The Effect of Re-Compression on Tomato Fruit Firmness

Abstract: In shelf-life tests when fruit firmness is measured by compressing the fruit, it may be desirable to re-compress the same fruit a number of times to keep the size of the experiment to a practicable scale. Results of tests showed that tomatoes which were re-compressed were softer than tomatoes tested only once. Therefore it was concluded that when absolute data are required it may be necessary to test a replicate set of tomatoes at each time of testing.

Introduction
Tomato fruit firmness is assessed at Kinsealy Research Centre by measuring the force required to compress individual fruit by 5 mm with a modified shear press (Gormley and Keppel, 1976). Normally 10 fruit constitute a sample. In shelf-life tests it is often necessary to measure firmness on a number of occasions over a period of a few days and the question arises as to whether the same 10 fruit can be re-compressed a number of times or whether replicate lots of 10 fruit (with 2-3 extra in case some go bad) must be kept for this purpose. For this reason tests were carried out to study the effect of re-compression on tomato fruit firmness.

Methods
Preliminary Tests 1 and 2 were carried out in 1982.

Test 1: 10 fruit at a similar colour stage from each of two sources were each compressed (by 5 mm) on four occasions, on the same day, with a modified shear press (Gormley and Keppel, 1976) using a ram speed of 5.2 mm/sec. The coefficient of variation (CV) (%) was calculated for each set of 10 fruit.

Test 2: 20 tomato fruit of similar shape, size and colour were divided into two lots of 10 fruit each and were stored for 6 days at 17-22°C. One lot was tested for firmness with a shear press on day 1 (day of picking) and again on day 6 while the second lot was tested on day 6 only. The force for a 5 mm compression was calculated in Newtons (N).

Test 3: This was more comprehensive and was conducted in 1986. A sample of 180 fruit of the cultivar Counter, graded for size (47-57 mm) and colour (visually), was divided at random in 12 sets of 15 fruit each. The fruit were put through the Kinsealy fruit handling simulator (Gormley, 1985) on the day of picking (day 1) in order to simulate handling. In the handling test individual
Tomatoes were subjected to an initial free fall of 50 cm followed by alternate rolling and free falls; the height of the four falls was 10 cm each and the final fall (25 cm) was into a tomato box. The samples were stored at ambient temperature for 12 days and fruits of set 1 were tested for firmness (shear press, 5 mm fruit compression, ram speed = 5.2 mm/sec) on each of days 1 to 12; set 2 fruit were tested on each of days 2 to 12, set 3 fruit on days 3 to 12 and so on to set 12 fruit which were tested on day 12 only. The CV was calculated for each set of readings on each day of firmness testing. Tomato colour (Hunter a/b = red/yellow ratio) was also measured (Gormley and Egan, 1978) in parallel with firmness testing.

Results and Discussion
The results for Test 1 (Table 1) showed that re-compression of tomato fruit, especially between the second and third compression, resulted in softer fruit but the effect was small. The % CV values were fairly similar within, but not between, sources (Table 1). In Test 2 a similar effect was found with a mean day 1 firmness value of 18.2 N (% CV = 15.6) which fell to 11.9 N (% CV = 11.1) by day 6; this was lower than the value of 13.7 N (% CV = 14.5) for the corresponding sample that was compressed on day 6 only. These findings were confirmed in the more comprehensive Test 3 and the data were modelled by fitting cubic curves (Fig. 1).

The top curve in Fig. 1 is for tomatoes that were compressed once, while the lower curve is for tomatoes that were re-compressed daily i.e. the day 12 value for tomatoes re-compressed on each of 12 days, the day 11 value for tomatoes re-compressed 11 times and so on to the day 1 value for the set of tomatoes that was compressed only once. The results can be summed up in the divergence of two curves with a difference of about 1.8 N on day 3 and 5 N by day 12 (Fig. 1). In the context of proposed desirable minimum firmness values for tomatoes (Gormley and Egan, 1978, 1984) of 30 N at the nursery, 20 N at the wholesale market, 10 N at retail and 7 N in the home a day 3 difference (Fig. 1) of about 1.8 N may appear small. However, previous work (Gormley and Keppel, 1976) has shown that most panellists can readily distinguish by finger feel between tomatoes whose firmness values differ by as little as 2.0 N.

The results in Figure 2 show firmness values for all the samples on day 12. The data suggest that the first few compressions result in a greater softening of the tomatoes than the later ones.

TABLE 1: Effects of re-compression on the firmness (Newtons) values of tomato fruit from two sources - Test 1

<table>
<thead>
<tr>
<th>Compression</th>
<th>Source 1 fruit</th>
<th>Source 2 fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>CV (%)</td>
</tr>
<tr>
<td>1</td>
<td>19.6</td>
<td>9.1</td>
</tr>
<tr>
<td>2</td>
<td>19.6</td>
<td>10.1</td>
</tr>
<tr>
<td>3</td>
<td>18.2</td>
<td>9.7</td>
</tr>
<tr>
<td>4</td>
<td>18.7</td>
<td>11.9</td>
</tr>
</tbody>
</table>

1 Each of 10 fruit/source compressed by 5 mm on 4 occasions in the same day
2 Coefficient of variation
These results suggest that if the nature of the experiment is that absolute rather than comparative data are required then a replicate set of tomatoes may be required at each time of testing. This will of course increase the size of the experiment. However, for most tests it should be permissible to re-use the same set of tomatoes for up to three compressions.

Coefficients of variation (CV) were calculated for the 15 fruit in each set at each time of testing; this amounted to 78 in all. Coefficients were in the range 10-27% but there was no pattern in the CV data.

Similar cubic curves to those for firmness in Fig. 1 were fitted for fruit colour (Hunter a/b) (Fig. 3). The colour of tomatoes compressed only once was slightly redder than that of samples re-compressed a number of times. This suggests that re-compression, and the consequent handling it entails, may slightly retard colour development in the fruit.

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References


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