

This study encompasses the synthesis and evaluation of *N*-(Dimethyl phenyl)-2-{4-[(*E*)-3-phenyl-2-propenyl]-1-piperazinyl} acetamides for their potential Anti-proliferative properties and Hemolytic effects. Chemical compounds and solvents, sourced from reputable suppliers including Sigma Aldrich, Alfa Aesar, and Merck, were utilized in the experiments. Silica gel-coated plates facilitated Thin Layer Chromatography (TLC) analyses using ethyl acetate and *n*-hexane solvents. Results were visualized under UV light. Thermal characteristics were explored using the Gallon Kamp apparatus, determining the melting points of the compounds. The Bruker Advance III 600 As-cend spectrometer aided Nuclear Magnetic Resonance (NMR) investigations using DMSO-*d*₆ as the solvent. Descriptive values such as "ppm" and "Hz" were employed to interpret NMR spectra, elucidating chemical details. The synthesis of 2-bromo-*N*-(dimethyl phenyl)acetamides involved sequential reactions, monitored through TLC. The subsequent step synthesized *N*-(dimethyl phenyl)-2-{4-[(*E*)-3-phenyl-2-propenyl]-1-piperazinyl} acetamides, with LiH as a reagent. Characterization and purification steps ensured product integrity. The compounds' potential to inhibit HCT 116 human colon cancer cell growth was examined via the Sulforhodamine B (SRB) assay. Cells were exposed to varying concentrations of the compounds, and anti-proliferative activity was calculated. Hemolytic activity was assessed using bovine erythrocytes, quantified by comparing absorbance readings with controls. IN summary, this study presents a comprehensive exploration of the synthesis, characterization, anti-proliferative potential, and hemolytic activity of *N*-(dimethyl phenyl)-2-{4-[(*E*)-3-phenyl-2-propenyl]-1-piperazinyl} acetamides. The findings contribute to understanding these compounds' potential as anti-cancer agents and their impact on biological systems.