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# WASTE MANAGEMENT FOR SMOKING SALMON BY- PRODUCTS TO EXTRACT OMEGA-3 FISH OIL

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***Abstract***

*The main objective of this investigation was to study the possibility of producing fish oil from smoking salmon waste by using cold pressing and wet rendering methods. The amount and the properties of extracted of oil were tested. The samples were used about 33.810 kg., smoked fish caused about 9.610 kg. As a Salmon waste (skin, viscera, backbone frames and cuts off) it's recorded about 20% of the total mass from salmon slices. The results showed the smoking salmon waste have more than18% of oil fish per one kg of salmon waste. The oil weight from Salmon by-products was increased with pressing time increase as well as oil yield increased. The oil extraction increased and characterization of quality. The optimum conditions at pressing time was 180 min., oil weight was 93 g. oil/500 g. Salmon by-products, oil productivity was 18.00%, and extraction efficiency were 98.46 % at constant pressure. The oil weight from Salmon by-products was increased with heating time increase as well as oil productivity increased. The oil extraction yield increased with the wet rendering processes at heating time of 60 min. have oil weight about 90 g. oil/500 g. Salmon by-products , oil productivity about 18.00%, and extraction efficiency was 95.23% . The oil yield increased with both processes and cold pressing methods gave good looking and high quality of oil fish.*

***Key words****: extract, efficiency, yield, smoking salmon, waste, fish oil, cold pressing, wet rendering.*

## INTRODUCTION

Management and handling of fish waste is an environmental, social priority for many countries and is more problematic because of rising production volumes. The fish processing industry causes a large quantity of tissue waste and by-products which tend to be either discarded or retailed at low value for fertilizer or animal feed. [5] The fish by product is nearly (skin 6 % - viscera 7% - off-cuts 10% - head 18% - backbone frames10%). [8] The fish processing industries produce large quantities of fish waste which often represent about 20-50% of the total fish weight. [3] Waste generated from fish processing plants is approximately 50 wt. % of harvested fish depending on the kind of fish product and processing techniques. [9]
Laboratory experiment illustrations that green extraction methods make available an excellent alternative to traditional methods – the volume of fish oil produced and the quality is comparable or even healthier. But, these methods need more research. It is necessary to advance the technology of pre-processing and the extraction method.

Conventionally, the oil fish was obtained as a by-product of the fish meal industry. Also smaller fish and spoiled fish have high fat content. The oil fish line considers the anchovies, sardines, herring, and others in the centre of attention as a raw material. Now fish oil has played a important role in the human diet addition to the demand for oil fish is still growing. [7]
The wet rendering extraction process involved first cutting the viscera still frozen into small pieces and putting them in 550 mL boiling water for 20 minutes. Then cooling down for 40 minutes and filtering in a strainer with fast flow rate. The process was repeated and after separation from water, the supernatant was filtered again using a fine sieve and brought to the fire for 30 minutes. [6]. The best conditions to extract oil fish from tilapia by-product by using heating temperature at 70°C for 35 minutes. [12]

The solvent extraction is another process that yields fish oil as a by-product. In this process, most of the water and some or the entire fat are removed using suitable chemical solvents. Normally, the solvent is recovered in the process and reused. The problems of solvent extraction method are complicated equipment and the high cost. [2] Dark salmon have 12.5% fats and oils 2.1% fats and oils and 17.5% protein, whereas the light salmon muscle had and 20.4% protein.[14] Salmon have higher fat content in the viscera than the fillet. [11] Tilapia viscera composition of 14.62% ± 0.79 protein, 10.75% ± 0.97 lipids, 60.44% ± 0.27 moisture and 4.90% ± 0.61 minerals. [10] The oil fish have long chain fatty acid, the prominent ones being EPA and DHA making it an attractive edible oil. [11] Fish oil is a very effective nutrient and contains omega 3 that can be absorbed easily. [7] A lot of studies recommended amounts of fish oil supplements to reduce the risk of heart attack and strokes. [1] The largest producer of by-product fish oil in Europe and big volume of fish waste from Asia. The fish by-product contributes the percentage of fishmeal to 33%, while fish oil being at 26%. [4]

Fish waste materials should be treated and disposal to avoid potential effects to the environment and human health. It can be by-product of a manufacturing process or an obsolete commercial product such as oil fish that can no longer be used for intended purpose and requires disposal. This study aimed to using the salmon waste material for producing fish oil and determines the optimum extract methods treatment addition to conserve the environmental during smoking processes.

## MATERIALS AND METHODS

Experiments were designed to extract fish oil from waste of salmon smoking processes and compare between two different oil extractions methods

**Sampling**

Samples were collected from Bentleys Egypt company one from Egyptian industrial group, the by-products of salmon smoking (skin, viscera, backbone frames and off cuts), weighted 500 grams and package under vacuum.

The raw material of Salmon waste (skin, viscera, backbone frames and off cuts) frozen at -12 °C for one day before it was used in the experiment. It was used from Bentleys Egypt company one from Egyptian industrial group

**Extract methods**

-The cold pressing processes: using plastic bag under vacuum with 0.5 kg, from fish waste were processed to keep the waste material and put five bags in the pressing box have about 10 cm in deep, 30 cm in long, 15 cm in wide and two plate with the same dimensions one of them acting load on the sample's as a small prototype for cold pressing methods.

Different compressed times from 10 to 260 min. at constant pressure were approximately 20 kilograms per square size of samples.

-The wet rendering processes: in this method 500 g. of salmon waste put in 500 mL of water in a stainless cooker at 100 °C and heated for 20 minutes.

At high temperature is expected to rupture the fat cells, the sample lift a lot of time to cool down and separate the fish oil from sample component and wastewater. Different heating times 20, 30, 40, 50, 60, 80 and 100 min at a constant temperature 100 ºC

**Fish Oil properties:** the biochemistry analyzer model Erba Chem-7 were using to test triglycrides Total cholesterol, Triglycerides, HDL, LDL and VLDL cholesterol, were 493.9, 173.8, 281.4, 178.2 and 34.8 Mg/dl.

**Measurements**

Oil weight (g) = Extract oil from fish by product sample (500,g.)

Oil productivity, % = Extract oil /Weight of fish by product × Average weight of fish.

Extraction efficiency, % = oil mass after extraction, g./ oil mass in sample, g.*100

**Oil mass in sample** determined three times for 500 g. of Salmon by-products by cold pressing and wet rendering methods the oil content ranged between 18.45 and 18.89 g/100 g.

Also through enzymatic extraction method at the same conditions for samples of salmon,

the oil content obtained ranged between 16.234 and 18.212 g/100 g. [13]

## RESULTS AND DISCUSSIONS

**Salmon fish components**: The results in Fig. 1 showed the components out from salmon fish, waste of fish percentage include water lose and fish by product were nearly from 43.65%, water lose from (change in freezing, 0.45%, salting 2% and smoking10.8%). While the fish by product percentage include (head-bone, 15.90%, and disposed off, 27.20%. Also edible portion nearly from 56.35% include trimmings, 4.90% and salmon slice, 51.45%.

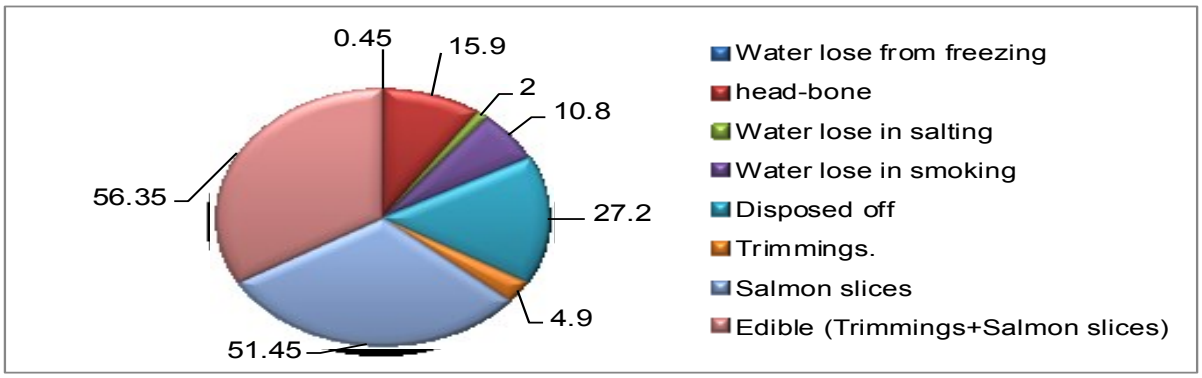


Fig. 1. Average components of salmon fish by-products percentage
Source: author's results.

**Oil productivity with wet rendering:**
The results in Fig. 2 showed that the oil weight from Salmon by-products was increased with heating time increase as well as oil productivity increased.

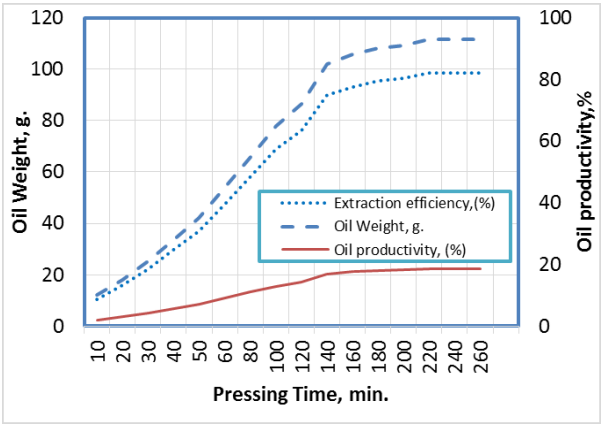


Fig. 2. The oil extracted from salmon by-products with heating time and oil productivity and oil extract efficiency.
Source: Own results

The effect of heating time on amount of oil extraction from Salmon by-products was tested at constant temperature. The results showed that heating time increased from 10 to 60 min. oil weight increased from 40 to 90 g. oil/500 g. Salmon by-products, oil productivity increased from 8.00 to 18.00%, and extraction efficiency increased from 42.35to 95.23% at constant temperature 100 ºC.
This temperatures reason's cell separation and so enable oil extraction and increase the oil yield. The results showing steady behaviour after 60 min. increased with heating time increase as well as oil productivity increased.

**Oil productivity with cold pressing:**
The results in Fig. 3 showed that the oil weight from Salmon by-products was increased with pressing time increase as well as oil productivity increased.

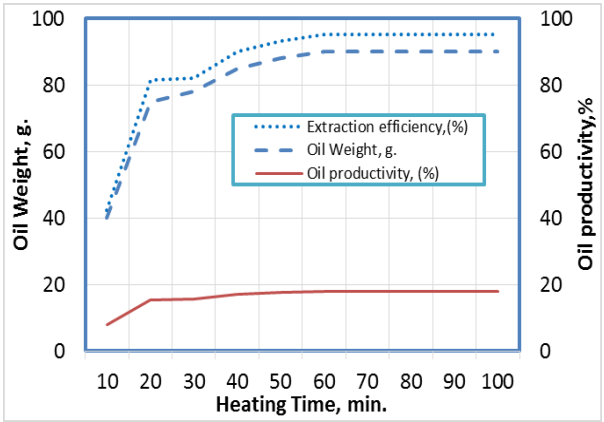


Fig. 3. The oil extracted from Salmon by-products with pressing time and oil productivity and oil extract efficiency.
Source: Own results.

The influence of pressing time on oil extraction from Salmon by-products was examined.

The results showed that pressing time increased from 10 to 260 min. oil weight increased from 10 to 93 g. oil/500 g. Salmon by-products, oil productivity increased from 2.00 to 18.60%, and extraction efficiency increased from 10.58 to 98.46 % at constant pressure, stress. This pressure causes oil extraction. The results showing steady behaviour for oil productivity and oil extract efficiency after 180 min.

## CONCLUSIONS

The important results obtained were summarized in the following:

-The optimum conditions with wet rendering at a constant temperature 100 ºC and heating time 20 min., oil productivity about 15.40% and extraction efficiency was 81.52%

-The preferred using cold pressing, oil extraction yield increased and characterization of quality. The optimum conditions at pressing time was 180 min., oil productivity was 18.00%, and extraction efficiency were 98.46% at constant pressure.

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## REFERENCES

[1]American Heart Association, 2010. In Fish and Omega-3 Fatty Acids. Retrieved June 1, 2010, from http://www.heart.org/ presenter.

[2]Bimbo, A.P., 2005, Industrial oil and fat products, 6th edn. Wiley, Hoboken, pp 57–102.

[3]Ghaly, A. E., Dave, D., Brooks, M. S., Budge, S. M., 2010, Production of biodiesel by enzymatic transesterification: A critical review. American Journal of Biochemistry and Biotechnology, 6:54-76.

[4]Jackson, A., Newton, R., 2016, Project to model the use of fisheries by-products in the production of marine ingredients with special reference to omega- 3 fatty acids EPA and DHA, University of Stirling.

[5]Lin, C. Y., Li, R. J., 2009, Fuel properties of biodiesel produced from the crude fish oil from the soapstock of marine fish. Fuel processing technology, 90(1), 130-136.

[6]Oliveira, L. E., Barboza, J. C. S., Da Silva, M. L. C. P., 2013, Production of ethylic biodiesel from Tilápia visceral oil. In Proceedings of the International Conference on Renewable Energies and Power Quality (ICREPQ'13) (pp. 20-22).

[7]Rizliya, V., Mendis, E., 2014, Biological, physical, and chemical properties of fish oil and industrial applications. Seafood Processing Trendsand Applications. Springer Science, New York.

[8]Rustad, T., 2007, Physical and Chemical Properties of Protein Seafood by-products. CRC Press.

[9]Sathivel, S., Prinyawiwatkul, W., Grimm, C. C., King, J. M., Lloyd, S., 2002, FA composition of crude oil recovered from catfish viscera. Journal of the American Oil Chemists' Society, 79(10):989-992.

[10]Shirahigue, L. D., Silva, M. O., Camargo, A. C., Sucasas, L. F. D. A., Borghesi, R., Cabral, I. S. R., Oetterer, M., 2016, The feasibility of increasing lipid extraction in Tilapia (Oreochromis niloticus) waste by proteolysis. Journal of Aquatic Food Product Technology, 25(2):265-271.

[11]Sun, T., Xu, Z., Prinyawiwatkul, W., 2006, FA composition of the oil extracted from farmed Atlantic salmon (Salmo salar L.) viscera. Journal of the American Oil Chemists' Society, 83(7):615-619.

[12]Suseno, S. H., Nurjanah, N., Yoshiara, Y., Saraswati, S., 2015, Determination of Extraction Temperature and Period of Fish Oil from Tilapia (Oreochromis niloticus) By Product Using Wet Rendering Method. KnE Life Sciences, 1: 125-135.

[13]Winny Routray Deepika Dave,Vegneshwaran V. Ramakrishnan, Wade Murphy, 2017, Study of drying kinetics of salmon processing by-products at different temperatures and the quality of extracted fish oil. Journal Drying Technology An International Journal Volume 35, 2017, Issue 16 Pages 1981-1993 https://www.tandfonline.com, Accessed 10 feb.2018.

[14]Yoshida, H., Takahashi, Y., Terashima, M., 2003, A simplified reaction model for production of oil, amino acids, and organic acids from fish meat by hydrolysis under sub-critical and supercritical conditions. Journal of chemical engineering of Japan, 36(4):441-448.