

Production of Tuna Fish Oil by Utilizing Tuna (*Thunnus Albacares*) Processing by-Products

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Introduction

Sri Lanka is surrounded by a coastline of approximately 1700 Km, and belongs to an Exclusive Economic Zone (EEZ) of 517,000 Sq Km. About 50,000 people in the country are directly involved in the fishery industry. The total marine fish production in 2010 was recorded about 332,260 Metric tons (Mt), while Tuna contributed 88903 Mt to the total (Fisheries year Book, 2010). From the total yield about one-third of the catch of fish is not used for direct human consumption but for the production of fishery by products (Balios, 2003). Every year thousands of tons of fish by-products of high nutrient content are discarded by fish processing plants through the world although they can be utilized for other purposes. Crude tuna oil is produced from tuna waste by steam followed by purification, wet rendering, alkali digestion, acid silage Soxhlet like methods (Bimbo, 1990). Tuna fish oil has been considered as an available source of long chain polyunsaturated Omega 3 and Omega 6 fatty acids, especially eicosapentaenoic acid (EPA) and Docosa Hexaenoic Acid (DHA). Tuna oil differs from other fish oils in the ratio of the C20:5 n-3 (EPA) to the C22:6 n-3 (DHA) fatty acids. It means that the ratio of EPA: DHA in tuna oil around 1:4 is similar to that of human breast milk. This study attempted to find out the feasibility of producing Tuna fish oil using fish waste.

Methodology

Heads of yellow fin tuna (*Thunnus albacares*) weighing more than 20 kg were obtained from tuna processing plant in Ja-ela, Sri Lanka. Selected tuna heads were separately crushed up using a mechanical crusher to get fine ground particles.

Tuna fish oil was separated using Soxhlet method, wet rendering method and alkali digestion method respectively. In Soxhlet method 100 g of sample of prepared tuna head sample was transferred into extracting thimbles. Oil was extracted with petroleum ether (chloroform and methanol at the ratio of 2:1). The temperature was maintained between 60 °C to 80 °C for 6 hours and extracted fish oil was weighed.

Wet rendering method was carried out according to the Bimbo (1990). A sample of 100 g of prepared tuna head were mixed with 20 % water and heated by using a water bath maintaining the temperatures 75 °C, 85 °C and 95 °C each with heating times of 10 minutes, 20 minutes and 30 minutes followed by pressing.

In Alkali digestion method, crushed tuna head samples were taken (100 g) and mixed with 10 % of distilled water and digested for 30 minutes at 50 – 60 °C. After 30 minutes 20 mL of 2% Sodium hydroxide was added slowly to avoid soap formation. The mixture was then cooked at a temperature of 80 °C up to 30 minutes with constant

stirring until the head muscle particles were turned semi colloidal state. After 30 minutes oil was separated using centrifugation.

Free fatty acid analysis was made by extracting free fatty acids in hot alcohol and titrating with standard alkali medium.

Results

Results of the analysis of oil, using different extraction techniques, are presented in Table 1.

Table 3 Yield of oil extracted using different extraction methods

Parameter	Soxhlet method	Wet Rendering	Alkali Digestion
Yield	13.655 +/-0.113	3.046 +/-0.509	5.296 +/-0.611
Free FA Value	.621 +/- .061	.125 +/- .074	.0008 +/- .0012

Soxhlet method recorded the highest oil yield of 13.65 +/-0.113. followed by Alkali digestion method (5.29 +/-0.611). Wet rendering method showed the lowest oil yield (3.04 +/-0.509).

All the mean values were subjected to One-way ANOVA to find the significant of the methods. A mean separation was done by using tukey test to find whether there is significant difference among the methods.

Free fatty acid content of tuna fish oils separated by different methods is presented in Table 1. The lowest free fatty acid value was recorded from oil recovered by the alkali digestion method (0.004%). Wet rendering method was the next oil extraction method which reported the low free fatty acid value (0.125%). Soxhlet method recorded the highest free fatty acid value (0.62%).

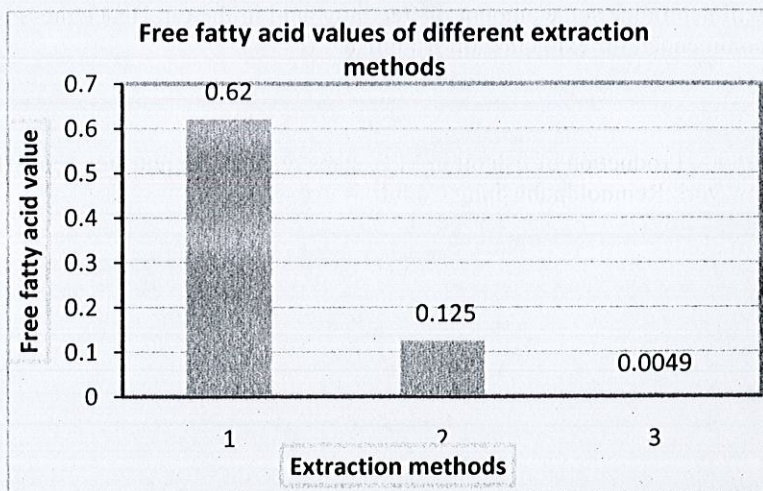


Figure 5 Free fatty acid value of soxhlet(1),wet rendering(2) and alkali digestion method(3).

Discussion

In this study tuna fish oil was extracted by using different methods and quality was determined by finding the free fatty acid values of the oil. According to the results of this study highest oil yield was obtained using Soxhlet method.

Lipids will dissolve in a variety of solvents. Solvents such as chloroform and methanol with somewhat higher polarity have high dissolving property and Soxhlet method has reported the highest oil yield.

In alkali digestion method fish tissues are digested with the help of alkali medium (sodium hydroxide 2%) and liberate oil from the fish tissues easily. Application of heat accelerate the digestion process to some extent, but release of complex lipids to the solution is lower than that of the Soxhlet method (Tanikwa, 1971).

Wet rendering method was carried out according to the method of Bimbo (1990). The highest oil yield was observed at 85 °C for 20 minute treatment and lowest oil yield observed in lower temperature treatment (75 °C) and also high temperature treatment for long time (95 °C for 20 min, 30 min) method. This is possible due to the fact that lipid cells were ruptured to a great extent with 85 °C (Bimbo (1990)). Among the different time temperature combinations the optimum condition for tuna oil extraction was observed to be heating the sample at 85°C for 20 min.

The highest free fatty acid percentage in oil was recorded from Soxhlet method and alkali digestion method recorded the lowest free fatty acid value. According to the oil prepared at higher temperatures had higher free fatty acid amount. This results indicated that the hydrolysis of ester bonds of triglyceride occurred less at lower temperatures as well as oil can undergo hydrolysis in the presence of moisture and heat. In Soxhlet method oil is kept at somewhat higher temperature for long time (50 -60 °C for 6 hours) and hydrolysis of triglyceride was high resulting high free fatty acid value. Second highest free fatty acid value was recorded in wet rendering method, because a high temperature (85 °C for 20 min) was used. Alkali digestion method gave the lowest free fatty acid value. In alkali digestion method Sodium hydroxide add to digest the fish tissues so it will neutralize some amount of free fatty acid in the oil. Hence the Soxhlet method is recommended for extracting oil from fish.

References

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