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Proximate Analyses of Some Selected Marine Food Fish from Farasan Island for Their Anti-Inflammatory Bioactivities and Cognitive Effects on Developing Fetus

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ABSTRACT

Background: Essential nutrients are critical for brain development and function. Inflammation involves an overproduction and release of reactive oxygen species. Various NSAIDs are used to treat inflammations. However, the serious side effects of some of these therapeutic agents often create a very high risk/benefit ratio. Fish contains high concentrations of long-chain n-3 polyunsaturated fatty acids (n-3 PUFA), which are essential nutrients for cell membrane formation, the development of neurons and their synaptic connexions. Regular consumption of fish has been related to several health benefits, including decreased incidence of inflammatory diseases, prevention of cardiovascular diseases and cancer, and normal brain development and function. These positive effects have been attributed to the high content of ω3 polyunsaturated fatty acids (PUFA), proteins, vitamins and minerals, as well as low cholesterol levels.

Aim: Present study was therefore conducted to generate data on the anti-inflammatory potential and cognitive effect of some selected food fish from Farasan Island.

Methods: Samples were collected from local fish market and were analyzed for their proximate composition as per AOAC (1995). Glasswares used were sterilized in an Autoclave (Maxterile-47, Daihan Scientific, South Korea). All analyses were done in quadruplicates with n=4. Statistical analyses as ONE WAY ANOVA was done using MS Excel and significance level was fixed at $P<0.05$.

Results: Highest fat content was recoded in Horse mackerel (71.23%) followed by small greasy grouper (62.78%) Arabi (36.8%), narrow-barred Spanish mackerel (30%), Shour (*Lethrinus nebulosus*, 32%), Greasy grouper (Hamoor 31.5%) and Bagrus (14.3%). Since marine oily fishes are more good for their anti-inflammatory and cognitive effects in the developing babies due to their being rich in ω -3 fatty acids as DHA & EPA which have potent anti-inflammatory effects and help in brain development in developing fetus.

Conclusion: Results clearly indicate that local community people could be made aware for the health benefit of the natural resources of high bioactive components for best health of both mother and developing fetus.

KEYWORDS: ω-3 fatty acids, anti-inflammatory potential of fish, cognitive effects, fetus

INTRODUCTION

The sea world is considered one of the most beautiful worlds that Allah Almighty created to contemplate and enjoy its beauty, as well as to benefit and work with it.

Essential nutrients are critical for brain development and function (Mendez 2009). Humans have particularly long neurodevelopmental periods, and the human brain is in development until the early 20s. The early life period, however, is decisive because of the rapid and intense neurodevelopment processes that are fully activated during that time. The long-term consequences of disturbing neurodevelopment in early life by environmental and nutritional hazards can be enormous (Grandjean 2006). In the evaluation of the evidence on the protection of the developing human brain from environmental hazards, it is also important to consider potentially beneficial factors such as breastfeeding, physical activity and seafood intake (Mozaffarian 2006). Furthermore, inflammation is an exceedingly complex process that has a crucial role in mammalian physiology (Medzhitov, 2008). The inflammatory response, triggered by noxious stimuli and pathologic conditions, aims to restore homeostasis and functionality

of the tissue/organ. However, if the abnormal conditions persist, a chronic inflammatory state can be observed, leading to alterations of the normal functioning of the tissues/organs. Fish contains high concentrations of long-chain n-3 polyunsaturated fatty acids (n-3 PUFA), which are essential nutrients for cell membrane formation, the development of neurons and their synaptic connexions (Rombaldi et al. 2012). Fish is a source of many nutrients that can be beneficial during pregnancy, Fish is rich in other essential nutrients required for normal brain function and development, such as selenium, vitamin D, and iodine (Oken et al. 2013). Previous investigations of fish intake in relation to cognitive/neurodevelopment have focused whereas potential benefits of fish consumption have been relatively unexplored. Fish intake by the mother during pregnancy, and by the infant postnatally, was associated with higher mean developmental scores. In this context, the development of pathological conditions, such as atherosclerosis, type 2 diabetes, cancer, rheumatoid arthritis and neurodegenerative diseases, is inevitable.

Inflammation involves an overproduction and release of reactive oxygen species (ROS; e.g., peroxyl radicals - $ROO^{\bullet}$, hydroxyl radicals - $^{\bullet}OH$, superoxide anion radicals - $O_2^{\bullet-}$, singlet oxygen, alkoxyl radical, hydrogen peroxide, and lipid hydroperoxide) and reactive nitrogen species (RNS; e.g., nitric oxide - $NO^{\bullet}$, and peroxynitrite) by immune cells (Chatterjee, 2016; Nimse & Pal, 2015). The production of ROS and RNS for prolonged periods, and the ineffective control of their levels by different endogenous antioxidants (superoxide dismutase, glutathione peroxidase, catalase, glutathione, lipoic acid, bilirubin, and ferritin) result in oxidative stress. Thereafter, inflammation and oxidative stress are interrelated and both processes may be attenuated by treatment with anti-inflammatory agents (non-steroidal anti-inflammatory drugs, glucocorticoids, and disease-modifying antirheumatic drugs) (Bennett et al. 2018 Mycroftwest et al. 2020) and/or antioxidants agents (vitamins and other scavenging compounds) (Chatterjee, 2016). However, the serious side effects of some of these therapeutic agents often create a very high risk/benefit ratio.

Regular consumption of fish has been related to several health benefits, including decreased incidence of inflammatory diseases, prevention of cardiovascular diseases and cancer, and normal brain development and function (Tilami & Sampels, 2018). These positive effects have been attributed to the high content of ω3 polyunsaturated fatty acids (PUFA), proteins, vitamins and minerals, as well as low cholesterol levels. Additionally, fish contains various antioxidants (such as enzymes - e.g., superoxide dismutase, catalase, glutathione peroxidase and glutathione S-transferase -, amino acids, peptides - e.g., anserine and carnosine -, gadusol, vitamins and ubiquinones) and compounds with anti-inflammatory activity (epolysaccharides - chondroitin sulphate and hyaluronic acid, for instance -, fatty acids, and proteins) (Mycroft-West et al., 2020; Wang et al., 2021). Consequently, we hypothesize that fish-derived compounds may have strong bioactivity to prevent or treat inflammatory diseases.

Seafood contains other essential nutrients that are also required for normal brain function and development, such as selenium, vitamin D, and iodine (Oken et al. 2013). Prenatal exposure to seafood as part of the maternal diet was found to have a positive relation with general developmental outcomes including improved scores on the MCDI and DDST scales at 18 months (Daniells et al. 2004), higher scores on the ALSPAC scale from 6 to 42 months of age (Hibbeln et al. 2007), having achieved foveal stereoacuity (an indicator of visual cortex maturity at 3.5 years of age; the association was only significant for oily fish) (Williams et al. 2001) and acquirement of developmental milestones at 6 and 18 months (Oken et al. 2008).

Most studies (William et al. 2001, Alberg et al. 2009, Theodore et al. 2009, Kim et al. 2010, de Groot et al. 2012), found a positive association between fish intake and neurodevelopment outcomes. For example, in the ALSPAC study in the UK (Hibbeln et al. 2007), a clear dose-response relationship was observed, higher amounts of fish and seafood intakes during pregnancy being associated with better developmental scores. Many studies point to the benefits of fish for the brain. It has been shown that increased consumption of fish reduces the risk of cognitive impairment with age, according to an observational study based on observation published in JAMA Neurology in 2005, and weekly fish consumption is associated with an increase in the volume of gray matter (in English: gray matter); It is one of the main functional tissues found in the part of the brain that regulates memory and feelings, according to a study published in the American Journal of Preventive Medicine in 2014.

Objectives of the study:

1- Identification of food fish species selected from Farasan Island that can act as anti-inflammatory during neonatal development.
2- Knowing the impact of food names on the health of newborns.
3- Knowing the benefits of food names selected from Farasan Island in the field of health.

The importance of studying

1- This study is one of the studies that focused on fish species in Farasan Island and its effect on newborns through its use as an anti-inflammatory.

2- These studies are among the studies that will help change everyone's perception of fish and its limited benefits, as fish have many great benefits.
3- The results of the study can also benefit new researchers as a reference for them in dealing with topics similar to the current topic, due to the importance of this study, which deals with approximate analyzes of some food fish selected from Farasan Island for their anti-inflammatory potential during neonatal development.

METHODOLOGY

SETTING

Biology Laboratory, Department of Nursing, Farasan University College

STUDY DESIGN

ıs samples of fish, then we measure the glass while it is empty, then we p fish sample on it and measure its weight

Then we put it in the dehydrator

Analytical study

STUDY SAMPLES

Samples of fish collected from local fish market

STUDY TIMELINE

Samples were collected during December to Mid of January 2023

PROXIMATE ANALYSES OF THE SAMPLES

CALCULATIONS

1- % Moisture content= Initial wt (g)-Final wt (g)/Initial wt (g)

2- % Dry matter= 100 - % Moisture

3- Crude fat%= Initial wt (g)-Final wt (g)/Initial wt (g)

4-Crude protein content %= Based of Optical density (OD) values of control and unknown samples

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RESULTS

Then we put the ether solution on the sample and put it in the desiccant

This is after the samples came out of the drying device, then we emptied the samples from the ether solution and put them in a filter paper, then we compared their weight after grinding with their weight after the ether solution in order to know the extent of the amount of fat for each fish

Grind dried fish

We measure the sample, then put the filter paper on it with the fishmeal, and measure its weight, then put the fishmeal in the sample box and measure its weight

A-*Lethrinus nebulosus*:شعور

B- *Lethrinus nebulosus*:شعور

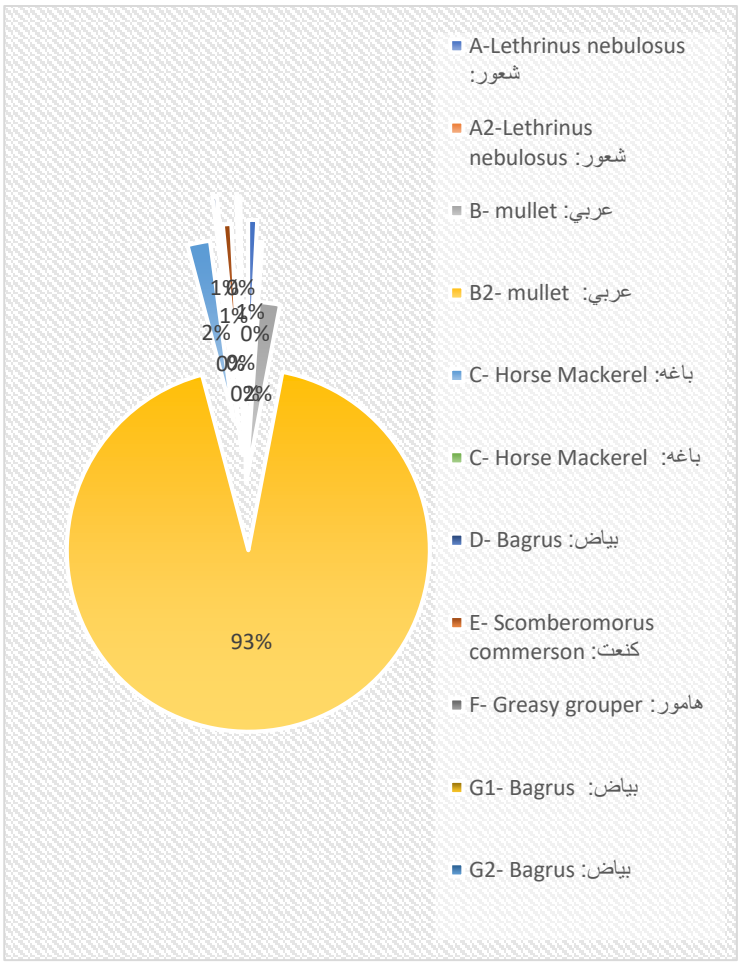
C- *Horse Mackerel*:باغه

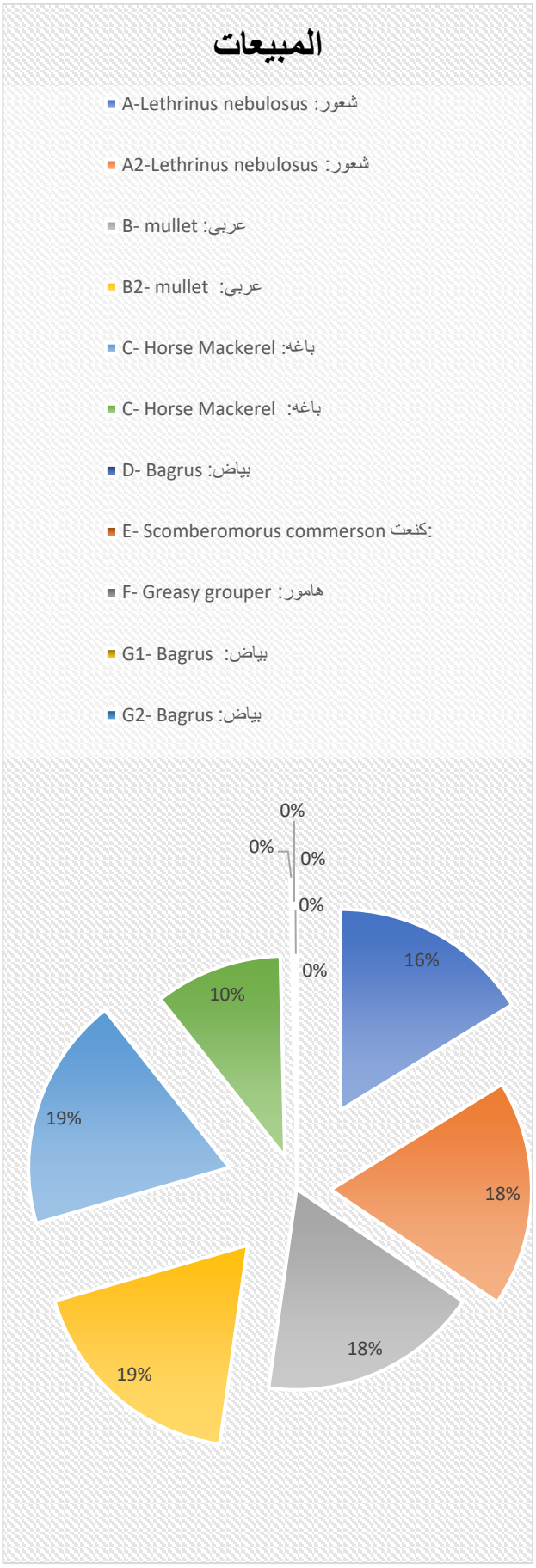
D- *Bagrus*:بياض

E- *Scomberomorus commerson* :كنعت

F- Greasy grouper :هامور

G1- *Bagrus* :بياض





DISCUSSION

The health benefits of consuming fish and its products have been attributed to their hydrophilic and hydrophobic compounds. Fish consumption during pregnancy has a significant influence on fetal growth and development but is particularly important for proper development of the brain and eyes. This has been largely attributed to the high amounts of omega-3 fatty acids in fish, and particularly to fish abundantly rich in Docosahexaenoic acid (DHA). However, fish also provide a variety of other important nutrients needed in neurodevelopment such as iodine and vitamin D. Iodine is critical for the production of thyroid hormones in normal growth and development of the fetal and infant brain, another plausible mechanism that links maternal fish consumption and child development. Evidence shows that both low and high iodine intake during pregnancy is associated with poor neurodevelopment.

Samples analyzed during present study exhibited high fat content for Horse mackerel (71.23%) followed by small greasy grouper (62.78%) Arabi (36.8%), narrow-barred Spanish mackerel (30%), Shour (*Lethrinus nebulosus*, 32%), Greasy grouper (Hamoor 31.5%) and Bagrus (14.3%). Since marine oily fishes are more good for their anti-inflammatory and cognitive effects in the developing babies due to their being rich in ω-3 fatty acids as DHA & EPA which have potent anti-inflammatory effects and could be helpful in brain development in developing fetus.

Fish as a natural anti-depressant

Studies indicate the importance of omega-3 fatty acids found in fish in reducing depression. A systematic review and statistical analysis of 31 studies and published in the Journal of Affective Disorders in 2016 found that fish consumption reduces the incidence of depression, due to its content of these fatty acids, including: In which; Docosahexaenoic acid or DHA for short, and eicosapentaenoic acid or EPA for short.

Benefits of fish for children

Fish contains many nutrients necessary for the health of children, such as vitamins, minerals, and high-quality proteins, in addition to various types of healthy fats. Docosahexaenoic acid, which is important for brain development

The benefit of fish for diabetics

The inclusion of fish in the diet of diabetics is a good thing, as it contains protein that provides their bodies with the necessary energy, in addition to omega-3, which may help promote heart health, moreover, its vitamin D content makes up for its common deficiency among diabetics.

Indeed, our team demonstrated that several bioactive compounds, including essential amino acids, better performances in cognitive functions related to verbal, memory, and visual-performance abilities; and improved behavioral outcomes related to hyperactivity, social competence, and school grades. Even though the exact mechanisms explaining these benefits are not clear, these findings may indicate that the essential nutrients such as omega-3 fatty acids derived from fish globally enhance neurodevelopment in both early and later stages. For instance, DHA may play an important role through several biological pathways during neuron differentiation and migration, axonal and synaptic growth, and synaptic connections until the early 20s. Deficit of dietary DHA is also known to alter neuronal myelination and cause mental retardation, and improvement is observed when DHA is restored (Beneto et al. 2018). Additionally, animal studies have linked insufficiency of omega-3 fatty acids to alterations in neurotransmitters (Claudia et al. 2014). This could be related to behavioral and emotional changes.

These ω3 PUFA are well known for their anti-inflammatory properties (Cheung et al., 2016). Additionally, polar bioactive compounds (e.g., essential amino acids, peptides, B vitamins, and gadusol) were detected as mentioned above in the aqueous extracts derived from the fish species analyzed (Guedes et al., 2022). For instance, taurine has been shown to suppress inflammatory cytokines, including TNF-α, IL-6, IL-1β, and iNOS in activated macrophages (Rudkowska et al., 2010).

LIMITATIONS OF STUDY

There were several limitations to this study. Firstly, the time constrains, and another is unavailability of some specific chemicals and equipment for further analyses essential nutrients and the body composition of each sample.

CONCLUSION

Several studies conducted during past decades support beneficial roles of fish/seafood intakes for their anti-inflammatory bioactive components and cognitive effects during neurodevelopment, both pre- and post-natally including social competence and school performance. However, intervention studies are highly recommended.

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