mesh nets at codends shall be operated by any mechanized fishing vessel.The government of Maharashtra has decided to supply square mesh codends on a buy-back scheme to all the 5613 trawlers operating along Maharashtra coast.

The stipulated mesh size for the codend is 40 mm, which, when used during the shrimp season may lead to escapement of small quantities of shrimp. So optimization studies would be required to finalize the legal mesh size of codends for use during shrimp season.

This approach, for implementation of gear-based technical measure, was very successful, since it actively involved the Department of Fisheries, Department of Forests and support of the Fishermen Societies and can be taken as a model for implementation of Bycatch Reduction Devices elsewhere.

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Development of antioxidant packaging film using Rosemary Essentail Oil (REO) and chitosan

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Active packaging is a type of packaging which changes the condition of the packed food to extend shelf-life or to improve safety or sensory properties, while maintaining the quality of packaged food. Typically, this refers to the incorporation of certain additives into the packaging systems with the aim of maintaining or extending product quality and shelf-life. Packaging can be termed active when it performs some desired role in food preservation other than providing an inert barrier to external conditions. Most important active packaging concepts include O_2 and ethylene scavenging, CO_2-scavengers and -emitters, moisture regulators, antimicrobial packaging concepts, antioxidant release, release or absorption of flavours and odours etc. Recently, with increasing health concerns of consumers, current packaging research is mainly focusing on the use of natural compounds such as chitosan, essential oil etc. either as edible coating or active agents in packaging material to preserve and prolong the shelf life of food. Among the essential oils, rosemary oil has proven antioxidant as well as antimicrobial properties

against spoilage and pathogenic microorganisms. In fishery products oxidation is the major quality problem affecting its quality and shelf life due to high amount of poly-unsaturated fatty acid (PUFA). Though synthetic antioxidants are being used to prolong the shelf life of food products, it may lead to shorter life span to consumers due to their ill effects on health. This resulted in demand for natural antioxidants either to use directly or as packaging film. A study was undertaken to develop an antioxidant film incorporating rosemary essential oil in chitosan and its characteristics were evaluated. Chitosan with degree of deacetylation of 90.28% and viscosity of 246 cP was used to develop an antioxidant film incorporating 0, 0.5, 1 and 2% rosemary essential oil. Thickness of the film ranged between 24 - 27 µm. The surface morphology of the film studied using SEM revealed non-porous film with plain texture with even surface for chitosan film without rosemary essential oil (Fig. 1). Addition of rosemary essential oil resulted in uneven flaky surface which increased with increasing level of essential oil. Oxygen transmission rate, tensile strength and elongation at break decreased with increasing level of rosemary essential oil whereas solubility increased with increased essential oil level. The solubility of control chitosan film was 11.7% compared to 16.7 to 18.6% for rosemary extract added chitosan films. Addition of rosemary extract affected the colour values of the films. The lightness showed a decreasing trend with the increase in rosemary extract level in the films. The whiteness index showed a decreasing trend whereas yellowness index showed an increasing trend with the increase in rosemary

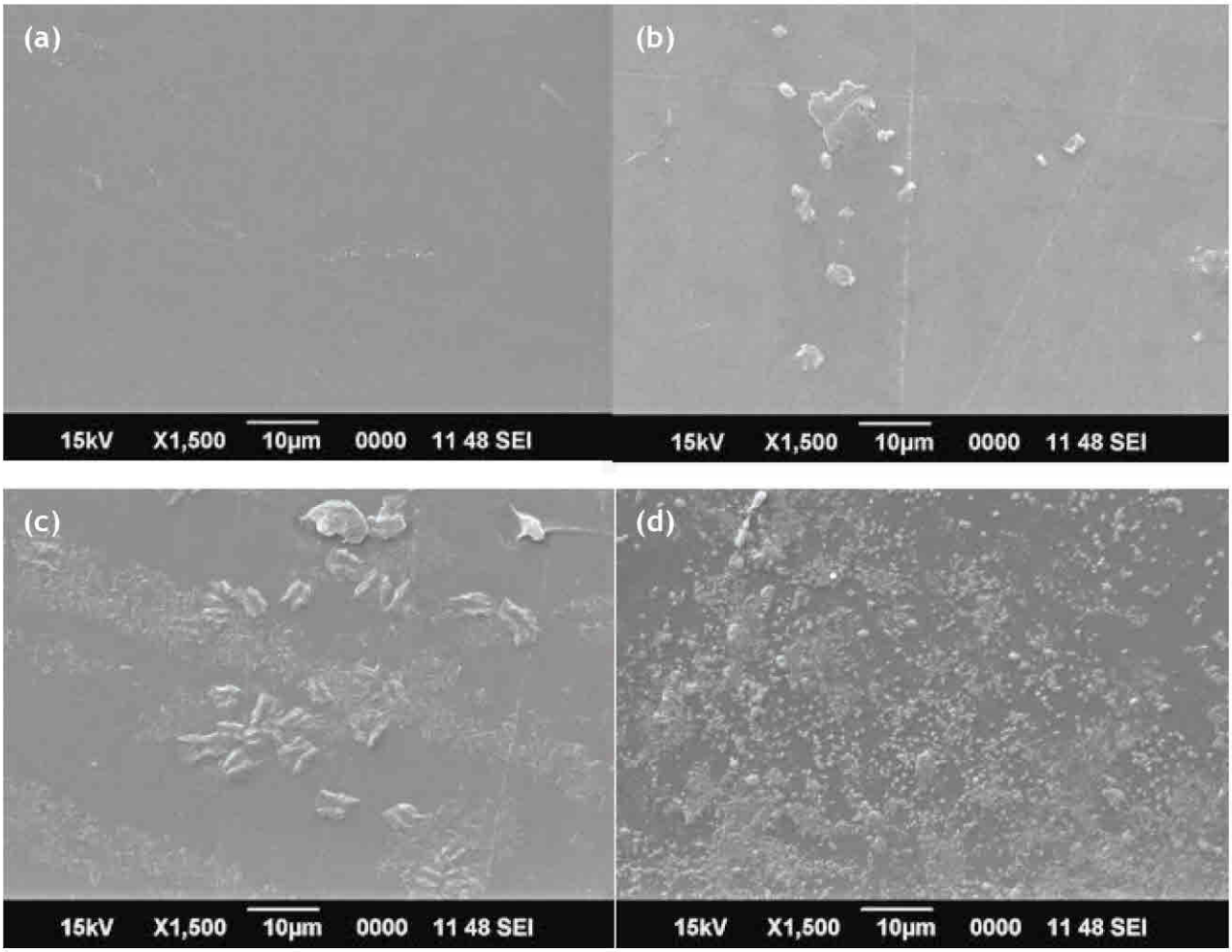

Fig 1. SEM images of surface morphology of chitosan films (a) chitosan film with 0.5% REO (b) 1% REO (c) and 2% REO (d)

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.

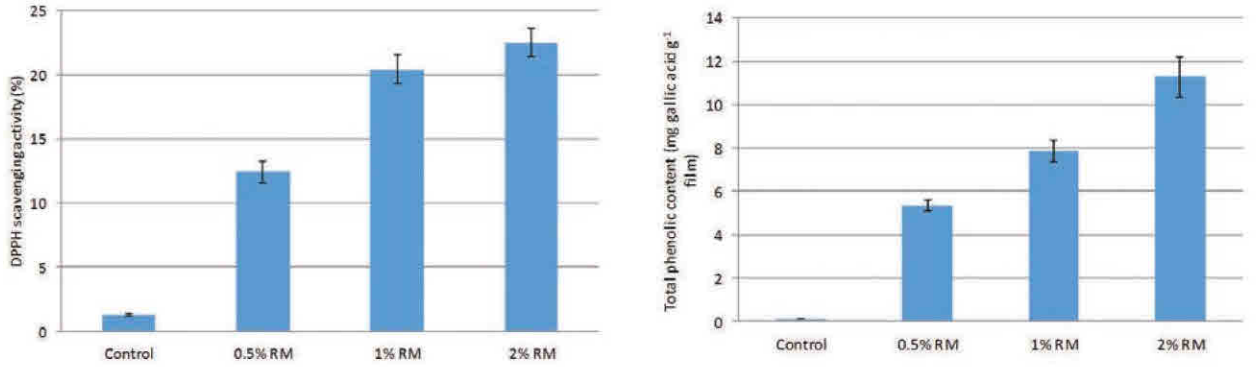

Fig 2. DPPH scavenging activity and total phenolic content of chitosan film incorporated with different levels of REO

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.