extract levels in the films. Yellowness of the film increased significantly to 39.23 for 2% rosemary essential oil compared to 1.99 for control chitosan sample. Both DPPH activity and total phenolic contents increased with the increase in rosemary extracts level in the films (Fig. 2). Total phenolic contents of the film varied between 0.1 to 11.28 mg gallic acid per g film. DPPH content of control sample was 1.3%, whereas it varied between 12.42 to 22.51% in chitosan film with rosemary extract. The results demonstrate that rosemary incorporated chitosan films can be used for packing food products including fishes to enhance the oxidation stability.

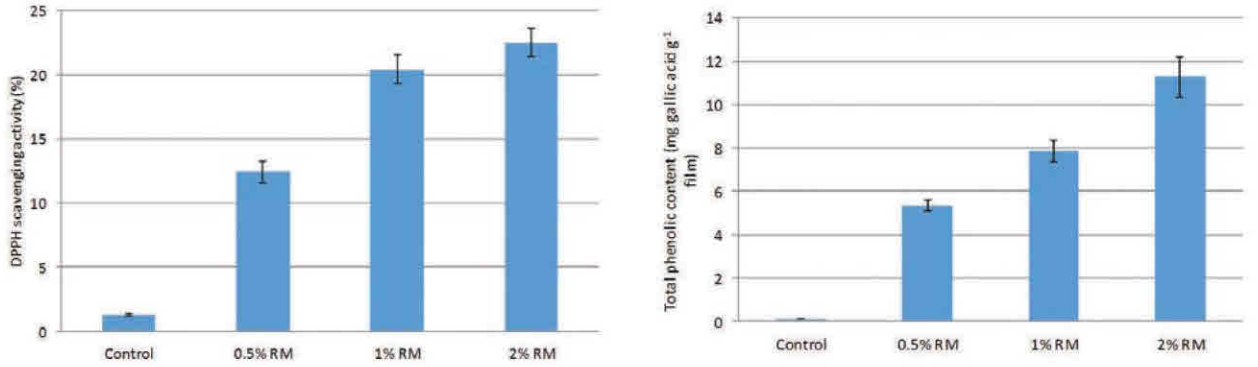

Fig 2. DPPH scavenging activity and total phenolic content of chitosan film incorporated with different levels of REO

Astaxanthin: A promisive antioxidant and UV protective agent

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Astaxanthin (3,30-dihydroxy-b,b-carotene-4,40-dione) is a naturally occurring carotenoid pigment belonging to class of phytochemicals, and is found in certain animals and plants. It is a powerful free radical scavenger and thereby naturally reduces the level of free radicals in the body. This uniqueness of astaxanthin may be effectively explored for its use as antioxidant and UV protective agent, where free radicals are primarily responsible for the deteriorative changes. This activity is mainly due to its unique molecular structure; polar ionic rings and non-polar conjugated carbon-carbon bonds. The main sources of astaxanthin are krill, algae, red trout, shrimp, crab and lobster. The intense colour of these species is on account of their richness in this red pigment.

Astaxanthin was extracted from shrimp head waste and characterized for antioxidant and UV protective properties. The highest yield was obtained with hexane 48.93 µg/g wet shell extract, followed by acetone, methanol, ethanol and chloroform. The extracted astaxanthin was further dispersed in virgin coconut oil (Fig. 1). The stereo-microscopic image of the extracted astaxanthin indicated spherical granular geometry (Fig. 2). The antioxidant activity assays indicated high DPPH free radical scavenging activity of 0.4 µg IC_{50}, Fe reducing activity (1.25 : A700/mg) and metal chelating activity of 34% at 70 µg/ ml.

Fig. 1. Astaxanthin in virgin coconut oil

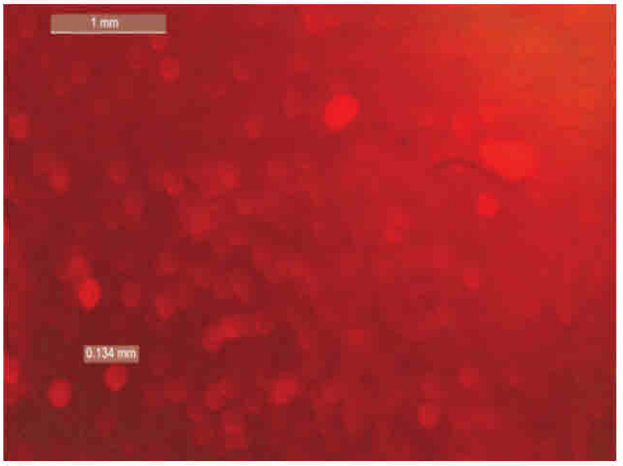

Fig. 2. Stereo-microscopic image of astaxanthin extracted from shrimp head waste

Thermal denaturation profile indicated a rapid rate of denaturation above 60 °C.

UV Spectra of astaxanthin indicated high absorption at UV range of 200-400 mm which suggests its potential to be used in as cosmetic formulations as UV protective agent. The UV protective effect of astaxanthin was evaluated on *Staphylococcus aureus* ATCC 25923. Results indicated good UV protective effect for the extracted astaxanthin in terms of cell viability. Bacteria grown in astaxanthin-incorporated culture media gave protection to the colonies even after exposure to UV radiation for 48 hours (Fig. 3). Further studies also indicated that the UV protective effect of astaxanthin was not altered during accelerated storage conditions.

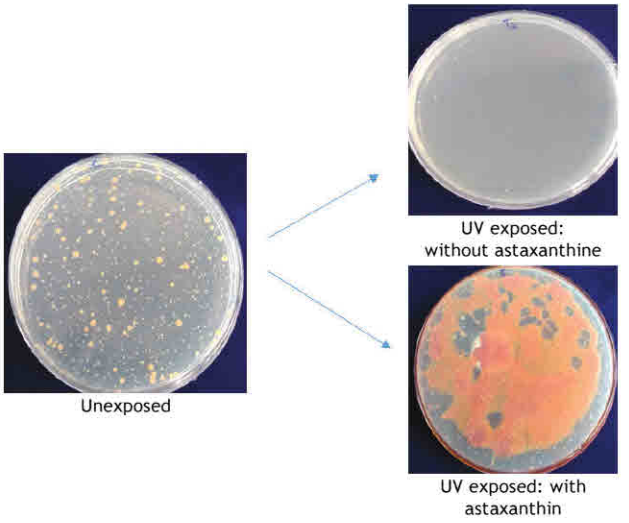

Fig. 3. UV protective activity of extracted astaxanthin on Staphylococcus aureus

Optimization of prawn pulp-incorporated fish sausage using mixture response surface methodology

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A study was undertaken to optimize the combinations of surimi and prawn pulp for the development of prawn pulp-incorporated fish sausage in order to enhance the utilization of small varieties of shrimps. Fish mince was taken from Thread fin bream and prawn pulp was taken from *Metapenous dobsoni* (Thelly chemmeen) for the development of combination sausage. A D-optimal mixture design for 10 different combinations of surimi and prawn pulp was