Antibacterial Activity of Medicinal Plants Used to Treat Infectious Disease in Northern Peru

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ABSTRACT

OBJECTIVE: In order to compare the treatment used by the curanderas (male healers) with Western medicine practice, the antibacterial activity of plant extracts (Achicoria ruiziana, Acanthoxanthium spicata, Eucalyptus globulus, Clusia spicata, and Echirea sp.) were evaluated. The aim was to observe and compare the activity of medicinal plants used in Peru and the University of Buffalo and the Universidad Nacional de Trujillo.

HYPOTHESIS: The plant extracts will have antibacterial activity.

METHODS: Plants were purchased, dried, and ground. Alcoholic extracts were prepared, concentrated, dried, and re-suspended in boiling water, and sterilized. Bacterial growth inhibition against S. aureus and E. coli was measured spectrophotometrically at various concentrations. The data were then used to create the line of best fit. The IC50 values for each trial were then averaged and the standard deviation was calculated.

RESULTS: Data were normally distributed and the IC50 values were calculated. Plant extracts were more efficacious against S. aureus than E. coli. The IC50 of plants used for infections against S. aureus was 0.15-5.6 mg/mL. Two of these had IC50 values against S. aureus of 110.859 mg/mL.

CONCLUSION: Antibacterial activity was observed in all plants. Further study of plants with high antibacterial activity could identify new antibacterial compounds.

RESULTS

Antimicrobial Activity of Plant Extracts:

Concentration-response curves were used to show the effects of various plant extract concentrations on the bacterial growth of E. coli and S. aureus. In all 12 experiments of Figure 7, bacterial growth was seen at lower extract concentrations, and in all experiments, bacterial inhibition was seen at higher extract concentrations. Bacterial growth at lower extract concentrations is thought to be due to the natural chemical nutrients in plants which stimulate the growth of bacteria rather than inhibit their growth. Achicoria (TB 74 and 75), Mentha (TD and T7), and Alanso (TE and T7) are said to be noninhibitory (NI) since their concentration-response curve did not show any inhibition of bacterial growth. In all 10 experiments, plant extracts screened against S. aureus showed a greater inhibition of bacterial growth at lower extract concentrations than their corresponding experiments in E. coli.

METHODS

Plant Collection:

Voucher specimens used in this study were purchased at a local market (Fig. 4), identified by botanists, and stored at the Universidad Nacional de Trujillo, Peru and the Missouri Botanical Garden, MO, USA.

Extract Preparation:

Plants purchased from the market were dried, ground, and incubated in 1 mL ethanol for one week to extract chemical components. Extracts made from single plants contained 50g of plant material in 1% of ethanol. Extracts were then filtered to remove plant debris, dried by rotary evaporation, transferred to a glass vial, and stored at -20°C. As needed, frozen extracts were thawed, resuspended in boiling water, and filter sterilized. Extract dry weights were used to determine concentrations.

Bacterial Growth Assay (BGA):

Bacterial strains Escherichia coli ATCC 2924 and a clinical isolate of Staphylococcus aureus were used. A common variety was inoculated into 2 mL of Mueller-Hinton Media and incubated for 24 hours at 37°C. Fresh overnight bacteria were prepared for each experiment from this master stock which was made fresh each week. Plant extracts were diluted 1:2 into media, and the diluted extracts were serially diluted (1:2). Each dilution was then aliquoted into four tubes to give an 14:1. The bacteria were added to each tube. Controls are prepared for media alone, extract alone, for total growth with no extract, and an antibiotic for growth inhibition. Next 4 steps are visualized below.

Data Analysis:

Data were normalized to percent survival or percent growth, in comparison to negative controls (without extract). Data were then plotted as concentration-response curves and the section of the curves showing maximum change was fit to a line (y = mx + b). The concentration which caused 50% inhibition of bacteria (IC50) were calculated where y=50.

RESULTS and DISCUSSION

Analysis of IC50:

Table 1 shows the IC50 values of the two plant sets. The same volume of resuspended plant extract was used for each set to eliminate potential confounding variables. For Manayupa, it is important to note that only 3 replicates were used due to the absence of a S. aureus pellet post-centrifugation. The concentration-response curve for Chancapiedra against S. aureus had to be modified twice to determine the corresponding IC50 values. According to Table 1, all plant extracts tested had at least one bacterial strain that it could inhibit. For all of the plant extracts there was a much lower concentration required to inhibit the growth of S. aureus than required to inhibit the growth of E. coli (lower IC50). This observation shows less bacterial strains that are incubated with plant extracts of varying concentrations.

TABLE 1: Summary of Extract IC50 values against S. aureus and E. coli

<table>
<thead>
<tr>
<th>Latin Botanical Name</th>
<th>Common Name</th>
<th>IC50 (mg/mL) S. aureus</th>
<th>IC50 (mg/mL) E. coli</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acanthoxanthium</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>spicatum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Borrago officinalis</td>
<td>Borraga</td>
<td>7.9 ± 2.0 (9)</td>
<td>20.7 ± 2.0 (4)</td>
</tr>
<tr>
<td>Desmodium moliellorum</td>
<td>Manayupa</td>
<td>0.38 ± 0.05 (7)</td>
<td>29.4 (8)</td>
</tr>
<tr>
<td>Phytafluus neri</td>
<td>Chancapiedra</td>
<td>13 ± 1.12</td>
<td>110.859</td>
</tr>
<tr>
<td>Picrosia longifolia</td>
<td>Mentha</td>
<td>0.56 ± 0.01 (6)</td>
<td>9.6 ± 0.1 (4)</td>
</tr>
<tr>
<td>Uncaria tomentosa</td>
<td>Uña de Gato</td>
<td>5.0 ± 0.1 (8)</td>
<td>102.0 (8)</td>
</tr>
<tr>
<td>Mentha spicata</td>
<td>Mentha</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CONCLUSIONS

• Antibacterial activity was seen in all of the plant extracts, used by the curanderas to treat infectious disease
• Antibacterial activity for plants used to treat infectious disease by the curanderas show similarity to allopathic medication.

REFERENCES

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