Air frying – An Alternative method to develop healthy fried food product

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Frying is a popular food processing method in which a series of phenomena such as heat and moisture transfer takes place between the food products and heating medium simultaneously. Deep fat frying is a conventional frying method where food items are fried by immersing in hot oil at high temperature ranging between 120-180 ^{0}C *(*Mellema*, 2003)*. In deep fat frying, heat transfers from oil to food surface through convection and into the core of the product by conduction. Mass transfer phenomena in frying involve the outflow of moisture and intrusion of fat caused by transfer of heat energy to the product. Thus, the fat content of deep fried product will be increased and makes one of the draw back to accept the deep fried product. Other drawbacks of deep frying are repeated use of oil or frying medium, difficulty in cleaning utensils and unwanted smells in the frying environment. The reactions in deep-fat frying also depend on factors such as frying temperature, quality of frying oil and food materials etc.

As an alternative healthier approach to fry food products could be Air-frying technique, where no oil or fat used to fry the product. In air frying, the cooking of the food item happens through the circulation of heated air by rapid air technology. Hot gas is circulated by the blower motor assembly into the air fryer cavity where the hot air is directed in a manner wherein a conflicting, colliding turbulent gas flow is directed at a food product kept for the accelerated cooking. The food item placed inside the chamber is cooked effectively by the heat radiated from the heating element with lesser energy. The air fryer is designed to circulate extremely hot air at high speed in a fashion that mimics the movement and flow of heat currents in a pot of boiling oil, to crisp up the outside of food while cooking it inside (Anonymous, 2016). In hot air frying, the flow of air inside the frying equipment is different from hot air drying or convective drying. The air fried food product will be healthier than any other fried food product as it would be having less fat content, no repeated use of oil as medium, easy to clean the utensils and no unwanted smell in the frying environment.

As a case study, fish cutlet - a popular fish snack was developed using air-frying technique. Fish cutlet samples were prepared using Pink Perch *(Nemipterus japonicas)* mince and other standard ingredients. The prepared cutlets samples were dipped in batter mix and then coated with bread crumbs. The cutlet samples were fried using air and deep frying methods for comparative evaluation. Different levels of temperature varying from 160 to 180 ^{0}C and time varying from 5 to 15 minutes were tried for air-frying method along with deep fried sample as a control. The proximate, sensory, texture and colour analysis of air and deep fried cutlet samples were carried out.

It was observed from the analysis that air fried cutlets were having less fat content (almost 50 % less) compared to deep fried samples. The protein content of air fried samples was higher than deep fried samples. The mineral and moisture contents were in the same range for both air and deep fried samples. Based on the sensory evaluation on a 9 point hedonic scale, it was found that cutlets fried at 180 ^{0}C and 10 minutes time got

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 ^{0}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 ^{0}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

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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 safety 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