Ginger Peeling Machine Parameters

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Abstract

Operational parameters of the abrasive brush-type ginger peeling machine developed by Agrawal et al (1983) were evaluated and established for maximum efficiency with minimum ginger meat loss. The capacity of the machine operated at the recommended machine parameters was determined.

Introduction

The abrasive brush-type ginger peeling machine (Fig. 1) essentially consisted of two continuous brush belts being driven in opposite directions with a downward relative velocity by a variable-speed motor. The movement of the two brush belts in opposite directions provided the abrasive action on the ginger passing in between while the downward relative velocity provided the downward flow of ginger. The spacing between the belts and the belts velocity could be varied. The machine was reported to functionally operate satisfactorily during the limited tests performed on stored ginger.

Evaluating and establishing the machine parameters was, however, essential because peeling of skin is associated with the loss of ginger meat from underneath the skin. The epidermal cells in ginger contain most of the essential oil which imparts the ginger it's characteristic aroma and is perhaps the most important factor in determining it's market price (Jaiswal, 1980). Therefore, loss of ginger meat from underneath the skin would result in not only the loss of weight but also in heavy loss of economic value of ginger. In general, high peeling efficiency would be associated with high material loss. Consequently, the machine parameters require to be so established as to obtain as high a peeling efficiency as possible with minimum loss of ginger meat.

The main objective of this paper, therefore, was to evaluate and establish the operational parameters of the abrasive brush-type ginger peeling machine for maximum peeling efficiency with minimum ginger meat loss. The other objective was to determine the capacity of the machine operating at the recommended machine parameters.

Materials and Methods

Ginger peeling experiments were conducted to determine the effects on peeling efficiency and ginger meat loss at the following machine parameter values:
- Brush belt spacing — 1.0, 1.25 and 1.5 cm.
- Belt speed — 45, 64 and 85 rpm of the driving brush belt resulting in 60, 86.7 and 113.3 rpm of the driven belt and the belts relative speeds of 137, 199 and 260 cm/s, respectively.
- Number of passes — 1, 2, 3, 4 and 5.

Fresh, graded ginger, average thickness of pawns ranging from 1.9 to 2.2 cm was procured from the market and was stored in moist sand during the experimentation.

For each peeling trial, a sample of about 200 g ginger was soaked in water overnight as per conventional practice (Nambiar, 1980), the excess moisture was removed by a
towel, and the sample was peeled in the machine. The sample was weighed before and after machine peeling on a triple beam balance with 0.05 g accuracy. The difference yielded the weight of skin peeled by machine plus the meat loss, w. The sample was then hand-trimmed carefully and was again weighed. Each experiment was replicated thrice. The peeling efficiency and the ginger meat loss were calculated as follows:

\[
\text{Peeling Efficiency} = \frac{\text{Weight of skin removed by machine}}{\text{Weight of total skin on ginger}} \times 100 = \frac{(Y - X)}{Y} \times 100\% \quad (1)
\]

and,

\[
\text{Meat loss} = \frac{\text{Weight of ginger meat lost during mechanical peeling}}{(\text{Total weight of the sample})} \times 100 = \frac{(W - (Y - X))}{W} \times 100\% \quad (2)
\]

where,

\[Y = \text{Weight of total skin on ginger, g}\]
\[X = \text{Weight of skin removed by hand trimming after mechanical peeling, g}\]
\[W = \text{Total weight of the sample, g}\]
\[w = \text{Total reduction in weight during mechanical peeling, g}\]

For determining the weight of total skin on ginger, Y, about 1 kg of ginger containing randomly sampled pawns of all sizes from the lot was hand-trimmed carefully after overnight soaking in water and removing the excess moisture. Each pawn was weighed before and after hand-peeling on the triple beam balance. The difference in weight divided by the original weight of each pawn yielded the skin weight per unit weight of ginger pawn. The average of the skin weight on each pawn was considered to represent weight of skin per unit weight of ginger in the whole experimental lot. This average unit skin weight, when multiplied by the weight of ginger peeled in each experiment, yielded the weight of total skin on ginger, Y.

The capacity of the peeling machine at the recommended machine parameters was determined by conducting the peeling experiment at full hopper capacity of 6 kg and noting the peeling time. The peeling efficiency and meat loss at the full hopper capacity were also determined. The time taken for hand-trimming was noted in order to determine the hand-trimming costs.

Results and Discussion

The average skin weight per unit weight of ginger was 0.164 g/g. The skin weight on individual pawns varied from 3 to 17% from this average value. Further, the variation of skin weight as observed had no relationship with pawn size.

The average peeling efficiency and the average meat loss during peeling by the abrasive brush-type ginger peeling machine at different machine parameter values as calculated from the data on ginger weights before peeling, after machine peeling and after hand trimming (Hiran and Galundia, 1981) are tabulated in Table 1.

Number of Passes

The effect of the number of passes on peeling efficiency and

\[\text{Fig. 2 Effect of number of passes on machines performance at 1 cm belts spacing.}\]

Table 1 Ginger Peeling Efficiency and Ginger Meat loss, %

<table>
<thead>
<tr>
<th>Belt speed rpm</th>
<th>No. of passes</th>
<th>Belt spacing 1.0 cm</th>
<th>Belt spacing 1.25 cm</th>
<th>Belt spacing 1.50 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>45 (137 cm/s)*</td>
<td>1</td>
<td>34.81</td>
<td>0.78</td>
<td>26.89</td>
</tr>
<tr>
<td>3</td>
<td>43.11</td>
<td>1.33</td>
<td>46.77</td>
<td>0.70</td>
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<td>4</td>
<td>55.42</td>
<td>2.77</td>
<td>50.49</td>
<td>0.88</td>
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<tr>
<td>5</td>
<td>66.83</td>
<td>3.40</td>
<td>55.22</td>
<td>1.65</td>
</tr>
<tr>
<td>6</td>
<td>70.28</td>
<td>4.20</td>
<td>62.60</td>
<td>2.96</td>
</tr>
<tr>
<td>7</td>
<td>45 (199 cm/s)</td>
<td>1</td>
<td>40.73</td>
<td>0.66</td>
</tr>
<tr>
<td>3</td>
<td>53.36</td>
<td>0.83</td>
<td>50.80</td>
<td>1.39</td>
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<td>4</td>
<td>61.48</td>
<td>1.59</td>
<td>55.32</td>
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<td>74.94</td>
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<td>58.73</td>
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<td>6</td>
<td>81.82</td>
<td>2.73</td>
<td>69.72</td>
<td>3.41</td>
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<td>7</td>
<td>84.47</td>
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<td>1.96</td>
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<tr>
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<td>3.14</td>
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<td>3.49</td>
<td>67.81</td>
<td>2.97</td>
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<tr>
<td>11</td>
<td>84.33</td>
<td>5.11</td>
<td>76.97</td>
<td>4.74</td>
</tr>
</tbody>
</table>

* Values of linear relative velocity between the brush-belts.
meat loss is illustrated in Fig. 2 at one of the belt spacings. Increasing the number of passes increased the peeling efficiency and the meat loss as well. Four or five passes were, nonetheless, required to obtain a reasonable peeling efficiency. Similar effect was observed at other belt spacings (Table 1).

Brush-Belts Spacing

Fig. 3 shows the effect of spacing between the brush-belts on the machine performance at 4 and 5 of passes. The peeling efficiency, in general, decreased with increasing belt spacing; the effect being more pronounced from 1.0 to 1.25 cm spacing. The meat loss had a general trend of decreasing when the spacing was increased from 1.0 to 1.25 cm but of increasing or remaining the same at 1.5 cm spacing. It was concluded that a brush belt spacing of 1 cm would be better in view of a significantly higher peeling efficiency, although a spacing of 1.25 cm may result in somewhat lower meat losses.

Belt Speed

The peeling efficiency, in general, increased with the increase in belt speed, the effect being more prominent from 45 to 65 rpm of the driving brush-belt (Fig. 4). The meat loss, on the other hand, increased substantially when the speed was increased from 65 to 85 rpm. It was concluded, therefore, that a driving brush-belt speed of 65 rpm resulting in the belt relative velocity of 199 cm/s was the best since increasing the velocity further increased the meat loss significantly while increasing the peeling efficiency only marginally.

Recommended Machine Parameters

Brush-belt spacing of 1 cm, driving belt speed of 65 rpm speed of 199 cm/s and 4 to 5 of passes are recommended. The average peeling efficiency and the meat loss at these recommended parameters were 82 and 2.7%, respectively, with 5 passes and 75 and 2.2% with 4 passes. The samples of fresh ginger and the ginger peeled at these recommended parameters with 5 passes are shown in Fig. 5 for comparison.
One hopperfull ginger, 6 kg, was peeled in 18 min in 5 passes at the recommended machine parameters. The machine, thus, had a capacity of 20 kg/h. The peeling efficiency and the meat loss at full capacity were 71% and 1.6%, respectively. While the peeling efficiency decreased from 82% obtained during the peeling trials to 71% at full capacity, the meat loss also reduced significantly from 2.2 to 1.6%. The reduction in peeling efficiency and meat loss at full capacity was due to the effect of bulk peeling. It was further determined that 16 man-h would be required to hand-trim the lot of 20 kg ginger peeled by the machine. Assuming the cost of labour to be US$0.20/h in local conditions, the cost of hand-trimming would be US$0.16/kg when peeling at full capacity.

Conclusions

The operational parameters of the abrasive brush-type ginger peeling machine for maximum possible efficiency with minimum ginger meat loss were:

- Brush-belt spacing - 1.0 cm.
- Belt speed - 65 rpm of the driving brush-belt resulting in the belts relative velocity of 199 cm/s.
- Number of passes - 4 or 5.

The capacity of the machine at the recommended parameter values with 5 number of passes was 20 kg/h. When operated at it's full capacity, the machine had a peeling efficiency of 71% with ginger meat loss of 1.6%. The hand-trimming cost of the peeled ginger was US$0.16/kg under Indian conditions.

Potential of Single Animal Ploughing in Bangladesh:
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In Bangladesh, single animal ploughing is practised only in some parts of Sylhet district. In this note, the results of a survey showing causes of localized and restricted use of this technique are discussed. Only buffaloes were found to be used as singles and single buffalo plough was found to be technically and economically more efficient than a plough drawn by a pair of cattle. However, expansion of the technique outside Sylhet seems to be restricted because draught buffaloes account for only about 2% of the total draught animals in the country.

Effect of Cement Mixing on Soil pH - An Approach for Improving Acid Soil:

An investigation was carried out with the acid sulphate soil of Bangkok Plain in order to determine the effects of adding varying amounts of portland cement on soil pH. It was found that cement, the major component of which is calcium oxide, provided some liming effect by increasing the pH of the soil depending upon the quantity of cement mixed with it.

REFERENCES


