Assessment of antimicrobial activity of onion (Allium cepa) and garlic (Allium sativum) extracts on Listeria monocytogenes; in vitro study

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ABSTRACT

Background: Allium sativum (garlic) and Allium cepa (onion) are well-known indigenous herbal medicine since ancient times and held a place of honor in Indian traditional ayurvedic medicine. Objective of the study: Assessment of antimicrobial activity of onion (Allium cepa) and garlic (Allium sativum) extracts on Listeria monocytogenes. Results and conclusion: Antibacterial activity of extracts of Allium sativum (garlic) and Allium cepa (onion) has been evaluated against (Listeria monocytogenes a 4/b). The results showed that good activity of organic solvents extract and the activity depends on extract concentration. On contrast low effect was observed with boiling water extract and no activity was observed with cold water extract. Also the results of the present work illustrate the inhibitory effects of Allium sativum crude extracts on L. monocytogenes. The results proved a good activity of cold water extract and the activity depend on extract concentration. On contrast low effect was observed with organic solvents extract and no activity was observed with boiling water extract.

Keywords: Allium cepa, Allium sativum, Listeria monocytogenes, extracts.

INTRODUCTION

Interest in occurrence of Listeria, and particularly Listeria monocytogenes, in food has escalated rapidly during the 1980s, and continues unabated, because of several major outbreaks of food borne listeriosis. The first of these occurred during 1981 and involved consumption of contaminated coleslaw. Heightened public concern regarding the prevalence of Listeria monocytogenes in food prompted the United State Food and Drug Administration to initiate a series of Listeria surveillance programs (1). Since ancient times garlic (Allium sativum) and onion (Allium cepa, L.) have been an important dietary resource and have also been of interest for medical purposes (2). Allium is the largest and important representative genus of the Liliaceae family comprises 450 species. Onion (Allium cepa) is a bulbous plant widely cultivated in almost every country of the world(3). Onions are easily propagated, transported and stored. Onions are effective against common cold, heart disease, diabetes, osteoporosis, coughs and sore throat (4). It is rich in proteins, carbohydrates, sodium, potassium and phosphorus (5). Onion was consumed throughout Europe during the middle ages and was later thought to guard against evil spirits and the plague, probably because of their strong odor. Folk healers traditionally used onion to prevent infections is among the oldest cultivated plants used both as a food and for medicinal applications (6). Allium sativum (garlic) is a well-known indigenous herbal medicine since ancient times and held a place of honor in Indian traditional ayurvedic medicine. Most of therapeutic effects are ascribed to specific oil and water-soluble organosulphur compounds, which are responsible for the typical odor and flavor of garlic (7). Fractionation and analysis of aqueous garlic extract have shown that the active ingredient is allicin, a low-molecular-weight compound whose biological activity is rapidly abolished by exposure to thios (such as L-cysteine), heat, or alkali (8). In vitro studies have shown onion to possess antibacterial, antiparasitic, and antifungal activity (2, 9, 10). Harris et al. reviewed the therapeutic effects of Garlic on the cardiovascular system, antibacterial, antiviral, antifungal, antiprotozoal, anticancer, antioxidant, immuno-modulatory, anti-inflammatory hypoglycemic and hormone like effects (11).

MATERIAL AND METHODS

Tested microorganism

The test microorganism (Listeria monocytogenes a 4/b) was kindly provided by Microbiology Department, Faculty of Science Zagazig University Egypt. L. monocytogenes was subjected to different biochemical tests in Microbiology Department, Faculty of Science Al-Margeb University, Libya in order to check its purity (12). The pure cultures were subcultured on nutrient agar slants and kept at 4°C until ready for the study.

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Plant Materials

*Allium cepa* (white onion bulb) and *Allium sativum* (garlic) were purchased from local dealers at Alkhoms vegetables market. It was identified in the herbarium of the Department of Botany, Faculty of Science, Almargeb University.

Extraction of phytochemical constituents

The onion bulb was washed with freshly prepared sterile distilled water. The outer covering of the bulb was manually peeled off and the fleshy part of the onion was re-washed with freshly prepared sterile distilled water. Onion bulb was cut into small parts and squashed. Fresh cloves and leaves of garlic also treated in the same way. The squashed preparation was extracted using boiling water and organic solvent (mixture of chloroform, cyclohexan, and methanol at ratio of 1:1:1). The extraction was done according to protocol mentioned by Indu et al. (13).

Preparation of inoculums and antibacterial activity

About 20 hour broth culture of the test *Listeria monocytogenes* a 4/b was suspended into sterile nutrient broth. It was standardized according to National Committee for Clinical Laboratory Standards (14).

Antibacterial activity

The antibacterial activity of the crude extract was determined in accordance with the agar-well diffusion method described by (15). Controls were set up in parallel using the solvent and sterile distilled water were used to reconstitute the extract. The plates were observed for zones of inhibition after 24 h.

Results and discussion

The present study investigates an antimicrobial activities of *Allium sativum* (garlic) and *Allium cepa* (onion) extract against tested bacteria (*Listeria monocytogenes* a 4/b). Table (1) and figures (1-A) and (1-B) illustrate the inhibitory effects of *Allium cepa* crude extracts on *L. monocytogenes*. The results showed that good activity of organic solvents extract and the activity depends on extract concentration. On contrast low effect was observed with boiling water extract and no activity was observed with cold water extract. Table (2) and figures (2-A) and (2-B) illustrate the inhibitory effects of *Allium sativum* crude extracts on *L. monocytogenes*. The results showed that good activity of cold water extract and the activity depend on extract concentration. On contrast low effect was observed with organic solvents extract and no activity was observed with boiling water extract.

**Table (1) Inhibitory effect of *Allium cepa* crude extracts on *L. monocytogenes***

<table>
<thead>
<tr>
<th>Plant name</th>
<th>Method of extraction</th>
<th>Extracts concentration (%)</th>
<th>Diameter of inhibition zone (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Allium cepa</em></td>
<td>Boiling water extract</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Organic solvents extract</td>
<td>40</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>13</td>
</tr>
<tr>
<td>Control</td>
<td>Water</td>
<td>Distilled water</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Org. solvents</td>
<td>Mixture*</td>
<td>0</td>
</tr>
</tbody>
</table>

*(Mixture of chloroform, cyclohexane, and methanol at ratio of 1:1:1).*
The antibacterial activity of onion juice can be attributed to the presence of flavonoids and polyphenols which has been reported to have broad spectrum of antibacterial activity. Polyphenols from plants have been reported to have antibacterial activity. Some of the advantages that herbal preparations have over the synthetic ones are that they do not act directly on bacteria but create an adverse environment for them, thus threatening their survival and they have also been found to deter the development of resistant strains of microorganisms. Other authors,
reported that petroleum ether, ethyl acetate and chloroform extracts of *Allium cepa* inhibited the growth of *Staphylococcus aureus* at both lower and higher concentration. In contrast, it was resistant to fresh *Allium cepa* extracts, also Butanol, ethanol and water extracted samples were ineffective to control the growth of *Staphylococcus aureus* at any concentration. Authors, also reported that petroleum ether, methanolic and aqueous extract of bulbs of *Allium cepa* was found to be inactive against *staphylococcus aureus*. Other authors, hexane, dioxan, ethanol extracts of scale leaves of *Allium cepa* at a concentration of 1000µg/ml showed an inhibition zone of 8 mm for each against gram positive bacteria *Staphylococcus aureus*, where is the aqueous, isopropyl alcohol and n-Butanol extract of the same plant showed no effect \(^{10-20}\). Modern antimicrobial garlic research started with the classic studies of some other authors, observed the antimicrobial activity in vitro against pathogenic bacteria \(^{(13&21)}\).

**CONCLUSIONS**

From this study and the earlier reports it is clear that, garlic and onion appear to satisfy all of the criteria for antibacterial agents, being cheap and safe. Because garlic is known to act synergistically with antibiotics, and resistance has not been reported for onion and garlic, more dose-response preclinical studies and eventually clinical studies should be done to assess the use of an antibiotic/garlic/onion combination for bacteria that are difficult to eradicate. In view of the strong antibiotic properties and the complete absence of development of resistance further investigation upon the principles of the antimicrobial activity of juices from Allium species merits consideration.

**REFERENCES**


5. Lampe J. (1999):


