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Radical Scavenging Properties of Some Teleosts in Ado-Ekiti Market, Nigeria

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Abstract

Consumption of fish, as a major protein source, is a common practice, despite the high increasing cost. This study was designed to determine the antioxidant activities of some selected fish species (*Scromber scrombrus, Oreochromis niloticus, Clupea pallasii, Gadus morhua and Trachurus trachurus*), commonly consumed in Nigeria, using 2, 2, diphenyl-1 picrylhydrazyl (DPPH). The result revealed that the antioxidant activities of *S. scrombrus* (3.52 ± 0.018), commonly called 'alaran,' was significantly higher ($p < 0.05$) than those of O. niloticus (1.71 ± 0.016), *C. pallasii* (1.69 ± 0.015), G. morhua (2.42 ± 0.016) and *T. trachurus* (1.79 ± 0.044). However, the trend of the antioxidant activities of these fish samples, sold in Oja Oba Market, Ado Ekiti, is in the order *S. scrombrus* > *G. morhua* > *T. trachurus* > Oreochromis niloticus > *O. niloticus* > *C. pallasii.* It is hoped that inclusion of these fish species, especially, S. scrombrus, in the diet will go a long way in scarvenging the free radicals generated by environmental pollution and essential metabolic reactions, in humans.

Key words: *Oxidation; Radicals; Scavenging; Diseases; Fish*

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Introduction

Antioxidants are compounds capable of delaying, reducing or preventing auto-oxidation processes (Shahidi and Wanasundara 1992). They block the formation of free radicals, stabilize hydroperoxides and thus slow down oxidation and rancidity development. The main characteristic of an antioxidant is its ability to trap highly reactive free radicals and oxygen species that are present in biological systems from a wide variety of sources.

Free radicals are inevitably produced in biological systems and also encountered exogenously. Free radicals are normal component of cellular oxygen metabolism in mammals (Roche., *et al*. 2008) These free radicals may oxidize nucleic acids, proteins, lipids or DNA and can initiate degenerative diseases, like mutagenesis, carcinogenesis, cardiovascular disturbances and ageing (Singh and Singh 2008). Antioxidant compounds like phenolic acids, polyphenols and flavonoids scavenge free radicals such as peroxide, hydroperoxide or lipid peroxyl. Free radicals may also be formed as nitrogen, carbonyl, chlorine, sulphur and other reactive species. During oxidation electrons

or hydrogen are transferred from one molecule to another, the latter serving as an antioxidant. Antioxidants, therefore, can stop the formation of free radicals and the chain reactions, which would otherwise result in cell damage or even death. Yet, the process of oxidation plays an n important role in the body's defence against infection or in response to tissue damage.

Pro-oxidant foods are principally those with excessive metals such as manganese, iron, zinc or copper. Zinc is of greater interest for its pro-oxidant roles, because of its involvement with amino acids, proteins and metallo-enzymes. Likewise, selenium, copper and iron are involved with enzymes such as glutathione peroxidase, superoxide dismutase and catalase. Free radicals and reactive oxygen species in general are no longer seen only as destructive factors but also (and perhaps first of all) as messengers involved in intracellular and intercellular signalling (Bartosz 2005; Halliwell 2006). Reactive species can also play roles as cellular secondary messengers and regulators or signalling molecules as with nitric oxide or gaseous sulphur dioxide. Physical activity increases the oxidant load and if regular, progressively increases the body's ability to respond to such a load. Anti-oxidant capacity is required both extra and intra-cellularly (in cytosol, nucleus and mitochondria) for the homeostasis of oxidant status.

Antioxidants are the compounds, which combat the free radicals by intervening at any one of the three major steps of the free radical mediated oxidative process, viz., initiation, propagation and termination (Cui., *et al*. 2004). Scientific evidence suggests that antioxidants reduce the risk for chronic diseases including cancer and heart disease. Antioxidants are also widely used as ingredients in dietary supplements in the hope of maintaining health and preventing diseases. Recently, the demand for novel natural antioxidants has increased. This is because of the possible adverse side effects of synthetic antioxidants and beneficial effects of natural antioxidants (Benjakul., *et al*. 2005; Sarkardei and Howel 2008).

Antioxidant compounds in food play an important role as a health protecting factor. Ascorbic acid (AA) and citric acid (CA) and their salts are widely known for their role as chelators (Boyd., *et al*. 1993; Oktar., *et al.* 2001; Kim., *et al.* 2006) in biological systems and synergists of other antioxidants. These antioxidants are also produced by biological system and occur naturally in many foods and the balance between oxidants and antioxidants decides the health and vigor of the organism (Halliwell 1996).

Therefore, the importance of screening naturally occurring alternatives, which are safe, effective as dietary supplements, or as processing aids, and relatively cheap, is increasing (Tang., *et al.* 2001). The plant kingdom offers a range of natural phenolic compounds, among which is tocopherol (vitamin E). Vitamin E is best known as one of the most efficient naturally occurring liposoluble antioxidants (Mallet., *et al*. 1994). Some of the major active compounds reported are flavonoids and related compounds in plant extracts such as phenolics in spices and herbs (Rajalakshmi and Narasimhan 1995). Most of the antioxidant compounds in a typical diet are derived from plant sources and belong to various classes of compounds with a wide variety of physical and chemical properties.

There is, however a dearth of information on the antioxidant properties of fish species commonly sold in the Nigerian markets, and consumed by Nigerians. This project was, thus designed, to analyze the anti oxidant properties of some frozen fish species [tilapia (*Oreochromis niloticus*) commonly called '*Epiya*'; titus (*Scomber scrombrus*) commonly called 'Alaran'; herrings (*Clupea pallasii*) commonly called 'Shawa'; gadus commonly called 'Kote', (*Gadus morhua*) and horse mackerel (*Trachurus trachurus*] available in Oja Oba market, Ado - Ekiti.

Materials and Method

Sample Collection and Preparation

The fish species [tilapia (*Oreochromis niloticus*); titus (*Scromber scrombus*); herrings (*Clupea pallasii*); gadus called 'Kote' in yoruba language, (*Gadus morhua*) and horse mackerel (*Trachurus trachurus*] were purchased from Oja Oba market in Ado-Ekiti. The trunk part of each sample was severed, wrapped in polyethylene foil labeled A, B, C, D, E accordingly, and taken to the laboratory, where it was kept in frozen form till use.

The antioxidant activities of the various fish fillet samples were carried out at the Animal Production and Health, Nutrition Laboratory, Federal University of Technology, Akure (FUTA), using the scavenging effect on 1,1, diphenyl-1-picrylhydrazyl (DPPH) free radical. 0.5 ml DPPH solution was prepared by dissolving 240 mg powder in 1 litre of methanol. 80:20 concentration of solvent mixture was prepared using 0.2% acetone and formic acid respectively. 2g of the sample was weighed and macerated in a blender using 20 ml of methanol. The mixture was allowed to stand for 2 mins. Then the sample suspension was filtered using Whatman filter paper and the resultant filtrate was used for analysis. After filtration, the filtrate was made up to 50 ml to make 2g/50ml. From this stock, 40 mg ml^{-1}., 30 mg ml^{-1}, 20 mg ml^{-1} and 10 mg ml^{-1} of the filtrate were prepared. The concentration was read at a wavelength of 570 nm, on a UV-spectrophotometer.

Statistical Analysis

Data generated were subjected to one way analysis of variance (ANOVA) according to Duncan's Multiple Range Descriptive Test (Duncan 1955) with mean at a significant level of $p < 0.05$. Standard errors of means were also determined at 95% confidence limit using SPSS 13.0 package.

Results and Discussion

The DPPH (2,2 diphenyl picryl hydrasyl) concentration of the fish samples were expressed as mg/100g as presented in Table 1. ANOVA of data shows there was significant difference ($p < 0.05$) between sample D and the others, However there was no significant difference ($p > 0.05$) between samples A, B, C and E. According to Serdaroglu and Felekoglu (2005), usage of antioxidants have best influence on increasing shelf life and delaying improper changes in sea food. Antioxidants in food may be water soluble, fat soluble, insoluble or bound to cell walls and thus not necessarily freely available to react with DPPH, hence they react at different rates. The result of the biochemical analysis in Table 1 revealed a high DPPH concentration in sample D with 3.52 ± 0.018 and lowest in sample C with 1.69 ± 0.015. There was no significant difference ($p > 0.05$) between radical scavenging properties of samples A, B, C and E. Similar results were reported by Chen., *et al*. (1998) on milk fish and Pourashouri., *et al*. 2009, on catfish. The findings of Engelhardt., *et al.*

Fish Samples	Mean ± Standard Deviation
Gadus morhua (A)	2.42 ± 0.016^{a}
Trachurus trachurus (B)	1.79 ± 0.044^{a}
Clupea pallasii (C)	1.69 ± 0.015^{a}
Scromber scrombus (D)	3.52 ± 0.018^{b}
Oreochromis niloticus (E)	1.71 ± 0.001^{a}

Values with the same superscript are not significantly different at $p > 0.05$ from one another

Table 1: *The DPPH concentration (mg/100g) of the fish samples.*

(1975) showed that the muscles of Atlantic herring contain 1.7 to 2.1 mg/100g antioxidants, which is similar to the result reported for the herrings (sample C) used in this study (1.69). The fish sample D (*Scomber scrombrus*) showed significantly higher ($p < 0.05$) antioxidant potential by the DPPH radical scavenging method, when compared to the other species. Ackman (1989) also reported that *Scomber scrombrus* shows a high antioxidant capacity and can be considered among fatty fishes. *Scomber scrombrus* is one of the highly recommended oily fish for a healthy diet. It contains protein and antioxidant coenzymes Q (ubiquinol) which helps to eliminate cancerous agents from afflicted cell. Antioxidant composition or activity of fish flesh is found to vary with the oil content of fish. High oil or fat content is usually a criterion for antioxidant capacity. *Scomber scrombrus*, a semi-pelagic fish is the largest source of fish oils, as reported by Allister and Colin (1992); the quantity of oil being dependant on capture season.

The lipid content and other biochemical composition of fish flesh can vary greatly depending on age, maturity, size of fish and the position from where the sample was taken (head to tail, back or belly flap, dark or light meat) (Flick., *et al*.1992). Aubourg., *et al*. (2005)

reported that Scomber scrombrus caught in May contained low concentration of antioxidants, while those caught in October had the highest concentration of antioxidants. Other factors that can determine the antioxidant activity include the area of the water from which the fish was caught. The length of the period of storage of these fish species could cause lipid oxidation which could affect their radical scavenging ability. Oxidation increases when dehydration occurs. Hiremath (1973) showed that the main reason for oxidation of fats in frozen fish was dehydration of the tissue during storage and exposure to atmospheric oxygen. The determination of the radical scavenging activites of fish has to be in relation to these factors. The antioxidant activity in a fish can influence the nutritional value of fish species.

With this high level of antioxidant composition reported in the fillet of *Scomber scombrus*, popularly known as 'Alaran' among the Yorubas of the south western Nigeria, it is recommended for consumption particularly by the elderly people. Even though multiple mechanisms underlie the human aging process, but interest continues in the role that free radicals and antioxidants may play.

Conclusion

Chiefly, the antioxidant capacity/radical scavenging property of a fish should always be considered in making choice of consumption because antioxidants in fish prevents the formation of free radicals which in turn decides the health and vigour of the consumer. Fish with high radical scavenging property should be taken by consumers so as to reduce the risk of various degenerative disorders like mutagenesis, carcinogenesis, cardiovascular disturbances and ageing. From the findings of this work, it is recommended particularly, that elderly people eat more of the fish *Scomber scrombrus*, popularly known as 'alaran' as an anti-ageing device. The result of this study would help consumers in selecting fish species to be purchased in the King's market, Ado Ekiti.

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