ATMOSPHERIC PLASMA TECHNOLOGY: APPLICATIONS IN SEAFOOD SECTOR

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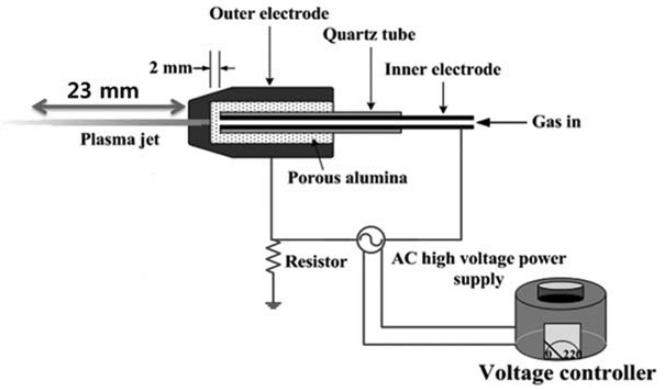
The excellence of seafoods with respect to its nutritional profile is well comprehended but simultaneously this advantage attracts stability issues. Hence effective approaches by adoption of viable processing and preservation techniques are mandatory to maintain its inherent quality characteristics and for enhanced stability. Better approaches in this regard simultaneously with demand driven product diversification can account for high price realization for the products as well as increased foreign exchange. Simultaneously, post-harvest losses can be managed to a greater extent. This has occasioned towards arising attention for innovative technologies in seafood industry that can enhance the microbial food safety and quality without compromising its nutritional, functional and sensory attributes. Further the growing population calls for innovative approaches for food processing and preservation to meet the global nutritional demand. Of the different processing and preservation techniques, high end technologies like high pressure processing are well-known but expensive and hence not viable on a commercial mode, hindering its adoption rate. Similarly use of other preservation modes like employing artificial preservatives are of great concerns with respect to handling and safety aspects. In this regard, effective approaches for seafood preservation is need of the hour, especially in a country like India where majority of the population depends on fish from a producer as well as consumer point of view.

Plasma, referred as the fourth state of matter comprises of positive and negative ions, electrons, excited and neutral atoms, free radicals, molecules in the ground and excited states and the UV photons (Fridman 2008). It is categorized into thermal (hot) plasma and non-thermal (cold) plasma based on the operational temperature. Plasma sources are widely used for food applications which include dielectric barrier discharges (DBD), corona discharges, gliding arc plasma generators and microwave induced plasma. Non-thermal plasma technology also referred to as cold plasma is one of the most promising and advanced minimal processing methods with the feasibility of being energy efficient, involves short processing duration and effective at reasonable temperature conditions. In the recent past, plasma technology has emerged as a potential preservation technique in agriculture in being a modern eco-agricultural high-tech that could increase crop yields as well as food industry for preservation and shelf-life extension applications (Thirumdas et al. 2018). The recent developments in this technology has confirmed strong antimicrobial potential and high-quality retention for plasma treated products leading to the advent of a new area within food science.

Plasma Generator

Source: *https://vinit.com.vn/en/cold-plasma-project-for-preserving-agricultural-food-products/*



The application of plasma technology in seafood sector includes direct application in fresh and dried products as well as indirect application of plasma activated water and seafood industry wastewater purification. However, this technology is globally less explored in the seafood sector and till now, no studies have been reported on the seafood application of plasma in India. In India, major domestic market of fish relies on fresh fish trade while frozen and dried forms of fish conquer a major share in export market. Though there is a huge potential for seafood value addition, it is mostly explored very little to a level of 23% and not beyond the level of dressed fish and a few coated products. Application of plasma technology can resolve this issue to a greater extent by enhancing the product diversification in the internal as well as export market. The atmospheric cold plasma has been demonstrated to be effective in reducing microbial and enzymatic actions in various vegetables, beverages and meat products. Various reactive species produced in the cold plasma such as free radicals, negative and positive ions and ultra-violet are thought to be responsible for microbial inactivation. But the application for control of pathogenic and spoilage bacteria in fish products has got meager attention, especially the studies reported in value added fishery products are very rare. Studies by Chiper et al. (2011) in salmon on plasma application for *Photobacterium phosphoreum* reduction; Chen et al. (2019) on chub mackeral fillets for shelf life extension etc. were a few reported. Corona discharge plasma jet was used for surface decontamination of dried laver without significant changes on colour, sensory and functional characteristics (Kim et al. 2015). Similarly plasma application studies were made in dried shreds of Alaska Pollack (Choi et al. 2016) and squid (Choi et al. 2017) without significantly affecting its sensory characteristics. Cold plasma treatment on semi dried pacific saury (Puligundla 2018), mackerel (Albertos et al. 2017) and herring fillets (Albertos et al. 2019) were also reported. Microbial inactivation studies were done by on Zhang et al. (2019) in fish balls and reported plasma to be a potential preservation method. Similarly, Kulawik et al. (2018) reported an insignificant reduction of aerobic bacterial count in CP treatment in sushi products. Effect of plasma-activated water (PAW) ice was studied for the preservation of fresh shrimps (Liao et al. 2018). These reported studies widen the application potential of plasma technology in seafood sector. However, a few aspects reported in these investigations viz., effect of plasma in oxidizing the treated products requires effective addressal. Further there exist extrinsic as well as intrinsic factors that influence the composition as well as other quality aspects of fish and for this reason the effect of plasma treatment varies with the commodity.

Hence comprehensive studies on the effect of plasma on major components of fish meat that affects the nutritional and functional properties are required to suggest plasma as the excellent candidate for fish processing and preservation.

This includes standardization of process and protocols including appropriate packaging techniques for plasma-based seafoods and storage stability studies with special emphasis to their antimicrobial inactivation mechanism.

The positive outcomes emerged out of this beneficial technology can ensure delivery of safe and stable seafood in the supply chain in a cost effective manner as well as augment seafood product diversification thereby meeting of the demands of the domestic consumers as well as improve the GDP by boosting the seafood export market.