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Effects of Peeling Methods on Mineral Content of Potato and Development of Potato Based Biscuit

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Abstract: An attempt was taken to select the effective peeling methods of potatoes based on mineral content and to formulate biscuits using potato flour as a partial substitute of wheat flour. The potatoes were collected and washed with water thoroughly to remove adhered dirt and soil. Fresh potatoes (P_1), potatoes peeled before boiling (P_2) and potatoes peeled after boiling (P_3) were analyzed for mineral content. Significant ($p<0.05$) effect of peeling treatment on mineral content was observed in this study. However, potato with peel was scored with highest mineral content namely Calcium (9.40mg/100g), Magnesium (21.6mg/100g), Potassium (413.91mg/100g), Phosphorus (60.57mg/100g), Iron (0.78µg/100g) and Zinc (0.29µg/100g) among samples. On the basis of mineral content, potato with peel was selected to produce potato flour to replace wheat flour partially in preparing nutritionally enriched biscuit. Potato flour was blended with wheat flour in ratio of 3:17, 1:3 and 7:13 in preparation of biscuits with maintaining all other ingredients constant. The prepared biscuits were evaluated for sensory quality by Hedonic Rating Test. The sensory evaluation revealed that the biscuits prepared using 25 percent potato flour were almost equally acceptable as control biscuits and secured the score for overall acceptability (7.20) and ranked as 'like very much'. Biscuits prepared using 35 percent potato flour secured the lowest score (5.20) in term of overall acceptability and was unacceptable to the panelist. To ensure adequate minerals, the use of potato flour to substitute wheat flour up to 25% level is advocated.

Keywords: Potato, Minerals, Potato Powder, Potato Based Biscuit, Potato Peel

1. Introduction

Potato (*Solanum tuberosum*) belongs to the family Solanaceace, occupies an important plant kingdom comprising a large and composition group of about 90 genera and 3000 to 4000 species (Marwaha, 2007). With increasing cropping intensity of Bangladesh, potato tubers are the second only to that of paddy rice. In 2006, Bangladeshi farmers harvested more than 4.1 million tones (12 times more than 1961) which placed at number 15 among the world's potato producers and number 5 in Asia (FAO, 2008). The per capita consumption of potato in Bangladesh is around 24 kg against the world average 33 kg (Khan, 2009).

Among the carbohydrate rich food crops, potato plays an important role as alternative food materials instead of rice and numerous different types of food preparation (Khan, 2009). Potato is a staple food crop in many countries of the world and emerging as a truly global food. Nowadays, potato has become a valuable winter cash crop and an alternative food crop instead of rice. The slogan has started to promote it as "Bhater bodoley aloo". Whereas potato supplies dietary energy (60-80% starch), vitamin C, B_1, B_3, B_6 and minerals such as potassium, calcium, iron, phosphorus and magnesium and contain folate, pantothenic acid, riboflavin and also contain dietary antioxidants and on dry weight basis, the protein content is similar to that of cereals and little fat (FAO, 2008).

Potato can be used as vegetable and also as substitute of rice and wheat. Boiled potato of an equal weight of boiled rice contains almost equal and superior protein than rice. It contains relatively low quantity of sodium. So combination of high potassium and low sodium makes potato an ideal food for people suffering from hypertension (Khan, 2009). Potato also contains assortment of phytochemicals such as carotinoids and polyphenols, which act against colon cancer, improve glycose tolerance and insulin sensitivity, lower plasma cholesterol and triglyceride concentration increase satiety and possibly even reduce fat storage (Hylla *et al*., 1998).

Moreover, due to inadequate cold storage capacity, the diversion of potatoes to processed potato products would benefit both growers and consumers, as it would help extend the storage life and serve as a means of increasing the supply in off-seasons (Misra and Kulshrestha, 2003). Among several processed products, potato flour is the oldest commercial potato products, which can be stored safely and incorporated into various recipes.

Potato flour has diversified uses in the home as well as in the food industry, especially, in the baking industry in the preparation of bread and biscuits. For preparing biscuits, the flour should contain 8-9.5% gluten but normally wheat flour contain more gluten than the required, so a portion of potato flour can be used easily as a supplement. Potato flour with negligible fat content, high dietary fiber, high vitamins a good amount of minerals and 6-12% protein content (Gahlawat and Sehgal, 1998) can be substituted for wheat flour in the preparation of biscuits. This also helps in lowering the gluten level and prevent from Coeliac disease (Tilman et al., 2003). Potato flour also enhances the sensory characteristics of biscuits and industries also find it economical to use in biscuits manufacture. Potato flour can be prepared by drying the peeled slices in a hot air dryer into flakes followed by grinding and sieving (Yadav et al., 2006).

The malnutrition is widespread in Bangladesh due to lack of balanced diet. For balanced diet potato contains optimum quantity of carbohydrate, protein, fat, vitamins, minerals and some dietary fiber needs no elaboration. Biscuit is popular bakery product in Bangladesh, and if we develop Potato Biscuit, it will be supplementary source of nutrients.

Considering accumulated information the research was conducted to achieve the following objectives:

i). to find out the effective peeling method of potato based on mineral content and
ii). to formulate biscuit using potato flour supplemented with wheat flour

2. Materials and Methods

This research was conducted in the Laboratories under the Faculty of Engineering, Hajee Mohammad Danesh Science and Technology University, Dinajpur.

2.1. Collection and Treatment of Potatoes

For this research, 'Granola' variety potatoes having uniform size with no signs of infection or infestation were collected from local market 'Basherhat' in Dinajpur. Potatoes were cleaned with tap water to remove adhering dirt and soil. The washed potatoes were then divided into three groups for selecting the best type for culinary uses based on mineral content. First group of potatoes was neither peeled nor boiled. Second group of potatoes was peeled by using knife. Finally, the third group was boiled and peeled immediately after boiling. Boiling was carried out by heating the potatoes with water at 90-95°C for 30-35 minutes.

2.2. Preparation of Potato Flour

Three groups of Granola variety potato were sliced (about 3mm thickness) using knife. The slices were then soaked into tape water about 2 minutes to avoid browning. The pieces of potato were dried in the cabinet drier (Model- 136-12, Seoul, Korea) at 65°C for 8 hours. The dried slices were cooled and followed by grinding into powder nearly 0.2mm using a grinder (Jaipan CM/L- 7360065, Japan).The sieved powder (MIC-212) was packed in high density polyethylene bags and kept at ambient condition for mineral analysis and further use.

2.3. Mineral Content in Potato Flour

Mineral content was concerned with the analysis of essential minerals including calcium, magnesium, phosphorus, potassium, iron and zinc in potato, peeled potato before boiling and peeled potato immediately after boiling using spectrophotometric methods described by Hunter Method (Pearson, 1976).

2.4. Formulation of Potato Biscuit

Potato flour was incorporated in the traditional recipe to replace refined wheat flour at levels of 20, 25 and 30% in preparation of potato biscuits. Biscuits were produced from the four formulations (Table 1) using the method described by Khaliduzzaman *et al.* (2010). After cooling at room temperature, biscuits were packed in laminated foil and kept at ambient condition for further analysis.

2.5. Proximate Analysis of Potato Biscuits

Proximate analyses were carried out to determine the moisture, crude protein, crude fat, ash content and total carbohydrate in accordance with the official methods of the Association of Official Analytical Chemist (AOAC, 2004).

2.6. Sensory Analysis

Sensory acceptability of biscuit samples was evaluated by 30 panelists on a nine-point hedonic scale to evaluate sensory characteristics including odor, texture, taste and overall acceptability of breads. Where 9=like extremely, 8=like very much, 7=like moderately, 6=like slightly, 5= neither like or dislike, 4= dislike slightly, 3= dislike moderately, 2=dislike very much and 1=dislike extremely as described by Amerine *et al.* (1965).

2.7. Statistical Analysis

All measurements were performed in duplicate for each sample. Data were analyzed using statistical software (SPSS for Windows Version 20.0). Significant differences between the means were estimated using Duncan's

Multiple Range Tests. Significant differences were considered at $p < 0.05$.

Table 1. *Formulation of potato biscuits.*

Ingredients	Samples			
	T_1	T_2	T_3	T_4
Wheat flour (g)	100	85	75	65
Potato flour (g)	0	15	25	35
Sugar (g)	20	20	20	20
Shortening (g)	15	15	15	15
Milk powder (g)	05	05	05	05
Soyabean oil (ml)	10	10	10	10
Baking powder (g)	1.5	1.5	1.5	1.5

T1- Control; T2- Biscuit with 15% potato flour; T3- Biscuit with 25% potato flour; T4- Biscuit with 35% potato flour

3. Result and Discussion

3.1. Composition of Potato, Potato Flour and Wheat Flour

The results of the proximate composition analysis of potato, potato flour and wheat flour are presented in Table 2.

3.1.1. Moisture Content

Moisture content of potato and potato flour were 79.0% and 7.67% respectively while the moisture content of wheat flour was 12.48% (Table 2). The value was higher than those found for high yielding variety by Islam (2004) who reported moisture content (78%). The moisture content of potato flour was much lower than that of potato. The drying process significantly reduced the moisture content in potato slices and hence potato flour. The potato flour has slightly less moisture content than that of the wheat flour and which might be due to compositional difference and extent of drying.

3.1.2. Protein Content

The protein contents of potato and potato flour were 1.8% and 5.3% respectively, whereas protein content of wheat flour was 10.63% (Table 2). Protein content in potato was almost similar to Islam (2004) who reported 2.02%, 1.87% and 2% respectively. This slight variation might be due to varietal differences, different maturity, storage time and time elapsed between harvesting and analysis and the growing conditions of the crop. Due to the drying process, the protein content increased proportionally along with other components in potato flour. Potato flour contained lower protein and higher starch or carbohydrate than wheat flour.

Table 2. *Composition of potato, potato flour and wheat flour (%).*

Sample	Composition				
	Moisture	Protein	Fat	Ash	Carbohydrate
Potato	79.0±0.01^{a}	1.8±0.01^{c}	0.25±0.02^{b}	2.13±0.012^{b}	16.82±0.03^{c}
Potato flour	7.67±0.02^{c}	5.3±0.02^{b}	0.95±0.01^{ab}	3.59±0.01^{a}	81.08±0.01^{a}
Wheat flour	12.48±0.01^{b}	10.63±0.01^{a}	1.06±0.01^{a}	0.53±0.02^{c}	75.3±0.01^{b}

Data are mean values of triplicate determinations ± standard deviation; Means within a row with different letters are significantly different at $P<0.05$.

3.1.3. Fat Content

The fat content of potato was very low (0.25%) and the fat content of potato flour was 0.95%, which was slightly lower than that of the wheat flour sample (1.06%). The value of fat content in potato was higher than results found by Schwimmer and Burr (1967) who mentioned 0.1% fat content in potato, and the fat content of wheat flour was higher than results found by Mollik and Shams-Ud-Din (2007) who mentioned 0.88% fat in wheat flour. This variation in fat content may result from varietals difference, chemicals used for fat extraction and milling process differences.

3.1.4. Ash Content

The ash contents of potato, potato flour and wheat flour were 2.13%, 3.59% and 0.53% respectively, and it was found that the potato flour contained substantially higher ash than wheat flour (Table 2). The value was higher than those found by Islam (2004) who reported 1.1% and 1% respectively.

3.1.5. Total Carbohydrate Content

Data corresponding to the total carbohydrate contents of potato, potato flour and wheat flour are shown in Table 2. The potato contained 16.82% carbohydrate. Potato flour was rich in total carbohydrate 81.08% than that of wheat flour 75.3% due to higher starch content of potato as a tuber crop. The value of total carbohydrate content in potato was lower than that found by Islam (2004) who reported 18.78%. The variation might be due to varietal differences, different maturity periods, storage time and time elapsed between harvesting and analysis, harvesting periods etc. These variations may also from the differences in the level of moisture, protein, fat and ash content. The total carbohydrate content, in fact, represents mostly the dietary fibre level in the potato samples. Dietary fibre encompasses cellulose, hemicelluloses, lignins, gums, pectic substances, mucilages etc. However, potato contains polyphenols, which are considered as anti-nutritional factors for certain proteins and enzymes (Salunkhe *et al*., 1985).

3.2. Mineral Contents in Potato Tuber

Significant effects of peeling treatment on concentration of Phosphorus (P), Potassium (K), Calcium (Ca), Magnesium (Mg), Iron (Fe) and Zinc (Zn) in potato tubers were recorded (Table 3). The concentration of Phosphorus ranged from 59.52 to 60.57mg/100 g in potatoes peeled after boiling (P_3) and in potatoes without peeling (P_1) on the other hand lower phosphorus content was observed in potatoes peeled before boiling (P_2) (45.65mg/100g). Woolfe (1987) reported a range of 27-89mg/100g (fresh weight basis) where Burton (1989) reported the range of 150-300mg/100g (dry weight basis). The range in present study compares more closely to the values reported by Woolfe (1987). On boiling potato, phosphorus content significantly losses due to leaching and it can be reduced by retaining the skin (True *et al*., 1979).

The concentration of potassium ranged from 400.78 to 413.91mg/100g in potatoes without peeling (P_1) and in potatoes peeled after boiling (P_3) to 360.17mg/100 g in potatoes before boiling (P_2). George *et al*. (2009) reported that the tubers had high amount of potassium ranging from 697mg to 2082mg per 100g of dry weight basis. Significant losses of potassium occurred in potatoes peeled immediately before boiling. There was no much variation on concentration of Iron and Zinc among the treatments. This is because the potato peel contains negligible amount of Iron and Zinc. The level of Zinc in the study compares well with those reported by Woolfe (1987) and Burton (1989). Level of Zinc did not significantly differ for treated potato compared to the potato.

The concentration of calcium ranged from 8.23 and 6.57mg/100g potatoes peeled after boiling (P_3) and in potatoes without peeling (P_1) to 9.40mg/100g in potatoes without peeling (P_1). According to George *et al*. (2009), potato tuber contains calcium in the range of 37-92mg per 100g.

Table 3. *Effect of peeling on mineral content of potato.*

Sample	Calcium (mg/100 g)	Magnesium (mg/100 g)	Potassium (mg/100 g)	Phosphorus (mg/100 g)	Iron (µg/100 g)	Zinc (µg/100 g)
P_1	9.40 ± 0.01^{a}	21.65 ± 0.01^{a}	413.91 ± 0.01^{a}	60.57 ± 0.01^{a}	0.78 ± 0.01^{a}	0.29 ± 0.01^{a}
P_2	6.57 ± 0.02^{c}	13.09 ± 0.03^{b}	360.17 ± 0.02^{c}	45.65 ± 0.03^{b}	0.69 ± 0.02^{a}	0.25 ± 0.02^{ab}
P_3	8.23 ± 0.02^{b}	19.89 ± 0.01^{ab}	400.78 ± 0.01^{b}	59.52 ± 0.01^{ab}	0.75 ± 0.02^{ab}	0.25 ± 0.02^{ab}

P1 = Potato without peeling; P2 =peeled potato before boiling; P3 =peeled potato after boiling; Data are mean values of duplicate determinations ± standard deviation; Means within a row with different letters are significantly different at P<0.05.

The higher Magnesium content 21.65mg/100g was observed in fresh potato (P_1) and the lower Magnesium content was observed in potatoes before boiling (P_2), which was peeled before boiling 13.09mg/100g. Ahmed (2006) reported that unpeeled potato contains higher mineral content than peeled potato. This may be due to higher solute content in unpeeled potatoes compared to the peeled ones.

Camire *et al*. (2009) investigated that most of the minerals reside just beneath the skin of the potato. Hence there is always a significant loss in minerals as a result of peeling before boiling. It was also observed that the potatoes peeled immediately after boiling contained more calcium, magnesium, potassium, iron and zinc in comparison with potatoes peeled before boiling.

Nassar *et al*., 2012 reported in their study that most of the mineral migrates to the center from the outer surface during boiling.

Based on the above study, it can be reported that the fresh potato with skin secured the highest mineral content compared to any kind of peeled potato. So, potato with peel is always recommended for further processing to make any value added food products with potato.

3.3. Mineral Content of Potato Flour and Wheat Flour

Variation in mineral content between potato powder and wheat flour is presented in Table 4.

Table 4. *Mineral content of potato flour and wheat flour.*

Sample	Phosphorus (mg/100 g)	Potassium (mg/100 g)	Calcium (mg/100 g)	Magnesium (mg/100 g)	Iron (µg/100 g)
Potato flour	60.57 ± 0.01^{a}	413.91 ± 0.01^{a}	9 ± 0.02^{b}	21 ± 0.01^{b}	0.78 ± 0.01^{a}
Wheat flour	25 ± 0.02^{b}	12.5 ± 0.03^{b}	160.32 ± 0.01^{a}	364.50 ± 0.01^{a}	-

Data are mean values of duplicate determinations ± standard deviation; Means within a row with different letters are significantly different at P<0.05.

From the Table 4, it was found that potato flour secured the higher Phosphorus and Potassium content 60.57mg/100g and 413.91mg/100g respectively compared to wheat flour 25mg/100g phosphorus and 12.5mg/100g potassium. But Calcium 9mg/100g and Magnesium 21mg/100g were much lower, whereas wheat flour showed much higher Calcium and Magnesium content 160.31mg/100g and 364.50mg/100g respectively. Considering the above findings, potato flour can easily be suggested as a good source of Phosphorus and Potassium and can be used with wheat flour to enrich the nutritive value. Adrogue and Madias (2007) reported that potassium is required in relatively large amounts because it functions as an important electrolyte in the nervous system. Potassium also plays a role in osmoregulation. High levels of potassium can help to control high blood pressure.

3.4. Nutrient Content in the Composite Biscuit

Biscuit was prepared using potato powder at 15%, 25% and 35% substitution respectively. Biscuits were analyzed for different parameters like moisture content, ash, protein, fat and carbohydrates. Table 5 shows the effect of treatment on moisture, protein, ash, carbohydrates and fat content of fortified biscuit.

Obtained results indicate that among the different treatments in biscuit, moisture content ranged from 5.00% to 7.30% (Table 5). Moisture content of the prepared biscuits was lower in control (5.0%) and higher (7.30%) in treatment T_3 (biscuit with 35% potato powder). Moisture content is increased with the increase of addition of potato powder. Since potato powder contains higher amount of carbohydrate which has higher water holding capacity, hence, the moisture content was higher. The value was nearly same as those found by Khaliduzzaman *et al.* (2010) who reported that moisture content of biscuits prepared by potato powder (20% substitution) was 5.48%.

The ash content of the prepared biscuits ranged from 0.99% to 3.33%. Ash content is also increased with the increase of addition of potato powder. This value is higher than those found by Khaliduzzaman *et al.* (2010) who reported that the ash percentage of biscuits was 1.7%. This is because of formulation of biscuit with the potato powder with peel.

Protein content of biscuits ranged from 9.70% to 15.20%, higher in control (15.20%) and lower in the biscuit with 35% potato powder (9.70%). The biscuits showed decrease in protein content when potato powder substitution was increased. These results were in close agreement with findings of Khaliduzzaman *et al.* (2010) who have reported 8.5% to 13.67% protein content respectively.

Fat content of the prepared biscuits increased from 11.0 to 12.67%. Khaliduzzaman *et al.* (2010) reported that the fat percentage of biscuits prepared from potato powder ranged from 25.8% to 27.6%. The slight variation between the ranges might be due to the use of shortening agents.

The carbohydrate content of biscuits ranged from 67.0% to 67.81%. There was no significant difference in carbohydrate content among the treatments. Khaliduzzaman *et al.* (2010) reported 64.0% in control and 63.9% carbohydrate in 20% potato powder incorporated biscuits.

Table 5. *Proximate composition of prepared biscuits.*

Sample	Compositions				
	Moisture (%)	Protein (%)	Fat (%)	Ash (%)	Carbohydrate (%)
T_1	5.00±0.01^{d}	15.20±0.01^{a}	11.0±0.02^{bc}	0.99±0.02^{c}	67.81±0.01^{a}
T_2	5.80±0.01^{c}	13.90±0.02^{b}	11.2±0.01^{b}	2.10±0.02^{ab}	67.00±0.01^{c}
T_3	6.50±0.02^{b}	11.00±0.02^{c}	12.30±0.01^{ab}	2.50±0.01^{b}	67.70±0.01^{ab}
T_4	7.30±0.02^{a}	9.70±0.03^{d}	12.67±0.01^{a}	3.13±0.01^{a}	67.20±0.01^{b}

T1 = Control; T2 = biscuit with 15% potato flour; T3 = biscuit with 25% potato flour; T4 = biscuit with 35% potato flour; Data are mean values ± standard deviations; Means within a row with different letters are significantly different at P<0.05.

3.5. Sensory Evaluation of the Prepared Biscuits

Results of sensory evaluation of biscuit samples containing different amount of potato powder as compared to the control are shown in Table 6. The score for color indicated that there was no significant ($p>0.05$) difference among samples. Among prepared biscuit samples, sample T_4 (35% potato powder substitution) was recorded with lowest score in color (6.10).

The result revealed that the texture of different samples of control and potato biscuits were not equally acceptable. As shown in Table 6, sample T_4 (35% potato flour incorporation) was secured the lowest score (5.20) for the taste preference than other samples. Control biscuits (T_1) secured the highest score 7.40 where T_2 and T_3 were secured score 7.00 and 6.90 respectively. There was significant difference ($p<0.05$) in texture of control biscuit and potato biscuits. Among prepared samples, sample T_3 (25% incorporation of potato powder) was the most preferred with a score 7.50, whereas lowest score 5.50 was recorded for sample T_4 (25% incorporation of potato powder).

On overall acceptability, there was significant ($p<0.05$) difference among potato biscuit samples. Result indicated that control sample and sample T_3 were most preferred on overall acceptability, whereas sample T_4 scored lowest score (5.20) among the prepared biscuit samples.

Sensory evaluation of prepared biscuits revealed that potato biscuit (25% incorporation of potato powder) was only acceptable like control sample. This result was very compatible with the findings of Khaliduzzaman *et al.* (2010) who revealed that biscuit containing 25% potato flour as a supplement secured the highest score in terms of all sensory attributes among all samples. Misra and Kulshretha (2003) formulated potato biscuits (10, 20, 30, 40 and 50% potato powder) and resulted that there were no significant difference in acceptability of the potato biscuits up to 20% incorporation of potato powder. According to Nazni *et al.* (2009), potato flour incorporated biscuits had obtained highest scores for overall acceptability compared to maize and green gram flour incorporated biscuits.

Table 6. *Mean sensory scores secured of prepared biscuit.*

Sample	Color	Flavor	Taste	Texture	Overall acceptability
T_1	7.80±0.01^{a}	7.20±0.01^{a}	7.40±0.01^{a}	6.30±0.01^{b}	6.90±0.01^{a}
T_2	6.90±0.012^{ab}	6.70±0.02^{ab}	7.00±0.01^{ab}	6.60±0.02^{b}	6.70±0.02^{b}
T_3	6.90±0.01^{ab}	6.60±0.01^{ab}	6.90±0.01^{ab}	7.50±0.01^{a}	7.20±0.01^{a}
T_4	6.100±0.02^{b}	5.40±0.03^{b}	5.20±0.02^{c}	5.50±0.02^{c}	5.20±0.03^{c}

T1 = Control; T2 = biscuit with15 % potato flour; T3 = biscuit with 25% potato flour; T4 = biscuit with 35 % potato flour; Data are mean values of duplicate determinations ± standard deviation; Means within a row with different letters are significantly different at P<0.05.

4. Conclusion

In the past, prior to cooking potato skins were peeled with the idea that the potato would be cleaner and therefore healthier. However, it has been discovered that leaving the potato skins intact can add nutrients to a meal. The potato as well as the skin is great source of vitamin C, vitamin B6, copper, potassium, zinc and protein, but neither naturally contains any fat, cholesterol or sodium. Leaving the skin intact can also help preserve the nutrients in the flesh of the potato, which have a tendency to escape during cooking. Potato mineral levels can be easily manipulated to meet the needs of consumers. If the goal is to add minerals to the diet through the consumption of potatoes, then this can be done by boiling whole potatoes.

The study was also conducted to find out the best proportion of wheat and potato flour to formulate the biscuit. Biscuit containing 25% potato flour showed the best performance compared to other proportion of flour used. For the large scale biscuit manufacture, potato flour can be incorporated up to 25% without affecting the sensory characteristics of biscuits as was accepted by the panelists. Moreover, nutritional value of potato flour incorporated biscuits was similar to the control (Wheat flour) biscuits, thus not affecting its nutritional quality. Hence, potato flour may prove to be quite economical and acceptable to replace wheat flour in biscuit preparation. A significant amount of potato is spoiled and wasted due to inadequate cold storage facilities and insufficient postharvest handling facilities. Potatoes can also be utilized for the preparation of value added products. Thus minimization of postharvest losses of potatoes might be possible through proper handling and processing them into value-added products, which would contribute to ensure the food security to some extent in Bangladesh as well as the overall world

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