

## Dropping potatoes onto a hard surface floor increases their moisture content during storage

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### ABSTRACT

The effect of dropping potatoes onto a concrete floor on the quality of potatoes during storage was investigated using a potato chip processing variety, Norin-ichigo, for 80 days. Impact did not influence the weight loss, specific gravity or reducing sugar content, but increased moisture content. The moisture content of potatoes dropped from heights of 15 cm or higher is higher than that of non-dropped potatoes.

**Key words:** potato tubers, drop height, moisture, storage

### INTRODUCTION

Bruising often occurs to potatoes while they are harvested and transported to commercial warehouses. Factors that influence potato tuber damage at harvest include temperature, tuber condition, soil conditions, and harvester operation<sup>1)</sup>. Johnston and Wilson (1969)<sup>2)</sup> have studied the effect of soil temperature on tuber damage, and found that an increase of 0.5 °C in soil temperature increases by 2 % the force necessary to bruise (by dropping). On the other hand, Turczyn *et al.*(1986)<sup>3)</sup> focused on potato bruising during handling and transport, and dropped packaged potatoes onto hard surfaces. Consequently, data showed that dropping from heights of 80 cm or higher is likely to incur shatter bruising. Furthermore, Grant *et al.*(1986)<sup>4)</sup> investigated

potato bruising during transport, and concluded that potatoes suffer frequent shatter bruising during handling and transport, but the amount of severe damage due to transport shock and vibrations is relatively low. Moreover, Paul *et al.* (1986)<sup>5)</sup> investigated sugar changes in tubers at 0, 5, 10 and 20 days following handling (potato-on-potato tumbling) of Norchip tubers stored 1 to 10 months at 9 °C, 90 % RH.; then, they found that month by month, the handled samples produced higher sugar concentrations and darker chips than the control potatoes. However, there has been little research on the effect of dropping potatoes on the quality of potatoes during storage. The purpose of the present study was to evaluate the effects of dropping on the quality of potatoes during storage.

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## MATERIALS AND METHODS

### Source and tuber preparation

Norin-ichigo potatoes were harvested on Oct. 7, 1993, and stored at 10 °C (90 % RH). On Oct. 13, 1993, potatoes approx. 160 g in size were then selected.

### Dropping and storage

Immediately after selection, the potatoes were dropped from heights of 10, 15, 20 and 25 cm onto a concrete floor. Then, dropped potatoes and non-dropped potatoes (the control) were stored at 10 °C, 90 % RH for roughly 80 days.

### Potato quality evaluation

#### Weight loss

Four samples from the two groups were weighed before and after storage.

#### Specific gravity

Specific gravity was measured on four tubers using the weight-in-air/weight in water method<sup>6)</sup>.

#### Moisture

Four potato tubers were washed, peeled and diced into approximately 5 mm cubes. Moisture of the samples (10g) was determined by predrying at 70 °C for 24 hours and drying at 70 °C in a vacuum oven for 2 hours<sup>7)</sup>.

#### Reducing sugar

Fifty ml distilled water was added to 50 g diced tubers and the resulting suspension was homogenized with an Osterizer at high speed for 1.5 min, then the homogenate was centrifuged at 2,860 × g for 15 min. The supernatant was used to determine reducing sugar by the Somogyi method<sup>8)</sup>.

All measurements were performed in duplicate and results were averaged to obtain mean values. Data were analyzed by analysis of variance (ANOVA). When F value was significant ( $p < 0.05$ ), Duncan's multiple range test of SPSS (1992)<sup>9)</sup> was used to determine differences between treatment means.

## RESULTS AND DISCUSSION

Figure 1 shows the weight loss of potatoes during storage. No significant difference in weight loss was found ( $p > 0.05$ ) between dropped and control potatoes. In Fig. 2, the statistic analysis of the data over storage time showed that dropping did not have a significant effect ( $p > 0.05$ ) on specific gravity of potatoes.

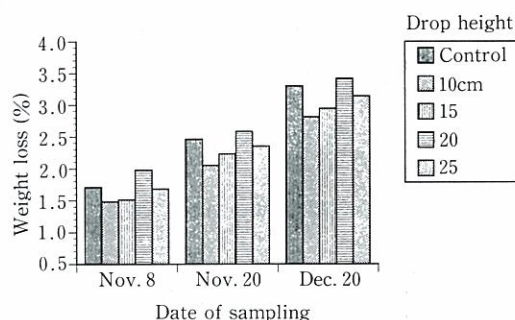


Fig. 1 Weight loss of potato tubers during storage at 10°C

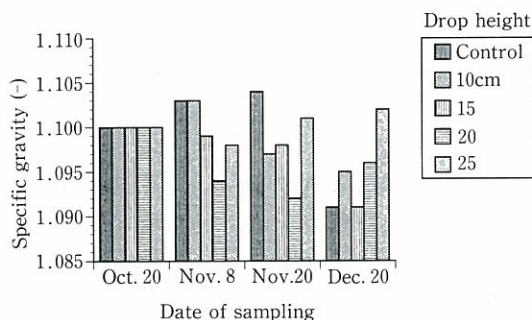


Fig. 2 Specific gravity of potatoes during storage at 10°C

In Fig. 3, ANOVA indicated that dropping influenced ( $p < 0.01$ ) reducing sugar content of potatoes, and potatoes dropped from heights of 15 cm or higher resulted in higher moisture content than control (Fig. 4).

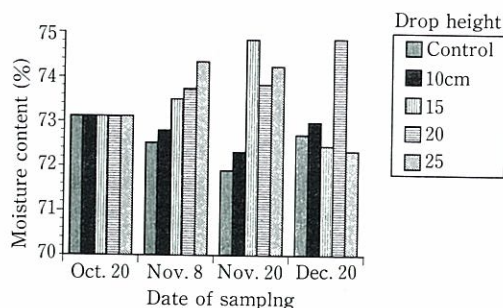


Fig. 3 Moisture content of potatoes during storage at 10°C

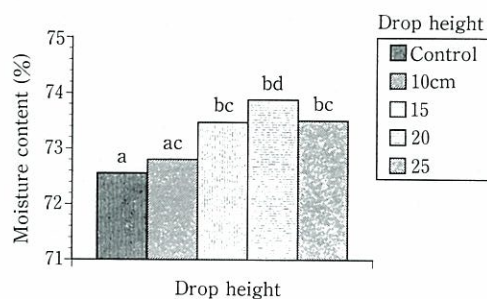


Fig. 4 Average moisture content over time (n=4) of 01 tubers stored at 10°C. Bars having the same letter within drop heights are not significantly different at P=0.05

Aeppli and Keller (1980)<sup>10</sup> subjected mature harvested potato tubers to a standardized shaking treatment and measured respiration at 10 °C. They found that respiration after treatment increased with the violence of shaking as did also the severity of blue spot. Also, it was observed that increasing susceptibility of the tubers to blue spot was accompanied by a proportional increase in respiration rate. Other researchers have shown that respiration rates and sugar levels increase in tubers when cell walls are damaged<sup>11-13</sup>. Pisarczyk (1982)<sup>12</sup> measured the

respiration of bruised potatoes, and showed that damage to potato tubers increased tuber respiration, which declined with time. Mulder (1955)<sup>14</sup> found an increase in rate of respiration if tubers were dropped from a height of 1 m onto a wooden floor.

Respiration (biological oxidation) is the oxidative breakdown of more complex substrates normally present in cells, such as starch, sugars, and organic acids, to simpler molecules (CO<sub>2</sub> and H<sub>2</sub>O), with the concurrent production of energy and other molecules, which can be used by the cell for synthetic reactions. The overall process of aerobic respiration involves the regeneration of ATP from ADP (adenosine diphosphate) and Pi (inorganic phosphate) with the release of CO<sub>2</sub> and H<sub>2</sub>O. If hexose sugar is used as the substrate, the overall equation can be written as follows (Burton *et al.*, 1992<sup>15</sup>):



As the above equation shows, respiration produces moisture. Thus, increased respiration due to dropping produces more moisture, leading to a higher moisture content in dropped potatoes (Fig. 4).

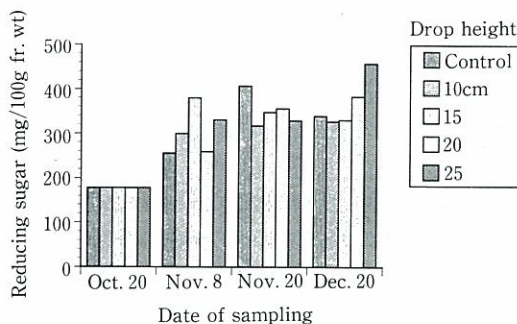


Fig. 5 Reducing sugar content during storage at 10°C

Figure 5 shows that reducing sugar contents of both dropped potatoes and control potatoes

increased gradually during storage. Paul *et al.* (1986)<sup>9)</sup> studied sugar changes in tubers at 0, 5, 10 and 20 days following handling treatments (potato-on-potato tumbling) of Norchip tubers stored 1 to 10 months at 9 °C, 90 % RH., and found that month by month, the handled samples produced higher sugar concentrations and darker chips than controls. However, no difference in reducing sugar content was observed ( $p > 0.05$ ) among treatments in this storage experiment.

### CONCLUSION

We concluded from the data, therefore, that dropping increases the moisture content of potatoes during storage.

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硬い床面への馬鈴薯の落下は  
貯蔵馬鈴薯の水分を増加させる

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和文摘要

馬鈴薯の落下が貯蔵馬鈴薯の品質におよぼす影響を、10°Cで80日間の貯蔵実験を行って検討した。落下は貯蔵馬鈴薯の水分を増加させ、とくに、コンクリートの床に、15cm以上の高さより落下させた馬鈴薯は、落下なしのものよりも、高水分となった。

キーワード：馬鈴薯塊茎，落下高さ，水分，貯蔵