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# Ancient Arabic Formulations as a Source of Antibiofilm Biomaterials: Synergistic Metal–Plant Combinations Against Multidrug-Resistant Bacteria

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## Résumé

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The rapid emergence of multidrug-resistant bacteria, particularly in the context of biofilm-associated infections, highlights the urgent need for alternative anti-infective strategies beyond conventional antibiotics. In this context, ancient pharmacopoeias represent a largely underexplored reservoir of therapeutic knowledge, built on centuries of empirical observations and combining plant, mineral, and animal-derived ingredients.

Unlike modern pharmacology, which often focuses on single active compounds, historical preparations frequently rely on complex combinations of ingredients, suggesting complementary or synergistic mechanisms of action. Among these, plant–metal associations appear recurrently in treatments for skin infections, a field in which topical applications allowed the use of otherwise toxic substances such as metals.

To rationally explore this chemical and biological diversity, we conducted an ethnopharmacological survey of Arabic medical manuscripts dating from the 9th to the 13th century. From more than 300 recorded formulations, 14 preparations targeting infection-related symptoms were identified, of which the majority included metallic components. A preparation described by Al-Kindī, combining copper with recurrent plant ingredients such as Aloe vera, myrrh and gum ammoniac, was selected based on the frequency and consistency of its components across sources. This selection provided a robust framework to investigate the biological relevance of ancient plant–metal combinations.

(1) Levey, M. (1966). The medical formulary or Aqrābādhīm of al-Kindī. Madison, WI: University of Wisconsin Press.

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