Specifications of the infrared dryer prototype

Heat source	:	Electrical
Rating of infrared lamp	:	150 W
No. of lamps	:	6
Dimensions (l x b x h)	:	1.219 x 914 x 0.381m
Tray dimension (l x b)	:	0.9 x 0.60 m
Tray material	:	Stainless steel
Total drying time	:	4-5 h
Loading capacity	:	5 kg
Suitable items for drying	:	Fish and fish products, spices, vegetables, fruits and agro-products

was recorded as 2.5-2.8 m/s and 55-60%, respectively. Performance evaluation of the dryer was conducted using different fish species like, threadfin bream, sardine, shrimps etc. Moisture content of shrimp was reduced from 77 (% wb) to 10 - 12 (% wb) in 5 h of drying at drying temperature of 60 °C, air velocity of 1.5 ms^{-1} and relative humidity of 60%.

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Green synthesis of gold nanoparticles using different reducing agents of aquatic origin

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Nanotechnology exists among the most fastest growing branches in science and engineering because of the unique physical and chemical properties of nano materials, such as novel electronic, optical and magnetic properties, catalytic activity etc. These properties gave applications for nanoscale metals in biotechnology, material science and chemistry. Gold nanoparticles were already used for medical and staining purpose since 16th century Santhoshkumar *et al.*, 2017). The Foods and Drugs Association approved the nano therapeutic approach with nanoparticle-based anticancer drugs (Tiwari *et al.*, 2011). Development of biosensors and biolabels using metal nanoparticles has recently gained extensive importance. Green synthesis of nanoparticles has several advantages over conventional methods involving chemical

agents associated with environmental toxicity. These include polysaccharide, mixed-valence polyoxo metallates, irradiation, Tollens (Ahmed *et al.*, 2016) and biomolecules. Many of these molecules act as stabilizing agents, sometimes as both reducing agent and stabiliser. Several studies have been done on the development of metal nanoparticles using plant extracts (leaves and flowers) as they are rich in phyto-chemicals with aromatic hydroxyl, carboxylic and aldehyde functional groups. Chitosan, a biodegradable and bio-compatible molecule have been widely used as both protective and reducing agent. This study aims to develop gold nanoparticles using different sources or reducing agents.

The AuNPs were synthesised using 1Mm auric chloride at a temperature of 90 °C for 30 minutes. Chitosan, squid skin protein hydrolysate, carrageenan and shuck water from black clam were used for reducing gold chloride. The chitosan, squid skin protein hydrolysate and carrageenan were used at a concentration of 1% (w/v) and shuck water was used at 10% concentration (v/v). The collective oscillations of the electron cloud at the surface of AuNPs results in surface plasmon resonance (SPR) which is responsible for the colour exhibited by the solution (Regiel-Futyra *et al.*, 2015). The surface plasmon bands (SPBs) for gold nanoparticle give characteristic UV absorption bands around the 500-550nm (Tiwari *et al.*, 2011). The spectral bandwidth, peak position and intensity of the SPBs are attributed to

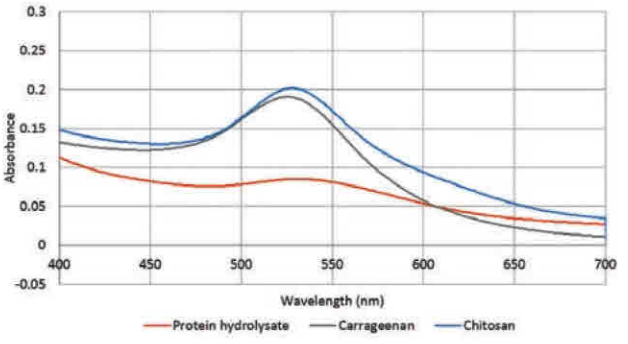

Fig. 1. UV visible absorbance spectra of AuNPs with squid skin protein hydrolysate, chitosan and carrageenan

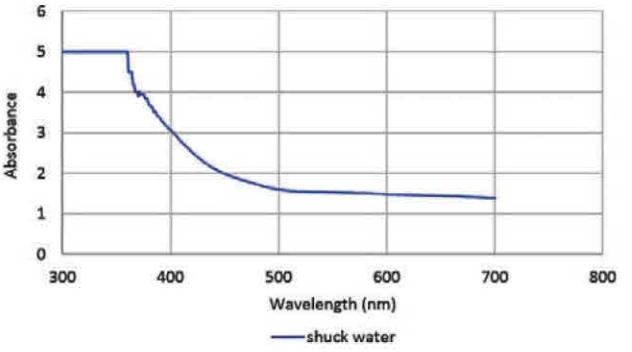

Fig. 2. UV visible absorbance spectra of gold chloride in shuckwater

AuNPs shape, size and productivity. The AuNPs synthesised with chitosan, squid skin protein hydrolysate and carrageenan gave typical band with peak at 520-550 nm (Fig. 1) and this proves the efficiency of these biomolecules to reduce gold ions to nanoparticles. The shuck water was not able to reduce the gold chloride hence there was no colour change of the solution and the characteristic band (Fig. 2) of AuNPs was absent.

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