

Biochemical Composition and Antimicrobial Activity of Some Plants in Mongolia

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Abstract

The antimicrobial activities of the methanol, butanol, ethylacetate, ethanol and chloroform extracts obtained from three different plant species of the Mongolian Gobi desert are evaluated by means of the disc diffusion method against eight species of bacteria. Extracts of *Ammopiptanthus mongolicus* demonstrated antibacterial activity against three species of microorganisms. Only butanol extract of *Incarvillea potaninii* demonstrated antibacterial activity against 3-5 species of microorganisms. The methanol and butanol extracts of *Gymnocarpus przewalskii* demonstrated antibacterial activity against five species. All extracts of three plant species did not demonstrate antibacterial activity against *Pseudomonas aeruginosa* and *Aspergillus niger*. In addition, we determined some biologically active substances, pH, vitamin P, raw oil, flavonoid, alkaloid and anthraglycoside in aboveground parts of these plants.

Key words: antimicrobial activity, biochemical composition, inhibition zone

Introduction

The desert zone occupies 19.1% of the Mongolian territory, of which 6.2% belongs to the semi-desert or desert-steppe, 9.2% to the typical desert and 3.7% to the extreme arid desert. The climate in Gobi desert is very extreme continental with annual precipitation of 50-100 mm. Flora of Gobi desert contains many rare and endemic species, such as *Populus diversifolia*, *Incarvillea potaninii*, *Ammopiptanthus mongolicus*, *Halimodendron halodendron* etc. (CBD Fourth National Report-Mongolia, 2009; Grubov, 1961, 1982; Bobrov, 1969).

Some researchers purified many kinds of antifreeze proteins (AFP) with high activity from the leaves of *A. mongolicus*. The antifreeze activities of these AFPs were measured by both osmometry and differential scanning calorimetry, and the inhibition of growth of ice crystals by the AFP was obvious. Additionally, the AFPs have been analyzed by sequencing, glycosylation reaction, mass spectroscopy, and circular dichroism spectroscopy. Both samples expressed some other unique structures different from those

of fish and insects. It was suggested that plant AFPs might have a particular antifreeze mechanism in comparison with that of fish and insects (Fei et al., 2008).

This decrease was induced by one of the alkaloids isolated from *A. mongolicus*, which grows in the Gobi desert. Alkaloid lessened the formation of FMNC with DETC both in the control animals and in those treated with lipopolysaccharide from *E. coli* initiating inflammation processes and intensification of NO synthesis. Proceeding from the data obtained the authors suggested that free radicals reacting with the antioxidant affect NO formation by increasing the level of free calcium in the cell (Burgedbazar et al., 1991).

The antibacterial and antifungal activities of methanol, ethylacetate, hexane, butanol, ethanol, water and chloroform extracts of *Empetrum sibiricum* V.Vassil were assayed. The different extracts have been individually tested against a panel microorganisms including *Staphylococcus aureus*, *Enterococcus faecalis*, *Micrococcus luteus*, *Escherichia coli*, *Bacillus cereus*, *Aspergillus niger* and *Saccharomyces cerevisiae* (Battsetseg & Sukhdolgor, 2008).

Material and Methods

Samples of three plant species were collected from the Nomgon district of the Umnugobi province, Mongolia on 16 June, 2007. The identification of all plants was performed by fourth author. Air-dried parts of three plant species subjected to the different extraction procedures taken from aboveground and underground parts. Dried portion of the plant materials were extracted with eight organic solvent (5h for each solvent). All extracts were kept in the dark at +4°C, and from each 0.1 ml of extract is used for antimicrobial activity.

The different extracts were individually tested against a panel microorganisms including *E. coli*, *Ent. faecalis*, *M. luteus*, *Staph. aureus*, *Bac. cereus*, and *Asp. niger*. Bacterial strains were cultured overnight at +37°C in Meat Peptone Agar (MPA). Fungi and yeasts were cultured at +30°C in Potato Dextrose Agar (PDA).

The disk diffusion method was used for antimicrobial screening as applied by (Black (1996) and Wistreich (1997)). Sterile MPA medium was prepared and distributed into Petri dishes of 90 mm diameter. This medium was used for antibiogram assays. The disk size

used was 8 mm (Whatman 11) filter paper. The microbial suspension was streaked over the surface of the meat peptone agar using a sterile cotton swab in order to get a uniform microbial growth on both control and test plates. Under aseptic conditions, the disks were placed on the agar plates and 0.1 ml from each extract was put on the disks. The 0.1 ml solvents (methanol, butanol, ethylacetate and others) were added to the disks on the control plates. The plates were then incubated at 37°C for 24-48 hours in order to get reliable microbial growth. All experiments were carried out in triplicate and averages were calculated for the inhibition zone diameters.

Biochemical composition of the plants were determined by the following methods. An acidity was measured by pH-meter; the vitamin P is by Levental's method; the amount of oil is by soxhlet method; the flavonoid, alkaloid, and anthroglycoside content are by method of Adikhodzhaeva et al. (1977).

Results

The different extracts of three plants species were tested against eight gram-positive and gram-

Table 1. Antibacterial activity of different plant tissue extracts

Plant spp.	Organic solvent	Extract	Bacterial species and inhibition zone, mm							
			<i>E. coli</i>	<i>E. faecalis</i>	<i>P. aeruginosa</i>	<i>M. luteus</i>	<i>S. aureus</i>	<i>B. cereus</i>	<i>S. cerevisiae</i>	<i>Asp. niger</i>
<i>A. mongolicus</i>	Methanol	Stem	a-	1.25	-	2.25	-	-	-	-
	Butanol	Leaves	-	2	-	1.5	-	-	-	-
		Branch	-	2.25	-	2.5	-	-	-	-
	Ethylacetate	Leaves	-	-	-	-	-	0.5	-	-
		Stem	b+	1.75	-	2.25	-	1	-	-
	Ethanol	Stem	-	1.25	-	1.75	-	1	-	-
Chloroform	Stem	-	-	-	0.5	-	-	-	-	
<i>I. potaninii</i>	Butanol	Blooming stem	0.5	-	-	-	-	0.5	1	-
		Seed	1.1	1.75	-	-	0.75	1	1.1	-
<i>G. przewalskii</i>	Methanol	Stem	-	-	-	-	-	+	-	-
	Butanol	Stem	1.75	-	-	-	1	1.5	1.4	-
		Seed	-	0.5	-	-	-	1.25	1.25	-

-: not active (inhibition zone was less than 0.1 mm); b+: active

Table 2. Biochemical composition of the studied plants.

Plant species	Plant parts	pH	Vitamin P (mg%)	Raw oil (%)	Flavonoid (%)	Alkaloid (%)	Anthraglycoside (%)
<i>A. mongolicus</i>	a/g	5.04	0.16	0.76	2.13	1.01	0.48
<i>I. potaninii</i>	a/g	5.12	nd	2.1	nd	nd	nd
	u/g	cnd	nd	0.37	nd	nd	nd
<i>G. przewalskii</i>	a/g	5.34	nd	0.43	nd	nd	nd

nd: not determined; a/g: above ground, u/g: under ground

negative bacteria and two fungi (Table 1).

Different extracts had various activities against all tested microorganisms. The methanol (stem), butanol (branch), ethylacetate (stem), and ethanol (stem) extracts of *A. mongolicus* are inhibited growth of *Ent. faecalis* and *M. luteus*. The ethylacetate (leaves) and chloroform (stem) extracts of this plant species are slightly inhibited the growth of *Bac. cereus* and *M. luteus*. Only the butanol extract of *I. potaninii* inhibited slightly the growth of *E. coli*, *Ent. faecalis*, *Staph. aureus*, *Bac. cereus* and *Sacch. cerevisiae* (0.5-1.0). But, the butanol (stem, seed) extract of *G. przewalskii* is inhibited the growth of *E. coli*, *Ent. faecalis*, *Staph. aureus*, *Bac. cereus* and *Sacch. cerevisiae*, slightly. In general, inhibition zones of these plants were little for all tested microorganisms (Table 2).

The acidity of aboveground parts of all three plants species had slight acidic (pH 5.04-5.34). The oil content of aboveground parts of *A. mongolicus* was equal to 0.76%, that of *I. potaninii* - 2.1%, *G. przewalskii* - 0.43%, but the oil content in the underground parts of *I. potaninii* was 0.37%. The flavonoid of aboveground parts of *A. mongolicus* was 2.13%, alkaloid - 1.01%, and anthraglycoside - 0.48%. However, it should be noted that the samples of three plant species were not quite enough.

References

- Adikhodzhaeva, K. B., Bankovskii, A. I., Glyzin, V. L. & Smirnova, L. P. 1977. Chemical composition of the preparation tanacin from the flowers of *Tanacetum vulgare* L. *Journal of Pharmacy*, 26(3): 24-28.
- Battsetseg, Ch. & Sukhdolgor, J. 2008. A study on antimicrobial activities of *Empetrum sibiricum* V. Vassil. *Mongolian Journal of Infectious Disease Research*, 1(20): 11-14.
- Black, J. G. 1996. *Microbiology, Principles and Applications*, 3rd ed., Printice Hall: International Editions: Upper Saddle River, N.J., pp. 366-369.
- Bobrov, G. I. 1969. Family Gymnocarpos Forsh (Caryophyllaceae) and its sorts. *Bot. Journal*, 54(10): 1576-1583. (in Russian)
- Burgedbazar, B., Kubrina, L. N., Egorov, V. Yu. & Vanin, A. F. 1991. Plant alkaloid from *Ammopiptanthus mongolicus* an inhibitor of nitrogen oxide synthesis in animals. *Biophizika*, 36(4): 700. (in Russian)
- CBD Fourth National Report-Mongolia (English ver.). 2009. Ulaanbaatar, Mongolia, pp. 14-15.
- Fei, Y. B., Cao, P. X., Gao, S. Q., Wang, B., Wei, L. B., Zhao, J., Chen, G. & Wang, B. H. 2008. Purification and structure analysis of antifreeze proteins from *Ammopiptanthus mongolicus*. *Preparative Biochemistry and Biotechnology*, 38(2): 172-183.
- Grubov, V. I. 1961. Plants of Central Asia and botanic-geographical relations. *Abstract of the thesis submitted for the degree of D.Sc. in biology*. Botanical Institute, Leningrad, pp. 13-14. (in Russian)
- Grubov, V. I. 1982. *Key to the Vascular Plants of Mongolia*. Nauka, Leningrad, pp. 152-155. (in Russian)
- Wistreich, G. A. 1997. *Microbiology Laboratory*. Printice Hall, Upper Saddle River, N.J., pp. 319-325.

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