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Broad Spectrum Antibacterial Activity of *Allium cepa, Allium roseum, Trigonella foenum graecum* and *Curcuma domestica*

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Abstract – In many parts of the world *Allium cepa, Allium roseum, Trigonella foenum graecum* and *Curcuma domestica* are extensively used as food and are popular in herbal medicine. The four were screened against 26 pathogens and all exhibited broad-spectrum anti-bacterial activity. The aqueous as well as fractionated methanol extract of *Allium cepa* and *A. roseum* demonstrated broader level of activity against most of the organisms. On the other hand the unfractionated methanol extracts as well as the fractions of both *Trigonella foenum graecum* and *Curcuma domestica* showed broad spectrum of activity. Fractionation was found to improve their level of activity. In both cases the ethyl acetate fractions exhibited higher level of activity. All the materials tested were inactive against any of the four moulds. *Allium cepa, Allium roseum, Trigonella foenum graecum* and *Curcuma domestica* are proposed as non toxic, safe, broad spectrum antibacterial agents.

Key words – *Allium cepa, Allium roseum, Trigonella foenum graecum, Curcuma domestica*, broad spectrum antibacterial activity.

Introduction

Some spices and other plant natural products are extensively used in local herbal medicine mostly in developing countries (Watt and Breyer-Brandwijk, 1962; Kokwaro, 1976; Mshigeni *et al.*, 1991). In light of the emergence of resistance strains of pathogens to known drugs and the high cost of health care in developing countries, the WHO recommendation on the use of medicinal plants in primary health care in developing countries can not be over emphasized (Akerele, 1988). Among the vast number of medicinal plants in current use, are *Allium cepa* (white onion, vegetable), *Allium roseum* (red onion, vegetable), *Trigonella foenum graecum* (fenugreek seed, a spice) and *Curcuma domestica* (tumeric, a spice). All are widely used as food through out the Asian sub-continent and have wide spread medicinal uses.

Allium cepa and *Allium roseum* (white and red onions) are perfect vegetable and flavoring agent as well as a condiment. Phytochemical investigations on onions resulted in isolation of glucoside similar to mustard oil, pungent volatile oil, a plant hormone like insulin as well as a large amount of amino acids and other vitamins, mineral salts and trace elements (Harborne and Baxter, 1993). Other isolated compounds from both onions includes Allicin and Alliin. The former compound has adiabatic, antihypertension, antibiotic and antithrombotic activities (Lowenfeld and Back, 1978). The latter contains a platelet aggregation inhibitor and antithrombotic activity. Other pharmacological properties include; antiseptic, diuretic, expectorant, detoxicant, anthalmintic, antispasmodium and antidiabetics (Lowenfeld and Back, 1978). Onions are irritating to the skin and stimulate the circulation of blood in the mucous membrane. It helps in reducing blood pressure, cleansing the blood generally and in kidney troubles, it also promotes digestion while stimulating the appetite and fortifies the nerves, heart and glands. Raw onion juice rubbed on to arthritic and rheumatic joints is believed to relieve the pain (Lowenfeld and Back, 1978).

Curcuma domestica is a yellow spices which like ginger comes from underground rhizome but is sweeter and more fragnant than ginger. Twenty species of curcuma, rhizomatomous herbs, native to China, Australia, Africa and especially Indo-Malaysia have been studied. They have tuberous rhizomes (Bairadi, 1974). Phytochemical investigations on *Curcuma domestica* resulted in isolation of compounds with antibacterial, antifungal, insect repellent, proteolytic, fungicidal, choleric properties and the ability to

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inhibit damage due to carbon tetrachloride (Phil, 1996). *C. domestica* yielded an essential oil known as oil of curcuma. For many centuries *Curcuma domestica* has been used as a vegetable, dye, food seasoning and in medicines and cosmetics. It is the essential ingredient in curry powders used for its colour and flavour. It is also used in mustard powder, pickles and chutneys (Howes, 1974). Medicinally in India and Asian countries, it is taken boiled with milk and sugar for cold and remedy of flatulence and liver complaints. It is also used in China against hemorrhage (Stockwell, 1988).

Trigonella foenum graecum (Fenugreek Seed) is one of the oldest culinary and medicinal herbs. It is the earliest of spices known to Egyptians and is used as food, medicine and embalming agent. The ripe dried fruit of a quick-growing annual leguminous herb has a strong, pleasant and quite peculiar odour reminiscent of maple (Soepardi, 1957). It is one of the herbs whose cultivation for medicinal purpose is increasing, since its potential in the field of birth control and feeding the hungry nations of the world has recently been recognised (Lowenfeld and Back, 1978). Phytochemical investigations on *Trigonella foenum graecum* resulted in the isolation of diosgenin, an important substance in the synthesis of oral contraceptives and sex hormones and are popular where meatless diets are customary. It is otherwise used as a tonic, for mouth ulcers, chapped lips, stomach complaints and also in veterinary practices as a source of diosgenin. Cosmetically, fenugreek is said to improve the complexion and the condition of the hair (Howes,1974).

Materials and Methods

Tested materials – *Allium cepa, Allium roseum, Trigonella foenum graecum and Curcuma domestica*

Table 1. Anti-bacterial activity of extractives from *Allium cepa* and *Allium roseum*

Microorganisms		*Allium cepa* (white onion) IZ[a]				*Allium roseum* (red onion) IZ				Standard[b] IZ
		W	P	D	E	W	P	D	E	Chl
Bacillus cereus	G+	10	8	12	8	8	8	14	8	16
B. coagulans	G+	12	8	12	8	12	8	16	10	18
B. megatarium	G+	8	10	10	8	8	8	10	8	16
B. subtilis	G+	8	10	12	8	8	8	12	8	16
Lactobacillus casei	G+	8	8	14	8	8	8	14	10	18
Micrococcus luteus	G+	14	8	14	8	10	10	12	8	16
M. roseus	G+	8	8	10	8	8	10	14	8	6
Staphylococcus albus	G+	8	8	12	8	8	10	12	10	16
S. aureus	G+	8	12	14	8	8	8	12	8	18
S. epidermidis	G+	8	12	12	8	8	8	14	8	0
Streptococcus faecalis	G+	10	8	10	8	8	8	10	10	0
S. pneumoniae	G+	8	8	14	10	8	8	14	8	18
S. mutans	G+	10	8	12	8	8	8	14	8	18
Agrobacterium tumefaciens	G–	8	12	18	18	8	10	14	10	12
Citrobacter freundii	G–	8	8	14	10	8	10	10	10	16
Enterobacter aerogenes	G–	8	12	14	12	8	8	12	8	18
Escherichia coli	G–	8	12	12	12	8	8	10	8	18
Klebsiella pneumonia	G–	10	8	10	8	12	8	10	8	0
Neisseria gonorrhoeae	G–	10	8	12	10	8	8	14	8	18
Proteus mirabilis	G–	8	14	12	14	8	8	10	8	16
P. vulgaris	G–	12	8	10	10	12	8	14	10	18
Pseudomonas aeruginosa	G–	10	12	12	8	8	8	10	8	24
Salmonella typhi	G–	8	8	10	8	8	8	12	8	16
S. typhymurium	G–	8	10	10	10	8	8	10	8	16
Serratia marcscens	G–	8	8	12	12	8	8	12	10	0
Trichomonas vaginalis	Pz	8	10	10	8	8	8	14	8	16

[a]Values are inhibition zone (mm) and an average of triplicate. W, Aqueous extract, C, unfractionated methanol extract; P, petrol (60-80°C) fraction; D, CH_2Cl_2 fraction; E, EtOAc; fraction (conc. 4 mg/disc), G, gram reaction of bacterium; Pz, protozoa.

[b]Chl, chloramphenicol (10∝g disc Oxoid B42960).

were purchased from a supermarket in Lae, Papua New Guinea in March 2000.

Used microorganisms – The bacteria used are given in Tables 1 and 2. These were obtained from the stock culture of the Microbiology Laboratory of the Department of Applied Sciences in Lae. Cultures were maintained as nutrient agar slants in screw capped bottles and stored at 4°C. Test cultures were prepared by transferring a loop full of bacteria from the stock culture into nutrient broth and incubated at 37°C for 24 hours except for *Micrococcus roseus* and *Micrococcus lutea* that were incubated at 30°C for 24 hours before use. All the 26 organisms were seeded into nutrient agar plate and incubated for 24 hours. Moulds were transferred into freshly prepared potatoes dextrose agar plates and incubated at 25°C for 3 days. The moulds used were *Trichophyton mentagrophytes T. verrucossum, Candida albican* and *C. tropicalis*.

Anti-microbial activity – Anti-microbial activity was determined by disc diffusion methods techniques (Barry, 1976; Bauer *et al.*, 1966) Aqueous extracts were prepared by grinding 4 gm by weight of the sample in 40 mls of distilled water. The aqueous extracts were filtered to remove tissue particles. The aqueous extracts were then introduced using a syringe on a small filter paper disc (10-mm diameter) of known weight. The paper discs were dried and more extracts was placed on the disc until a total of 4mg by weight of the extract has been absorbed on the disc. The discs after drying were then placed on agar plates (90 mm) which have been previously seeded with cultures of the organisms. The plates with the organisms were incubated for twenty hours. A standard antibiotic (chloramphenicol 10 µg disc Oxoid B42960) was used for comparison. Zones of

Table 2. Anti-bacterial activity of extractives from *Trigonella foenum-graecum* and *Curcuma domestica*

Microorganisms		Trigonella foenum- graecum (fenugreek seed) IZ[a]				Curcuma domestica (Turmeric) IZ				Standard[b] IZ
		C	P	D	E	C	P	D	E	Chl
Bacillus cereus	G+	8	8	10	12	8	8	8	12	16
B. coagulans	G+	8	8	12	12	12	8	8	10	18
B. megatarium	G+	8	8	8	16	10	10	8	12	16
B. subtilis	G+	10	10	10	12	12	12	12	14	16
Lactobacillus casei	G+	8	18	20	16	8	8	8	12	18
Micrococcus luteus	G+	8	8	8	12	10	8	8	14	16
M. roseus	G+	10	12	8	10	10	8	8	10	6
Staphylococcus albus	G+	8	10	8	10	8	10	12	12	16
S. aureus	G+	8	10	12	12	8	8	8	14	18
S. epidermidis	G+	8	10	10	12	8	10	10	12	0
Streptococcus faecalis	G+	8	10	10	12	8	8	8	14	0
S. pneumoniae	G+	8	10	8	12	8	8	10	10	18
S. mutans	G+	8	12	10	12	8	12	10	12	18
Agrobacterium tumefaciens	G–	12	16	14	14	8	14	14	12	12
Citrobacter freundii	G–	8	12	8	10	8	10	10	14	16
Enterobacter aerogenes	G–	8	12	8	10	8	12	12	14	18
Escherichia coli	G–	8	8	10	12	10	10	10	12	18
Klebsiella pneumonia	G–	10	12	12	14	8	8	10	14	0
Neisseria gonorrhoeae	G–	8	8	10	12	8	8	10	12	18
Proteus mirabilis	G–	12	12	12	14	8	12	12	14	16
P. vulgaris	G–	8	10	10	14	10	12	8	12	18
Pseudomonas aeruginosa	G–	8	10	12	14	10	10	8	12	24
Salmonella typhi	G–	8	10	8	12	8	10	8	10	16
S. typhymurium	G–	10	14	12	12	8	8	10	12	16
Serratia marcscens	G–	10	12	12	14	8	8	10	12	0
Trichomonas vaginalis	Pz	10	12	10	12	8	10	8	10	16

[a]Values are inhibition zone (mm) and an average of triplicate. C, unfractionated methanol extract; P, petrol (60-80°C) fraction; D, CH_2Cl_2 fraction; E, EtOAc; fraction (conc. 4 mg/disc), G, gram reaction of bacterium; Pz, protozoa.
[b]Chl, chloramphenicol (10∝g disc Oxoid B42960).

inhibitions were measured to the nearest mm.

Results and Discussion

The antibacterial activities of the tested materials are shown in Tables 1 and 2. In all cases, fractionation improved the activity of all the materials tested compared to the aqueous as well as the unfractionated methanol extracts. Both the aqueous as well as the fractionated extracts of *Allium cepa, Allium roseum* exhibited a broader anti-bacterial activity. The dichloromethane fractions exhibited a higher level of activity in both cases Table 1. All the tested fractions, aqueous (W), petrol (P), dichloromethane (D) and ethyl acetate (E) all exhibited lower but a broader antibacterial activity compared to the standard antibiotic chloramphenicol (10 μg). The antibacterial activity of both *Trigonella foenum-graecum* and *Curcuma domestica* are shown in Table 2. Fractionated samples exhibited a higher level of activity compared with the crude (C) methanol extracts. In both cases the ethyl acetate (E) fractions exhibited a higher level of anti-bacterial activity compared with the petrol (P) and dichloromethane (D) fractions. All exhibited a broader level of activity against all the tested bacteria. The diet containing *Allium cepa, Allium roseum, Trigonella foenum-graecum* and *Curcuma domestica* are well proven and extensively used house hold remedies for diabetes, cardiovascular disorder and, as tonics, antihypertension, antithrombotic, oral contraceptives, sex hormones, mouth ulcers, chapped lips, stomach complaints, remedy of flatulence, hemorrhage. From these results and considering the previous study on the medicinal properties of all the tested materials we propose *Allium cepa, Allium roseum, Trigonella foenum-graecum* and *Curcuma domestica* as non-toxic, safe potential antibacterial agents. The present investigations add on to the numerous therapeutic benefits of the four amazing food ingredients.

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