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## **NANOPARTICLES FROM BIOWASTES AND MICROBES: FOCUS ON ROLE IN WATER PURIFICATION AND FOOD PRESERVATION**

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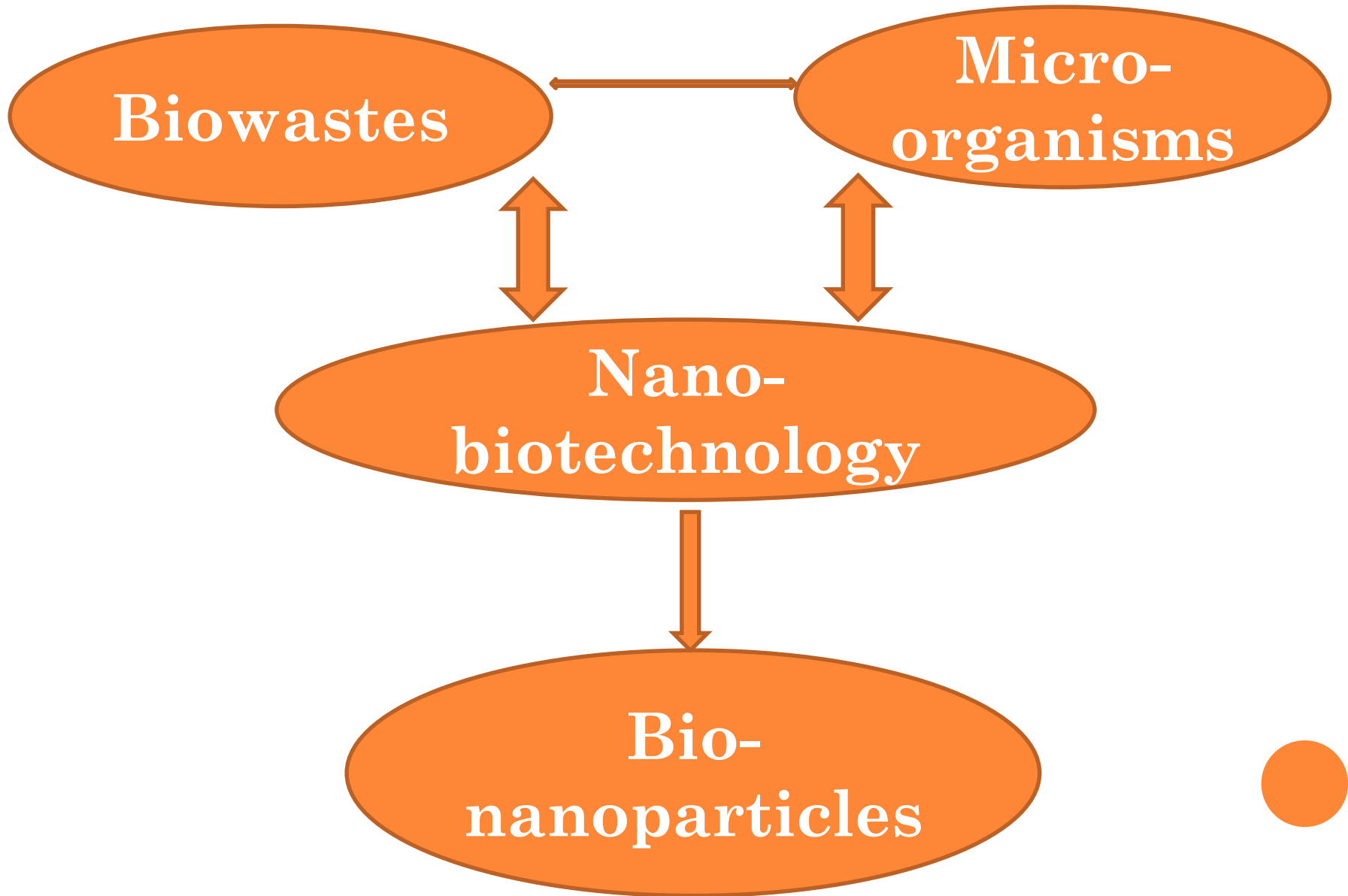
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# Contents

- 1- Introduction
- 2- Nanoparticles from biowastes
- 3- Nanoparticles from microorganisms
4. Application of nanoparticles in food systems as antimicrobial agents.
5. Application of nanoparticles in water systems.



# Introduction



## - Nanotechnology

- **An important area of research in nanotechnology deals with synthesis of nanoparticles of different chemical composition and size.**
- Nanobiotechnology is the branch of biotechnology which deals with synthesis and fabrication of nanoparticles by biological systems and their applications especially in biological systems

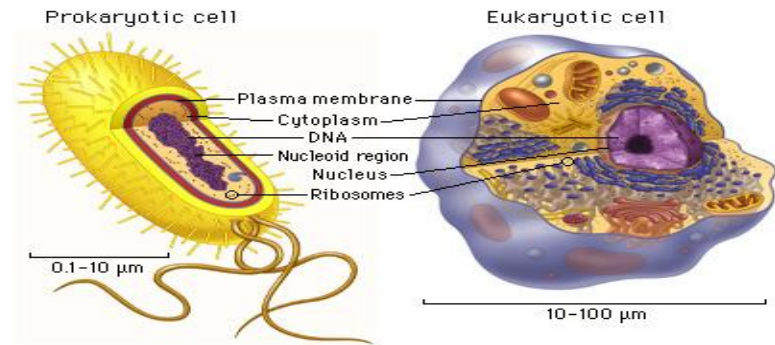


# Synthesis of nanoparticles by biological systems

1- use of microorganisms

2- use of extracts plants or enzymes

3- use of biowastes



# Synthesis of nanoparticles by Biowastes

- Biowaste refers to any organic waste such as cow dung ash, corn cob ash, mango stone ash, lemon peel, pomegranates peel, orange peel, eggs and shrimp peel as well as the organic fraction of municipal solid wastes and animal manure.
- Food waste is a growing problem in many parts of the world, but discarded fruit peel, in the case of pomegranates, lemon could be put to good use in the burgeoning field of nanotechnology for producing nanoparticles.



# Synthesis of bionanoparticles using microorganisms

Microorganism are the organisms which are detectable under microscope such as Bacteria, yeasts, fungi, algae etc.

Some microbes are quite useful and are used in processing of cheese, bread, alcohol, vaccine

Some are harmful and are responsible for spoiling food and causing diseases


Some microorganisms are capable of interacting with metal coming in contact with them through their cell and form nanoparticles



# Disadvantage of chemical synthesis

- chemical methods are too harsh and non-ecofriendly
- nano metals have limited shelf life
- the chemicals used are quite often toxic and flammable

# Advantage of biological synthesis

- tightly controlled, highly reproducible synthesis
  - biocompatible particles
  - the avoidance of toxic surfactants or organic solvents
- 



# Nanoparticles

- Nanoparticles possess at least one dimension in the size range of 1 to 100 nm and the width of three or four atoms.
- The principal properties of nanoparticles include size, shape and sub-surface of the substance
- Nanoparticles can be classified as organic (for e.g. carbon nanoparticles) or inorganic (for e.g. magnetic and noble metal nanoparticles).
- Gold, silver, gold-silver alloy, selenium, tellurium, platinum, silica etc.

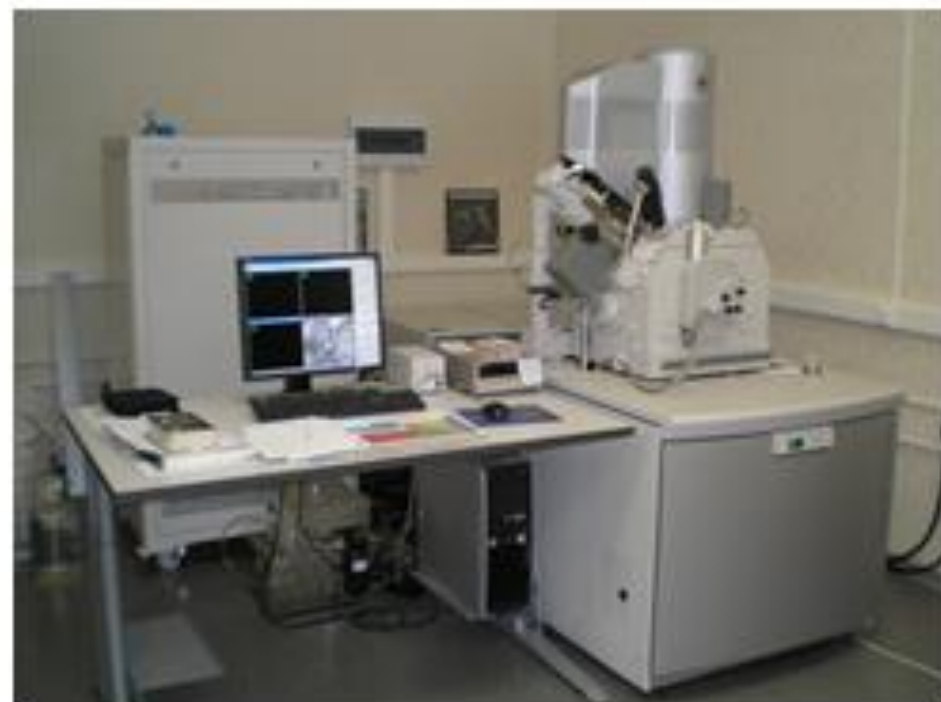


# Characterization of nanoparticles

- SEM and EDAX were used to characterize the silver and gold nanoparticles.
- SEM showed formation of nanoparticles in the range of 4- 200 nm



## Scanning electron microscope



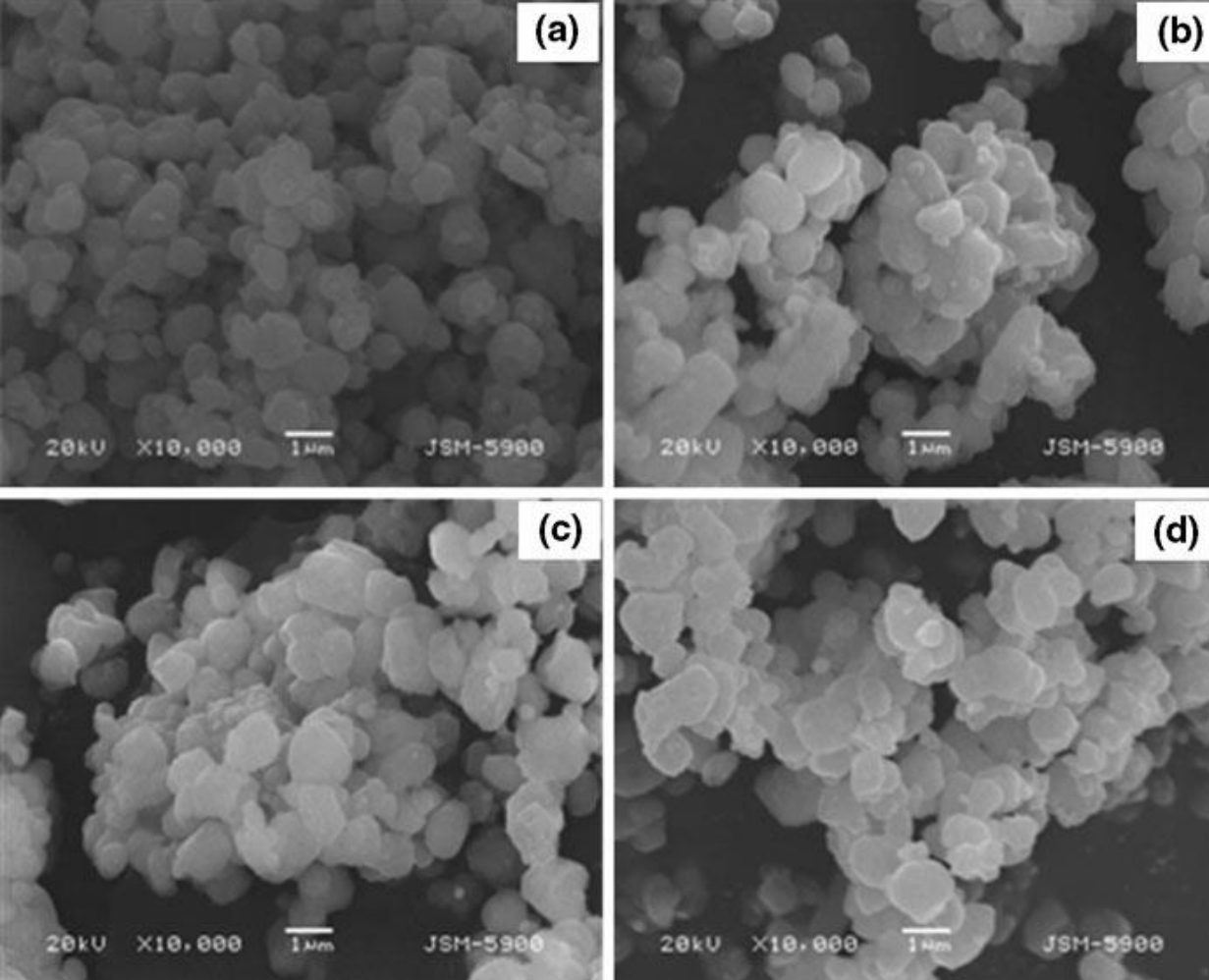
Resolution 1.2 nm

Magnification 5000–150000x

Voltage 1–30 kV

### **Quanta 3D FEG**

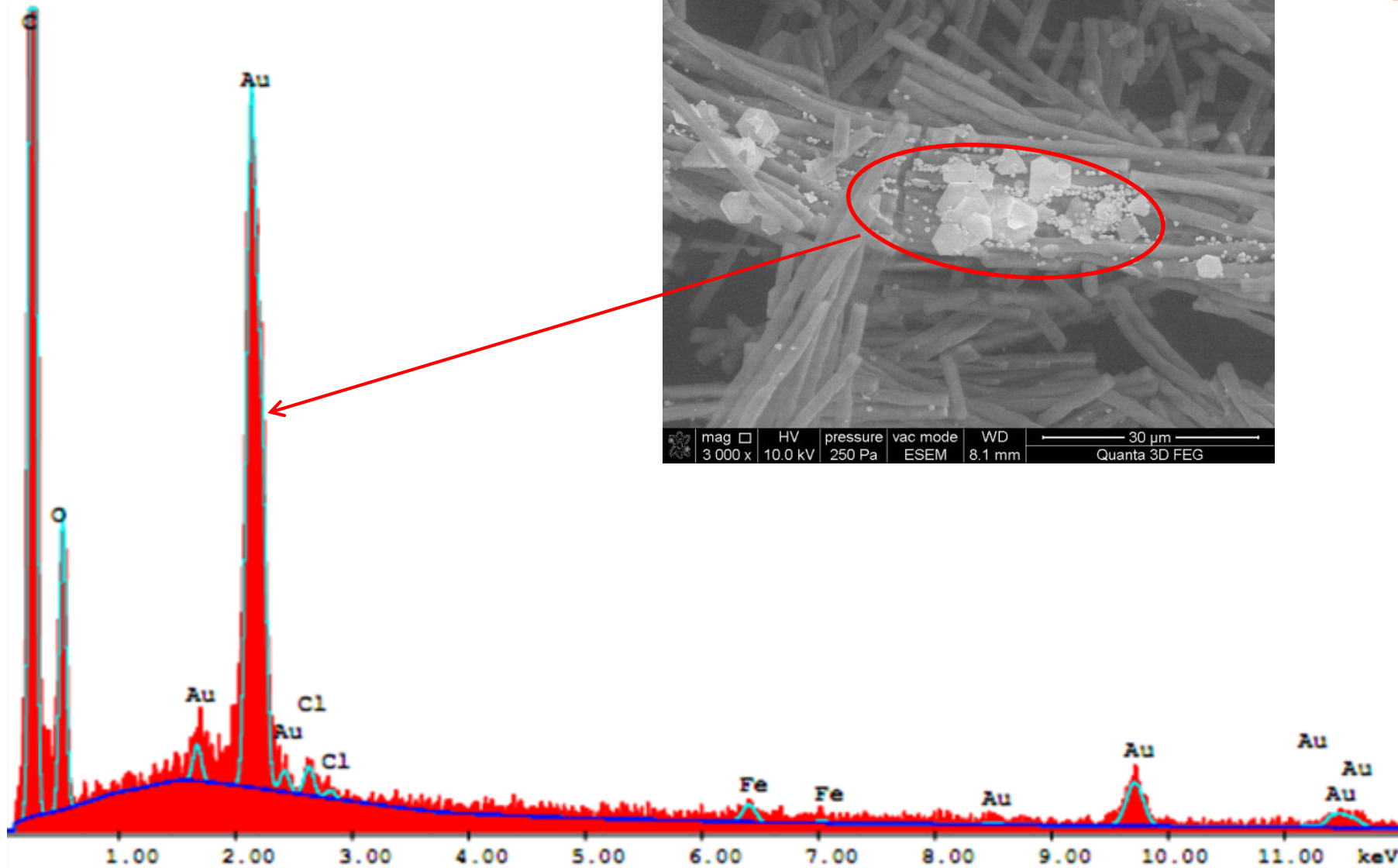
The Netherlands' Firm "Systems for Microscopy and Analysis" (Moscow, Russia)



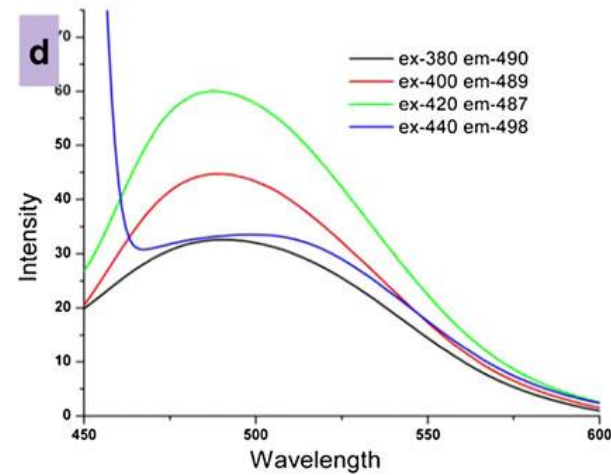
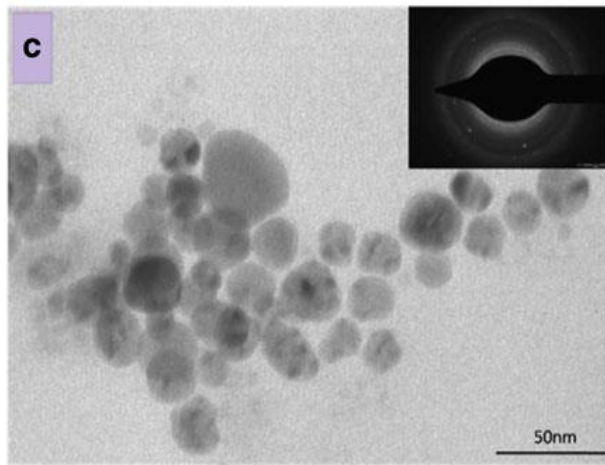
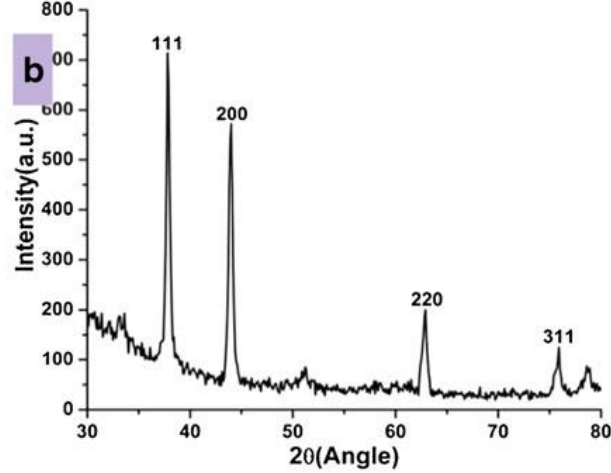
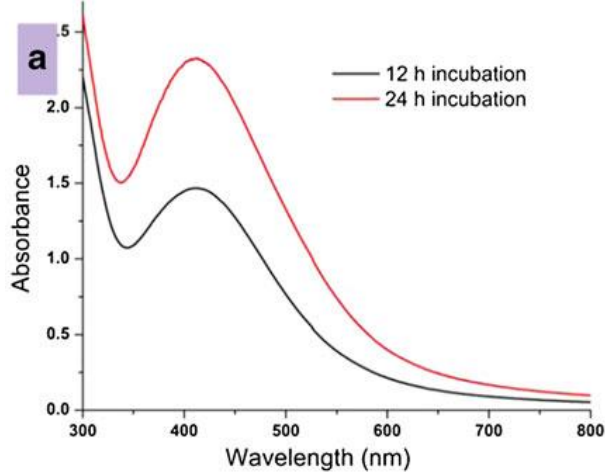
**SEM images showed that the Ag nanoparticles with size ranging from 8 to 20 nm**

SEM images of HA-Ag nanoparticles from bovine bone with various Ag concentrations of a 0%, b 1%, c 3%, and d 5% (cited from Nirmala, et al., 2011).





**EDAX**



UV-Vis spectroscopy of AgNPs, b XRD of AgNPs, c TEM image of AgNPs (inset, SAED pattern), d fluorescence spectroscopy of AgNPs from phenol degrading *Rhodococcus* sp. (cited from Otari, et al., 2014).



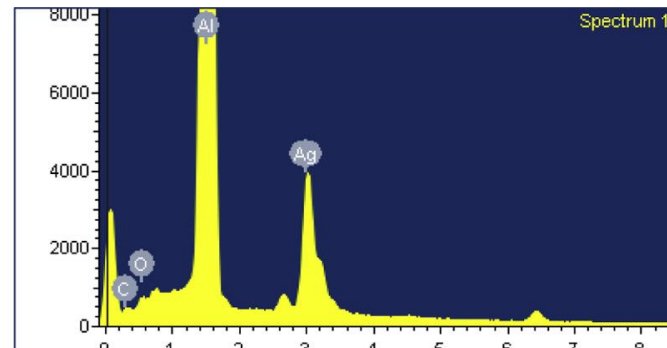
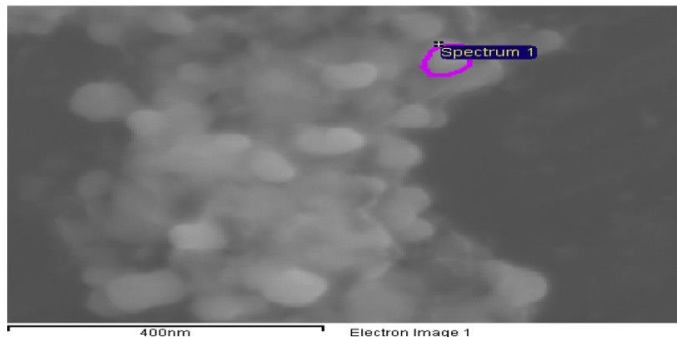


# Silver nanoparticles from biowastes

The extract of lemon peel was prepared and mixed with 1mM  $\text{AgNO}_3$  solution



The bioreduction of  $\text{Ag}^+$  ion in solution was monitored using UV-visible spectrometer, Fourier-Transform IR spectroscopy (FTIRS) and X-ray diffraction (EDAX) analysis.



# Preparation of nanoparticles from microbes

Culture medium was prepared



Sterilized and inoculated with fresh microorganisms



Incubated the culture at the suitable temperature degree



After the incubation time the culture were centrifuged and their supernatant were used for synthesis of nanoparticles





Silver nitrate at concentrations (1-3 M) separately add to  
to the supernatant



The reactions between supernatant and Ag<sup>+</sup> ion were  
carried out in the dark or in the bright conditions



Aliquots of reaction was removed and the absorption was  
measured using UV-Vis-spectrophotometer



The silver or gold nanoparteicls were characterized by  
Scanning electron microscope



# Application of nanoparticles in food

## Antimicrobial agents

## Application in water

, nanomembrane and nanopowder used for detection and removal of chemical and biological substances include metals (e.g. cadmium, copper, lead, mercury, nickel, and zinc), nutrients (e.g. phosphate, ammonia, nitrate and nitrite), cyanide, organics, algae (e.g. cyanobacterial toxins), viruses, bacteria, parasites and antibiotics.



**Thank you for your  
attention!**

