**A REVIEW ON THE EFFECTS OF SMOKED FISH ON THE HEALTH OF ITS CONSUMERS**

**ABSTRACT**

Fish smoking is an ancient and popular way of fish preservation. Fish smoking is a combination of various processes such as salting, drying, heating, smoking, and sometimes cooking effects depending on smoking method used. Smoked fish are highly rich in protein and are palatable with longer shelf life. Smoked fish enhances growth and metabolism, foetal development among others. However, prolonged consumption of fish intoxicated with PAHs could occur as a result of incomplete combustion of wood or coal causes cancer and retarded growth. This article describes various smoking methods and the health effects of smoked fish consumption to humans.

*Keywords: fish smoking, consumption , health , Carcinogenic compounds*

**1.0 INTRODUCTION**

Considerable portion of the protein intake in the diets of a large proportion of the people, particularly in developing countries like Nigeria are made up of fish as it represents about 14% of all animal protein in the globe. Fish is cheaper and relatively more abundant constituting about 40% of animal protein intake in the diet of the people, thus giving it an advantage over meat in Nigeria [1]. Fish is mostly preferred over pork, beef and other animal because it has little or no religious embargo in Nigeria. Fish deteriorates immediately as it dies, therefore as an effort to reduce post harvest losses, various preservation and processing techniques such as refrigeration, freezing, canning, smoking, salting, and drying have been put in place. Smoke dried fish have extended shelf life due to the antioxidant and bacteriostatic effects of the smoke on the fish. Smoking is applied to wide range of food including fish and meat products and not also limited to other food categories, such as cheese and mushroom[4]. Polycyclic aromatic hydrocarbons (PAHs) a harmful Carcinogenic compound constitute a large class of organic compounds, containing two or more fused aromatic rings made up of carbon and hydrogen atoms which occur from incomplete combustion. Smoked food is one source of PAH [7]. To prevent as well as to mitigate the effect of this harmful Carcinogenic compound (PAH) it’s imperative to study the effect of smoked fish on the health status of its consumers

**2.0 FISH SMOKING**

Smoking is the most commonly practiced method of preserving food. Fish Smoking as the name implies entails exposing fish to smoke from burning plant materials (wood) or coal in order to enhance the palatability and the shelf life of fish. Fish is smoked usually by the combination of drying, heating, smoking, and sometimes salting effects on the fish product . The drying, antioxidant and bacteriostatic effects of smoke enhance the shelf-life of smoked fish products. Smoked seafood includes different varieties like, smoked finfish and smoked bivalves. Smoked products are mostly ready-to-eat form [8].

Smoking is an ancient method of food preservation and has been heavily relied upon for long term storage of fish and meat products. Smoking enhances the flavor, appearance and texture of the products. In Africa, smoke is mostly brought about by the burning of fire wood. Smoke emitted from a burning wood contains three major components(cellulose, hemicellulose and lignin) that are broken down in the combustion process known as pyrolysis (a chemical decomposition of wood by heat).

Smoking of fish is usually done to enhance the flavor and texture of the fish product in developed countries where refrigeration and efficient transportation system are put in place, but not as a means of fish preservation which is contrary to developing countries where refrigeration and efficient transportation system are not in place thus, making it a very important method of fish preservation. In the smoking process, drying effect is crucial as it reduces the moisture content in the flesh of the fish that allows bacterial activity and spoilage thereby extending the shelf life of the products [9].

Modernization of food preservation technology including various methods such as pasteurization, cooling/refrigeration, deep-freezing, and vacuum packaging, have outmatch the preserving functions of many traditional methods including smoking. Recently, the purpose of smoking is shifting to sensory quality rather than for its preservative effect [8]. Four basic types of smoking method can be defined depending on the temperature and how the smoke is been delivered to the fish product: hot smoking, cold smoking, liquid smoking, and electrostatic smoking.

**2.1 Hot smoking**

Hot smoking is usually done at temperature above 70°C and for smoked fish product, a minimum thermal process of 30 minutes at or above 62.8°C is required for optimum preservation. Hot smoking is mostly done traditionally, however, Some recently designed smokehouses have more precise control of the temperature, air ventilation, and smoke density . Thus, the fish products from modern smokehouses have more quality and are much more uniform than those produced with traditional smokers.

**2.2 Cold smoking**

In this method as the name implies fish are not cooked but are rather exposed to temperature below 30°C. Cold smoking has higher yield ,runs longer as compared to the traditional hot smoking method and also retains the original texture of the products

Cold smoking of varied fish species has been reported, including rainbow trout.

**2.3 Liquid smoking**

In this method, fish are directly dipped in the smoke or uniformly sprayed with the smoke. As compared with cold and hot smoking methods it can easily be modified and applied to the fish, less environmental pollution, low operation cost and it also ensures a uniform smoke flavor. However, flavor and color from the traditional smoking cannot be exactly duplicated [3]. This method has been reported in swordfish ,salmon and trout

**2.4 Electrostatic smoking**

This method as the name implies is brought about by the deposition of smoke particles which are positively charged onto the surface of the fish which are negatively charged. This method may however change the composition of the smoke but it’s still more efficient than the traditional smoking. Composition of the smoke maybe influenced by the skin thickness, subcutaneous fat amount, presence of scale among other factors.

Application of electrostatic smoking has been reported mainly in salmon and herring.

**3.0 POSITIVE EFFECTS OF SMOKED FISH CONSUMPTION**

However, it is difficult to find a comprehensive study providing a comparison of the chemical composition and nutritional value of many freshwater and sea fish species as well as the content of micronutrients and analysis of the impact of culinary methods on changes in nutrient compounds.

Smoked fish is widely consumed for its nutritional values and health benefit not only for it’s palatability. Fish is a rich source of nutrients such as proteins, healthy fats, and minerals. These nutrients are also present in dried fish products, thus furthering the benefits by prolonging the shelf-life of the fish by smoke drying. Crucial essential amino acids like cysteine, methionine and lysine which are effective antioxidants are absent in some plant and animal protein but are found in smoked fish [19][20]. Cysteine prevents the accumulation of toxic metabolic wastes that fosters ageing whereas methionine controls nucleotide and redox statuses [21]. Methionine can also possibly aid in the prevention of cancer as it metabolism is ought to be linked with tumour cell metabolism. It has been reported. that lysine could have preventative and therapeutic effects on osteoporosis as it actively participate in the uptake of calcium in the body [22] It is mentioned that smoked fish proteins contain essential amino acids for body growth, repairing functions and metabolism, [19]. Hence, it can be concluded that the protein contents in dried fish aid in regulatory functions in the body and prevent various diseases.

Fish contain fats that are claimed to be healthy, especially when smoked. For instance, fish contain EicosaPentaenoic Acid(EPA) and DocosaHexaenoic Acid (DHA) acids which help in foetal development and the prevention of cardiovascular diseases [24]. Smoked ﬁsh are rich in mineral and vitamins such as calcium, phosphorus, and B-vitamins which are active participants in bone marrow development and maintenance.

**5.0 THE NEGATIVE EFFECT OF SMOKED FISH ON CONSUMPTION**

Formation of PAHs is brought about by the incomplete combustion of fuel (wood, coal or oil). Environmental contaminants as well as various food processing methods such as smoking, grilling, boiling and toasting, are the common sources of PAHs in foods. The health effects resulting from the consumption of food contaminated with PAH have recently been discussed extensively in the literature [41]. Among the effects include the include following : retarded growth, low birth weight, small head circumference, low IQ, damaged DNA in unborn children and the disruption of endocrine systems, such as estrogens, thyroid and steroids [42]. Early menopause due to destruction of ova have also been associated with PAHs accumulation . It has been reported that PAHs metabolizes in mammalian cells to diol and epoxides that form complexes with macro molecules such as DNA, thereby causing errors in DNA replication and mutations [43][44]. Glutathione transferase deficiencies which occur as a result of polymorphisms may result in elevated breast cancer, lung cancer and other forms of human cancer risk from PAHs accumulation [46][47].

**7.0 CONCLUSIONS**

Smoked fish can have both positive and negative effects on health depending on various factors such as the type of fish, the smoking process, and the frequency of consumption.

Smoked fish consumption is a good source of protein and other essential nutrients needed for growth and various metabolic processes such as omega-3 fatty acids, which have been associated with numerous health benefits. However, smoked fish containing high levels of salt can lead to high blood pressure in some individuals. Additionally, smoked fish maybe contaminated with carcinogenic compounds called polycyclic aromatic hydrocarbons (PAHs) and heterocyclic amines (HCAs), which can increase the risk of certain cancers when consumed in large amounts over a long period.

**8.0 RECOMMENDATION**

It is recommended that liquid smoke should be used in fish smoking since it passes through a filter that removes impurities and other carcinogenic compounds, and also balanced diet should be maintained with plenty of fruits and vegetables to mitigate any potential negative effects of smoked fish consumption.

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