

highest overall acceptability score (OAS - 7.94) compared to other time-temperature combinations of air-frying method. This was not significantly different from the OAS (8.01) of control sample. The textural and colour parameters at 180 °C and 10 minutes time were equally comparable with deep fried cutlet samples. Priya *et al.* (2017) reported that air fried fish fingers were having good acceptability and economic viability compared to deep fried fish fingers. Mohan *et al.* (2017) also reported that air fried tilapia steaks found to have better fatty acid profile compared to deep oil fried tilapia steaks. To conclude, the combination at 180 °C and 10 minutes time was found to be best combination for the development of healthy fish cutlet using air-frying technique.

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Study of e-commerce fish marketplace in Kerala

Sajeev M.V.*, Suresh A., Sajesh V.K. and Rejula K.

ICAR- Central Institute of Fisheries Technology, Matsyapuri-P.O., Kochi-29

*Corresponding author : sajeev.mv@icar.gov.in

Seafood is considered as an important part of a healthy and balanced diet by most consumers. It's been estimated that around 60 per cent of the Indian population consumes fish and the consumption pattern varies widely and across the different social fabric (Shyam, et al. 2013). The annual per capita consumption of fish for the entire Indian population is estimated at 5-6 kg whereas for the fish eating population it is found to be 8-9 kg. Average annual per capita fish consumption is highest in Kerala state at 30 kg which is very high compared to that of other states of India (Shyam, et al. 2015).

Consumers in Kerala and elsewhere are forced to buy fish from unhygienic markets and vendors. In general, parties in the fish supply chain don't necessarily conform to scientific food safe-

ty norms. Without a proper cold chain, bacterial contamination typically starts within 30 minutes. Poor quality ice and preservatives like sodium benzoate and formalin are reportedly used to keep the fish from deteriorating, which are potentially harmful and carcinogenic for humans. In recent times, the wide scale media highlight on fish adulteration has created an increased health concern and consciousness about safety and quality standards among consumers (Sajeev, 2018a).

In this context, online fish marketing has emerged in a big way and is assumed to disrupt traditional fish vending business (Sajeev, et al. 2018b). Online fish marketing claims to provide fresh and chemical/pesticide free fishes, which gives them an edge over other fish retail sources. There is a

steady rise of e-commerce fish marketplace that has gained momentum with the rise of e-grocery and advent of new cost-effective freezing technology (Vishal, 2015). Online sale of fish sounds crazy in India where vendors have a virtual monopoly over door sales of both marine and inland fish. Moreover, fish being a highly perishable product, the idea was found too difficult to implement unlike other consumables where online marketing rules the roost. However, things changed drastically over the last couple of years particularly in urban areas.

With an increased knowledge, attitude and better perception about health, quality and safety issues related to fish consumption, customers are fast switching to online fish markets. Orders are just a touch away on android mobile apps, websites, Facebook page, Whatsapp message, an SMS or a call. More than a dozen e-commerce sites are into business and are expanding their market base day by day (Cynthia, 2016). These fish E-commerce sites offer a rich array, mostly the variety available at local coast. Pre-ordered fresh fish reaches consumers' doorstep in curry cut, steak, fully cleaned or even as whole fish at prices affordable to the discerning homemaker. More than price, the focus in e-marketing of fish is on quality and safety (Sajeev, 2018b). Some online sites levy delivery charges while others do it for free.

Fish being a highly perishable commodity, adhering to quality standards makes its sales, marketing and promotion a risky affair. Sustenance of online fish marketing depends on providing fresh and affordable fish to the consumers on time. This distinguishing factor makes online fish marketing an interesting topic of study. Fifteen online fish vendors operating in Kerala were studied with respect to their products menu, price range, quality and safety guarantees, delivery systems and consumer accessibility over online, mobile and social media platforms. The portals studied were: www.freshtohome.com, www.dailyfish.in,

www.mathafreshfish.com, www.healthyfishonline.com, www.suvichar.in, www.onedaycart.com, www.freshandhealthy.in, www.wildfish.in, www.biggro.com, www.cheenavala.com, www.onlinekochi.com, www.nallameen.com, www.bigbasket.com, www.matsya.in and www.pooi.in

Products menu/options:

The analysis revealed that wide range of options provided by online portals was the major attraction for consumers with 3 to 40 fish varieties made available on online platform. The choice included marine, fresh water and farmed fish and other products like shrimps, squids, crabs and mussels. The portals focused on convenience and easy availability of variety of products/dressing options (2-8) like whole, whole cleaned, steaks, curry cut, fillets, skinless cubes, marinated, tail-on, peeled, peeled deveined and peeled undeveined which was hardly possible in case of traditional fish vendors and markets.

Price of fish:

It was found that fish prices ranged from Rs 49 to 1000/kg on dressed fish and on all the online portals the prices were always higher than local vendors. On an average it was 20-25% higher than that of local vendors. It can be understood that online fish marketing focuses on quality and convenience rather than price advantage (Sajeev, 2018b).

Quality and safety:

Quality and safety guarantees were given by 100% of online vendors studied. 'Fresh Not Frozen', 'As good as live', 'Always the catch of the day' were some of the tag lines used. While consumers perceive better safety and quality for fish with online sellers, the claims are yet to be ascertained through lab tests.

Delivery systems:

Unlike traditional vending, online vendors have 2-3 time slots for delivery in a day thus providing

great convenience to consumers. Besides, portals charged an additional amount between Rs. 29-50 for delivery depending on size of the order. Home delivery and 'Cash on Delivery' / Card payment / Net banking facilities were provided by all vendors. They covered almost all the pin codes in the cities and 2-3 time slots for delivery covering early morning to evening hours. Advance booking facility was available in nearly 70 per cent of the portals studied with some portals providing bookings up to 4 days in advance.

Consumer accessibility over online, mobile and social media platforms

Study on consumer accessibility over online, mobile and social media platforms revealed unique facts about online fish marketing. All 15 vendors had option of taking orders through phone call and messages. The study indicated that nearly half (7 out of 15) of the online vendors developed their own mobile apps which instantly notifies about stock and offers thus providing maximum consumer reach. All 15 vendors had their own websites that provided complete information on a day's stock and products available. With regard to hybrid media marketing done by all the online vendors, it was observed that 'e-mail+website' was the most popular mode adopted closely followed by 'Facebook+Mobile' mode. Nearly half of the vendors (7 out of 15) made 24x7 consumer engagements through dedicated Facebook pages providing latest update about stock position and immediate responses to consumers. Online marketing through Twitter, Instagram and YouTube was found to be in infancy stage with only one, three and two portals utilizing the above mentioned media, respectively.

Online marketing is a dynamic kind of marketing that is at a nascent stage in India and is constantly evolving and changing. It is gaining momentum with focus on quality and convenience rather than price advantage (Sajeev, 2018b). With unmatched consumer accessibility through

web, mobile and social media platforms and options for wide range of products and quick home delivery systems, online fish vending portals have potential to disrupt traditional fish vending in urban Kerala. Online fish marketing is in a nascent stage in Kerala and conclusive studies need to be taken up to prove their sustainability in the long run.

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Exopolysaccharide producing bacteria associated with brown seaweed- *Sargassum wightii*

Minimol V.A.*, Pankaj Kishore, Ranjit K. Nadella and Sreelakshmi K.R.

ICAR- Central Institute of Fisheries Technology, Matsyapuri-P.O., Kochi-29

*Corresponding author : minimattath@gmail.com

Biopolymers are the polymers obtained from various biological organisms containing covalently bonded monomers and are classified into polysaccharides, polypeptides and polynucleotides. The main source of biopolymers from marine environment includes macro algae, micro algae, bacteria, and fungi. Among the microorganisms, bacteria are widely accepted as the source of exopolysaccharide with different functional properties and can be exploited for novel industrial and biotechnological applications. Exopolysaccharides (EPS) are high molecular weight polymers secreted by bacteria, consisting of different functional groups such as acetyl, succinyl or pyruvyl, sulfate etc. Biodegradation ability of EPS from bacterial origin can replace the traditional polysaccharide sources from various fields such as biomedical, food and textile industries in larger extent. However, the high cost of production and low yield from bacterial sources may limit the use in industry scale.

In the present study, an attempt was made to screen brown seaweeds viz, *Sargassum wightii*, *Padina gymnocephalus*, and *Turbinaria connoides* for EPS producing bacteria. Bacterial isolation was carried out by homogenizing the dried seaweed samples (25 g) in 225 ml 1X phosphate buffer saline and plated on trypticase soya agar (TSA) with 2% NaCl. A total of five distinct morphological isolates were selected based on their slimy mucoid appearance on the TSA plate. EPS

was extracted according to the method by Berkekaa and Ezzeldin (2018). Initial screening for EPS production by the bacterial isolates was carried out on the basis of EPS yield after 10 days of incubation in a shaker incubator with 180 rpm at 37 °C in trypticase soya broth (TSB). The EPS production in these isolates varied from nil to 0.62 mg ml⁻¹. Out of five isolates, one isolate from *Sargassum wightii* showed maximum production and was further inoculated into Luria bertani (LB), and Brain Heart Infusion (BHI) broth and the dry weight was measured. The dry weight of EPS was recorded maximum in BHI (1.27 mg ml⁻¹) followed by LB broth (1.12 mg ml⁻¹). The EPS production is often accompanied with the aging of the culture and exhaustion of available nutrients in the media. During chemical analysis, it was found that EPS from BHI broth contained 59.9% carbohydrate, 8.1% protein, 3.2% total uronic content and 1.5% sulphate content. The isolate was identified as *Bacillus cereus* by 16S rRNA sequencing.

Structural analysis of EPS by FT-IR analysis (Fig. 2) which showed a characteristic N-H and OH stretch at around 3292.93 cm⁻¹ and a C-H stretching vibration at around 2925 cm⁻¹ (Deepika et al., 2016). The absorption peaks within 1650-1540 cm⁻¹ attributed to vibrations of a C O, NH and CN bending of protein and peptides. The absorption peaks within 1200-1000 cm⁻¹ attributed to vibrations of a broad stretch of C O and C O C