Figure 5). At 30 DAS due to different locations was found significant. The highest Crispness (4.95) was found in Panchagarh whereas the lowest (2.75) was found in Munshiganj (Figure 5). At 40 DAS due to different locations was found significant . The highest Crispness (4.95) was found in Panchagarh and the lowest (2.75) was found in Munshiganj (Figure 5). At 50 DAS due to different locations was found significant. The highest Crispness (4.39) was found in Panchagarh whereas the lowest (2.26) was found in Munshiganj (Figure 5). At 60 DAS due to different locations was found significant . The highest Crispness (4.27) was found in Panchagarh and the lowest (2.16) was found in Munshiganj (Figure 5).

The results demonstrated that the crispness of potato decrease with increasing storage period irrespective of locations.The potato grown in Panchagarh showed the highest value followed by Dhaka and Munshiganj.

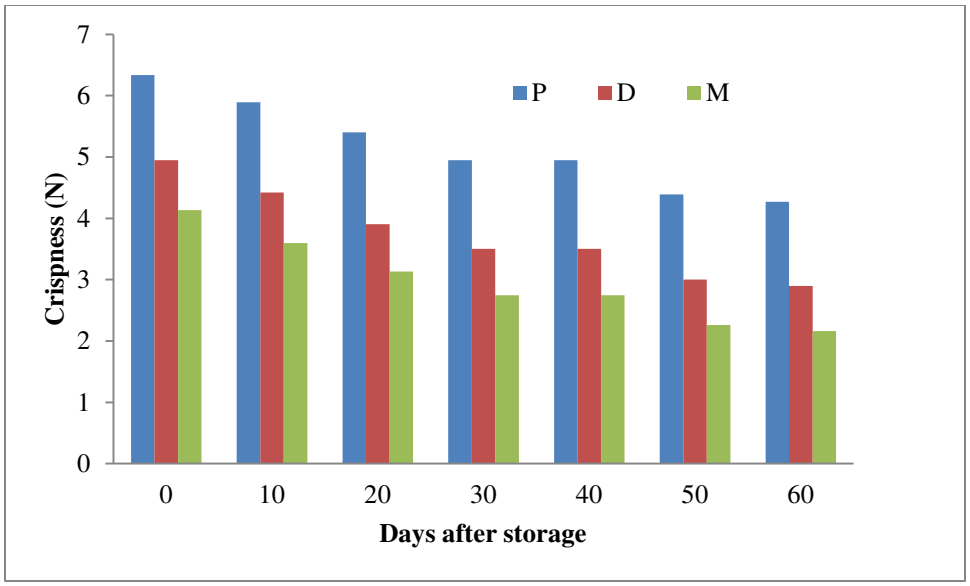

Figure 5. Response of different locations to crispness of different potato varieties at different days after storage (LSD values 0.0465, 0.0648, 0.0409, 0.0549, 0.0494, 0.0464, 0.0481 for 0 DAS, 10 DAS , 20DAS, 30 DAS, 40 DAS, 50 DAS and 60 DAS respectively).

P-Panchagarh, D-Dhaka, M-Munshiganj

4.3.2 Effect of varieties

Significant dissimilarity was found among different varieties on Crispness of potato at 0 DAS (Appendix IV).The maximum Crispness (5.43) was obtained by Dura and the minimum Crispness (4.67) was found in Felsina (Figure 6). At 10 DAS due to different varieties was found significant. The highest Crispness (4.87) was found in Dura whereas the lowest Crispness (4.26) was found in Felsina (Figure 6).At 20 DAS due to different varieties was found significant. The highest Crispness (4.35) was found in Dura while the lowest Crispness (3.733) was found in Felsina (Figure 6). At 30 DAS due to different varieties was found significant .The highest Crispness (3.93) was found in Dura and the lowest (3.3) was found in Felsina (Figure 6). At 40 DAS due to different varieties was found significant. The highest Crispness (3.65) was found in Courage which is statistically similar to Dura (3.593) and the lowest (2.99) was found in Felsina which is statistically similar to Lady Rosetta (3.33) (Figure 6). At 50 DAS due to different varieties was found significant .The highest Crispness (3.45) was found in Courage and the lowest Crispness (2.79) was found in Felsina (Figure 6). At 60 DAS due to different varieties

was found significant . The highest Crispness (3.34) was found in Courage and the lowest (2.69) was found in Felsina (Figure 6).

The result exhibited that the crispness value decrease with the advancing period of time. Dura showed the maximum value during the storage period.

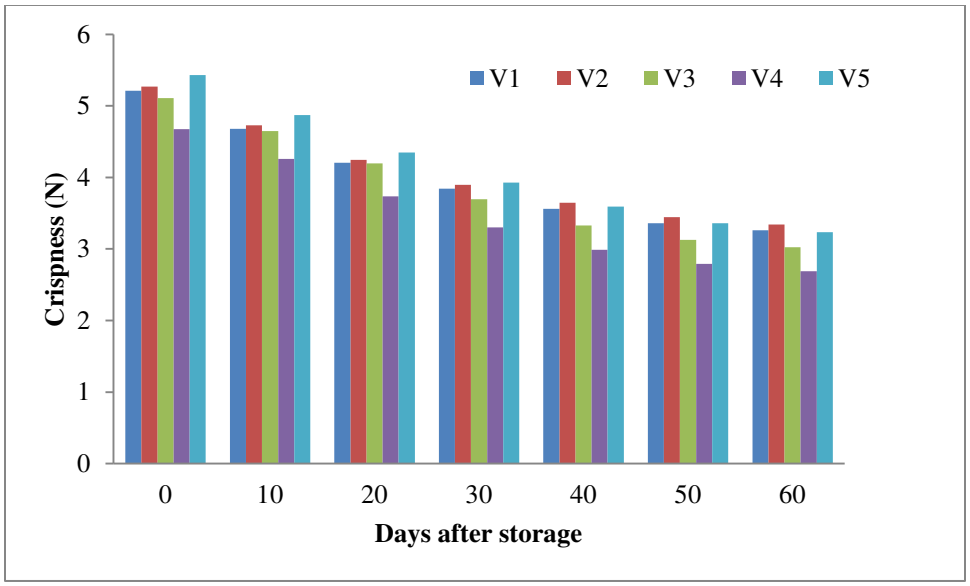

Figure 6. Response of different potato varieties to crispness at different days after storage

(LSD values 0.0706, 0.0984, 0.0621, 0.0834, 0.0750, 0.0704, 0.0730 for 0 DAS, 10 DAS , 20DAS, 30 DAS, 40 DAS, 50 DAS and 60 DAS respectively).

P-Panchagarh, D-Dhaka, M-Munshiganj

4.3.3 Combined effect of locations and varieties

Profound dissimilarity was found among different locations and varieties on Crispness of potato at 0 DAS (Appendix IV). The highest value (6.8503) was showed by PV_5 which is statistically similar to PV_2 (6.8) and the lowest value (4.00) was showed by MV_1 statistically similar to MV_2 (4.09) and MV_3 (4.14). At 10 DAS due to different locations and varieties was found significant. The maximum Crispness (6.22) was showed by PV_2 and the minimum Crispness (3.5) was found in MV_1 (Table 3).At 20 DAS due to different locations and varieties was found significant. The maximum Crispness (5.77) was showed by PV_2 which is statistically similar to PV_5 (5.72) and

the minimum Crispness (3.08) was found in MV_1 (Table 3).At 30 DAS due to different locations and varieties was found significant .The maximum Crispness (5.42) was showed by PV_2 which is statistically similar to PV_5 (5.27) and the minimum (2.64) was found in MV_3 (Table 3). At 40 DAS due to different locations and varieties was found significant. The maximum Crispness (5.17) was showed by PV_2 and the minimum Crispness (2.34) was found in MV_3 (Table 3). At 50 DAS due to different locations and varieties was found significant. The maximum Crispness (5.0197) was showed by PV_2 and the minimum Crispness (2.14) was found in MV_3 (Table 3). At 60 DAS due to different locations and varieties was found significant. The maximum Crispness (4.9) was showed by PV_2 and the minimum (2.04) was found in MV_3 (Table 3). The results reveal that the crispness of all treatment combination decreased with advancing storage period .Among the treatment combinations, PV_5 showed the best performance at 0, 10, 20, 30 DAS.

Table 3. Combined effect of location and variety on crispness of different potato varieties

Combinations	Crispness at						
	0 DAS	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
PV_1	6.3900 b	5.8401 b	5.3397 b	4.9400 b	4.6397 c	4.4400 c	4.3397 b
PV_2	6.8000a	6.2200a	5.7700a	5.4200a	5.1700a	5.0197a	4.9000a
PV_3	6.0600c	5.7600b	5.3600b	4.7800b	4.2800d	4.0799d	3.9800c
PV_4	5.5800d	5.3800c	4.8300c	4.3303c	4.0000e	3.8000e	3.7000d
PV_5	6.8503a	6.2700a	5.7183a	5.2700a	4.8900b	4.6030b	4.4300b
DV_1	5.2500e	4.7000d	4.2000d	3.8000d	3.5000f	3.2990f	3.2000e
DV_2	4.9200f	4.4200e	3.8700e	3.4700e	3.1700g	2.9700g	2.8700f
DV_3	5.1300e	4.5900de	4.0900d	3.6697d	3.3600f	3.1600f	3.0503e
DV_4	4.2303g	3.7303f	3.2100f	2.8093f	2.5103hi	2.3103h	2.2100g
DV_5	5.2100e	4.6600d	4.1600d	3.7600d	3.4600f	3.2600f	3.1599e
MV_1	4.0000h	3.5000g	3.0800f	2.7903f	2.5400hi	2.3400h	2.2400g
MV_2	4.0900gh	3.5400fg	3.1000f	2.8000f	2.6000h	2.3500h	2.2500g
MV_3	4.1400gh	3.5900fg	3.1400f	2.6400f	2.3397j	2.1400i	2.0400h
MV_4	4.2100g	3.6600^{f}g	3.1600f	2.7600f	2.4600h-j	2.2600hi	2.1600gh
MV_5	4.2300g	3.6800fg	3.1699f	2.7503f	2.4300ij	2.2100hi	2.1100gh
CV%	1.00	1.55	1.09	1.63	1.60	1.59	1.71
$LSD_{0.05}$	0.1555	0.2168	0.1369	0.1838	0.1652	0.1552	0.1608
Level of Significance	**	**	**	**	**	**	**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

P-Panchagarh, D-Dhaka, M-Munshiganj

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.4 Firmness

4.4.1 Effect of location

Profound dissimilarity was found among different locations on firmness of potato at 0 DAS (Appendix V).The maximum firmness (28.244 N) was obtained by Panchagarh and the minimum (26.830) was found in Munshiganj (Figure 7).At 10 DAS due to different locations was found significant .The highest firmness (28.244 N) was found in Panchagarh and the lowest (26.830 N) was found in Munshiganj (Figure 7). At 20 DAS due to different locations was found significant. The highest firmness (24.446 N) was found in Panchagarh and the lowest (23.054 N) was found in Munshiganj (Figure 7). At 30 DAS due to different locations was found significant. The highest firmness (22.736 N) was found in Panchagarh and the lowest (21.430 N) was found in Munshiganj (Figure 7). At 40 DAS due to different locations was found significant. The highest firmness (20.846 N) was found in Panchagarh and the lowest (19.479 N) was found in Munshiganj (Figure 7). At 50 DAS due to different locations was found significant. The highest firmness (18.757 N) was found in Panchagarh and the lowest (17.284 N) was found in Munshiganj (Figure 7). At 60 DAS due to different locations was found significant. The highest firmness (16.768 N) was found in Panchagarh and the lowest (15.284 N) was found in Munshiganj (Figure 7).

The result revealed that the firmness value decreased with the storage period. Panchagarh showed the highest value all over the storage period.

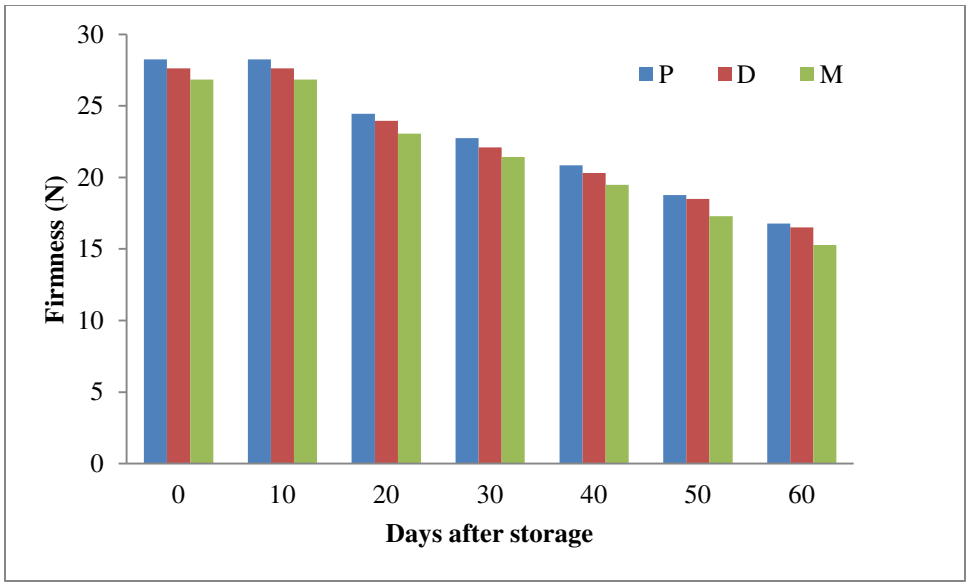

Figure 7. Response of different locations to firmness of different potato varieties at different days after storage (LSD values 0.3614, 0.3614, 0.3021, 0.2831, 0.3428, 0.2259, 0.2058 for 0 DAS, 10 DAS , 20DAS, 30 DAS, 40 DAS, 50 DAS and 60 DAS respectively).

P-Panchagarh, D-Dhaka, M-Munshiganj

4.4.2 Effect of varieties

Significant dissimilarity was found among different varieties on firmness of potato at 0 DAS (Appendix V). The maximum firmness (28.055 N) was obtained by Asterix statistically similar to Courage, Felsina, Lady Rosetta and the minimum firmness (26.720 N) was found in Lady Rosetta (Figure 8). At 10 DAS due to different varieties was found significant. The highest firmness (26.005 N) was found in Asterix while the lowest (24.687 N) was found in Lady Rosetta (Figure 8). At 20 DAS due to different varieties was found numerically significant. The highest firmness (24.290 N) was found in Dura and the lowest firmness (22.739 N) was found in Lady Rosetta (Figure 8). At 30 DAS due to different varieties was found numerically significant (Appendix V). The highest firmness (22.557 N) was found in Dura whereas the lowest firmness (21.004 N) was found in Lady Rosetta (Figure 8). At 40 DAS due to different varieties was found significant. The highest firmness (20.612 N) was found in Dura and the lowest firmness (19.107 N) was found in Lady Rosetta (Figure 8). At 50 DAS due to different varieties was found significant .The highest firmness (18.890 N) was found in Dura and the lowest firmness

(16.924 N) was found in Lady Rosetta (Figure 8). At 60 DAS due to different varieties was found significant. The highest firmness (16.889 N) was found in Dura and the lowest firmness (14.940 N) was found in Lady Rosetta (Figure 8).

The above discussion showed that firmness value decreased with increasing storage period. Dura variety showed the highest firmness values irrespective of storage period.

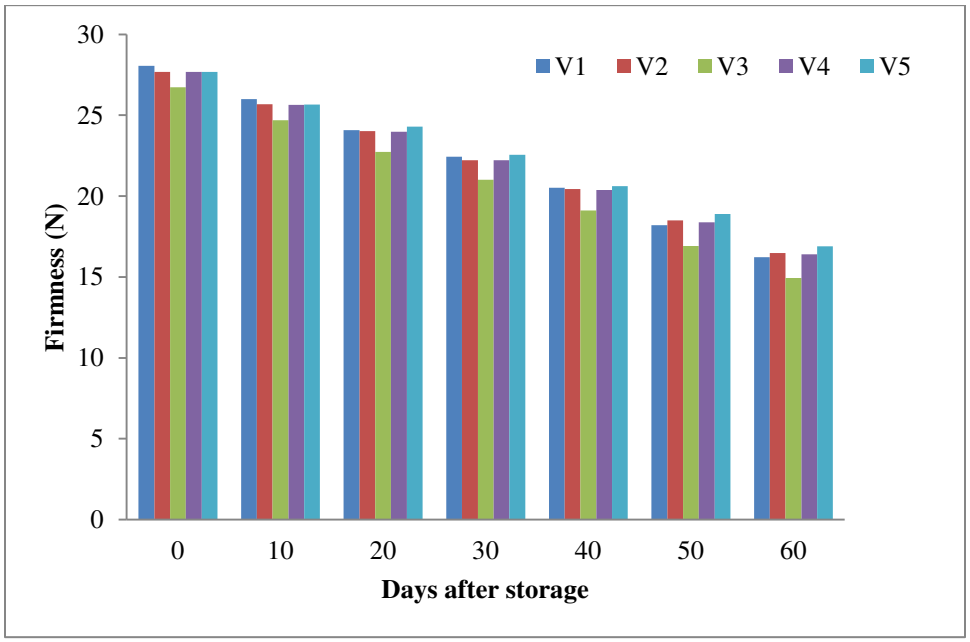

Figure 8. Response of different potato varieties to firmness at different days after storage

(LSD values 0.5493, 0.5280, 0.4592, 0.4303, 0.5210, 0.3433, 0.3127 for 0 DAS, 10 DAS , 20DAS, 30 DAS, 40 DAS, 50 DAS and 60 DAS respectively).

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.4.3 Combined effect of locations and varieties

Profound dissimilarity was found among different locations and varieties on firmness of potato at 0 DAS (Appendix V). The highest value (29.050 N) was showed by PV_1 which is statistically similar to PV_5, PV_4, PV_2, DV_1, DV_2, DV_4 and the lowest value (26.018 N) was showed by MV_3 (Table 4).At 10 DAS due to different locations and varieties was found significant .The maximum firmness (27.00 N) was showed by PV_1 which is statistically similar to PV_5, PV_4, PV_2, DV_2, DV_1, DV_4 and the minimum firmness (23.968 N) was found in MV_3 (Table 4). At 20 DAS

due to different locations and varieties was found significant. The maximum firmness (25.110 N) was showed by PV1 which is statistically similar to PV_5, PV_4, PV_2, DV_2 and the minimum firmness (22.075 N) was found in MV_3 which is statistically similar to MV_4, DV_3, MV_2 and PV_3 (Table 4). At 30 DAS due to different locations and varieties was found significant. The maximum firmness (23.610 N) was showed by PV_1 which is statistically similar to PV_5, PV_4, DV_2 and the minimum firmness (20.568 N) was found in MV_3 which is statistically similar to PV_3 , MV_2 , DV_3 (Table 4).At 40 DAS due to different locations and varieties was found significant .The maximum firmness (21.610 N) was showed by PV_1 which is statistically similar to PV_5, , DV_2, PV_4 and the minimum firmness (18.578 N) was found in MV_3 which is statistically similar to DV_3, PV_3 , MV_4, MV_2 , MV_1 (Table 4). At 50 DAS due to different locations and varieties was found significant. The maximum firmness (19.815 N) was showed by PV_4 which is statistically similar to DV_2, PV_1, PV_4 and the minimum firmness (16.078 N) was found in MV_3 (Table 4). At 60 DAS due to different locations and varieties was found numerically significant (Appendix V). The maximum firmness (17.815 N) was showed by PV_4 which is statistically similar to DV_2, PV_1 and the minimum firmness (14.078 N) was found in MV_3 (Table 4).

The result revealed that firmness of all treatment combination decreased with increasing storage period. Among the combination PV_1 showed the best performance all over the storage period.

Table 4 .Combined effect of location and variety on firmness of different potato varieties

Combinations	Firmness(N) at						
	0 DAS	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
PV_1	29.050 a	27.000 a	25.110 a	23.610 a	21.610 a	19.177 ab	17.220 ab
PV_2	28.015 ab	26.015 ab	24.065 b-e	22.315 bc	20.365 bc	18.350 cd	16.315 c
PV_3	27.124 bc	25.076 bc	23.076 ef	21.126 de	19.376 cd	17.376 e	15.426 d
PV_4	28.025 ab	26.015 ab	24.915 a-c	23.065 ab	21.315 ab	19.815 a	17.815 a
PV_5	29.005 a	26.955 a	25.065 ab	23.565 a	21.565 a	19.065 a-c	17.063 b
DV_1	28.015 ab	25.965 ab	23.965 c-e	22.015 cd	20.265 bc	18.265 d	16.315 c
DV_2	28.011 ab	26.001 ab	24.901 a-d	23.051 ab	21.301 ab	19.801 a	17.801 a
DV_3	27.017 bc	25.017 bc	23.067 ef	21.317 de	19.367 cd	17.317 e	15.317 d
DV_4	28.010 ab	25.960 ab	23.960 c-e	22.010 cd	20.260 bc	18.260 d	16.310 c
DV_5	27.014 bc	25.004 bc	23.904 c-e	22.054 cd	20.304 bc	18.804 b-d	16.804 bc
MV_1	27.100 bc	25.050 bc	23.160 e	21.660 cd	19.660 cd	17.160 e	15.160 d
MV_2	27.021 bc	25.021 bc	23.071 ef	21.310 de	19.629 cd	17.321 e	15.321 d
MV_3	26.018 c	23.968 c	22.075 f	20.568 e	18.578 d	16.078 f	14.078 e
MV_4	27.001 bc	24.951 bc	23.061 ef	21.561 cd	19.561 cd	17.060 e	15.060 d
MV_5	27.011 bc	25.001 bc	23.901 de	22.051 cd	19.968 c	18.801 b-d	16.801 bc
CV%	1.45	1.51	1.40	1.42	1.88	1.38	1.41
$LSD_{0.05}$	1.2098	1.1629	1.0113	0.9476	1.1476	0.7562	0.6888
Level of Significance	**	**	**	**	**	**	**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

P-Panchagarh, D-Dhaka, M-Munshiganj

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.5 Specific gravity

4.5.1 Effect of location

Profound similarity was found among different locations on specific gravity of potato at 0 DAS (Appendix VI). The maximum specific gravity (1.0668 g cm^{-3}) was obtained by Panchagarh followed by Dhaka (1.0607 g cm^{-3}) and Munshiganj (1.0547 g cm^{-3}) (Figure 9). At 10 DAS due to different locations was found significant. The highest specific gravity (1.0683 g cm^{-3}) was found in Panchagarh and the lowest (1.055 g cm^{-3}) was found in Munshiganj and Dhaka (Figure 9). At 20 DAS due to different locations was found non significant .Numerically highest specific gravity was found in Munshiganj (1.0491g cm^{-3})while the lowest in Dhaka (1.0447 g cm^{-3}).At 30 DAS due to different locations was found non significant.

Numerically the highest value was found in Munshiganj (1.0479 g cm^{-3}) whereas the lowest in Dhaka (1.0446 g cm^{-3}). At 40 DAS due to different locations was found non significant .The highest value was got from Munshiaganj (1.0421 g cm^{-3}) and the lowest was from Panchagarh (1.0384 g cm^{-3}). At 50 DAS due to different locations was found significant .The highest specific gravity (1.0323 g cm^{-3}) was found in Munshiganj and the lowest specific gravity (1.0124 g cm^{-3}) was found in Panchagarh (Figure 9). At 60 DAS due to different locations was found significant. The highest specific gravity (1.024) was found in Munshiganj and the lowest specific gravity (1.01 g cm^{-3}) was found in Panchagarh (Figure 9).

The above result showed that specific gravity decreased with increasing storage period irrespective of locations. Among the locations Panchagarh showed the highest value of specific gravity though Munshiganj showed highest value at 20, 30, 40,50 and 60 DAS.

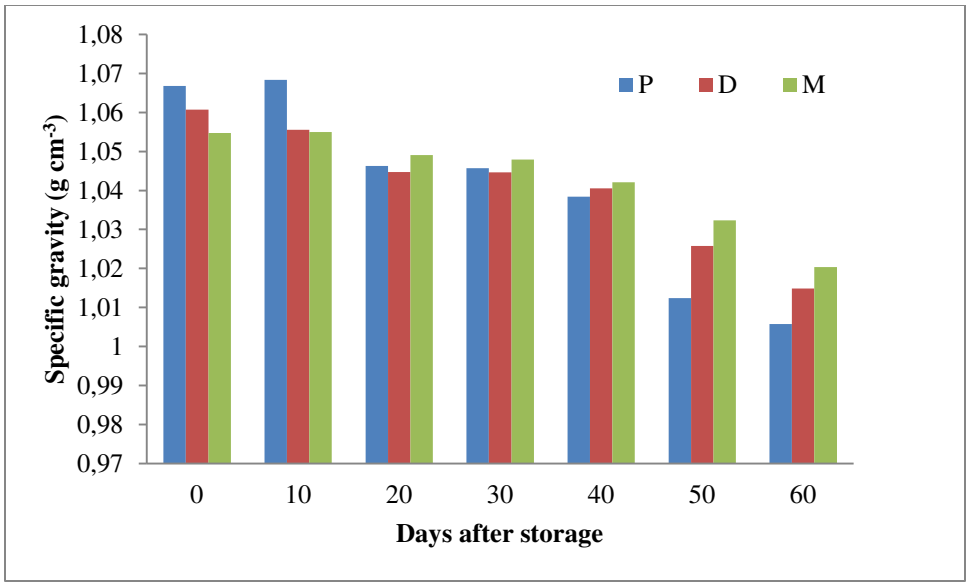

Figure 9. Response of different locations to specific gravity of different potato varieties at different days after storage (LSD values 0.0072, 0.025, 0.0144, 0.0143 for 0 DAS, 10 DAS ,50 DAS and 60 DAS respectively).
P-Panchagarh, D-Dhaka, M-Munshiganj

4.5.2 Effect of varieties

Non significant variation was found among different varieties to specific gravity of potato at 0 DAS (Appendix VI). Numerically the maximum specific gravity of potato (1.0692 g cm^{-3}) was obtained by Lady Rosetta and the lowest (1.0501 g cm^{-3}) was obtained by Dura (Figure 10). At 10 DAS due to different varieties was found significant .The highest specific gravity (1.0792 g cm^{-3}) was found in Lady Rosetta and the lowest (1.0507 g cm^{-3}) was found in Dura (Figure 10). At 20 DAS due to different varieties was found non significant .Numerically the highest specific gravity (1.0633 g cm^{-3}) was found in Lady Rosetta whereas the lowest (1.037 g cm^{-3}) was found in Asterix (Figure 10). At 30 DAS due to different varieties was found significant. The highest specific gravity (1.0580 g cm^{-3}) was found in Lady Rosetta and the (1.0351 g cm^{-3}) was found in Asterix (Figure 10). At 40 DAS due to different varieties was found significant .The highest specific gravity (1.0609 g cm^{-3}) was found in Lady Rosetta and the lowest (1.0269 g cm^{-3}) was found in Asterix (Figure 10). At 50 DAS due to different varieties was found significant .The highest specific gravity (1.0433 g cm^{-3}) was found in Lady Rosetta which is statistically similar to Courage and the lowest (1.01 g cm^{-3}) was found in Asterix (Figure 10). At 60 DAS due to

different varieties was found significant .The highest specific gravity (1.0342 g cm^{-3}) was found in Lady Rosetta which is statistically similar to Courage and the lowest (0.997 g cm^{-3}) was found in Asterix (Figure 10).

The result revealed that the specific gravity decreased with the advancing storage period. And the Lady Rosetta showed the highest specific value of potato .

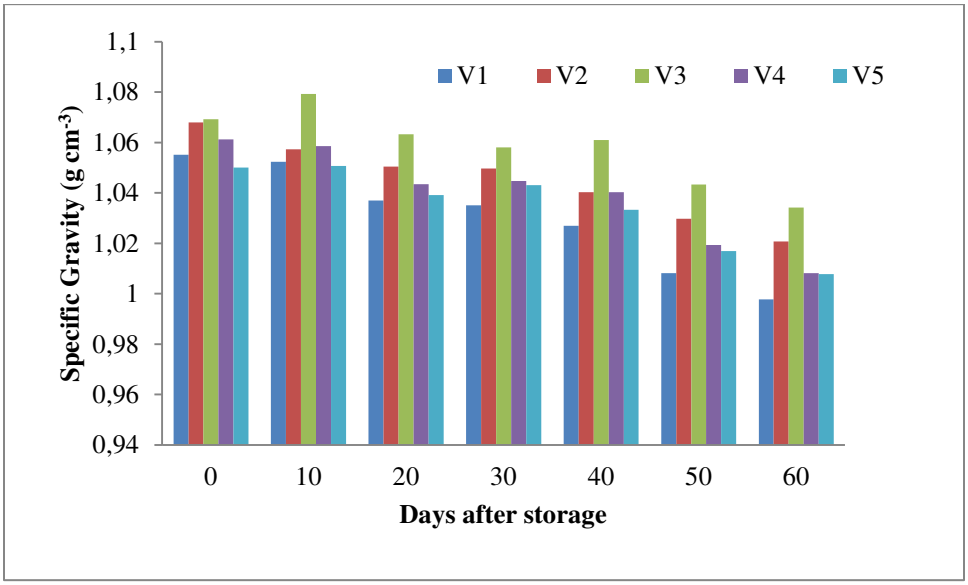

Figure 10. Response of different potato varieties to specific gravity at different days after storage (LSD values 0.0120, 0.0140, 0.0146, 0.0153, 0.0218, 0.0219 and 0.0218 for 0 DAS, 10 DAS,20 DAS, 30 DAS, 40 DAS,50 DAS and 60 DAS respectively).
V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.5.3 Combined effect of locations and varieties

Profound similarity was found among different locations and varieties on specific gravity of potato at 0 DAS (Appendix VI). At 10 DAS, 20 DAS, 30 DAS,40 DAS due to different locations and varieties was found numerically non significant. At 50 DAS due to different locations and varieties was found significant .The maximum specific gravity (1.0670 g cm^{-3}) was showed by MV_3 and MV_3 which is statistically similar to DV_4, D V_3,PV_2, MV_1, MV_5, DV_2, MV_2 ,PV_3 and the minimum (0.9847 g cm^{-3}) was found in PV_1 (Table 5). At 60 DAS due to different locations and varieties was found significant. The maximum specific gravity (1.0563 g cm^{-3}) was

Table 5. Combined effect of location and variety on specific gravity of different potato varieties

Combinations	Specific gravity (g cm^{-3}) at						
	0 DAS	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
PV_1	1.0630	1.0600	1.0350	1.0330	1.0147	0.9847 c	0.9777 c
PV_2	1.0760	1.0740	1.0583	1.0580	1.0560	1.0360 ab	1.030 ab
PV_3	1.0840	1.0810	1.0533	1.0540	1.0510	1.0210a-c	1.0140a-c
PV_4	1.0770	1.0740	1.0487	1.0470	1.0357	1.0057bc	0.9987 bc
PV_5	1.0340	1.0527	1.0360	1.0367	1.0347	1.0147bc	1.0087 bc
DV_1	1.0530	1.0490	1.0320	1.0330	1.0310	1.0110bc	1.0017 bc
DV_2	1.0650	1.0500	1.0487	1.0490	1.0340	1.0280a-c	1.0197a-c
DV_3	1.0820	1.0800	1.0627	1.0470	1.0620	1.0420 ab	1.0323 ab
DV_4	1.0527	1.0497	1.0477	1.0510	1.0447	1.0370 ab	1.021 a-c
DV_5	1.0509	1.0490	1.0323	1.0430	1.0310	1.0110 bc	0.9997 bc
MV_1	1.0493	1.0480	1.0440	1.0393	1.0350	1.0290a-c	1.0137a-c
MV_2	1.0630	1.0480	1.0443	1.0417	1.0310	1.0250a-c	1.0123a-c
MV_3	1.0417	1.0767	1.0740	1.0730	1.0697	1.0670 a	1.0563 a
MV_4	1.0540	1.0520	1.0340	1.0360	1.0407	1.0153bc	1.0047 bc
MV_5	1.0653	1.0503	1.0490	1.0493	1.0343	1.0250a-c	1.0150a-c
CV%	1.88	0.94	1.06	1.23	1.63	1.55	1.46
$LSD_{0.05}$	___	__	__	__	__	0.0479	0.0449
Level of Significance	NS	NS	NS	NS	NS	*	*

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

P-Panchagarh, D-Dhaka, M-Munshiganj

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

showed by MV_3 which is statistically similar to DV_4, PV_2, MV_1, MV_5, DV_2, MV_2 ,PV_3 and the minimum (0.977 g cm^{-3}) was found in PV_1 (Table 5).

The results showed that specific gravity of all treatment combination decreased with increasing storage period. Among them MV_3 showed the best performance all over storage period.

4.6 Weight loss percentage

4.6.1 Effect of location

Similarity was found among different locations on weight loss percentage of potato at 10 DAS (Appendix VII). At 20 DAS due to different locations was found numerically significant. The highest Weight loss percentage (3.4140) was found in Munshiganj and the lowest weight loss percentage (2.6133) was found in Panchagarh (Figure 11). At 30 DAS due to different locations was found significant. The highest weight loss percentage (5.49) was found in Munshiganj and the lowest weight loss percentage (3.3367) was found in Panchagarh (Figure 11). At 40 DAS due to different locations was found significant. The highest weight loss percentage (6.5087) was found in Munshiganj and the lowest weight loss percentage (4.8060) was found in Panchagarh (Figure 11). At 50 DAS due to different locations was found numerically significant (Appendix VII). The highest weight loss percentage (7.3373) was found in Munshiganj and the lowest weight loss percentage (5.8120) was found in Panchagarh (Figure 11). At 60 DAS due to different locations was found significant. The highest weight loss percentage (7.65) was found in Munshiganj and the lowest weight loss percentage (6.0673) was found in Panchagrh (Figure 11). The result reveal that the weight loss percentage increased with the storage period. Munshiganj showed the highest value all over the storage period.

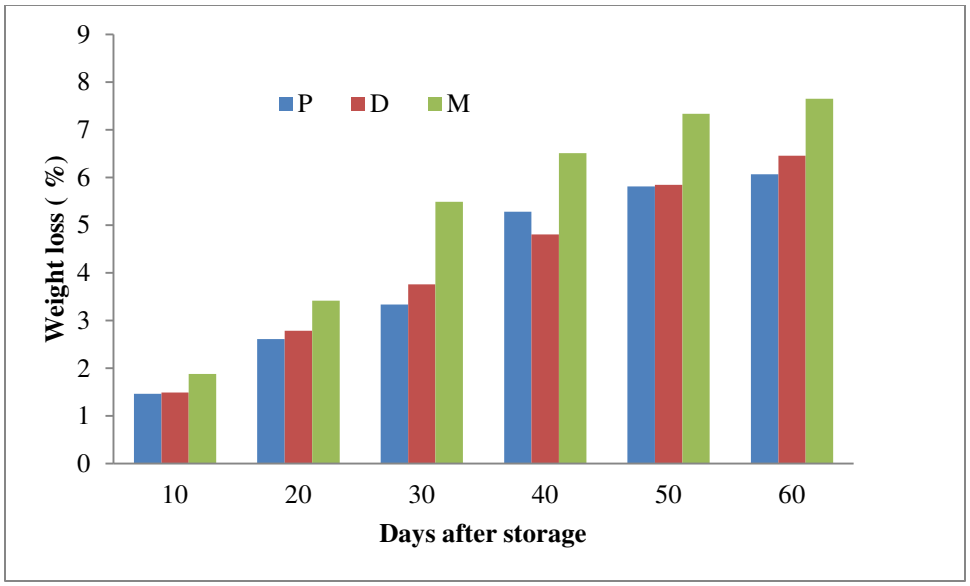

Figure 11. Response of different locations to weight loss (%) of potato varieties at different days after storage (LSD values 0.4949, 0.4221, 0.7127, 0.8554, 0.9175 and 0.9868 for 10 DAS, 20 DAS, 30 DAS, 40 DAS,50 DAS and 60 DAS respectively).
P-Panchagarh, D-Dhaka, M-Munshiganj

4.6.2 Effect of varieties

Non significant variation was found among different varieties to weight loss percentage of potato at 10,20, 30, 40, 50and 60 DAS (Appendix VII). At 10 DAS, numerically the highest value (1.71%) of weight loss percentage was given by Courage whereas the lowest (1.41%) was given by Asterix. At 20 DAS, numerically the maximum value (3.2%) was found from Lady Rosetta and the minimum (2.7%) from Asterix. At 30 DAS, the highest value (4.53%) was given by Courage and the lowest (3.94%) by Asterix. At 40 DAS, the highest value (5.8%) was found from Asterix and the lowest (5.4%) from Felsina. At 50 DAS, the highest value (6.8%) was found from Lady Rosetta while the lowest (5.9%) from Dura. At 60 DAS, the highest value (7.4%) was found in Lady Rosetta whereas the loest (6.1%) from Dura.

The result revealed that the weight loss (%) of different potato varieties increased with advancing storage time. Among the varieties Asterix showed minimum value at 10, 20, 30 DAS and Dura showed minimum value at 50 and 60 DAS.

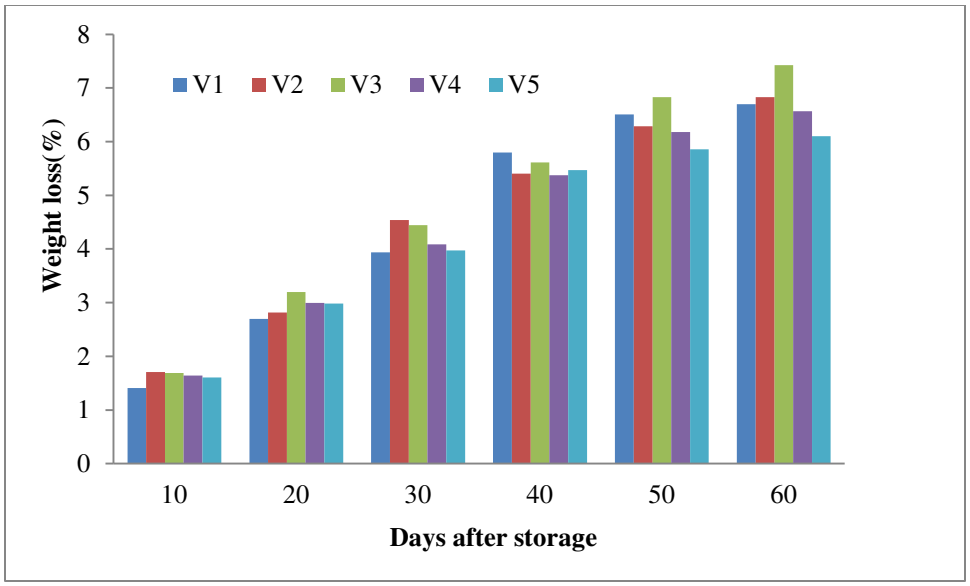

Figure 12. Response of different locations to weight loss (%) of potato varieties at different days after storage (LSD non significant)

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.6.3 Combined effect of locations and varieties

Profound similarity was found among different locations and varieties on Weight loss percentage of potato at 10 DAS (Appendix VII). At 20 DAS due to different locations and varieties was found significant. The highest value (3.83 %) was found in MV_5 which is statistically similar to PV_3, MV_1,MV_2 and the lowest value (1.61) was showed by PV_1 which is statistically similar to PV_5, DV_2. At 30 DAS due to different locations and varieties was found significant. The highest value (6.0367 %) was found in MV_1 which is statistically similar to MV_2 and the lowest value (2.0667 %) was showed by PV_1 which is statistically similar to PV_5, DV_2. At 40 DAS ,50 DAS and 60 DAS due to different locations and varieties was found non significant .

The result demonstrated that weight loss (%) of all treatment combinations increased with storage time.Among them PV_1 showed lowest value. Weight loss is initially attributed to the water loss that happens through the outermost skin tissues during the processes of respiration and sprouting (Tester *et al.,* 2005).

Table 6. Combined effect of location and variety on weight loss % of different potato varieties

Combinations	Weight loss % at					
	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
PV_1	0.9167	1.6100 c	2.0667 e	5.5067	5.7400	5.7400
PV_2	1.6400	2.8200 a-c	3.9167 a-e	4.8500	5.5567	6.0267
PV_3	1.9800	3.6333 a	4.4600 a-d	5.9500	6.9433	7.5100
PV_4	1.6900	2.8967 a-c	3.6267 b-e	4.8533	5.6600	5.9000
PV_5	1.1000	2.1067 bc	2.6133 de	5.2400	5.1600	5.1600
DV_1	1.7133	2.8600 a-c	3.7133 a-e	4.6400	5.7267	6.3000
DV_2	1.2133	2.1233 bc	3.7933 a-e	4.5867	5.4033	6.3133
DV_3	1.2400	2.9867 a-c	4.0533 a-e	5.2967	6.8300	7.4500
DV_4	1.6367	2.9433 a-c	3.1467 c-e	4.5833	5.7933	6.4467
DV_5	1.6400	3.0067 a-c	4.0967 a-e	4.9233	5.4667	5.7500
MV_1	1.5967	3.6133 a	6.0367 a	7.2467	8.0533	8.0533
MV_2	2.2733	3.5033 ab	5.9067 ab	6.7767	7.8967	8.1467
MV_3	1.8400	2.9767 a-c	4.8133 a-d	5.5933	6.7133	7.3100
MV_4	1.5900	3.1467 ab	5.4900 a-c	6.6900	7.0833	7.3467
MV_5	2.0833	3.8300 a	5.2033 a-c	6.2367	6.9400	7.3933
CV%	34.01	15.90	18.80	17.11	16.04	16.24
$LSD_{0.05}$	---	1.4127	2.3857	---	----	---
Level of Significance	NS	**	*	NS	NS	NS

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

P-Panchagarh, D-Dhaka, M-Munshiganj

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.7 Starch content percentage

4.7.1 Effect of location

Profound dissimilarity was found among different locations on Starch percentage of potato at 10 DAS (Appendix VIII). The maximum Starch percentage (15.408) was obtained by Panchagarh and the minimum (15.158) was found in Munshiganj (Figure 13).

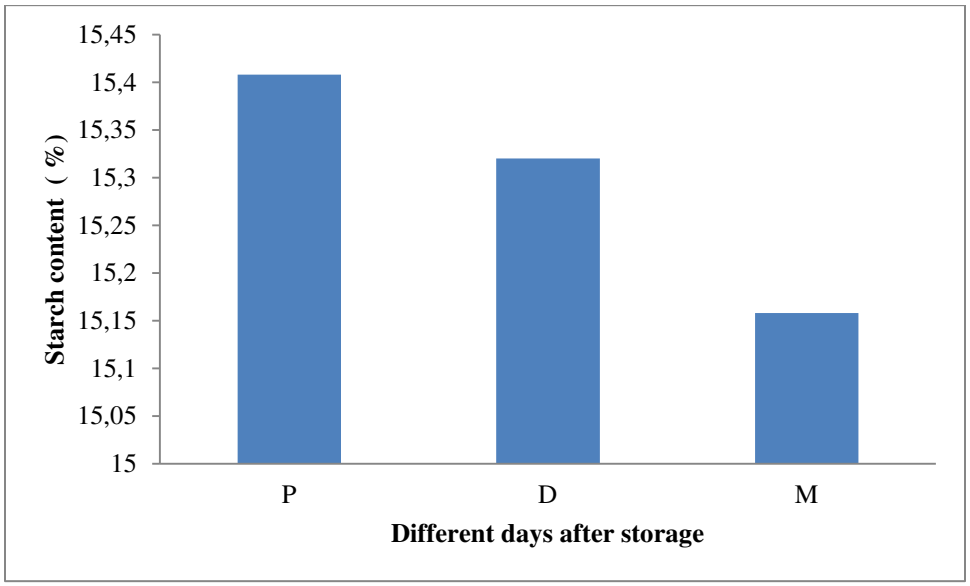

Figure 13. Response of different locations to starch content (%) of potato varieties at different days after storage (LSD values 0.1713 10 DAS respectively).

P-Panchagarh, D-Dhaka, M-Munshiganj

4.7.2 Effect of variety

Significant variation was found among different varieties to Starch percentage of potato at 10 DAS (Appendix VIII). The maximum Starch percentage of potato (15.667) was obtained by Lady Rosetta and the lowest (14.947) was obtained by Dura which is statistically similar to Felsina (Figure 14).

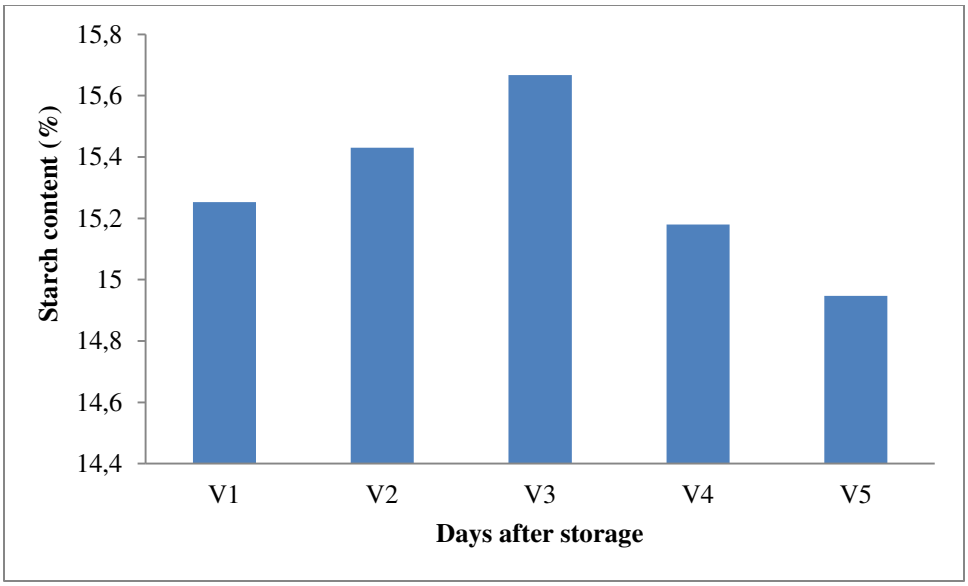

Figure 14. Response of different locations to weight loss (%) of potato varieties at different days after storage (LSD values 0.2603 at 10 DAS).

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.7.3 Combined effect of locations and varieties

Profound similarity was found among different locations and varieties on Starch percentage of potato at 10 DAS (Appendix VIII). The maximum Starch percentage of potato (16.340) was obtained by PV_3 and the lowest (14.570) was obtained by PV_5 which is statistically similar to MV_3, DV_4, MV_5 and DV_1 (Table 7).

Table 7. Combined effect of location and variety on starch content (%) of different potato varieties

Combinations	Starch content (%) at 10 DAS
PV_1	15.340 b-d
PV_2	15.450 bc
PV_3	16.340 a
PV_4	15.340 b-d
PV_5	14.570 e
DV_1	15.130 c-e
DV_2	15.470 bc
DV_3	15.870 ab
DV_4	14.970 c-e
DV_5	15.160 cd
MV_1	15.290 cd
MV_2	15.370 bc
MV_3	14.790 de
MV_4	15.230 cd
MV_5	15.110 c-e
CV%	1.24
$LSD_{0.05}$	0.5734
Level of Significance	**

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

P-Panchagarh, D-Dhaka, M-Munshiganj

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.8 Fleshcolor

4.8.1 Effect of location

Dissimilarity was got from different locations on lightness (L*), green-red chromaticity (a*) and blue-yellow chromaticity (b*) of potato flesh at 10 DAS (Appendix X). The highest L* value (92.366) was taken by Panchagarh and the lowest value (90.718) was taken by Munshiganj. The highest value of a* (1.0957) was given by Panchagarh and the lowest value (0.8083) was taken by Munshiganj. The highest value of b* (22.642) was taken by Panchagarh and the lowest (20.175) was by Munshiganj (Table 8).

Table 8. Effect of location on fleshcolor different potato varieties

Treatment	Fleshcolor at 10 DAS		
	L*	a*	b*
P	92.366 a	1.0957 a	22.642 a
D	91.564 ab	0.9533 b	21.731 b
M	90.718 b	0.8080 c	20.175 c
CV%	1.37	1.16	1.35
$LSD_{0.05}$	1.1369	1.998	0.2618
Level of Significance	*	*	*

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

P-Panchagarh, D-Dhaka, M-Munshiganj

4.8.2 Effect of variety

Significant and non significant variation was found among different varieties on lightness (L*), green-red chromaticity (a*) and blue-yellow chromaticity (b*) of potato flesh at 10 DAS (Appendix X). The L* value was found non significant.The highest value of a* (1.02) was given by Asterix and Courage and the lowest value (0.8828) was taken by Felsina. The highest value of b* (22.170) was taken by Courage and the lowest (20.828) was by Lady Rosetta (Table 9).

Table 9.Effect of Variety on Fleshcolor of different potato varieties

Treatment	Fleshcolor at 10 DAS		
	L*	a*	b*
V_1	91.937	1.0200 a	21.743 b
V_2	91.524	1.0200 a	22.170 a
V_3	91.423	0.9400 b	20.828 c
V_4	91.650	0.8828 d	21.850 ab
V_5	91.213	0.8994 c	20.988 c
CV%	1.37	1.16	1.35
$LSD_{0.05}$	--	0.0152	0.3979
Significance	NS	*	*

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.8.3 Combined effect of locations and varieties

Profound similarity and dissimilarity was found among different locations and varieties on flesh color of potato at 10 DAS . The L* value was found non significant. The maximum a* value of potato flesh (1.31) was obtained by PV_1 and the lowest (0.5017) was obtained by MV_5 (Figure 3). The highest b* value (23.060) was found in PV_2 and DV_4 which is statistically similar to PV_5,PV_1,PV_4 and DV_1 (Table 10).

Table 10. Combined effect of location and variety on fleshcolor of different potato varieties

Combinations	Fleshcolor at 10 DAS		
	L*	a*	b*
PV_1	92.740	1.3100 a	22.550 ab
PV_2	92.180	1.0000 d	23.060 a
PV_3	92.280	1.0800 c	22.090 bc
PV_4	92.081	0.8983 e	22.500 ab
PV_5	92.550	1.1900 b	23.010 a
DV_1	92.080	0.9000 e	22.500 ab
DV_2	91.190	1.0100 d	21.450 c
DV_3	90.990	0.8500 f	20.193 d
DV_4	92.369	1.0000 d	23.060 a
DV_5	91.190	1.0067 d	21.450 c
MV_1	90.990	0.8500 f	20.180 d
MV_2	91.201	1.0500 c	22.000 bc
MV_3	91.000	0.8900 e	20.200 d
MV_4	90.500	0.7500 g	19.990 d
MV_5	89.900	0.5017 h	18.503 e
CV%	1.37	1.16	1.35
$LSD_{0.05}$	---	0.0334	0.8763
Level of significance	NS	*	*

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

P-Panchagarh, D-Dhaka, M-Munshiganj

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.9 Chipscolor

4.9.1 Effect of location

Dissimilarity was got from different locations on lightness (L*), green-red chromaticity (a*) and blue-yellow chromaticity (b*) of potato chisp at 10 DAS (Appendix X). The highest L* value (86.716) was taken by Panchagarh and the lowest value (84.482) was taken by Munshiganj. The highest value of a* (0.4980) was given by Panchagarh and the lowest value (0.2480) was taken by Munshiganj. The highest value of b* (55.749) was taken by Panchagrh and the lowest (53.170) was by Munshiganj (Table 11).

Table 11. Effect of location on chipscolor of different potato varieties

Treatment	Chispcolor at 10 DAS		
	L*	a*	b*
P	86.716 a	0.4980 a	55.749 a
D	85.662 a	0.3480 b	54.570 b
M	84.482 b	0.2480 c	53.170 c
CV%	1.48	1.47	1.51
$LSD_{0.05}$	1.1446	1.0257	0.7451
Level of Significance	*	*	*

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

P-Panchagarh, D-Dhaka, M-Munshiganj

4.9.2 Effect of variety

Significant and non significant variation was found among different varieties on lightness (L*), green-red chromaticity (a*) and blue-yellow chromaticity (b*) of potato chisp at 10 DAS. The L* value was found non significant. The highest value of a* (0.46) was given by Asterix and the

lowest value (0.2567) was taken by Lady Rosetta. The highest value of b* (55.483) was taken by Asterix and the lowest (53.077) was by Lady Rosetta (Table 12).

Table 12. Effect of variety on chipscolor of different potato varieties

Treatment	Chipscolor at 10 DAS		
	L*	a *	b*
V_1	86.420	0.4600 a	55.483 a
V_2	85.437	0.3567 c	54.357 a
V_3	84.573	0.2567 d	53.077 b
V_4	86.000	0.3733 b	54.976 a
V_5	85.670	0.3767 b	54.589 a
CV%	1.48	1.47	1.51
$LSD_{0.05}$	1.7396	1.734	1.1324
Level of Significance	NS	*	*

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

4.9.3 Combined effect of locations and varieties

Profound similarity and dissimilarity was found among different locations and varieties on skin color of potato at 10 DAS . The L* value was found non significant. The maximum a* value of potato crisp (0.60) was obtained by PV_1 and the lowest (0.25) was obtained by DV_3 which is statistically similar to MV_4. The highest b* value (56.640) was found in PV_1 which is statistically similar to PV_2, PV_5, PV_4 , DV_4 , DV_1 and PV_3 and the lowest value (51.921) was found in MV_3 statistically similar to MV_2, MV_4, MV_2, DV_3, DV_5, MV_1, MV_5 and PV_3 (Table 13).

Table 13. Combined effect of location and variety on chipscolor of different potato varieties

Combinations	Chipscolor at 10 DAS		
	L*	a*	b *
PV_1	87.190	0.6000 a	56.640
PV_2	87.010	0.5400 c	56.020
PV_3	85.490	0.3200 g	54.180
PV_4	86.890	0.4500 e	55.917
PV_5	87.000	0.5800 b	55.990
DV_1	86.980	0.4800 d	55.890
DV_2	85.090	0.3000 h	54.020
DV_3	84.350	0.2500 j	53.130
DV_4	86.880	0.4300 f	55.920
DV_5	85.010	0.2800 i	53.890
MV_1	85.090	0.3000 h	53.920
MV_2	84.210	0.2300 k	53.030
MV_3	83.880	0.2000 l	51.921
MV_4	84.230	0.2400 jk	53.090
MV_5	85.000	0.2700 i	53.887
CV%	1.48	1.47	1.51
$LSD_{0.05}$	---	0.0162	---
Level of Significance	NS	*	NS

In a column means having similar letter (s) are statistically similar and those having dissimilar letter (s) differ significantly.

** and *= Significant at 1% & 5 % level of probability, respectively

P-Panchagarh, D-Dhaka, M-Munshiganj

V_1 – Asterix , V_2-Courage, V_3-Lady Rosetta, V_4-Felsina, V_5-Dura

CHAPTER 5

SUMMARY AND CONCLUSION

The same field experiments were conducted at Panchagarh, Dhaka and Munshiganj and laboratory experiment was conducted at Laboratory of Department of Agronomy, Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar, Dhaka-1207 during November 2017 to April 2018 to study the processing quality of some potato varieties influenced by growing environment. The experiment consisted of 2 factors: Factor A : Location (3 locations) as - P: Panchagarh, D: Dhaka, M: Munshiganj; Factor B : Potato variety (5 varieties) as-V_1: Asterix, V_2: Courage, V_3: Lady Rosatta, V_4: Felsina, V_5: Dura. The experiment was laid out in a 2 factors Randomized Complete Block Design (RCBD) with 3 replications.

For different locations , the highest dry matter percentages of potato (21.496, 20.980, 20.462 %) were recorded from Panchagarh at harvest, 10 and 20 DAS respectively, whereas the lowest values(21.113, 20.763, 20.505%) were recorded from Munshiganj at harvest,10 and 20 DAS respectively. The highest total soluble solid (TSS) of potato (5.58, 5.8803, 6.18, 6.5, 6.84, 7.2, 7.5467^0 Brix) from Munshiganj while the lowest (4.5, 4.6999, 4.98, 5.24, 5.46, 5.64, 5.9067^0 Brix) from Panchagarh at harvest,10, 20, 30, 40, 50 and 60 DAS respectively. The highest firmness (28.244, 28.244, 24.446, 22.736, 20.846, 18.757, 16.768 N) from Panchagarh and the lowest (26.830, 26.830, 23.054, 21.430, 19.479, 17.284, 15.284 N) from Munshiganj at harvest,10, 20, 30, 40, 50 and 60 DAS respectively. At harvest,10, 20, 30, 40, 50 and 60 DAS the maximum crispness (6.3361, 5.8940 5.4036, 4.9481, 4.9481, 4.3885, 4.2699 N) was observed from Panchagarh whereas the minimum (4.1340,3.5940, 3.13, 2.7481, 2.7481, 2.26, 2.16 N) was observed from Munshiganj at harvest,10, 20, 30, 40, 50 and 60 DAS respectively.

At harvest,10 DAS the maximum specific gravity (1.0668, 1.0683 g cm^{-3}) was observed from Panchagarh while the minimum (1.0547, 1.055 g cm^{-3}) was observed from Munshiganj. The highest weight loss percentage (1.8767, 3.4140, 5.4900, 6.5087, 7.3373, 7.6500) was found from Munshiganj at harvest,10, 20, 30, 40, 50,60 DAS while the lowest (1.4653, 2.6133 , 3.3367) was at harvest,10, 20 DAS from Panchagarh. At harvest the maximum starch percentage (15.408) was found from Panchagarh and the minimum (15.158) was found from Munshiganj.

For different varieties, the highest dry matter percentage (21.733, 21.273, 20.863, 20.553, 20.093, 18.627 and 16.727 %) was found from Lady Rosetta at harvest,10, 20, 30, 40, 50,60 DAS respectively whereas the lowest (20.934, 20.621, 20.278 %) was found from Dura at harvest,10, 20 DAS respectively. The maximum total soluble solid (TSS) (5.5, 5.7333, 5.9667, 6.2, 6.4333, 6.8, 7.0711) was observed from Lady Rosetta at harvest,10, 20, 30, 40, 50,60 DAS respectively and the lowest (4.9333, 5.1676, 5.5, 6.3667, 6.6333) was observed from Felsina at harvest,10, 20, 50,60 DAS respectively. The highest crispness (5.4301, 4.87, 4.3494, 3.9268 N) was observed from Dura at harvest,10, 20, 30 DAS respectively and the lowest (4.6734, 4.2568, 3.7333, 6.2999, 2.9901, 2.7901, 2.69) was observed from Felsina at harvest,10, 20, 30, 40, 50,60 DAS respectively . The highest firmness value (24.290, 22.557, 20.612, 18.890, 16.889 N) was observed from Dura at 20, 30, 40, 50,60 DAS respectively while the lowest (26.720, 24.687, 22.739, 21.004, 19.107, 16.924, 14.940) was observed from Lady Rosetta at harvest,10, 20, 30, 40, 50,60 DAS respectively .The highest specific gravity (1.0692, 1.0792, 1.0633, 1.0580, 1.0609, 1.0433, 1.0342 g cm^{-3}) was found from Lady Rosetta and lowest (1.0501, 1.0507 g cm^{-3}) was found from Dura at harvest,10 DAS respectively . The highest starch % (15.667) was found from Lady Rosetta whereas the lowest (14.947) was found from Dura at 10 DAS.

For combination of location and variety the maximum dry matter percentage (22.7) was found from PV_3 at 0 DAS and the minimum (20.678) was found from PV_5 at 0 DAS.The maximum dry matter (22.1%) was found from PV_3 at 0 DAS whereas the minimum (20.440) was found from PV_5 at 10 DAS. The maximum dry matter percentage (21.550) was found from PV_3 at 20 DAS and the minimum (19.9) was found from PV_5 at 20 DAS. The maximum dry matter percentage (21.160) was found from PV_3 which is statistically similar to DV_2 and MV_2 at 30 DAS and the minimum (19.072) was found from PV_1 at 30 DAS. The maximum dry matter percentage (20.560 %) was found from PV_3 which is statistically similar to DV_3, MV_3 at 40 DAS and the minimum (18.412 %) was found from PV_1 at 40 DAS. The maximum dry matter percentage (19.06 %) was found from PV_3 and the minimum (16.96 %) was found from PV_5 at 50 DAS. The maximum dry matter percentage (17.26 %) was found from PV_3 and the minimum (14.861 %) was found from PV_5 at 60 DAS.

The maximum total soluble solid (6.0) was found from MV_1 ,MV_3 at 0 DAS and the minimum (4.0) was found from PV_1 at 0 DAS. The maximum total soluble solid (6.4) was found from MV_1 which is statistically similar to MV_3 at 10 DAS and the minimum (4.1980) was found from PV_1 which is statistically similar to PV_2 at 10 DAS. The maximum total soluble solid (6.8) was found from MV_1 at 20 DAS and the minimum (4.5) was found from PV_1 at 20 DAS. The maximum total soluble solid (7.0) was found from MV_1 which is statistically similar to MV_3 at 30 DAS and the minimum (4.8) was found from PV_1 which is statistically similar to PV_2 at 30 DAS. The maximum total soluble solid (7.4) was found from MV_1 which is statistically similar to MV_3 at 40 DAS and the minimum (5.0) was found from PV_1 which is statistically similar to PV_2 at 40 DAS. The maximum total soluble solid (7.8) was found from MV_1 at 50 DAS and the minimum (5.2) was found from PV_1 which is statistically similar to PV_2 at 50 DAS. The maximum total soluble solid (7.4) was found from MV_1 which is statistically similar to MV_3 at 60 DAS and the minimum (5.5) was found from PV_1 which is statistically similar to PV_2 at 60 DAS.

The maximum crispness (6.8503 N) was found from PV_5 which is statistically similar to PV_2 and the minimum (4.0 N) was found from MV_1 at harvest. The maximum crispness (6.27 N) was found from PV_5 which is statistically similar to PV_2 and the minimum (3.5 N) was found from MV_1 at 10 DAS. The maximum Crispness (5.77 N) was showed by PV_2 which is statistically similar to PV_5 and the minimum Crispness (3.08 N) was found in MV_1 w at 20 DAS. The maximum Crispness (5.42) was showed by PV_2 which is statistically similar to PV_5 and the minimum (2.64) was found in MV_3 at 30 DAS. The maximum Crispness (5.17 N) was showed by PV_2 and the minimum (2.34 N) was found in MV_3. The maximum Crispness (5.0197 N) was showed by PV_2 and the minimum (2.14 N) was found in MV_3. The maximum Crispness (4.9 N) was showed by PV_2 and the minimum (2.04 N) was found in MV_3 .

The highest firmness (29.050 N) was found from PV_1 which is statistically similar to PV_5, PV_2, PV_4 and the minimum (26.018 N) was found from MV_3 at harvest. The highest firmness (27.00 N) was found from PV_1 which is statistically similar to PV_5, PV_2, PV_4 and the minimum (23.968 N) was found from MV_3 at 10 DAS. The highest firmness (25.110 N) was found from PV_1 which is statistically similar to PV_5 and the minimum (22.075 N) was found from MV_3 at 20 DAS. The highest firmness (23.610 N) was found from PV_1 which is statistically similar to PV_5,

PV_4 and the minimum (20.568 N) was found from MV_3 at 30 DAS. The highest firmness (21.610 N) was found from PV_1 which is statistically similar to PV_5, PV_4 and the minimum (18.578 N) was found from MV_3 at 40 DAS. The highest firmness (19.177 N) was found from PV_1 which is statistically similar to PV_5, PV_4 and the minimum (16.078 N) was found from MV_3 at 50 DAS. The highest firmness (17.815 N) was found from PV_3 which is statistically similar to PV_1, DV_2 and the minimum (14.078 N) was found from MV_3 at 60 DAS.

The highest starch (16.340 %) was found from PV_3 and the minimum starch (14.570 %) was found from PV_5 which is statistically similar to DV_1, DV_4, MV_3, MV_5 at 10 DAS. The highest weight loss percentage (3.83 %) was found from MV_5 which is statistically similar to MV_1, MV_2, MV_3, MV_4 and the minimum weight loss percentage (1.61 %) was found from PV_1 which is statistically similar to PV_4,PV_5, MV_2 at 20 DAS. The highest weight loss percentage (6.0367 %) was found from MV_1 which is statistically similar to MV_2, MV_3, MV_4 ,MV_5 and the minimum weight loss percentage (2.0667 %) was found from PV_1 at 20 DAS.

The result demonstrated that the processing quality of potato such as dry matter percentage, specific gravity, firmness, crispness decreased but the TSS and weight loss percentage increased with the advancing period of time. This quality remains acceptable upto 40 DAS. But after 40 DAS the quality drastically reduced. So it can be said that the farmers of Bangladesh can store tubers upto 40 DAS.

Among the locations Panchagarh showed the best performance for producing processing quality potato and Lady Rosetta, Asterix and Dura variety showed good performance compared to those of other varieties on specific gravity, dry matter percentage, TSS, starch content (%) of potato when harvested at same time.

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APPENDICES

Appendix I. Monthly meteorological information during the period from November, 2017 to April. 2018

Month	Air Temperature(^{0}C)		Relative humidity (%)	Total rainfall (mm)
	Maximium	Minimum		
November	33	23	60	3.6
December	30	20	54	5.3
January	28	18	48	26.14
February	32	15	51	68.80
March	32	17	64	4824.19
April	36	20	72	11521.25

Source: Bangladesh Meteorological Department (Climate & weather division) Agargaon, Dhaka-1212

Appendix II: Mean square values of the data for dry matter percentage at different days after storage of potato

Source of variation	df	Dry matter (%)						
		0 DAS	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Replication	2	5.36620	6.10227	6.10227	5.06567	5.06292	0.26978	0.250
Location	2	0.555**	0.187**	0.0072^{NS}	0.571**	1.503**	1.579*	1.602*
Variety	4	0.067**	0.032**	0.0316**	0.941**	1.112**	1.518*	1.613**
Combination	8	0.606**	0.438**	0.4179**	0.070**	0.623**	0.635^{NS}	0.762^{NS}
Error	28	0.82513	0.68088	0.65296	0.60438	0.07065	0.41303	0.41177

** : Significant at 0.01 level of significance, *: Significance at 0.05 level of significance, NS=Non-significant

Appendix III: Mean square values of the data for TSS at different days after storage of Potato

Source of variation	df	TSS (^{0}Brix)						
		0 DAS	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Replication	2	0.34	0.314	0.411	0.4018	0.3556	0.494	0.7451
Location	2	4.382**	5.23**	5.402**	5.958**	7.1713**	9.128**	10.1213**
Variety	4	1.027**	0.97**	0.918**	0.912**	0.8879**	1.017**	0.9871**
Combination	8	0.232**	0.285**	0.3345**	0.243**	0.27009**	0.318**	0.2338**
Error	28	0.005	0.0074	0.00733	0.00752	0.0214	0.0066	0.0103

** : Significant at 0.01 level of significance, *: Significance at 0.05 level of significance

Appendix IV: Mean square values of the data for crispness (N) at different days after storage of potato

Source of variation	df	crispness (N)						
		0 DAS	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Replication	2	0.2063	0.0051	0.1573	0.1796	0.1603	0.1110	0.1218
Location	2	18.5969**	20.3624**	20.0359**	0.0037**	17.4465**	0.2735**	17.1965**
Variety	4	0.7313**	0.4699**	0.0020**	0.5973**	0.0030**	0.6373**	0.0028**
Combination	8	.3372**	0.2138**	0.2103**	0.2327	0.2586**	0.0026**	0.2631**
Error	28	0.0026	0.2423	0.5131	18.7485	0.6626	17.5159	0.6175

** : Significant at 0.01 level of significance, *: Significance at 0.05 level of significance, NS=Non-significant

Appendix V: Mean square values of the data for Firmness at different days after storage of potato

Source of variation	df	Firmness (N)						
		0 DAS	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Replication	2	10.7212	9.94382	7.13833	6.82284	5.42792	4.05721	3.45864
Location	2	7.5224**	7.53386**	7.49101**	6.39823**	7.10175**	9.23078**	9.42468**
Variety	4	0.1600**	2.21927**	3.41421**	3.47661**	3.48067**	4.99209**	4.90082**
Combination	8	0.6092**	0.58774**	0.11178**	0.91513**	0.77246**	1.47233**	1.47605**
Error	28	2.2361	0.14781	0.70756	0.09815	0.14393	0.06249	0.05185

** : Significant at 0.01 level of significance, *: Significance at 0.05 level of significance

Appendix VI: Mean square values of the data for specific gravity at different days after storage of potato

Source of variation	df	Specific gravity (g cm^{-3})						
		0 DAS	10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Replication	2	0.009	0.01291	0.01134	0.01371	0.0009	0.008	0.006
Location	2	0.0005^{NS}	0.00085**	0.00007^{NS}	0.00004^{NS}	0.00005^{NS}	0.002**	0.0008*
Variety	4	0.0006^{NS}	0.00118**	0.00102**	0.00064*	0.001**	0.002**	0.002**
Combination	8	0.00070^{NS}	0.00012^{NS}	0.00012^{NS}	0.00026^{NS}	0.0003^{NS}	0.006*	0.0006*
Error	28	0.000	0.00	0.000	0.00017	0.0003	0.000	0.0002

** : Significant at 0.01 level of significance, *: Significance at 0.05 level of significance, NS=Non-significant

Appendix VII: Mean square values of the data for weight loss % at different days after storage of potato

Source of variation	df	weight loss (%)					
		10 DAS	20 DAS	30 DAS	40 DAS	50 DAS	60 DAS
Replication	2	0.12572	0.05842	0.4226	1.0511	1.1068	0.2149
Location	2	0.80071 NS	2.66774 **	19.5180 **	11.5834 **	11.3943 **	10.2200 **
Variety	4	0.12812 NS	0.33197 NS	0.6898 NS	0.2751 NS	1.1925 NS	2.0570 NS
Combination	8	0.45167 NS	1.13473* *	1.6838 NS	0.9161 NS	1.1141 NS	0.9423 NS
Error	28	0.29986	0.21813	0.6220	0.8960	1.0308	1.1924

** : Significant at 0.01 level of significance, *: Significance at 0.05 level of significance, NS=Non-significant

Appendix VIII: Mean square values of the data for Starch % at different days after storage of potato

Source of variation	df	Starch %
		10 DAS
Replication	2	2.50525
Location	2	0.24120**
Variety	4	0.65857**
Combination	8	0.53184**
Error	28	0.03593

** : Significant at 0.01 level of significance, *: Significance at 0.05 level of significance