

# Isolation and incorporation of Nitrogenous compounds from Yellow Fin Tuna (*Thunnus albacares*) to produce a fish flavored vegetable burger

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## Introduction

Fish processing industry is increasing continuously in the world *Thunnus albacares* is a one of the major fish used by many processing companies. Value added products are produced using tuna which include tuna steaks, tuna loin, tuna fillets, tuna blocks and canned tuna. At processing, trimmings are resulted as waste and discharged without any utilization. Hence, maximum utilization of fish waste is important. There are many nitrogenous compounds present in fish flesh. Nitrogenous compounds play an important role in flavor and taste of fish. Fish flavor components are non-protein-nitrogen compounds such as ammonia, monomethylamines, dimethylamines, trimethylamines, trimethylammonia bases (trimethylamine oxide and betaines), and guanidine derivatives such as creatine and arginine (Teerasuntonwat and Raksakulthai, 1995). Soya bean and chick pea can be used to produce vegetable burger since both contain high amounts of protein. Soya bean contains 38% to 42% protein (Balasubramanian and Palaniappan, 2004). Chickpea has significant amounts of all essential amino acids and is rich in nutritionally important unsaturated fatty acids such as linoleic and oleic acid (Jukanti, 2012). The objectives of this study was to find out the ways to maximize the utilization of fish waste generated in fish processing industry and to use them to extract flavor compounds in order to incorporate it in to a vegetable burger.

## Methodology

Vegetable burger was prepared using soya and chick pea as the main ingredients. Dried soya bean was steamed at 80°C for 20 minutes and ground using a grinder (IS 4250, Jaipan family mate, India). Weighed ingredients were mixed and the pulp was made. Prepared mixture was then cooked in a steamer (WP5525, WIPRO, China) at 80°C for 20 minutes. Ingredients level of the burger was determined by preliminary sensory evaluations keeping soy and chick pea flour levels constant. For determination of best combination of soya and chick pea flour, 5 recipes of vegetable burger were prepared by decreasing the soya level from 100% to 0% and increasing the chick pea level from 0% to 100% while keeping the other ingredients constant. Thirty untrained panelists were used to select the best formula for the burger. Fish flavor was extracted according to the method of Teerasuntonwat and Raksakulthai (1995) with some modifications. Yellow fin tuna trimmings were cut in to small pieces and ground using the grinder (Jaipan family mate) with 1% (w/v) NaCl (Fluka, England). Blended samples were transferred in to a 1000 mL beaker (PYREX, England) and heated at 60°C for 15 minutes using a stirrer (SR No:67702, VELP® SCINTIFICA, Europe). Heated samples were filtered using Whatman No: 4 filter papers. Filtration was dialysed to remove salt. Extracted fish flavor was kept under freezing condition and used instead of water (28%) in vegetable burger preparation.

For determination of best concentration to extract volatile compounds series different concentrations (w/v) of NaCl (0.1%, 1%, 5% and 10%) were prepared. Vegetable burger was prepared using the recipe developed and separated dialysis solutions. Best NaCl concentration was determined by a sensory evaluation test using 30 untrained panelists. Sensory evaluation data were statistically analyzed using non parametric Friedman test in Minitab 16. Lipid oxidation, pH value and proximate composition were determined in triplicate during 30 days of storage at 4°C. Microbiology tests were

done for *Escherichia coli*, *Salmonella*, *Staphylococcus* and total plate counts. Crude protein, crude fat, moisture and ash contents of fish flavored vegetable burger were analyzed using AOAC standard methods (2002) with some modifications. The cost of product was calculated for the best treatment selected from the final trial.

## Results and Discussion

Majority of the panelist did not accepted the chick pea containing recipe ( $p < 0.05$ ). Therefore, only soya flour was selected as the plant protein source of the vegetable burger. At the same time cost analysis results showed that 100% soya containing recipe was cheaper than chick pea containing recipe. Hence, vegetable burger recipe was finalized. Finalized vegetable burger recipe containing 55% (w/w) of soya flour, 5% (w/w) of wheat flour, 1.5% (w/w) of chili powder, 1% (w/w) of pepper, 2% (w/w) of garlic, 1.6% (w/w) of salt, 5.9% (w/w) of vegetable oil, and 28% (w/w) of water. Then several trials were carried out to determine the best dilution series. Then NaCl:fish= 1:1 ratio was selected as the best dilution series by sensory evaluation tests.

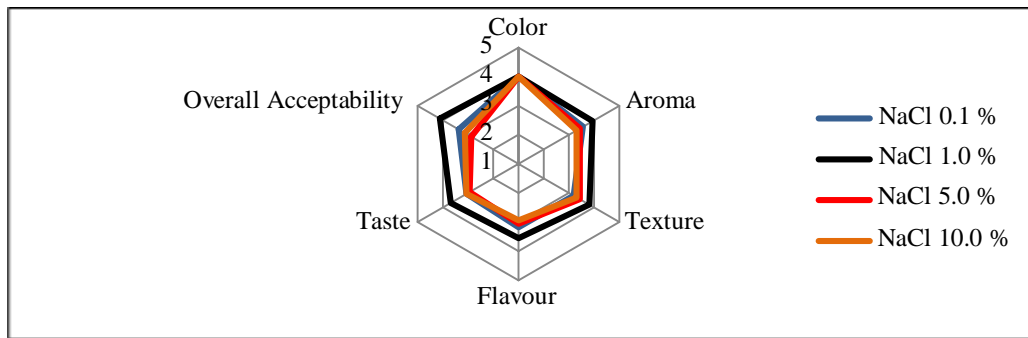


Figure 1: Sensory evaluation for determination of best NaCl concentration

According to Figure 1; 1% (w/v) of NaCl gave the highest organoleptic properties compared to rest of treatments ( $p < 0.05$ ). Therefore to separate protein and other volatile compounds 1% (w/v) with 1:1 dilution can be considered as the best NaCl concentration.

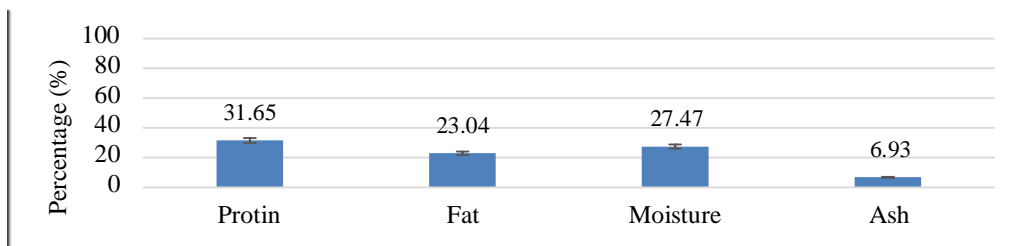


Figure 2: Proximate composition of the developed vegetable burger

According to the proximate analysis results, the fish flavored vegetable burger is rich in protein and fat content. Vegetable oil such as soy bean, nuts and rapeseed containing poly unsaturated ( $\omega 3$ ) fatty acids (Linolenic acids). Soy bean containing 7% of  $\alpha$ -linolenic acid and 18 carbon omega-3 fatty acids with 3 double bonds.  $\omega$ -3 fatty acids prevent from the cardio vascular disease and  $\omega$ -3 fatty acids such as docosahexaenoic acid are incorporated in to neural tissues, notably brain and retina. Hence poly unsaturated fatty acids are healthier than saturated fatty acids such as animal fat (Nettleton, 1995). It proved that this fish flavored vegetable burger is healthier than a meat origin burger.

There was no significant increase in pH during storage at 4°C. The pH value range of the burger was 6.29-6.8 during storage time. Soy protein has a relatively high pH value compared to the meat protein. Lean meat has approximately pH of 6.0. Therefore increasing the levels of soy protein have a tendency to increase the pH value (Hoogenkamp, 2005).

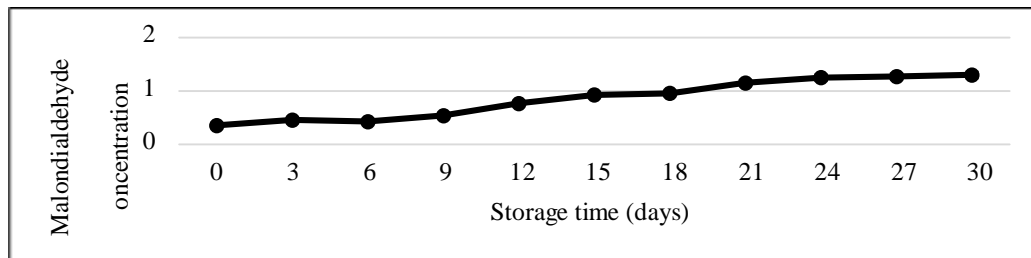


Figure 3: Changes in lipid oxidation value with the storage

There was a significant increase in lipid oxidation during the storage at 4°C for 30 days. Polyunsaturated fatty acids oxidized readily because their double bonds are unstable. Oxidation of unsaturated fats produces a variety of compounds that smell and taste rancid. Saturated fats are more resistant to oxidation (Whitney *et al.*, 2011). Soya bean is rich in lipoxygenase and unsaturated fatty acids. Mechanical destruction and the presence of water or heat can accelerate the rate at which lipoxygenase catalyze unsaturated lipid oxidation (Riaz, 2006). Therefore increase of the oxidation due to the continuous oxidizing process of the poly unsaturated fatty acids of the soya bean. But according to the results, level of oxidation was within the acceptable level. Therefore, the product developed is suitable even after 30 days of storage even though the lipids oxidized during storage.

There was no growth of hazardous microorganism in the sample during the time of testing. According to SLSI specification for quick frozen whole fish, fish fillets, steaks and minced fish products microbiology test were done. There were only positive results in total plate count but levels did not exceed the SLSI recommended limits

## Conclusion

The best dilution series for fish flavor extraction is 1:1 ratio of fish and NaCl (1% w/v). Fish flavored vegetable burger was a nutrient rich low cost product.

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