AZO AND SCHIFF BASES AND THEIR METAL COMPLEXES AS ANTIBACTERIAL COMPOUNDS

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SCHIFF bases and benzothiazole compounds bearing azo and azomethine groups are known to possess bacteriostatic, anticancerous and other biochemical properties[1–6]. Considering that the metal complexes of azo derivatives and schiff bases derived from 2-amino-benz(d)-thiazole condensed with salicyl-aldehyde, 4, 4'-diaminodiphenyl condensed with 2-hydroxy propyl methyl ketone, may possess anti-microbial property, an attempt is made to screen various metal complexes for their antibacterial properties against two common human pathogens, *Staphylococcus aureus* and *Escherichia coli.*

Antibacterial activity of azo and schiff bases and their metal complexes were assessed against *Staph. aureus* and *E. coli* by cup plate method[7]. For this purpose the following new azo compounds and schiff bases synthesised in our laboratory were used.

The azo derivatives included four groups (ligands) namely group I, 5-methoxy-4-hydroxy-3-diazo-benzenebenzaldehyde (vdb), group II, 2-diazo (2-hydroxy-3-methoxy-5-benzaldehyde) phenol (vhdb), group III, 1, 4-Diazo (2-hydroxy-3-methoxy 5-benzaldehyde) benzene (dvb) and group IV, 4, 4' Di-diazo (2-hydroxy-3-methoxy-5-benzaldehyde) diphenyl (dvdp) complexed with bivalent metal ions such as Mn, Fe, Co, Ni, Cu, Zn, Cd and Hg respectively. Similarly, the schiff bases (ligands) included three groups, group I, 2-amino-benz (d) thiazole condensed with salicyl-aldehyde (abts), Group II, 4, 4'-diaminodiphenyl condensed with 2-hydroxypropylmethyl ketone (acb) and group III, 4-Amino-4' (3-methoxy-4-hydroxy-benzene) azomethinediphenyl (vbz), complexed with bivalent metal ions such Co, Ni, Cu, Zn, Cd and Hg respectively. Sub-cultures of the said organisms were prepared in peptone broth and incubated at 37°C for 18–24 hr. Nutrient agar plates were prepared seeded with the organisms in question. Later, to cups of 10 mm size, made by punching the agar plate, 0.1 ml (10^{-3} M concentration) of the test compound in dimethyl formamide was added using sterile pipettes. The plates were incubated at 37°C for 24 hr. The extent of zone of inhibition produced was measured. The plates with aqueous phenol and solvent (DMF) were used as control.

Table 1 *Antibacterial activity of azo and schiff base derivatives.*

Group	Azo derivatives	*Staph. aureus*	*E. coli*	Schiff base derivatives	*Staph. aureus*	*E. coli*
I	Ligand (Vdb)	b	b	Ligand (abts)	c	c
	Cu, Hg complex	c	c	Cu, Co, Zn, Hg	c	c
	Cd	c	b	Ni	a	a
	Co, Ni, Zn, Mn, Fe	b	b			
II	Ligand (Vhbd)	a	—	Ligand (acb)	a	a
	Hg	c	c	Cu, Co, Ni, Cd	b	b
	Zn, Cd, Co, Ni, Cu	b	b	Zn	b	a
	Fe	a	a	Hg	c	c
III	Ligand (dvb)	a	b	Ligand (vbz)	b	c
	Hg	c	c	Zn, Cd, Co, Ni	b	a
	Fe, Cu, Zn, Cd	b	b	Cu	c	b
	Mn, Co, Ni	a	a	Hg	c	c
IV	Ligand (dvdp)	a	a			
	Hg	c	c			
	Cd	b	b			
	Cu	a	a			
	Zn	a	—			

Abbreviation:— —Inactive, (< 13 mm), a Less active (13 16 mm), b Moderately active (17 20 mm), c Highly active (21–27 mm).

The group I ligand and most of its metal complexes were moderately active, except Cu, Cd and Hg complexes which were highly active against the test organisms (table 1). The Cd complex was highly active against *Staph. aureus* and was moderately active against *E. coli*. Group II ligand and metal complexes varied widely in their antibacterial properties. Hg complex showed highest activity, while Cd and Zn were moderate and Fe was less active against both the organisms. The group III ligand was moderately active against *E. coli* and less active against *Staph. aureus*. Among its metal complexes Hg showed highest activity, Fe was moderate and Mn, Co, Ni were less active against the organisms, whereas the response of Cu, Zn and Cd complexes was moderate against *Staph. aureus* and less active against *E. coli*. The group IV ligand and most of its metal complexes were less active, except Hg and Cd which were highly and moderately active.

Similarly, the schiff base ligands and their metal complexes varied in their responses against the indicator organisms. Group I ligand and its metal complexes were in general highly active, except Ni which was less active. The group II ligand and its metal complexes were less active comparatively. The Hg complex was highly active whereas others were moderate, except Cu complex which was less active against both the indicator organisms. As regards group III ligand and its complex, again Hg complex was highly active against both the organisms, whereas other complexes varied in their responses to different organisms.

The azo derivatives and schiff bases (Ligands) with their metal complexes tested against *Staph. aureus* and *E. coli* showed different ranges of activity. They were found active against both test organisms and hence can be regarded as active antibacterial agents.

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HISTOLOGY OF RHIZOGENESIS AND SHOOT BUD FORMATION IN CULTURES OF *TAGETES ERECTA* L.

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REGENERATION of plants from leaf segments[1], disc florets[2], callus[3], and morphactin-induced barren capitula[4] of *Tagetes erecta* (African marigold) has been earlier reported. In this note, we present an account of the histology of differentiation of roots and shoot buds from the cultured leaf segments of *T. erecta*.

Leaves taken from the plants growing in the botanic garden of the University, were surface-sterilized for 5 min in a 0.1 % $HgCl_2$ solution and washed thrice in sterile distilled water. Leaf segments (ca 1.5 × 0.6 cm) were cultured aseptically on 0.8 % agar solidified MS[5] basal medium supplemented with auxins and cytokinins. The pH of the medium was adjusted to 5.8 before autoclaving at 1.06 kg/cm^2. All cultures were incubated at 28°C under 24 h illumination from cool white fluorescent tubes and incandescent bulbs. Wide neck Erlenmeyer flasks (100 ml) and test tubes (25 × 150 and 25 × 200 mm) were used as culture vessels. A 40 ml medium was dispensed in each flask and 20 ml in a tube.

For the histological study, the leaf segments and callus were fixed at different times of culture in formalin : acetic acid : alcohol (5 : 5 : 90; v/v). After dehydration in tertiary butyl alcohol series and em-

Figures 1–8. 1, 2. Transverse section of leaf explant showing differentiation of vascular tissue and root primordia. **3, 4.** Root primordia gradually pushing out of the parent leaf tissue (figure 3) and the callus (figure 4). **5.** Sections of leaf explant showing differentiation of tracheid-like cells prior to shoot bud development. **6.** Meristematic nodule situated deep in the proliferated leaf callus. **7.** A superficial meristemoid on the surface of the callus. **8.** A shoot bud cut longitudinally with first and second leaf primordia.