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Synthesis and Antimicrobial Properties of Some Compounds

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Abstract

In this study, N-cyclohexylacrylamide (NCA), N-cyclohexylmethacrylamide (NCMA) andN-(4-nitrophenyl)acrylamide (4NPA) amide-derivative monomer, 2-(bis(cyanomethyl)amino)-2-oxoethyl methacrylate (CMA2OEM) acrylate-derivative monomer and 2-(4-methoxyphenylamino)-2-oxoethyl methacrylate (MPAEMA) monomer and its homopolymer, and the resin of MPAEMA with 2-acrylamido-2-methyl-1-propanesulfonic acid (AMPS) were synthesized. The antimicrobial activity of compounds were tested *Escherichiacoli*ATCC 66032, *Staphylococcus aureus* COWAN 1, *Bacillusmegaterium* DSM 32, *Enterobacteraeregenes CCM 2531Candida tropicalis* ATCC 13803.

Keywords: Monomer; Polymer; Antimicrobial activity.

Introduction

The polymers are classified according to the type of mer which they have: Homopolymer, polymers formed by the incorporation of a single monomer. Copolymer, a polymer formed by two or more monomers. When a compound passes from the monomer structure to the polymer structure, there are many variations in physical, chemical and biological properties with increasing molecular weight. A number of studies have been performed in our laboratories on the synthesis of meth/acrylamide and meth/acrylate monomer and their radical polymerization. In the literature, there are many copolymer and hydrogel synthesis with AMPS monomer[1-5].Copolymers of AMPS with ethylene dimethacrylate are used in contact lenses, and AMPS-g-styrene gives self-reinforced hydrogels [5]. These studies show that the nature, as well as position of the substituent, had a large effect on antimicrobial properties.

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Microorganism contaminationis important fornumerous industries, including but not limited to medical devices, healthcare products, water purification systems, hospital and dental equipment, food storage and packaging. One way to avoid the microbial contamination is to develop materials with antimicrobial properties. Therefore, biocidal substances have attracted much attention in recent years [6]. We report in this manuscript the synthesis and characterization of monomer, as well as homopolymer and resin. These compounds were also tested for their antimicrobial properties against microorganisms such as *Escherichia coli*, *Staphylococcus aureus*, *Bacillus megaterium*, *Enterobacter aeregenes*, *Candida tropicalis*.

Experimental

Experimental Studies

The amide-monomer N-cyclohexylacrylamide (NCA) and N-cyclohexylacrylamide (NCMA) (Fig. 1) were obtained by reaction of cyclohexylamine with meth/acryloyl chloride [7-9].

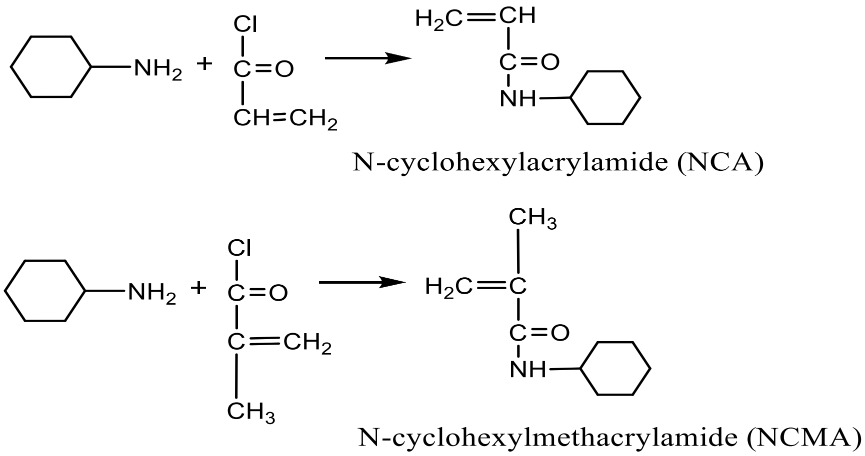

Figure 1: Synthesis of NCA/NCMAmonomer

N-(4-nitrophenyl)acrylamide (4NPA) (Fig. 2) [10] and 2-(bis(cyanomethyl)amino)-2-oxoethyl methacrylate (CMA2OEM) (Fig. 3) [11] monomer, and 2-(4-methoxyphenylamino)-2-oxoethyl methacrylate (MPAEMA) monomer [12, 13] and its homopolymer (Fig. 4, 5) were synthesized by a method adapted from the literature in the our lab. Synthesis schemes are given in Fig. 2-5.

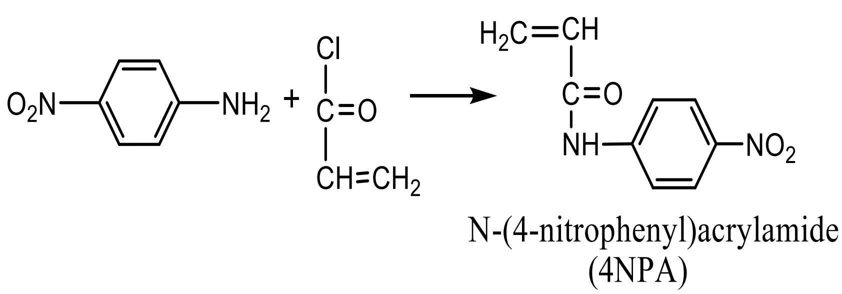

Figure 2: Synthesis of 4NPA monomer

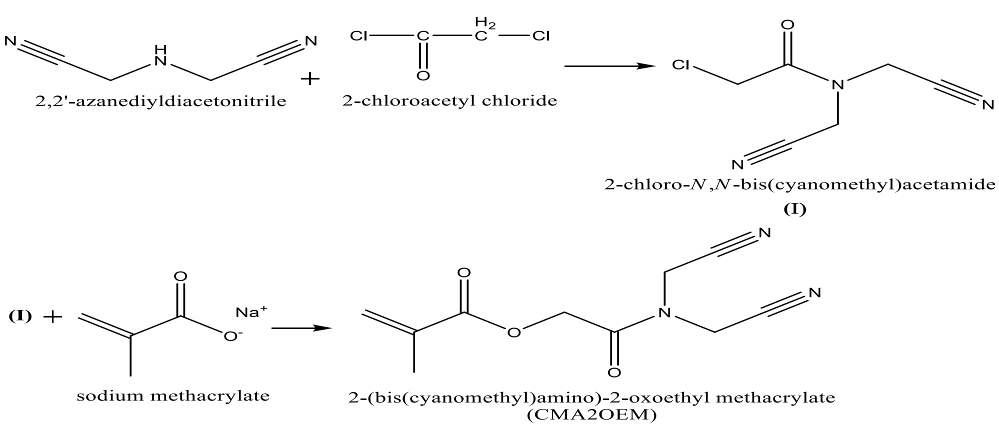

Figure 3: Synthesis of CMA2OEM monomer

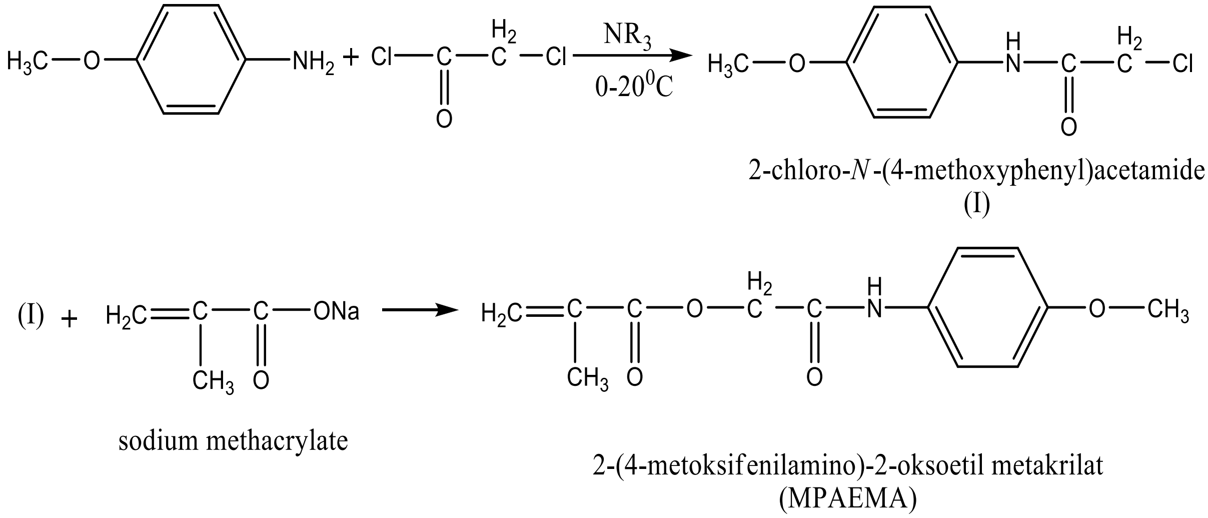

Figure 4:Synthesis of MPAEMA monomer

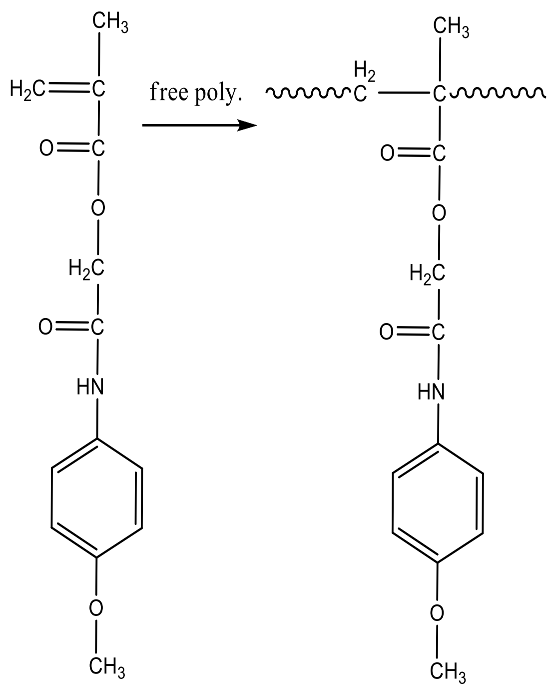

Figure 5: Synthesis of MPAEMA homopolymer

Chelating resin poly(2-(4-methoxyphenylamino)-2-oxoethyl methacrylate-co-divinylbenzene-co-2-acrylamido-2-methyl-1-propanesulfonic acid) (MPAEMA-co-DVB-co-AMPS) was prepared by the procedure described in the literature (Fig. 6) [14].

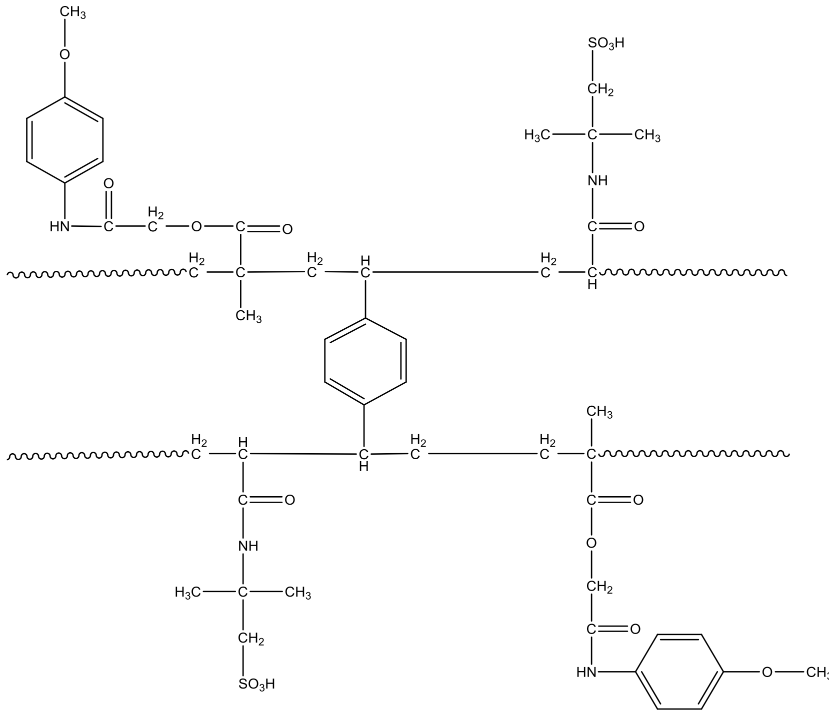

Figure 6: Synthesis of MPAEMA-co-DVB-co-AMPS resin

Microbial Strains, Culture Media and Antimicrobial Screening

Escherichia coli ATCC 66032, *Staphylococcus aureus* COWAN 1, *Bacillus megaterium* DSM 32, *Enterobacter aeregenes CCM 2531Candida tropicalis* ATCC 13803 used in the study were provided by the culture collection of the Microbiology Laboratory of University of Firat.Antimicrobial tests were carried out by disc diffusion method using 100 µL of suspension containing 10^6 cells / mL of bacteria, 10^4 cells / mL yeast as per McFarland standard, inoculated into Mueller Hinton Agar (Difco), Malt Extract Agar (Difco) and Sabouroud Dextrose Agar (Oxoid), respectively. The discs (6 mm diameter) were impregnated with 100 µg of the compound, placed on the inoculated Mueller Hinton Agar (Difco), Malt Extract Agar (Difco), respectively. Steril petri dishes (9cm diameter) were placed at 4 ºC for 2h. Then, the inoculated plates were incubated at 37±0.1ºC at 24 h for bacterial strains and also at 25±0.1ºC at 72 h for yeasts. Antimicrobial activity was evaluated by measuring the zone of inhibition against the test microorganism.Streptomycin sulfate (10 mg/disc) and Nystatin (30 mg/disc) were used as standard antibiotic[15].

Results and discussion

The resulting inhibition zones on the plates were measured (mm). The data reported in Table 1.
The results were standardized against Streptomysinsulfat and Nystatin under the same conditions. The compounds showed selective antimicrobial activities. The results show that most of the compounds did not inhibit the growth of the test microorganisms (except MPAEMA-co-DVB-co-AMPS). While MPAEMA mono and homopolymer showed no biological activity, MPAEMA-co-DVB-co-AMPS showed bio activity. This may be due to the many electronegative atoms present in AMPS. In the literature, it is seen that many polymers are synthesized by using AMPS monomer. Among these, it was observed that, when looking at the polymers with AMPS, they showed biological activity [1-4]. The results we found in this study are consistent with the literature.

Table 1:Antimicrobial effects of monomer, homopolymer, and copolymer (diameter zones of inhibition, mm)

Compound	*E.coli*	*S.aureus*	*B.megaterium*	*E. aeroginosa*	*C.tropicalis*
NCA monomer	-	8	-	-	-
NCMA monomer	-	7	-	-	-
4NPA monomer	-	-	-	-	-
CMA2OEM monomer	-	-	-	8	9
MPAEMA mono and homopolymer	-	-	-	-	-
MPAEMA-co-DVB-co-AMPS	10	12	8	12	8
Standard antibiotics	10**	9**	13**	15**	12*

Compound concentration = 0.1 mg/disk; (-) the compounds have any activity against the microorganism. **: Nystatin (Antifungal, 30 µg/disc), *: Streptomysinsulfat (antibacterial, 10 µg/disc).

Conclusion

In this study, N-cyclohexylacrylamide, N-cyclohexylmethacrylamide, N-(4-nitrophenyl)acrylamide, 2-(bis(cyanomethyl)amino)-2-oxoethyl methacrylate and 2-(4-methoxyphenylamino)-2-oxoethyl methacrylate (MPAEMA) monomer and its homopolymer, and the resin of MPAEMA with 2-acrylamido-2-methyl-1-propanesulfonic acid (AMPS) (MPAEMA-co-DVB-co-AMPS) were synthesized in our laboratory. This compounds were tested for its antimicrobial activity against microorganism. Some of the compounds prevented the development of microorganisms while others did not affect.We believe that this study will guide the biological properties of the substances to be synthesized in the future.

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