SF OR 09

Development of fish freshness indicator with red cabbage and turmeric extracts

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Fish freshness indicators were developed using pH sensing red cabbage and turmeric extracts. Chitosan films entrapped with the natural extracts were evaluated for their efficiency in detecting fish freshness during storage. The films act as visual colorimetric sensors inside fish package, changing colour with the rate of spoilage. The colour change indicates the degree of fish freshness. The pH chart developed in pH buffer gradient solutions with the extracts were correlated with the headspace pH. Biochemical (TMA, TVBN), microbial (TPC) and sensory quality of the fish were estimated during storage. The colour change of the film was measured using colorimeter. The red cabbage film turned from purple to green and the turmeric film turned from yellow to orange. The study reveals that the smart films can be effectively used as visual fish freshness detectors.

SF OR 10

Development of freshness indicator for packed fish and shell-fishes

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The intelligent packaging systems with emphasis on monitoring real-time freshness of food are gaining increased importance. Keeping this in view, the present study was undertaken to develop a freshness indicator for packed fish and shellfishes in refrigerated storage condition (2-3^{o}C). Indian mackerel (*Rastrelliger kanagurta*), Indian white shrimp (*Fenneropeneaus indicus*) and squid (*Loligo duaceuli*) was used in the study. Ten different pH-sensitive dyes, with chemical modification were impregnated on to the sterile filter paper and allowed to dry. Cleaned fish and shellfishes were packed in HDPE trays and filter paper impregnated with pH-sensitive dyes was attached separately to the inner-side of the tray top sealing packaging material. The trays were placed in refrigerator and samples were drawn at regular intervals to monitor the visible colour change, CO_2 level in headspace, pH, total volatile base nitrogen, microbial and sensory quality. A progressive increase in the CO_2 level was observed in all the packs. TVB-N values, total aerobic plate counts, total psychrotrophic counts and *Pseudomonas* counts increased with the storage period. Among the 10 different dyes, bromocresol purple correlated well with the biochemical and microbial changes, thus indicating its application as real-time monitoring of freshness for packed fish and shellfishes.

SF OR 11

Comparative *in- vitro* studies on antimicrobial activity of bulk and nano-zinc oxide incorporated chitosan

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ZnO-Nano particle (ZnO-NP) is known for its antimicrobial property but as it is not food grade, it has limitations in seafood application. However, ZnO-Bulk particle (ZnO-BP) is a GRAS (Generally Recognized As Safe) listed substance and hence can be added in the food as a supplement (CFR-No.182.8991). However, no previous literature is available on the antimicrobial property exhibited by ZnO-BP. Hence, the present study was carried out to exploit the antimicrobial activity of ZnO-BP incorporated chitosan and its comparison with ZnO-NP incorporated chitosan. ZnO-NP was prepared by Solgel method and the size was confirmed by the UV-Visible spectrometer (Blue shift from the 385 nm to 370 nm) and scanning electron microscope (flake size with the length of 70 – 90 nm). The activity of the BP and NP was assessed by minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC). Similarly, the activity of the ZnO-NP incorporated chitosan (ZnO-NP-CH) and ZnO-BP incorporated chitosan (ZnO-BP-CH) was assessed by antibiogram with various food borne pathogenic and specific spoilage organisms (SSO) in fish. The results indicated that ZnO-BP-CH was equally effective to ZnO-NP-CH against most of the bacteria. Both ZnO-BP-CH and ZnO-NP-CH exhibited higher inhibition zone i.e., 10 - 15 mm than chitosan alone. Among the SSOs, *Pseudomonas* was found highly susceptible. The order of susceptibility of the SSOS against ZnO-BP-CH and ZnO-NP-CH were as follows: *Pseudomonas*>H_2S formers > Mould>*B. thermosphacta*>Lactobacillus > Yeast. Hence, the present study concluded that ZnO-BP-CH can be used as a suitable antimicrobial agent in seafoods for their shelf stability.

SF OR 12

Incidence of *Aspergillus* fungal species in cured fish of Gujarat based on internal transcribed spacer regions 1 and 4

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Fungal infestations cause quality losses and often pose serious health hazards to the consumers. The sun dried fish samples (n = 36) such as ribbon fish, bombay duck, catfish, horse mackerel, dhoma, leather jacket, prawn and acetes were collected from the dried fish processing facilities and commercial markets from Veraval and Nawabhandar in Gujarat. Ten gram of the fish samples were homogenised in sterile normal saline and serial dilution was made from 10^{-1} to 10^{-6} and spread onto a duplicate plate of Rose Bengal Chloramphenicol Agar and incubated at 25 to 30^{o}C for 5 days. The total fungal counts ranged from 2.0 x 10^1 to 5.0x 10^2cfu.g^{-1} and the higher counts were frequently seen in the ribbon fish sample. The morphologically distinct colony was streaked on to Sabouraud Dextrose Agar (SDA) for DNA isolation. The fungal DNA was isolated and purified as per the manufacturer's guidelines (Invitrogen, US) and PCR was carried out with the universal primers for the 18S gene with the ITS1 and ITS4 regions of 670bp. The DNA sequences were submitted to the European Nucletide Archives (Accession Number: LT 745387- LT 745395) and found that *Aspergillus nidulans, Aspergillus oryzae, Aspergillus flavus, Aspergillus sydowii, A. foetidus* and