ABSTRACT

Fish processing waste are good source of lipids rich in polyunsaturated fatty acids (PUFA) particularly linolenic acid, EPA and DHA. Studies on lipid class and fatty acid composition of different body parts of selected fresh water and marine fishes have shown the higher content of lipid rich in PUFA in fish visceral waste (FVW). Lipid content was found to be higher in fresh water fishes compared to marine fishes. Hence, biotechnological approaches such as lactic acid fermentation (LAF) and enzymatic hydrolysis (EH) were employed for simultaneous recovery of lipids and protein from fresh water fish visceral waste. Among the lactic acid bacteria (LAB) used for LAF Pediococcus acidilactici NCIM5368, a native LAB resulted in highest oil (93.57%) and protein (74.59%) recovery. In case of EH, fungal protease was found to be the best enzyme, which on hydrolysis of FVW resulted in highest oil yield (80.33 %) and protein recovery (62.5%). In comparison between the two approaches LAF was found to be the ideal to recover lipids and proteins. Different lipases were used to enrich PUFA whereas antioxidant to prevent oxidation in recovered oil during LAF and EH of FVW. Among the lipases used Aspergillus niger lipase was able to enrich higher PUFA and TBHQ (100ppm) added to homogenized FVW prevented oxidation of PUFA during recovery of oil by LAF and EH. To evaluate the safety, bioavailability and bioefficacy of lipids recovered from FVW rats were fed different concentrations of FVW-FO providing 1.25, 2.50, 5.0% EPA+DHA recovered by either LAF (FO-LAF) or EH (FO-EH) for 8 weeks. Feeding FVW-FO to rats showed no adverse effect in growth and biochemical parameters even at oil containing 5% EPA+DHA. Feeding FVW-FO reduces triacylglycerols (5.96–20.3%), total cholesterol (7.9–21.5%) and LDL (7.39–21.7%) cholesterol levels in serum compared to control groundnut (GNO) fed group. EPA+DHA level in serum, liver, brain and heart increased with increase in dietary EPA+DHA. Further results show the hypolipidemic property of FVW-FO and reduced HMG-CoA reductase activity which is proportional to the incorporation of EPA+DHA in tissues. Feeding FO-LAF and FO-EH improved the activity of membrane bound enzymes in a tissue specific manner and enhanced the activity of antioxidant enzymes in tissues. Compared to control group, LAF-FO and EH-FO fed groups showed a decrease in platelet aggregation by 12.8 - 23.3% and 11.8 - 21.7%, respectively which is comparable to cod liver oil. To conclude the recovery of FVW-FO will address the increasing demand for fish oil which demonstrate various health benefits and may reduce pollution problem associated with FVW.
Fish processing by product are an potential source of lipids and protein.

Lipid content is higher in fresh water fish visceral waste - good source of n-PUFA.

Fish visceral waste

Enzymatic hydrolysis

Fungal protease

Native lactic acid bacteria

Bacteriocins

Lactic acid fermentation

Proteases

Proteins

Protein hydrolysate

Protein hydrolysate + bacteriocin

In vitro Antioxidant & Antibacterial properties

Feeding to rats, no harmful effect, No change in growth parameters, hematological, serum biochemical parameters

Beneficially modulates the microsomal lipid composition and activities of membrane bound enzymes in tissues

Decrease platelets aggregation and serum thromboxane B2 level, platelets cholesterol levels similar to cod liver oil

Decrease serum and liver cholesterol, triglyceride and LDL, activity of HMG-CoA reductase similar to cod liver oil

Utilization will reduce pollution problems and will meet the demand of fish oil.