Modelling the Growth Inhibition of Common Food Spoilage and Pathogenic Micro-organisms in Presence of Solvent Extract from Irish York Cabbage

Shilpi Gupta
Dublin Institute of Technology, shilpi.19may@gmail.com

Amit Jaiswal
Dublin Institute of Technology, amit.jaiswal@dit.ie

Nissreen Abu-Ghannam
Dublin Institute of Technology, nissreen.abughannam@dit.ie

Follow this and additional works at: http://arrow.dit.ie/schfsehart
Part of the Food Science Commons

Recommended Citation
Crucifer vegetables are a rich source of phytochemicals such as flavonoids and glucosinolates and their hydrolys products. These phytochemicals possess antimicrobial and anti-oxidant activities. In order to assess the antimicrobial potential of different members of crucifer family, Irish York cabbage, Broccoli and Brussels Sprouts, the effect of solvent extracts on the growth inhibition of common food spoilage and pathogenic bacteria was studied. Broccoli and Brussels sprouts, at a concentration of 2.8%, showed a weak inhibition in the range of 11.50% and 7.38%, respectively, against the different micro-organisms. Extracts from York cabbage were highly effective at a concentration of 2.8% resulting in 100%, 75% and 57% inhibition against Listeria monocytogenes, Salmonella abony and Pseudomonas aeruginosa, respectively. Growth/survival of the microorganisms in presence of York cabbage extract was mathematically modelled using the Baranyi model. Lower concentrations of cabbage extract prolonged the lag phase and reduced both the maximum specific growth rate and final population densities.

### Materials and Methods

**Extracting Procedure**: (Gupta et al., 2010)

- 5 gm sample was crushed with liquid nitrogen
- Extraction with 60% methanol under nitrogen atmosphere
- Shaking at 40°C and 100 rpm for 2 h
- Extracts filtered and evaporated to dryness

**Antimicrobial Analysis**

- **Gram Positive**: Food Pathogen: Listeria monocytogenes; Food Spillage: Enterococcus faecalis
- **Gram Negative**: Food Pathogen: Salmonella abony; Food Spillage: Pseudomonas aeruginosa

Microtitre plate based analysis (Gupta et al., 2010)

<table>
<thead>
<tr>
<th>Log CFU/ml</th>
<th>S. abony</th>
<th>L. monocytogenes</th>
<th>P. aeruginosa</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.2</td>
<td>0.60</td>
<td>0.05</td>
<td>0.00</td>
</tr>
<tr>
<td>0.4</td>
<td>0.61</td>
<td>0.05</td>
<td>0.00</td>
</tr>
<tr>
<td>0.6</td>
<td>0.63</td>
<td>0.07</td>
<td>0.00</td>
</tr>
<tr>
<td>0.8</td>
<td>0.65</td>
<td>0.10</td>
<td>0.00</td>
</tr>
</tbody>
</table>

**Antimicrobial Activity**

- Extracts from York Cabbage were the most effective followed by Broccoli and Brussels sprouts which had weak inhibition.

<table>
<thead>
<tr>
<th>Extracts</th>
<th>Log CFU/ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>York Cabbage</td>
<td>0.20</td>
</tr>
<tr>
<td>Broccoli</td>
<td>0.40</td>
</tr>
<tr>
<td>Brussels Sprouts</td>
<td>0.60</td>
</tr>
</tbody>
</table>

- L. monocytogenes and E. faecalis were the most sensitive and resistant organisms, respectively.

- An inhibition of 100% and 75% was observed against L. monocytogenes and S. abony, respectively, with 2.8% York cabbage extract.

- The inactivation effect reduced with a reduction in extract concentration.

- York cabbage extracts, with an inhibition of 100%, were more potent than sodium benzoate (84.4%) and sodium nitrite (96%) against L. monocytogenes at a concentration of 2.8%.

- Kinetics studied with extracts from York Cabbage

- A rapid and prolific growth was observed in control samples.

- An extract concentration of 1.4% resulted in complete inactivation of L. monocytogenes whereas 0.7% extract resulted in 76% reduction in the stationary level growth as compared to the control.

- For the other three organisms, addition of 2.8% extract resulted a reduction of 72, 64 and 32% in the stationary level growth of S. abony, P. aeruginosa and E. faecalis as compared to the control.

- Maximum specific growth rate was reduced and lag phase increased upon addition of extract.

**Growth/Inhibition Kinetics**

- Reducing the extract concentration to 0.7% resulted in 4 and 2 times increase in λ for L. monocytogenes and P. aeruginosa, respectively.

- Addition of extract at 2.8% resulted in 57% and 55% reduction in the μc of P. aeruginosa and S. abony, respectively.

- Viable counts and growth rate studies were done using the Baranyi model for the prediction of growth and lag time.

**Growth Kinetics using Baranyi Model**

- Extracts from York Cabbage have the potential of imparting microbiological safety to food products.

- Higher antimicrobial activity was seen against L. monocytogenes and S. abony as compared to typical food preservatives such as sodium benzoate and sodium nitrite.

- The present finding brings out a new insight towards the development of natural antimicrobial agents against L. monocytogenes from Irish York cabbage.

### References


The authors would like to acknowledge the funding from the Irish Government under the Technological Sector Research Scheme (Strand III) of the National Development Plan.