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Preliminary study on the effect of combined treatment of hot air and irradiation on the control of neck rot in onions infected with Botrytis spp

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ABSTRACT

Preliminary study on the effect of combined treatment of hot air and irradiation on the control of neck rot in onions infected with Botrytis spp.

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4 figures, 2 tables, 18 references.

Onions are one of the most widely used condiments because of its characteristic odour and flavour. The losses are mainly due to sprouting and mould attack. The aim of this experiment is to investigate the effect of a combined treatment of heat and irradiation on the control of neck rot in onions.

The onions were artificially infected with Botrytis spp and treated, for 35 min, with moist air of 20, 45 and 50 °C, 99% relative humidity. The onions were irradiated at doses of 0, 0.1, 0.5 and 1.0 kGy within half an hour after the heat treatment in order to achieve a synergistic effect.

It proved from the results that a heat treatment of 50 °C combined with an irradiation dose of 0.1 kGy gave the best results.

Key words: Botrytis aclada, bulb products, combined treatment, heat treatment, irradiation, mould, neck rot, onions, sprout inhibition
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1 INTRODUCTION

Onions are one of the most widely used condiments due to its characteristic odour and flavour. This condiment is needed throughout the year, but the spoilage of onions which is due to sprouting and microbial attack presents a serious problem when the commodities are stored under ambient temperatures (25 to 35 °C) prevailing during most of the year in tropical and sub-tropical countries (Sreenivasan 1973). Microbial decay may partly be prevented by using fungicides before and after harvest. The use of fungicides, however, increases the chemical burden of onions. This is probably the reason why chemicals have not been widely used for sprout and mould control. Cooling delays mould infection but does not prevent it.

Since 1950, irradiation has been applied to inhibit sprouting and to prevent attack of mould in onions (Dallyn et al. 1955, 1956, Hannan 1958, Sawyer & Dallyn 1956, Metlitsky et al. 1968, Mahmoud et al. 1977). With onion bulbs, the overdose brings about an increase in rotting and losses due to softening, and sometimes the acceleration of sprouting or transitory stimulation of sprouting (Mullins & Burr 1961, Nair et al. 1972). Therefore it is necessary to discover a means of lessening the natural effect of radiation on irradiated onions.

Heat treatment of food is a well established and accepted method of processing food for consumption. An alternative treatment to prevent mould infection is the application of heat or irradiation, however, for an effective control, a heat treatment higher than 55 °C or an irradiation dose of more than 2 kGy is necessary. Both treatments cause damage to the skin or tissue of the commodity. For this reason the combination of a low irradiation dose combined with a mild heat treatment is one of the methods which is the most effective on preventing this disadvantaged changes (Langerak 1986).

The synergistic effect of heat and radiation, its kinetic pays a role in improving the keeping quality of onions. However, the mechanism of synergistic effect of heat and irradiation is now not clear (Grecz et al. 1981).

Some investigators proved that a heat treatment combined with an irradiation treatment on different objects was more effective than both treatments alone as well as the sum of both treatments (Islam et al.

In relation to above mentioned problem the following research have been set up with the aim control of neckrot on onions caused by Botrytis aclada spp under combined treatment of hot air and irradiation.

2 MATERIALS AND METHODS

2.1 Sample preparation

The sample material have been received from a local firm in the Netherlands. The onions were stored at 4°C, 90% relative humidity for about 2 month before the experiment was carried out. Before they were used in the experiment, the injured and deseased onions were removed. From a number of rotten onion bulbs mould spores of Botrytis spp were collected. From these spores, a spore suspension of approximately $2 \times 10^5$ spores.ml$^{-1}$ was made. The onions were artificially infected as follows.

On two sides of the onion bulbs a hole was made of 5 mm diameter and approximately 2 mm deep. To each hole 0,050 ml of the spore suspension was added. The samples were incubated for 48 hours at 20°C, 95% relative humidity.

The samples were subsequently placed into a climate chamber at 20, 40, 45 and 50°C, 99% relative humidity, till the surface of the onions had reached the same temperature of the environment. The temperatures were measured with the help of thermocouples. Within 30 min after treatment the samples were irradiiated with doses of 0, 0,1, 0,5 and 1,0 kGy. The samples were stored at 20°C, 90 to 95% relative humidity.

2.2 Rot incidence

In order to estimate the percentage of decay during the storage the product was sorted in 2 groupes: 1. Onions which showed a clear mould growth in the hole, but no softening of the tissue, were considered as moulded; 2. Onions which showed softening were counted as rot. Onions
which showed mould or rot diseases were not removed from the experiment assuming that in the practice also rotten bulbs will not be removed from a storage room. On the end of the storage period all onions were cut in order to check the rot incidence.

3 RESULTS AND DISCUSSION

The effects of combined treatment of heat and irradiation on the mould growth and rot incidence are presented in table 1 and figures 1 to 4. From the results it showed that a heat treatment decreases the mould growth and rot incidence with increasing temperature. Irradiation with 0,1 kGy did not have an effect on the mould growth and rot incidence whereas irradiation with 0,5 and 1,0 kGy seemed to have a negative effect probably due to the disturbance of the native resistance mechanism of the onion bulbs.

The combination of heat and irradiation, however, showed a synergistic effect on the control of mould or rot. The best results, in this experiment, were obtained with the combination heat at 50 °C and irradiation with 0,1 kGy. The applied combination was, however, not enough to prevent completely the decay.

The experiment was carried out on the end of the storage period. The product was quickly used up. The following experiments have to be carried out just after harvest, expecting better results.
Figure 1: Average percentage of moulded spots ± SE of 3 samples onions infected on two sides with *Botrytis* spp., heat treated at 20 °C, irradiated and unirradiated and stored at 20 °C.

Figure 2: Average percentage of moulded spots ± SE of 3 samples onions infected on two sides with *Botrytis* spp., heat treated at 40 °C, irradiated and unirradiated and stored at 20 °C.
Figure 3: Average percentage of moulded spots ± SE of 3 samples onions infected on two sides with Botrytis spp, heat treated at 45 °C, irradiated and unirradiated and stored at 20 °C.

Figure 4: Average percentage of moulded spots ± SE of 3 samples onions infected on two sides with Botrytis spp, heat treated at 50 °C, irradiated and unirradiated and stored at 20 °C.
Table 1: Average percentage of rotten spots ± SE of 3 samples of 25 onions infected on two sides with Botrytis spp, heat treated at different temperatures, irradiated and non-irradiated and stored at 20 °C.

<table>
<thead>
<tr>
<th>Storage [days]</th>
<th>Irradiation dose [kGy]</th>
<th>Heat treatment [°C]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0,1</td>
<td>0</td>
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</tr>
<tr>
<td>0,5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1,0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>39</td>
<td>0</td>
<td>45 ± 8</td>
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<tr>
<td>0,1</td>
<td>52 ± 17</td>
<td>51 ± 5</td>
</tr>
<tr>
<td>0,5</td>
<td>76 ± 17</td>
<td>65 ± 10</td>
</tr>
<tr>
<td>1,0</td>
<td>85 ± 5</td>
<td>71 ± 7</td>
</tr>
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</table>

4 CONCLUSIONS

A heat treatment alone of 50 °C has a positive effect on the prevention of mould growth and rot incidence.

An irradiation dose up to 1 kGy is not enough to kill Botrytis spp.

A combination treatment of heat at 50 °C with irradiation using 0,1 kGy, applied within the dormancy period, prevents sprouting and reduces mould growth and neck rot.
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