Introduction Antimicrobial resistance (AMR) is a serious global concern, as infectious diseases become harder to treat [1].The methods covered include disk diffusion assay, well diffusion, spot assay, cross-streaking method, poisoned food method, agar dilution, broth macrodilution and microdilution, resazurin assay, co-culture method, time-kill kinetics, flow cytometry, thin layer chromatography-bioautography (TLC bioautography), bioluminescence assay and impedance measurement.The agar diffusion assay serves as a valuable tool in antimicrobial research, providing qualitative data on the effectiveness of different substances against specific microorganisms.Types of antimicrobial nanoparticles include silver nanoparticles which disrupt bacterial cell membranes and damage intracellular structures [22], zinc oxide nanoparticles which produce reactive oxygen species (ROS) elevating membrane lipid peroxidation that causes membrane leakage of reducing sugars, DNA, proteins, and reduces cell viability [23]; copper nanoparticles generate ROS, disrupt microbial cell walls and membranes, and interact with proteins and DNA [24]; the calcium oxide nanoparticles produce free radicals that damage bacterial cell membrane and the arrangement of polyunsaturated phospholipids [25]; and titanium dioxide nanoparticles which possess photocatalytic properties generating antimicrobial reactive oxygen species [26].Other synthetic antimicrobial agents include daptomycin, a semisynthetic lipopeptide antibiotic that disrupts bacterial cell membranes and is used to treat skin and bloodstream infections caused by Gram-positive bacteria [21]; metronidazole, used to treat infections caused by anaerobic bacteria and parasites by disrupting their DNA synthesis; and others.Among the phytochemicals, polyphenolics such as flavonoids, tannins, quinones, coumarins, and others have shown significant antimicrobial properties by disrupting microbial cell membranes, inhibiting key enzymes, and interfering with key cellular processes [3].Additionally, the arsenal of microbial antimicrobial compounds includes other bioactive substances such as bacteriocin-like inhibitory substance (BLIS), cyclic lipopeptides, and lectins, all of which display potent activity against a wide range of microbial pathogens [14].Synthetic antimicrobials Synthetic antimicrobial compounds are chemically synthesized substances meticulously designed to possess potent antimicrobial properties, providing protection against the escalating challenge of bacterial resistance to conventional antibiotics.This comprehensive overview aims to aid researchers and practitioners in choosing appropriate screening techniques, allowing for the efficient identification of potential antimicrobial agents and contributing to the development of effective therapies against infectious diseases.Terpenoids represent another important group of plant-extract bioactives which exhibit potent antimicrobial activity by disrupting microbial membranes, inhibiting protein synthesis, or interfering with essential metabolic pathways [4].Moreover, alkaloids, another group of plant-derived bioactive compounds, also demonstrated remarkable antimicrobial properties with some alkaloid-based drugs such as quinine, berberine, among others historically utilized for treating infectious diseases [3].Like plants, various animal species including insects, amphibians, reptiles, birds, and mammals, also produce AMPs that can target and disrupt microorganisms' cell membranes, showing broad-spectrum activity against bacteria, fungi, and certain viruses [7].An iconic example is Penicillin, derived from the Penicillium fungus [11], which marked a groundbreaking advancement in modern medicine and paved the way for numerous crucial therapeutic agents to combat bacterial infections.By discussing gaps and limitations in current methodologies, the paper encourages researchers to explore approaches and technologies that enhance the accuracy, sensitivity, and efficiency of antimicrobial detection.Sources of antimicrobials The presence of antimicrobial activity has been documented in a diverse array of sources, encompassing natural origins derived from plants, animals, and microorganisms as well as synthetic compounds, nanoparticles, and so forth.Quinolones, a class of synthetic antimicrobial compounds such as ciprofloxacin and levofloxacin, impede bacterial DNA replication by inhibiting enzymes such as DNA gyrase and topoisomerase IV [19].Methods to evaluate antimicrobial activity The relentless quest for novel and highly effective antimicrobial compounds remains an ongoing pursuit driven by the pressing challenge of antimicrobial resistance, which diminishes the effectiveness of traditional antibiotics.On the other hand, newer methods like flow cytometry, bioluminescence, and impedance measurement offer higher sensitivity and throughput, but they may be costlier and less accessible in resource-limited regions.The phytochemicals employ various mechanisms to inhibit the growth and survival of microorganisms including bacteria, fungi, and viruses that make them promising candidates in developing antimicrobial agents.Microbial sources of antimicrobials Microbial products encompass a remarkable diversity of antimicrobial activity, as microorganisms themselves produce potent compounds to compete for resources and ensure survival in their environments.These small cationic peptides exhibit impressive effectiveness against closely related bacteria, contributing to food preservation by inhibiting spoilage and pathogenic bacteria in fermented foods [12, 13].These methods rely on the diffusion of antimicrobial agents from paper discs, wells, or plugs into the adjacent agar medium, inhibiting the growth of the test microorganism inoculated on the agar surface [27].Defensins penetrate microbial membranes, leading to cell death and preventing infections in various anatomical sites like the respiratory and gastrointestinal tracts [8].Linezolid, another synthetic antibiotic, inhibits protein synthesis in Gram-positive bacteria including Staphylococcus aureus and Streptococcus pneumoniae [18].For each assay, their respective advantages and limitations are presented, addressing issues of cost, accessibility, reproducibility, complexity of the tested samples, and other relevant factors.Nanoparticles exhibit potent antimicrobial activity against bacteria, fungi, and viruses.1.