NOTE

Biomedical Polymers. IV. Bacteriocidal Property of the Resins Derived from Semicarbazone and 2,4-Dinitrophenyl Hydrazone of Some Hydroxy Acetophenones

Phenols have been extensively studied for their antimicrobial activities and found to be effective eradicants. A literature study reveals that resins from aromatic compounds (having hydroxy, amino, and carboxyl groups) are potential substrates for fungicidal and bacteriocidal applications. Polymers derived from salicylic acid and its derivatives are well known for their biological activity.[1-2] Ciampa and co-worker[3-5] have extensively investigated the biological properties of a number of polymers incorporating salicylic acid as one of the components. The present study reports the bacteriocidal properties of the resins derived from semicarbazone and 2,4-dinitrophenyl hydrazone derivative of some hydroxy acetophenones.

EXPERIMENTAL

Material

Analar-grade hydroxy acetophenones were used. Semicarbazones of the hydroxy acetophenones were prepared by condensing the acetophenones with semicarbazide hydrochloride following the standard procedure. Similarly, 2,4-dinitrophenyl hydrazine was condensed with the acetophenones to prepare the corresponding 2,4-dinitrophenyl hydrazones. All the other chemicals used were of Analar grade.

For carrying out bacteriocidal tests of the polymers, various animal pathogenic organisms, viz, *Staphylococcus aureus, Staphylococcus citrus, Klebsiela, Escherichia coli, Pseudomonas Pyocyanus, Streptococcus viridius,* and *Proteus* were employed.

Synthesis of the Resins

The polymers were prepared by condensing the semicarbazone and 2,4-dinitrophenyl hydrazone of the hydroxy acetophenones with substituted aromatic compounds as per our earlier communications.[6-8]

Antibiotic Sensitivity Test

Antibiotic sensitivity of the resins was monitored by a diffusion test where the chemical is allowed to diffuse through a solid medium so that a gradient is established, the concentration being nearer the site of application of the drug and decreasing with distance. The bacteria to be tested was seeded on the medium, and its sensitivity to the drug was estimated from the inhibition of its growth.

In the disc diffusion method, filter-paper discs of 6 mm diameter were used, being charged with an appropriate concentration of test chemical. The discs were stored dry and cold. The broth culture solution was spread uniformly over the surface of a solid medium (nutrient agar), and the excess broth was decanted off. After drying (37°C for 30 min) the antibiotic discs prepared beforehand were placed with sterile forceps on the agar. After incubation for 24 h, the degree of sensitivity was determined by measuring the zones of inhibition of growth around the discs.

Antibiotic sensitivities of the compounds were evaluated against the previously mentioned pathogens after isolation of the pathogenic bacteria from clinical specimens. Test chemicals were employed at different dilutions in DMSO such as 5, 7, 10, 15, 20, 25, 30, 50, 60% w/v.

The results are furnished in Table I in terms of minimum percentage (w/v) at which the sensitivity pattern is observed.

RESULTS AND DISCUSSION

The chemical reaction that a polymer may undergo in an organism, i.e., hydrolysis, oxidation, and conjugation with the biomolecules have been widely reviewed.[9] Polymers, depending on the charge, charge density, molecular weight, hydrophobicity, conformation, and tacticity, interact more or less strongly with cell membrane components like lipid protein, glycoprotenin,[10,11] etc, and displace the equilibrium of different vital processes, thereby causing death to an organism. The antibacterial activities of 20 copolymers have been investigated using 6 bacteria.

Perusal of the results of the antibiotic activity of the copolymers presented in Table I shows that the resin copolymer prepared from *p*-hydroxy acetophenone 2,4-dini-

Journal of Applied Polymer Science, Vol. 46, 1875–1877 (1992)
 CCC 0021-8995/92/101875-03

Table I Sensitivity Pattern in 1000 ppm (%) of Resins against Test Organisms[a]

		Bacteria Strains					
			Staphylococcus				
Sl. No. (1)	Name of Resin (2)	*Klebsiela* (3)	*Aureus* (4)	*Citrus* (5)	*Escherichia Coli* (6)	*Pseudomonas Pyocyanus* (7)	*Proteus* (8)
1.	OHAP-2,4-DNPH-F	—	—	> 60	> 60	5	> 10
2.	PHAP-2,4-DNPH-F	> 10	> 10	—	> 10	> 10	> 10
3.	OHAP-2,4-DNPH-F-PABA	> 10	> 10	> 15	> 25	> 10	15
4.	PHAP-2,4-DNPH-F-PABA	> 60	—	> 25	> 5	> 25	> 25
5.	OHAP-2,4-DNPH-F-ASA	> 60	—	> 5	> 25	> 25	—
6.	ASA-F	—	—	> 25	> 25	> 25	—
7.	PHAP-2,4-DNPH-F-ASA	> 60	> 5	> 50	> 5	—	> 10
8.	OHAS-PABA-F	> 25	> 10	> 50	> 25	—	> 10
9.	OHAS-PCBA-F	> 25	> 10	> 10	> 10	> 10	> 15
10.	OHAS-OABA-F	> 25	> 15	> 25	—	> 10	> 15
11.	OHAS-PABA-F	> 25	> 10	> 25	—	> 10	> 25
12.	4-OHAS-Ph-F	> 25	> 60	> 25	15	> 20	—
13.	4-OHAS-8-OH quin-F	> 25	> 60	5	> 30	> 25	—
14.	4-OHAS-OAPY-F	> 10	—	> 10	> 25	> 25	> 25
15.	4-OHAS-m-T-F	> 15	15	10	10	> 25	> 25
16.	RAS-PABA-F	> 15	> 25	> 10	> 25	> 10	7
17.	RAS-PCBA-F	—	> 25	> 5	> 25	> 25	> 10
18.	RAS-OABA-F	> 5	> 25	5	10	> 5	> 5
19.	RAS-PABA-F	> 20	> 20	> 10	> 25	> 25	5
20.	RAS-Ph.F	> 20	> 25	> 10	> 10	> 25	> 5

[a] OHAP-2,4-DNPH: *o*-Hydroxy acetophenone-2,4-dinitrophenyl hydrazone.
PHAP-2,4-DNPH: *p*-Hydroxy acetophenone-2,4-dinitrophenyl hydrazone.
OHAS: *o*-Hydroxy acetophenone semicrabazone.
4-OHAS: 4-Hydroxy acetophenone semicrabazone.
RAS: Resacetophenone semicarbazone.
F: Formaldehyde.
PABA: Paraamino benzoic acid.
PCBA: Para chlorobenzoic acid.
OABA: Orthoamino benzoic acid.
M.T.: Meta toludine.
8-OHQui: 8-Hydroxy quinoline.
OAPY: *o*-Amino pyridine.
ASA: Acetyl salicylic acid.
Ph: Phenolpthalein.

trophenyl hydrazone[5]–formaldehyde (PHA-2,4 DNPH-F) is the most active of all these resin copolymers, being toxic to all the pathogenic organisms under study, marked by an obtainable sensitivity pattern at above 10% concentration. Another resin synthesized from *o*-hydroxy acetophenone 2,4-dinitro-phenyl hydrazone–*p*-amino benzoic acid–formaldehyde (OHA-2,4-DNPH-PABA-F) shows toxicity to *Klebsiela–S. aureus* and *P. pyocyanous* at 10% concentration whereas it is toxic to *S. citrus* and *Proteus* at 15% concentration.

Of the copolymers prepared from the substituted hydroxy acetophenone semicarbazones, the resin prepared from *o*-hydroxy-acetophenone semicarbazone–*p*-chlorobenzoic acid–formaldehyde (OHAS-PCBA-F) shows toxicity to *S. aureus, S. citrus, E. coli,* and *P. pyocyanous* at more than 10% concentration. Similarly, copolymer derived from resacetophenone semicarbazone *p*-amino benzoic acid–formaldehyde (RAS-PABA-F) is the most active of all the resin copolymers showing toxicity to *Klebsiela, S. citrus, P. pyocyanous,* and *Proteus* at 5% concentration.

The results of the antibacterial activity of the resins undertaken in the present investigation could be explained by considering a number of causes such as injurious effect on the cell wall, or cell division, effect on permeability of cell membrane and cell enzyme system, and chelation and precipitation of chemicals. The normal hydrogenation and dehydrogenation reactions in the cell are disturbed as the oxygen and nitrogen atoms present in the resin, and the reactive free radicals formed act as the hydrogen acceptor in the metabolism of the cell.

The authors are thankful to Prof. (Mrs.) S. Kar, Head of Microbiology Department, S. C. B. Medical College, Cuttack, for providing facilities for microbial test of the resins.

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Received October 25, 1991
Accepted February 18, 1992