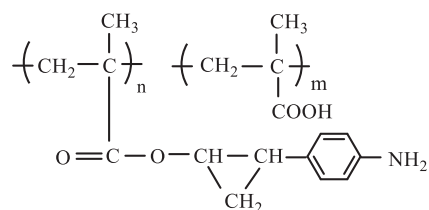


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**ANTIMICROBIAL PROPERTIES
OF P-AMINOPHENYLCYCLOPROPYL METHACRYLATE
COPOLYMER WITH METHACRYLIC ACID**

Our study focused on the radical copolymerization of para-aminophenylcyclopropylmethacrylate (p-APCM) with methacrylic acid in bulk and in benzene. The copolymer was obtained with high yield. It was determined that in all cases, the copolymer macromolecule is enriched with p-aminophenylcyclopropylmethacrylate units. The structural formula of the copolymer was determined using IR and NMR spectroscopy methods. IR and NMR spectroscopy data indicate that the functional groups in the polymer chain remain undamaged. The copolymerization was carried out at different mass ratios of the monomers. As a result of copolymerization, it was found that our synthesized monomer – para-aminophenylcyclopropylmethacrylate (r_1) – is more active than methacrylic acid (r_2), as evidenced by the calculated copolymerization constants: $r_1 > r_2$. Additionally, the polymer's activity (Q) and polarity (e) were calculated. Furthermore, the average block length of monomer units and the blockiness coefficient were calculated. The presence of methacrylic acid units makes the copolymer more water-soluble. According to spectroscopy data, the copolymerization of p-APCM with methacrylic acid occurs only due to the opening of double bonds of vinyl groups with the preservation of the remaining reactive functional fragments of both monomers. Thus, based on the analysis of the IR and PMR spectra of the copolymers, the following structure of the copolymer is assumed



It was found that antimicrobial activity depends on the composition of the copolymer: with an increase in the number of p-APCM links in the composition of the copolymer macrochain, the antimicrobial properties also increase. The antimicrobial activity of all copolymers with different concentrations of the initial monomers was assessed against gram-negative and gram-positive bacteria, which usually cause biofilm formation on materials [1]. Antibacterial activity against *E. coli* and *S. aureus* bacteria was tested by the disk diffusion method; the inhibition zone was measured against

both types of bacteria. Bacterial bonding of *E. coli* and *S. aureus* on the polymer surface does not significantly depend on the molecular weight of the polymers; with an increase in the aminophenylcyclopropyl units in the copolymer, the antibacterial properties improve. Copolymers of different compositions showed different inhibition zones with gram-positive and gram-negative bacteria. The copolymer showed the maximum biocidal activity with an inhibition zone of 19 and 20 mm against *E. coli* and *S. aureus*, respectively. Copolymers V and IV had a higher concentration; they showed greater antibacterial activity, since in comparison with I–III. Such high activity is explained by the presence of amine group and cyclopropane. Antimicrobial indices of methacrylic acid and the obtained copolymer containing methacrylic acid are presented comparatively in the table. It is seen from the table that in relation to gram-negative bacteria the inhibition zone was calculated as V-19mm, IV-17mm, III-14mm, II-12mm, I-10mm; the inhibition zone of the copolymer in relation to gram-positive bacteria is V-20mm, IV-18mm, III-16mm, II-15mm, I-12mm. (I, II, III, IV, V are copolymers taken in different compositions).

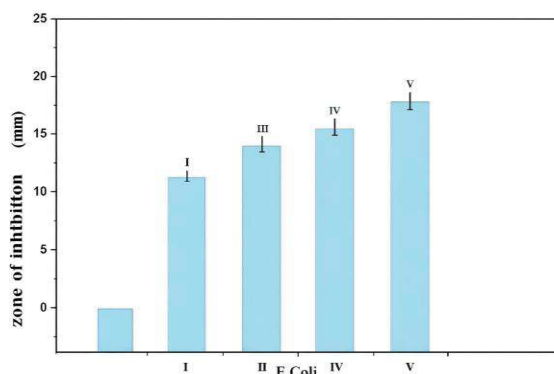


Figure 1 – Zone of inhibition (mm) against *E. coli* for copolymers I–V (disk diffusion method)

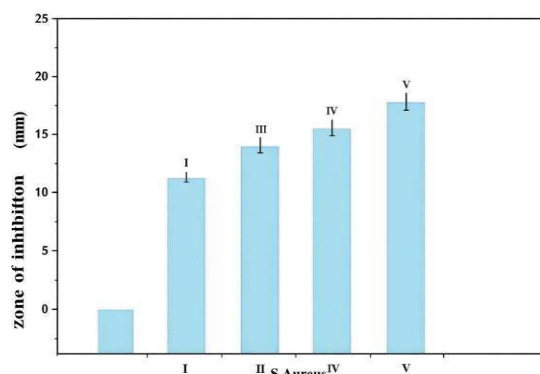


Figure 2 – Zone of inhibition (mm) against *S. aureus* for copolymers I–V (disk diffusion method)

The copolymerization of p-APCM with methacrylic acid produced functional, water-compatible copolymers that exhibit measurable antibacterial activity in the disk diffusion assay. The inhibition zones increased from copolymer I to V, reaching up to 19 mm against *E. coli* and 20 mm against *S. aureus*, which indicates that composition/sequence characteristics strongly influence bioactivity. These materials may be considered promising candidates for antimicrobial coatings and related biomedical applications.

LITERATURE

1. Kazim G. Guliyev, Vusala A. Vahabova, Aynura F. Mammadova Synthesis and polymerization of *Para*-aminophenyl cyclopropyl methacrylate, *PPOR*, Vol. 23, No. 4, 2022, pp. 638-643.