Analysis of the Antimicrobial Efficacy of the Lichen Extract Usnic Acid, Year Two

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As antibiotic resistance increases, new antibiotics will be needed to combat the older one that can no longer treat a human with a simple, yet resistant bacteria. This project continuation focused on lichen extract Usnic Acid's (UA) antimicrobial potential and mechanism(s) of action by performing minimum inhibitory concentration tests, disk diffusion tests, organismal toxicity tests (trialing eukaryotic toxicity), and molecular docking simulations, as well as GC/MS and electron microscopy. This testing showed statistically significant bacterial growth inhibition, with the UA showing heavy gram-positive bacteriostatic properties, as well as antimicrobial properties in gram-negative bacteria and Candida albicans. Transmission electron microscopy indicated decreased repair of ethanol-related membrane damage with UA exposure. Coupled with antibiotic synergism data showing a relative decrease in chloramphenicol effectiveness with added UA, protein synthesis inhibition was proposed. UA's interaction with a variety of proteins was then analyzed with Autodock Vina and iGEMDOCK in order to obtain details on possible proteins interactions and affinities. Similarity Ensemble Approach (SEA) and homology modeling were used to find PKC1 as another possible target. After RNA polymerase (4Q5S) showed the highest binding affinity of -13.7 kcal/mol, it was further tested against decoy ligands (DUD [directory of decoys]), further showing its significance (Z: -2.76). Visual inspection shows UA binding to 4Q5S on the sigma factor binding site, possibly inhibiting the transcription factor, indicating it as the most likely MOA. This information hopes to push UA further into the spotlight as a potential antimicrobial, although more research is needed.

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