Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI:10.21474/IJAR01/13648
DOI URL: http://dx.doi.org/10.21474/IJAR01/13648

RESEARCH ARTICLE

Nutritional and Bioactive Analysis of Extracted Soybean and Fish Oil

Joseph O. Toluhi
Department of Integrated Science Kogi State College of Education, Ankpa.

Manuscript Info

Manuscript History
Received: 31 August 2021
Final Accepted: 30 September 2021
Published: October 2021

Key words:-
Fish Oil, Soybean Oil, Nutrition, Bioactive

Abstract

Extensive literature abounds that applauds the importance of fish and soybean oils to human functioning. Evidence suggests that fish and soybean oil constitute a significant public and medical importance to human existence. Numerous authors have emphasized the health benefits of oils. The current research aimed to produce and analyze the nutritional and bioactive constituents of fish and soybean oil widely used in Nigeria. The samples were extracted from fish and soybean seeds using the standard procedures described in the literature. Thirty liters of the oils were removed from the samples, respectively. The nutritional contents and other properties were determined. The study provided insight into the nutritional composition of fish oil and soybean oil. The findings and recommendations are discussed.

Introduction:-

Over the years, soybean oils have been widely depended on for various purposes across the globe(Lin et al., 2018). It is a common type of cooking oil that has been associated with several health benefits, especially with the heart, skin, and bones. Soybean oil is a vegetable oil commonly extracted from soybean seeds (Glycine max). Research suggests that the omega-3 fatty acids content of the soybean oil makes it healthier than other vegetable oil. Perhaps, Omega-3 fatty acids are associated with several health benefits and play an integral role in heart health, fetal development, brain function, and immunity(Swanson et al., 2012). Soybean oil is rich in vitamin E (Arianto et al., 2019), an anti-inflammatory nutrient implicated in healthy skin(Keen & Hassan, 2016). The vitamin and mineral constituents associated with soybean remain healthy parts of this delightful and commonly used legume (Cheng, 2008).

According to Ahsan (2018), soybeans are part of the legumes that comprise peanuts, chickpeas, other beans, and pulses, commonly processed into oil, flour, and meal. A large quantity of soybean oil is produced around the globe, making it one of the most common cooking oils available and is highly consumed across cultures (Deol et al., 2020; Korach-Rechtman et al., 2020). The oil is versatile and has been increasingly used in various cooking and industrial purposes (Cheng & Rosentrater, 2017). Extensive literature has linked soybean oil to numerous health benefits (Ciabotti et al., 2019; Darr et al., 2020; Dhakal et al., 2014; O'Bryan et al., 2014; Segura et al., 2020). For example, soybean has been found effective in the control of cholesterol (Freeman, 2009), impact positively on cognition (Elbouruee, 2010), bone enhancement (Janse, 2010), maintains healthy eye and skin (Judith, 2007), and have antioxidant potential (Kristin, 2011).

Fish oils come from fatty or oily fish, such as trout, mackerel, tuna, herring, sardines, and salmon, and is considered a significant medical and public interest (de Magalhães et al., 2016). The health advantage of fish oil has been widely recognized (Miyashita, 2019). Primarily due to the presence of omega -3-fatty acid and, and docosahexaenoic acid

Corresponding Author:- Joseph O. Toluhi
Address:- Department of Integrated Science Kogi State College of Education, Ankpa.

(DHA). Fish oil has been commonly used in fortified food products because of its remarkable health benefits (Jamshidi et al., 2020). Accordingly,Encina et al. (2016) reported that fish oil is a natural source of long-chain polyunsaturated fatty acids, which are typically incorporated into food products. For instance, the most nonvitamin, and nonmineral dietary supplements are rich in fish oil(Hilleman et al., 2020). Some fish oil products are recognized as prescription medications to lower triglycerides levels. Although, fish oil supplements do not contain the same amount of fish oil as prescription products, thus, they cannot be substituted with prescription products. Fish oil supplements have been found useful in heartand mental health. However, studies into supplement use have produced mixed results, and it is unclear whether or not supplements are helpful.

The dietary potential of fish oil has been indicated(Ghorbanzade et al., 2017).Similarly, Gao et al. (2017) contends that the oil is helpful in wide range of chronic diseases and in reducing the incidence of metabolic syndromes. Although fish oil is uneven during the production, storage, and application process(Li et al., 2020). It is an industrial product of high nutritional value because of its Omega-3 polyunsaturated fatty acids content (Bonilla-Mendez & Hoyos-Concha, 2018). The health benefits of fish oil are well documented(see., Bakuła et al., 2011; Ballou &DePeters, 2008; Durmuş, 2019; Ghasemi Fard et al., 2019; Harris, 2004; Lin et al., 2019; Parletta et al., 2019; Raatz & Bibus, 2016; Ramalingam et al., 2018; Sidhu, 2003; Suzana et al., 2016; Ulven &Holven, 2015). There is overwhelming evidence supporting the high nutritional value of fish and soybean oil (Alfonso Valenzuela et al., 2012; Amanlou et al., 2012; Cho et al., 2013; Lim et al., 2011; Ryckebosch et al., 2014; Xia et al., 2019), thus, leading to the increasing global demand(Lokuruka, 2011). The present study aimed to extract and evaluate the nutritional and bioactive components of soybean and fish oil.

Materials and Method:-

All the materials used in the study were adequately prepared and sterilized in line with the procedure outlined in IvanovsandBlumberga(2017). The soybean seed and fish oil were sourced from the general public and subjected to laboratory analysis. The extraction method highlighted in (Campbell & Glatz, 2009) and (Bako et al., 2017) respectively were applied. The moisture content, ash content, fat content, carbohydrate, protein, vitamin, and mineral contents of the fish oil were determined. The nutritional contents of soybean oil and the bioactive constituents, including flavonoids, saponins, sugars, phenolic compounds, fatty acid, vitamins, and phosphorus in the samples were also examined.

Result:-

Thirty liters of fish oil and soybean oil were extracted and poured in a white sterile bottle. Drops of the oil were dropped on the filter paper and allowed for few minutes. The tables below show the sample's observed properties, proximate analysis, bioactive component, and mineral constituents.

Table 1:- Table showing the observed properties of the examined fish and soybean oil.

	Color	smell	texture
Soybean oil	Yellow	Soybean aroma	Viscous
Fish oil	Yellow	Strident, oily smell like fish	Greasy

Table 2:- Table showing the proximate analysis of fish oil and soybean oil.

Raw Material	Fish Oil	Soybean oil
Fat	12.41	18.9
Moisture content	8.29	8.6
Protein	87.6	76.5
Carbohydrate	5.2	6.2
Ash	6.30	1.7

Table 3:- Table showing the bioactive component of soybean oil.

Alkaloids	+ +
Flavonoids	+ + +
Tannin	+ +
Saponin	+ +

Table 4:- Table showing the mineral content of fish oil and soybean oil.

Mineral	fish oil (mg/kg)	soybean oil (mg/kg)
Calcium	+ -	++
Magnesium	+ +	+ +
Sodium	+	+
Potassium	+ +	+
Copper	+	+ -
Zinc	+ +	+
Iron	+	+ +
Phosphorus	+ +	+ + +

Note: + = Indicates the presence in trace or minutes amount. ++ indicate the presence in moderate amount. + + + = indicates the presence of appropriate amount. + = Indicates presence in very trace amount.

Discussion:-

The present study aimed to analyze the nutritional and bioactive components of extracted soybean and fish oil. The color, smell, and texture of the fish and soybean oil was observed as shown in the table 1 above. The analysis revealed a yellowish color, and ascent similar to fish and soybean oil. Although the textures were found to be greasy, the oil from the soybean was tackier. Also, the compositions of the fish oil and soybean oil were observed as shown in the table 2 above. It was observed that the carbohydrate constituent of soybean oil was higher compared to the fish oil. This indicates that soybean oil can serve as food. The higher value was indicated as a result of profound color change during the reaction. The moisture content or iodine value in the oils reflects their susceptibility to spoilage. Perhaps, they are meant to be preserved appropriately to ensure longer shelf life (Warner, 2002). The protein constituent represents an essential aspect of the diet required for human and animal survival. Their primary function in nutrition is to supply an adequate amount of required amino acids. Protein deficiency increases growth retardation, abnormal swelling, and fluid collection in the body (Mount, 2000). Conceivably, the observation revealed a significant level of protein in the samples. Thus, crude fat is essential because they provide essential fatty acids (EPA) in that they are part of the vital nutritional requirements of the body. Perhaps, crude fibers are essential for digestion(Dhingra et al., 2012; Lattimer & Haub, 2010; Yang et al., 2017). The vitamin content in the samples indicates that they are positive antioxidants that could promote resistance to disease, delay aging, and preside over the health of the eyes, skin, nails, and hairs. Additionally, the phytochemical component of soybean oil indicated the presence of alkaloid, flavonoid, tannin and saponin as shown in the table 3 above. Similarly, the tables 4above shows the mineral compositions of the oils. Nevertheless, the analysis based on changes shows that soybean oil has more minerals than fish oil. The probable explanation to this outcome could be attributed to the sources. Perhaps, the presence of minerals such as zinc might indicate that these oils may be useful in reproduction, predominantly male fertility. Accordingly, zinc have been found to stimulate the activity of vitamin formation of red and white corpuscles(Chen et al., 2018).

Conclusion:-

The purpose of the present study was to extract oils from soybean and fish sources primarily to evaluate the nutritional constituents and bioactive strengths. The analysis revealed that fish and soybean oil contain numerous essential dietary compositions. The study provides insight into the usefulness of oils in food and drug formulations. Moreover, the study contributes to the literature by proving that the widely used EPA (eicosapentaenoic acid) and DHA (Docosahexaenoic acid) in Nigeria are essential in human functioning. Therefore, the study recommends increased attention relating to the production, evaluation, and consumption of fish and soybean oil.

References:-

1. Ahsan, F. (2018). Effects of Dietary Soy and Its Constituents on Human Health: A Review. Biomedical Journal of Scientific & Technical Research, 12(2). https://doi.org/10.26717/bjstr.2018.12.002239
2. Alfonso Valenzuela, B., Julio Sanhueza, C., & Fernando de la Barra, D. (2012). El aceite de pescado: Ayer un desecho Industrial, hoy un producto de alto valor nutricional. RevistaChilena de Nutricion, 39(2). https://doi.org/10.4067/S0717-75182012000200009

3. Amanlou, H., Maheri-Sis, N., Bassiri, S., Mirza-Aghazadeh, A., Salamatdust, R., Moosavi, A., & Karimi, V. (2012). Nutritional value of raw soybeans, extruded soybeans, roasted soybeans, and tallow as fat sources in early lactating dairy cows: Open Veterinary Journal, 2(1).
4. Arianto, A., Cella, G., &Bangun, H. (2019). Preparation and evaluation of sunscreen nano emulsions with synergistic efficacy on SPF by a combination of soybean oil, avobenzone, and octyl methoxycinnamate. Open Access Macedonian Journal of Medical Sciences, 7(17). https://doi.org/10.3889/oamjms.2019.745
5. Bako, T., Umogbai, V. I., &Awulu, J. O. (2017). Criteria for the extraction of fish oil. Agricultural Engineering International: CIGR Journal, 19(3).
6. Bakuła, T., Lis, Iwaniuk, Z., &Ordyński, Z. (2011). The effect of diets supplemented with fish broth and fish oil on the health of weaners. Polish Journal of Veterinary Sciences, 14(2). https://doi.org/10.2478/v10181-011-0033-8
7. Ballou, M. A., &DePeters, E. J. (2008). Supplementing milk replacer with omega-3 fatty acids from fish oil on immunocompetence and health of Jersey's calves. Journal of Dairy Science, 91(9). https://doi.org/10.3168/jds.2008-1017
8. Bonilla-Mendez, J. R., & Hoyos-Concha, J. L. (2018). Methods of extraction, refining and concentration of fish oil as a source of omega-3 fatty acids. CorpoicaCiencia y TecnologiaAgropecuaria, 19(3). https://doi.org/10.21930/rcta.vol19_num2_art:684
9. Campbell, K. A., & Glatz, C. E. (2009). Mechanisms of aqueous extraction of soybean oil. Journal of Agricultural and Food Chemistry, 57(22). https://doi.org/10.1021/jf902298a
10. Cheng L.C (2008). "Should Patients with Cardiovascular Disease Take Fish Oil or Soya Oil Extract" Journal of African for Comparative Analysis of Fish Oil and Soya Extract,18(100): 2009 – 2013.
11. Cheng, M. H., & Rosentrater, K. A. (2017). Economic feasibility analysis of soybean oil production by hexane extraction. Industrial Crops and Products, 108. https://doi.org/10.1016/j.indcrop.2017.07.036
12. Cho, K. M., Ha, T. J., Lee, Y. B., Seo, W. D., Kim, J. Y., Ryu, H. W., Jeong, S. H., Kang, Y. M., & Lee, J. H. (2013). Soluble phenolics and antioxidant properties of soybean (Glycine max L.) cultivars with varying seed coat colors. Journal of Functional Foods, 5(3). https://doi.org/10.1016/j.jff.2013.03.002
13. Ciabotti, S., Juhász, A. C. P., Mandarino, J. M. G., Costa, L. L., Corrêa, A. D., Simão, A. A., & Santos, E. N. F. (2019). Chemical composition and lipoxygenase activity of soybean (Glycine max L. Merrill.) genotypes, specific for human consumption, with different tegument colors. Brazilian Journal of Food Technology, 22. https://doi.org/10.1590/1981-6723.00318
14. Darr, L., Cunicelli, M., Bhandari, H., Bilyeu, K., Chen, F., Hewezi, T., Li, Z., Sams, C., & Pantalone, V. (2020). Field Performance of High Oleic Soybeans with Mutant FAD2-1A and FAD2-1B Genes in Tennessee. JAOCS, Journal of the American Oil Chemists' Society, 97(1). https://doi.org/10.1002/aocs.12306
15. de Magalhães, J. P., Müller, M., Rainger, J. E., &Steegenga, W. (2016). Fish oil supplements, longevity, and aging. Aging, 8(8). https://doi.org/10.18632/aging.101021
16. Deol, P., Kozlova, E., Valdez, M., Ho, C., Yang, E. W., Richardson, H., Gonzalez, G., Truong, E., Reid, J., Valdez, J., Deans, J. R., Martinez-Lomeli, J., Evans, J. R., Jiang, T., Sladek, F. M., & Curras-Collazo, M. C. (2020). Dysregulation of Hypothalamic Gene Expression and the Oxytocinergic System by Soybean Oil Diets in Male Mice. Endocrinology (United States), 161(2). https://doi.org/10.1210/endocr/bqz044
17. Dhakal, K. H., Jung, K. H., Chae, J. H., Shannon, J. G., & Lee, J. D. (2014). Variation of unsaturated fatty acids in soybean sprouts of high oleic acid accessions. Food Chemistry, 164. https://doi.org/10.1016/j.foodchem.2014.04.113
18. Durmuş, M. (2019). Fish oil for human health: Omega-3 fatty acid profiles of marine seafood species. Food Science and Technology, 39. https://doi.org/10.1590/fst.21318
19. Elbourne D. (2010). "Effects of 2 – Years – 3 Long Chain Polysaturated FattyAcid Supplementation on Cognitive Function in Older People" American, Journal Clinical Nutrition, 91(6): 1725 – 1732.
20. Encina, C., Vergara, C., Giménez, B., Oyarzún-Ampuero, F., & Robert, P. (2016). Conventional spray-drying and future trends for the microencapsulation of fish oil. In Trends in Food Science and Technology (Vol. 56). https://doi.org/10.1016/j.tifs.2016.07.014
21. Gao, H., Geng, T., Huang, T., & Zhao, Q. (2017). Fish oil supplementation and insulin sensitivity: A systematic review and meta-analysis. Lipids in Health and Disease, 16(1). https://doi.org/10.1186/s12944-017-0528-0
22. Ghasemi Fard, S., Wang, F., Sinclair, A. J., Elliott, G., &Turchini, G. M. (2019). How does high DHA fish oil affect health? A systematic review of evidence. In Critical Reviews in Food Science and Nutrition (Vol. 59, Issue 11). https://doi.org/10.1080/10408398.2018.1425978

23. Ghorbanzade, T., Jafari, S. M., Akhavan, S., &Hadavi, R. (2017). Nano-encapsulation of fish oil in nano-liposomes and its application in fortification of yogurt. Food Chemistry, 216. https://doi.org/10.1016/j.foodchem.2016.08.022
24. Harris, W. S. (2004). Fish oil supplementation: Evidence for health benefits. In Cleveland Clinic Journal of Medicine (Vol. 71, Issue 3). https://doi.org/10.3949/ccjm.71.3.208
25. Hilleman, D. E., Teply, R., & Packard, K. A. (2020). Knowledge, Perceptions, and Patterns of Fish Oil Use in Cardiac Patients. Journal of Pharmacy Practice, 33(5). https://doi.org/10.1177/0897190018824485
26. Ivanovs, K., &Blumberga, D. (2017). 477-483 1876-6102Environmental and Climate Technologies. Energy Procedia, 128, 10–12. https://doi.org/10.1016/j.egypro.2017.09.033
27. Jamshidi, A., Cao, H., Xiao, J., & Simal-Gandara, J. (2020). Advantages of techniques to fortify food products with the benefits of fish oil. In Food Research International (Vol. 137). https://doi.org/10.1016/j.foodres.2020.109353
28. Jain A., Jain R., Jain S. (2020). Sterilization of Glassware; Preparation and Sterilization of Media.
29. In: Basic Techniques in Biochemistry, Microbiology, and Molecular Biology. Springer Protocols Handbooks. Humana, New York, NY. https://doi.org/10.1007/978-1-4939-9861-6_28
30. Jense, C. L. (2010). "Effects of Early Material DocosahexaenoicAcid intake on NeuropsychologicalStatus and Visual Acuity at Five years of Age of Breast-Fed term Infants" British Journal of pediatric, 157(6): 900 – 905
31. John B. Woerfel. (1995). Practical Handbook of Soybean Processing and Utilization. In David R. Erickson (Ed.), Practical Handbook of Soybean Processing and Utilization (pp. 65–92). AOCS Press. https://doi.org/10.1016/c2015-0-04084-9
32. Judith, C.T (2007). "Is There a Role for Fatty Acids in Early Life Programming of the Immune System" Journal of Nutrition Society,69(3): 373 – 380.
33. Kristin K.H (2011). "Description of the Processes in the Value a Chain and Risk Assessment of Decomposition Substances and Oxidation Products in Fish Oil and Soya Oil Extracts" Journal of Environmental Biology, 15(2): 60 – 66.
34. Korach-Rechtman, H., Rom, O., Mazouz, L., Freilich, S., Jeries, H., Hayek, T., Aviram, M., & Kashi, Y. (2020). Soybean oil modulates the gut microbiota associated with atherogenic biomarkers. Microorganisms, 8(4). https://doi.org/10.3390/microorganisms8040486
35. Lim, C., Yildirim-Aksoy, M., &Klesius, P. (2011). Lipid and fatty acid requirements of tilapias. North American Journal of Aquaculture, 73(2). https://doi.org/10.1080/15222055.2011.579032
36. Lin, T. K., Zhong, L., & Santiago, J. L. (2018). Anti-inflammatory and skin barrier repair effects of topical application of some plant oils. In International Journal of Molecular Sciences (Vol. 19, Issue 1). https://doi.org/10.3390/ijms19010070
37. Lin, Z., Chen, R., Jiang, Y., Xia, Y., Niu, Y., Wang, C., Liu, C., Chen, C., Ge, Y., Wang, W., Yin, G., Cai, J., Clement, V., Xu, X., Chen, B., Chen, H., & Kan, H. (2019). Cardiovascular Benefits of Fish-Oil Supplementation Against Fine Particulate Air Pollution in China. Journal of the American College of Cardiology, 73(16). https://doi.org/10.1016/j.jacc.2018.12.093
38. Li, Y., Li, M., Qi, Y., Zheng, L., Wu, C., Wang, Z., & Teng, F. (2020). Preparation and digestibility of fish oil nano emulsions stabilized by soybean protein isolate-phosphatidylcholine. Food Hydrocolloids, 100. https://doi.org/10.1016/j.foodhyd.2019.105310
39. Lokuruka, M. (2011). Effects of processing on soybean nutrients and potential impact on consumer health: An overview. African Journal of Food, Agriculture, Nutrition and Development, 11(4). https://doi.org/10.4314/ajfand.v11i4.69170
40. Miyashita, K. (2019). Prevention of fish oil oxidation. In Journal of Oleo Science (Vol. 68, Issue 1). https://doi.org/10.5650/jos.ess18144
41. O'Bryan, C. A., Kushwaha, K., Babu, D., Crandall, P. G., Davis, M. L., Chen, P., Lee, S.-O., & Ricke, S. C. (2014). Soybean Seed Coats: A Source of Ingredients for Potential Human Health Benefits-A Review of the Literature. Journal of Food Research, 3(6). https://doi.org/10.5539/jfr.v3n6p188
42. Parletta, N., Zarnowiecki, D., Cho, J., Wilson, A., Bogomolova, S., Villani, A., Itsiopoulos, C., Niyonsenga, T., Blunden, S., Meyer, B., Segal, L., Baune, B. T., & O'Dea, K. (2019). A Mediterranean-style dietary intervention supplemented with fish oil improves diet quality and mental health in people with depression: A randomized controlled trial (HELFIMED). Nutritional Neuroscience, 22(7). https://doi.org/10.1080/1028415X.2017.1411320
43. Raatz, S. K., & Bibus, D. M. (2016). Fish and Fish Oil in Health and Disease Prevention. In Fish and Fish Oil in Health and Disease Prevention. https://doi.org/10.1016/c2014-0-02727-x

44. Ramalingam, L., Menikdiwela, K. R., Clevenger, S., Eboh, T., Allen, L., Koboziev, I., Scoggin, S., Rashid, A. M., Moussa, H., &Moustaid-Moussa, N. (2018). Maternal and Postnatal Supplementation of Fish Oil Improves Metabolic Health of Mouse Male Offspring. Obesity, 26(11). https://doi.org/10.1002/oby.22319
45. Ryckebosch, E., Bruneel, C., Termote-Verhalle, R., Goiris, K., Muylaert, K., & Foubert, I. (2014). Nutritional evaluation of microalgae oils rich in omega-3 long-chain polyunsaturated fatty acids as an alternative for fish oil. Food Chemistry, 160. https://doi.org/10.1016/j.foodchem.2014.03.087
46. Segura Munoz, R. R., Quach, T., Gomes-Neto, J. C., Xian, Y., Pena, P. A., Weier, S., Pellizzon, M. A., Kittana, H., Cody, L. A., Geis, A. L., Heck, K., Schmaltz, R. J., Bindels, L. B., Cahoon, E. B., Benson, A. K., Clemente, T. E., & Ramer-Tait, A. E. (2020). Stearidonic-Enriched Soybean Oil Modulates Obesity, Glucose Metabolism, and Fatty Acid Profiles Independently of Akkermansiamuciniphila. Molecular Nutrition and Food Research, 64(17). https://doi.org/10.1002/mnfr.202000162
47. Sidhu, K. S. (2003). Health benefits and potential risks related to consumption of fish or fish oil. Regulatory Toxicology and Pharmacology, 38(3). https://doi.org/10.1016/j.yrtph.2003.07.002
48. Suzana, S., Nik Nur Izzati, N. M. F., Siti Hajar, M., Hasnah, H., & Kamaruddin, M. Z. A. (2016). Sustainability supplementation intervention of fish oil and health education among elderly with mild cognitive impairment. SainsMalaysiana, 45(12). https://doi.org/10.17576/jsm-2016-4512-06
49. Ulven, S. M., &Holven, K. B. (2015). Comparison of bioavailability of krill oil versus fish oil and health effect. In Vascular Health and Risk Management (Vol. 11). https://doi.org/10.2147/VHRM.S85165
50. Xia, Y., Chen, F., Liu, K., Zhang, L., Duan, X., Zhang, X., & Zhu, Z. (2019). Compositional differences between conventional Chinese and genetically modified Roundup Ready soybeans. Crop and Pasture Science, 70(6). https://doi.org/10.1071/CP19006.