Microwave vacuum drying: An innovative technology for rapid drying of fish

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Drying is an age old and least expensive method for preserving the quality of fish for a long period. Dried fish represent the cheapest source of concentrated protein to people in remote places, hilly areas and in locality where no water bodies are present. In India, 15-20% of the total fish catch is preserved by drying. Salt dried fish is highly demanded by the fish lovers because of its unique taste and has good demand in domestic and international markets. Traditionally, fish is dried openly under sun, which results in an unhygienic and low quality product. Over the years, several mechanical drying methods including hot air oven drying, combination of solar energy and mechanical drying, smoke drying, freeze drying, vacuum drying etc. have been developed. However, the fishermen still follow the unscientific practice of fish drying and the production of hygienic and export quality dried fish is being achieved only to a limited extend.

Microwave processing has been extensively used in the food industry for heating, cooking, pasteurization, sterilization and drying. Micro waves are electromagnetic waves of frequencies varying from 300 MHz to 300 GHz; smaller frequency waves having high penetration power. Microwave drying is a recent technique adopted for drying vegetables and fruits. In order to improve the drying rate and to enhance the quality of final products, other traditional methods are used in combination with microwave. Microwave vacuum drying has been used initially for drying vegetables like banana, carrot and potato slices. Through microwave vacuum drying, high product quality can be achieved by the low temperature and the rapid energy transfer of microwave heating. The combination of vacuum and microwave has the potential to reduce drying time, improve product quality and decrease energy consumption. However, the use of microwave-vacuum combination has not been much exploited for fishery products.

Visakhapatnam Research Centre of ICAR-CIFT has made an attempt to dry Indian mackerel using microwave vacuum drier. Indian mackerel was dressed in butterfly style and brined in common salt (4:1, fish to salt) overnight. Salted fishes were dried by microwave vacuum drying (MVD) and hot air drying (HAD). The moisture content of Indian mackerel was found to be reduced from an initial value of 76% to 32% by drying in a lab scale microwave vacuum dryer (600 W and 650 Hg mm) within 1.2 h whereas in hot air dryer (temp. 50-55 °C), fishes were dried for 12 h to reduce the moisture content to 32%. It is important to note that 10-fold reduction in drying time was achieved by employing microwave vacuum drying technique. Moreover, there was a marked difference between the colour and appearance of the fishes dried under both the methods where the MVD fishes scored higher than HAD fishes (Fig. 1). HAD fishes had salt particles condensed over the surface where as it was absent in MVD fishes. No significant difference was observed between the proximate composition of fishes dried by hot air and microwave vacuum drying. However, salt content in the muscle of MVD samples were higher than that of HAD samples.

Fig.1. MVD and HAD fishes

Rehydration ability and water absorption index of MVD samples were slightly higher to that of HAD samples. HAD sample had more salt-soluble and water soluble protein nitrogen fraction than MVD samples. Higher instrumental hardness values were observed for HAD samples. The study revealed that through microwave vacuum drying, drying time can be reduced to a greater extent compared to hot air drying. It was also realized that microwave vacuum drying can retain the original colour, improve the sensory attributes while maintaining the enhanced physico-chemical qualities. Microwave vacuum drying technique can be adopted by small scale and large scale entrepreneurs to market high quality dried fish products.

Molecular phylogenetic study of *femA* gene sequences of Methicillin Resistant *Staphylococcus aureus* in seafood

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Staphylococcus aureus is a common inhabitant of human skin surfaces and anterior nostrils of the healthy people and animals. But it's a well-known opportunistic pathogen that can cause a broad range of infections including mild skin infections, invasive diseases, and toxin-mediated diseases (Kroneberg *et al*., 2011). It is an ubiquitous gram-positive, catalase positive Cocci and facultative anaerobic bacteria and most frequently occurring food-borne pathogen world-wide by the presence of heat stable preformed Staphylococcal enterotoxins (FDA, 2012). Methicillin was introduced as a new β-lactam antibiotic in 1950 to overcome the penicillin resistant *S. aureus*. A decade later in 1961, Methicillin Resistant *Staphylococcus aureus* (MRSA) was reported in United Kingdom (Jevons, 1961) which is resistant to most recent β-lactam antibiotics (Katayama *et al*., 2000). In India, the significance of MRSA had been recognized relatively late and it emerged as a major health problem in the 1980s and 1990s (Mantri Rupali *et al*., 2014). MRSA is a major nosocomial pathogen causing significant morbidity and mortality (Sachdev *et al*., 2003).

Seafood contamination with antibiotic resistant MRSA could be a major threat to public health, as this resistance can be transferred to humans (Diana Gutiérrez *et al*., 2012). No strict guidelines are being practised in India regarding the use of antimicrobials in animal feeds as growth promoters that are used in human medicine (Patrick Butaye *et al*., 2003). The present study was undertaken to know the *femA* (factor essential for methicillin resistance) gene sequence differences in the identified MRSA isolates and its phylogeny in seafood (Sivaraman *et al*., 2017). The fish and fishery products (n= >400) were collected from the retail fish markets and fish processing establishments in Gujarat State, India and 19 number of isolates confirmed as *femA* positive.

A multiplex PCR was carried out with *mec*A gene (293 bp) and Staphylococcus genus specific (597 bp) for the confirmation of MRSA and found that 3.84% of the samples were positive for MRSA. These results made quite interesting to study the gene sequence of the factor essential for methicillin resistant gene A (*femA*) and was amplified by PCR (450 bp) as shown in Figure 1 and the DNA sequencing were out-sourced. 50 µl PCR reaction contains 200 µM dNTPs, 2.5 mM $MgCl_2$,