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COMPARATIVE PROXIMATE ANALYSIS OF TELFAIRIA OCCIDENTALISAND AMARANTHUS HYBRIDUSLEAVES SOLD IN JATTU MARKET IN ETSAKO WEST LOCAL GOVERNMENT AREA OF EDO STATE

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ABSTRACT

- This study was undertaken to compare the nutritional value of the leaves of *Telfairia occidentalis* (Pumpkin leaf) and *Amaranthus hybridus* (Green leaf) sold at Jattu Market in Etsako-West Local Government Area of Edo State. The fresh samples of *Telfairia occidentalis* and *Amaranthus hybridus* were purchased from Jattu Market, washed thoroughly with distilled water, sundried for three days and grinded. The moisture content, ash content, fat content, crude fibre content and carbohydrate content were determined. The result shows that the moisture content value obtained for *Telfairia occidentalis* and *Amaranthus hybridus* were 7.90% and 23.10% respectively. The percentage ash content for *Telfairia occidentalis* and *Amaranthus hybridus* were 2.60% and 10.04% respectively. The fat content value obtained for the samples were 0.95% and 1.22% for *Telfairia occidentalis* and *Amaranthus hybridus* respectively. The Crude fibre value for *Telfairia occidentalis* and *Amaranthus hybridus* were 3.20% and 10.44% respectively. *Telfairia occidentalis* and *Amaranthus hybridus* had carbohydrate value of 83.26% and 38.18% respectively. *Telfairia occidentalis* had a higher nutritional value in terms of carbohydrate contentwhile *Amaranthus hybridus* had a higher nutritional value in terms of moisture, ash, fat and crude fibre content. The results provide useful information in selecting vegetable for health benefits.

- **Keywords**: Nutritional value, *Telfairia occidentalis*, *Amaranthus hybridus,* Jattu market, Fresh Samples, sundried.

INTRODUCTION

Leafy vegetables are sources of essential and trace elements which play a major role in the normal functioning of the body system, maintaining regular metabolic processes and repair of worn-out cells and tissues in man (Bruijnzeel *et al.*, 2010). Vegetables serve as an indispensable constituent of human diet, supplying the body with minerals, vitamins and certain hormone precursors, in addition to protein and energy (Yetunde *et al*., 2017). It has been reported that vegetables contains numerous vitamins such as beta carotene, ascorbic acid, riboflavin, folic acid as well as minerals like iron, calcium, phosphorus and others (Lubdha and Anjali, 2014). Vegetables act as powerful medicine which can help reduce the risk of chronic diseases (Olagbemide and Philip, 2014). They have great potentials against heart diseases,

cancer, blood pressure and high cholesterol (Antonious *et al*., 2009). Lawal *et al* (2015) reported that fresh vegetables contain high amount of ascorbic acid content when compared to vegetables that have undergone any form of processing. Vegetable are highly perishable and require careful processing in order to preserve the nutrients, especially the water soluble vitamins. *Telfairia occidentalis* (Pumpkin leaf) is a popular edible leaf and seed vegetable which belongs to the family *Cucurbitaceae*. It is endemic to southern Nigeria, and was an asset to international food trades of the Igbo ethnic group (Wahua *et al*., 2020). The leaves are rich in vitamins and minerals such as calcium, phosphorus and iron (Eseyin *et al*., 2018). The leaves are good sources of PotassiumK, Copper, Iron, Manganese, moderate sources of Magnesium and Zinc which are essential in human and animal nutrition (Lawal *et al*., 2015). The seed is also eaten as food. The oil obtained from the seed is used in cooking (Okoli, 2013). *Amaranthus hybridus*, popularly called "Green leaf, Amaranth or pigweed", is an annual herbaceous plant of 1- 6 feet high. Theleaves combined with condiments are used to prepare soup (Ullah *et al*., 2017). A mixture of the boiled leaves and groundnut sauce is eaten as salad in Mozambique and in West Africa (Akinnibosun and Adeola, 2015). Generally, the leaves of Amaranths have sufficient amount of vitamin 'A' forming carotenoids and can be used to fortify weaning food for children (Dada *et al*., 2017)

It is the aim of this study to compare the nutritional value of the leaves of *Telfairia occidentalis* and *Amaranthus hybridus* sold at Jattu Market in Etsako-West Local Government Area of Edo State.

MATERIALS AND METHODS

Materials

The materials include Oven, Desiccator, Crucible, Soxhlet Apparatus, Petroleum ether, Potassium Hydroxide, Muffle Furnace, 1.25% tetraoxosulphate (IV), Potassium sulphate, and Copper sulphate.

Sample Collection and Preparation

The fresh samples of *Telfairia occidentalis* (Pumpkin leaf) and *Amaranthus hybridus* (Green leaf) were purchased from Jattu market in Etsako-West local government Area of Edo State. The samples were washed thoroughly with distilled water, sun-dried for three days and blended (AOAC, 2006).

NUTRITIONAL ANALYSIS

Determination of Percentage Moisture Content

Washed crucibles were oven dried at 105 ^{0}C for an hour to ensure total dryness. They were then transferred into the desiccator to cool for about 30 minutes. The crucibles were weighed on an electronic balance and the weight recorded as (W_1). 5 g of grinded sample was weighed into the dried pre-weighed crucible (W_2). The crucibles and the content were oven-dried at 105 ^{0}C for 4 hours. The samples were removed from the oven and dried until a constant weight was obtained. After drying, the crucible was transferred into the desiccators to cool for

about 45 minutes and weighed (W_3). This analysis was carried out in triplicate and the average value was recorded as moisture content (AOAC, 2006).

Calculations

% Moisture content = $\frac{\text{Loss in weight due to drying}}{\text{Weight of sample before drying}}$

% Moisture content = $\frac{W2-W3}{W2-W1} \times 100$

Where,

W_1 = Weight of empty Crucible

W_2 = Weight of empty crucible + sample before drying

W_3 = Weight of crucible+ sample after drying (constant weight).

% Total Solid = $\frac{W3-W1}{W2-W1} \times 100$

Or % Total solid = (100 - % Moisture content)

Total Solid is the part that is not water.

Determination of Total Percentage Ash Content

Clean crucible was pre-dried in an oven for 30 minutes at 100 ^{0}C to assure total dryness of the crucible. It was then transferred into the desiccator to cool for 30 minutes and weighed on an electronic weighing balance as W_1. 5 g of sample was weighed into it and recorded as W_2. It was placed in a muffle furnace for 4 hours and the temperature was slowly increased to 450 ˚C to avoid incomplete ashing. Samples was ashed until it becomes whitish in colour. It was removed into the desiccator with a tong and cooled to room temperature for an hour (AOAC, 2006). Sample was reweighed as W_3. The percentage ash was calculated as followed and average taken:

Calculation

% Ash Content = $\frac{\text{weight of ash}}{\text{weight of sample (after drying)}} \times 100$

% Ash Content = $\frac{W3-W1}{W2-W1} \times 100$

% Organic matter = 100 - % Ash

Determination of Percentage Crude Fat Content

Previously dried, fat free thimble was weighed as W1. 5 g of sample was weighed into the thimble and weighed as W_2. The thimble and the sample was carefully wrapped and tied. Washed and dried 500 ml round bottom flask was weighed as W_3. The flask was half filled with 40/60 petroleum ether and the sample was dropped into the sample holder of the soxhlet extraction apparatus. The flask was then placed on a heating mantle and the heat source was adjusted to allow it to boil gently at 34^{0}C. It was allowed to siphon over 5 hours. The condenser was detached and the thimble removed. Petroleum ether was distilled from the flask. The distilling flask containing the oil was air dried at 100 ^{0}C for exactly 5 minutes to remove the solvent residues in oil. This was put inside a desiccator to cool and the weight was taken as W_4. The percentage fat contained was determined thus:

% Crude fat = $\frac{\text{Weight of Flask + oil – Weight of empty flask}}{\text{Initial Weight of Sample}} \times 100$

% Crude fat = $\frac{W4-W3}{W2-W1} \times 100$

(AOAC, 2006)

Determination of Percentage Crude Fibre

The starch and the protein part of food were dissolved by boiling with acid and then with a very strong base (NaOH). The residue, which comprises of cellulose and lignin was washed, dried and weighed. The residue was

ashed and the weight was subtracted from the weight of the residue. 3 g of defatted sample was weighed (W_1) into 250 ml beaker containing 200 ml of 0.125 M or 1.25 % tetraoxosulphate (iv) acid (Sulphuric acid). The mixture was heated in a steam bath at 70 – 90 ^{0}C for 2 hours, it was then allowed to cool. The cooled mixture was filtered using a muslin cloth over a Buckner funnel. The residue was washed three times with hot distilled water to remove the acid and then put in a beaker containing 200 ml of potassium hydroxide. The mixture was heated as before over a steam bath for 2 hours. The solution was filtered and the residue washed three times with hot distilled water, then with petroleum ether and water. The final residue obtained was put in clean pre-weighed (W_2) crucible and dried at 120 ^{0}C to a constant weight. The crucible with the oven-dried sample was put in a muffle furnace and ashed at 550 ^{0}C for 30 minutes such that the sample became ash white. The crucible and its contents were removed from the furnace, cooled in a desiccator and reweighed (W_3). Percentage fibre was calculated according to Association of Analytical Chemists (AOAC) (AOAC, 2006).

$$\% \text{ Crude fibre} = \frac{\text{weight of oven dried sample – weight of ash X 100}}{\text{Initial weight of sample}}$$

$$\% \text{ Crude fibre} = \frac{W2-W3}{W1} \times 100$$

Carbohydrate Content Determination

The carbohydrate content of the sample was obtained by difference, that is, as the difference between the total summations of percentage moisture, fat, fibre, protein and ash (Oyeleke, 1984).

% Carbohydrate= 100 – (% moisture + % fat + % protein + % fibre + % ash)

RESULTS AND DISCUSSION

Result

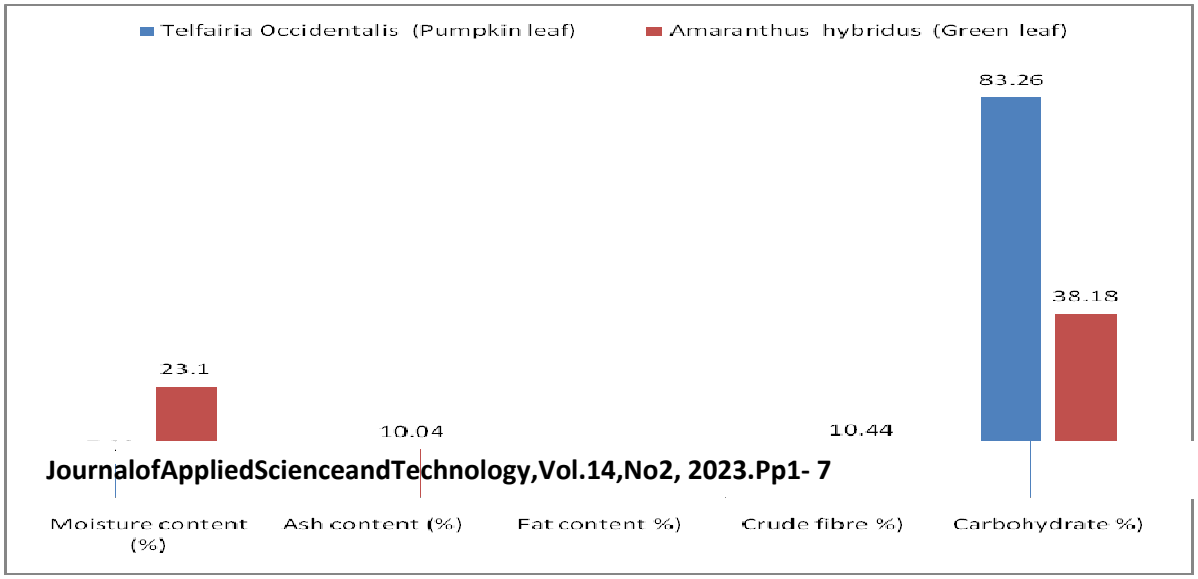

Figure 1**:** Nutritional value of*Telfairia Occidentalis* (Pumpkin leaf) and *Amaranthus hybridus* (Green leaf)

Discussion

The percentage moisture content values obtained for the samples were 7.09 % and 23.10 % for *Telfairia Occidentalis (*Pumpkin leaf) and *Amaranthus hybridus* (Green leaf) respectively.*Telfairia Occidentalis*had a lower moisture content value when compared to *Amaranthus hybridus.*The lower moisture content value of *Telfairia Occidentalis*shows that it has better preservative ability and more resistance to deterioration than *Amaranthus hybridus* (Green leaf).Moisture content determination is an important factor that is critical in food quality, preservation and resistance to deterioration.

The percentage ash content values obtainedfor *Telfairia Occidentalis (*Pumpkin leaf) and *Amaranthus hybridus* (Green leaf) were 2.60 % and 10.04 % respectively. The result showed that *Amaranthus hybridus* (Green leaf) has higher ash content when compared to *Telfairia Occidentalis (*Pumpkin leaf).Ash is the inorganic residue after the water and organic matter have been removed from a substance by heating in the presence of certain oxidizing agents. The importance of Ash content is that it gives an idea of amount of mineral elements present and the content of organic matter in the sample. The organic matter account for quantitative constituents of protein, lipids or fat, carbohydrate, plus nucleic acid. The measure of ash content provides a measure of the total amount of minerals present.

The percentage fat content values obtained for the samples were 0.95 % and 1.22 % for *Telfairia Occidentalis (*Pumpkin leaf) and *Amaranthus hybridus* (Green leaf). *Amaranthus hybridus* had a higher fat content value when compared to *Telfairia Occidentalis.*A small amount of fat is an essential part of a healthy, balanced diet. Fat is a source of essential fatty acids which the body cannot make itself. Fat helps the body absorb vitamin A, vitamin D and vitamin E. These vitamins are fat soluble, which means they can only be absorbed with the help of fats.

The percentage crude fibre content values obtained for the samples were 3.20 %, and 10.44 % for *Telfairia Occidentalis* (Pumpkin leaf) and *Amaranthus hybridus* (Green leaf).*Amaranthus hybridus*had higher fibre content when compared to *Telfairia Occidentalis.*The higher fibre content of *Amaranthus hybridus*shows that it is morebeneficial to people desirous of having higher fibre content in their diet. Crude fibre is the portion of the plant material which is not ash. Foods with high fibre content can absorb cholesterol and toxic agents in food. It also raises the excretion of bile and sterols. It is known however that fibre consists of cellulose which can be digested to a considerable extent by both ruminants and non-ruminants. The interest in fibre in food and feed has increased, based on the noticed number of serious illnesses associated with diet low in fibre.

The carbohydrate content values obtained were 83.26 % and 38.18 % for *Telfairia Occidentalis (*Pumpkin leaf) and *Amaranthus hybridus* (Green leaf) respectively. *Telfairia Occidentalis* had higher compar

Carbohydrate is the body's main source of energy. The higher carbohydrate content value of *Telfairia Occidentalis*shows that it is more beneficial to people desirous of energy building foods.

CONCLUSION AND RECOMMENDATION

This study compared the nutritional value of *Telfairia occidentalis* and *Amaranthus hybridus* sold at Jattu Market in Etsako-West Local Government Area of Edo State. *Telfairia occidentalis* had a higher index of nutritional quality in terms of carbohydrate content when compared to *Amaranthus hybridus,*while *Amaranthus hybridus* had a higher index of nutritional quality in terms of moisture content, ash content, fat content and crude fibre when compared to *Telfairia occidentalis*.It isrecommended that further research should be carried out on these vegetables, as well as other vegetables for nutritional evaluation.

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THE EFFECT OF IBIENAFE METROPOLITAN WASTE DUMPSITE ON NUTRIENT COMPOSITION OF SOIL

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ABSTRACT

This study investigated the effect of waste dump in Ibienafe metropolis on nutrient composition of soil. Soil samples were collected for analysis in August, 2021. 200g of the soil samples were collected from the dumpsite and at a distance of 500, 1000, 1500 and 2000 metres away from the dumpsite. The soil samples collected from the dumpsite were labeled as sample I while the samples collected at a distance of 500, 1000, 1500 and 2000 metres away from the dumpsite were labeled as sample II, III, IV and V respectively. The samples were taken to the laboratory of the Nigerian Institute for oil palm research (NIFOR) (chemistry division) to determine the nutrient composition. The nutrients determined include Nitrogen, Phosphorus, Calcium, Magnesium and Potassium. The effective cation exchange capacity was also determined. For Nitrogen, the highest concentration was observed in soil sample 1 (0.120 %) (Dumpsite soil) while the lowest concentration was observed in soil sample 5 (0.009 %) (Soil at a distance of 2000 metres away from the dumpsite). For Phosphorus, the highest concentration was observed in soil sample 1 (29.40 mg/kg) (Dumpsite soil) while the lowest concentration was observed in soil sample 5 (1.22 mg/kg) (Soil at a distance of 2000 metres away from the dumpsite). For Calcium, the highest concentration was observed in soil sample 1 (16.26 cmol/kg) (Dumpsite soil) while the lowest concentration was observed in soil sample 5 (1.11 cmol/kg) (Soil at a distance of 2000 metres away from the dumpsite). For Magnesium, the highest concentration was observed in soil sample 1 (2.06 cmol/kg) (Dumpsite soil) while the lowest concentration was observed in soil sample 5 (0.83 cmol/kg) (Soil at a distance of 2000 metres away from the dumpsite). For Potassium, the highest concentration was observed in soil sample 1 (2.50 cmol/kg) (Dumpsite soil) while the lowest concentration was observed in soil sample 5 (0.03 cmol/kg) (Soil at a distance of 2000 metres away from the dumpsite). The highest effective cation exchange capacity (ECEC) was observed in soil sample I (21.43 cmol/kg) (dumpsite soil) while the lowest effective cation exchange capacity (ECEC) was observed in soil sample 5 (2.50 cmol/kg) (soil at a distance of 2000 metres away from the dumpsite). The results showed that the concentrations of nutrients decreased with increase in distance from the dumpsite. The effective cation exchange capacity also decreased with increase in distance from the dumpsite. Waste should therefore be added to the soil to increase it fertility status if proper sorting and separation of poisonous substances is done.

Keywords: *Waste dumpsite, Nutrient composition, Soil samples, Laboratory, Fertility status.*

INTRODUCTION

Dumpsites are known to be rich in soil nutrients for plant growth and development because decayed and composted wastes enhance soil fertility (Ogunyemi *et al*., 2003). Dumpsite soils are used to fill poly-bags and nursery pots to grow seedlings. Dumpsites, especially in most third world countries, comprise of a high proportion (50 – 90%) of organic materials (Asomani – Boateng and Murray, 1999); however, a considerable proportion of plastic, metal rubbish and batteries which are known to be sources of metals which may be hazardous to man and his environment are also present (Alloway and Ayres, 1997; Pasquini and Alexander, 2004). These metals are not biodegradable and have toxic effects on living organisms at certain level of concentration. Exposure of man to such metals may cause blood and bone disorders, kidney damage and decreased mental capacity and neurological damage (National Institute of Environmental Health Sciences (NIEHS), 2002). These metals are known to bioaccumulate in soil and have long persistence time through interaction with soil component and consequently enter the food chain through plants or animals (Dosumu *et al*., 2003; Mohammed and Elsayed, 2007; Rubio *et al*., 2000). Nevertheless, most abandoned waste dumpsites in Nigeria have been used extensively as fertile grounds for cultivating varieties of vegetables even through research works have indicated that some common vegetables are capable of accumulating high levels of heavy metals from contaminated and polluted soils (Benson and Ebong, 2005; Cobb *et al*., 2000; Garcia *et al*., 2005).

The aim of this study is to find out the effect of Ibienafe metropolitan waste dumpsite on nutrient composition of soil.

MATERIALS AND METHODS

Dumpsite Location and Description

The waste dumpsite is located at Agbulumi Quarters in Ibienafe Community, Etsako-West Local Government Area of Edo State. It spreads over an area of approximately 1,100,000 square metres and the waste fill height very from 5 metres to 10 metres. The waste dumped at this site includes kitchen waste, plastics, metals, glass, papers, and batteries.

Soil Sample Collection

Soil samples were collected for analysis in August, 2021. 200g of the soil samples were collected from the dumpsite and at a distance of 500, 1000, 1500 and 2000 metres away from the dumpsite. The samples were put in black polythene bags, tied and labelled with a masking tape and marker. The samples collected from the dumpsite were labelled as sample I while the samples collected at a distance of 500, 1000, 1500 and 2000 metres away from the dumpsite were labelled as sample II, III, IV and V respectively. The soil samples were taken to the laboratory of the Nigerian Institute for oil palm research (NIFOR) (chemistry division) to determine the nutrient composition.

Sample Treatment and Analysis

For nitrogen, 0.12 g sample (dry wt) was weighed into a kjeldahl flask and 1 tablet of Selenium catalyst (as powder) and 2 mls of concentrated sulphuric acid were added; the content of the digestion flask was mixed properly. Tissue digestion was allowed to continue untill the mixture became clear. After cooling, the mixture was diluted with 10 mls of distilled water. The content was then filtered into 100 ml graduated flask and made up to the mark. Aliquot (10 mls) of the filtrate was used for nitrogen determination using the technicon auto analyzer. Samples were analyzed in triplicate (AOAC, 2006).

For phosphorus, potassium, calcium and magnesium, 1g of dry sample was put in a 10 ml pyrex glass container and this was placed in a muffle furnace. Ashing was done at 500^0C for 3 hours. The ash was allowed to cool and then dissolved in 10 mls of 20% nitric acid using a hot water bath (about 30 minutes). The mixture was filtered into a 250 ml volumetric flask and made up to the mark with distilled water. Phosphorus was read in the technicon auto analyzer, while potassium, calcium and magnesium were read in the gallenkamp flame photometer (AOAC, 2006).

The effective cation exchange capacity (ECEC) is the total amount of exchangeable cations, which are mostly sodium, potassium, calcium and magnesium (AOAC, 2006).

RESULTS AND DISCUSSION

Table 1: Nitrogen concentration of soil samples

Soil samples	**Nitrogen concentration (%)**
Sample I	0.120
Sample II	0.077
Sample III	0.052
Sample IV	0.032
Sample V	0.009

Table 2: Phosphorus concentration of soil samples

Soil samples	**Phosphorus concentration (mg/kg)**
Sample I	29.40
Sample II	21.63
Sample III	13.80
Sample IV	5.04
Sample V	1.22

Table 3: Calcium concentration of soil samples

Soil samples	**Calcium concentration (cmol/kg)**
Sample I	16.26
Sample II	13.96

Sample III	6.66
Sample IV	2.50
Sample V	1.11

Table 4: Magnesium concentration of soil samples

Soil samples	**Magnesium concentration (cmol/kg)**
Sample I	2.06
Sample II	1.74
Sample III	1.44
Sample IV	1.14
Sample V	0.83

Table 5: Potassium concentration of soil samples

Soil samples	**Potassium concentration (cmol/kg)**
Sample I	2.50
Sample II	1.72
Sample III	1.16
Sample IV	1.60
Sample V	0.03

Table 6: Effective cation exchange capacity (ECEC) of soil samples

Soil samples	**ECEC (cmol/kg)**
Sample I	21.43
Sample II	18.00
Sample III	9.82
Sample IV	4.80
Sample V	2.50

Table 1 shows the nitrogen concentration of soil samples. It was observed that the nitrogen concentration of soil decreased with increase in distance away from the dumpsite. The highest nitrogen concentration was observed in soil sample I (0.120 %) (dumpsite soil) while the lowest nitrogen concentration was observed in soil sample 5 (0.009 %) (soil at a distance of 2000 metres away from the dumpsite).

Table 2 shows the phosphorus concentration of soil samples. The phosphorus concentration of soil decreased with increase in distance away from the dumpsite. The highest phosphorus concentration was observed in soil sample I (29.40 mg/kg) (dumpsite soil) while the lowest phosphorus concentration was observed in soil sample 5 (1.22 mg/kg) (soil at a distance of 2000 metres away from the dumpsite).

Table 3 shows the calcium concentration of soil samples. It was observed that the calcium concentration of soil decreased with increase in distance away from the dumpsite. The highest calcium concentration was observed in soil sample I (16.26 cmol/kg) (dumpsite soil) while the lowest calcium concentration was observed in soil sample 5 (1.11 cmol/kg) (soil at a distance of 2000 metres away from the dumpsite).

Table 4 shows the magnesium concentration of soil samples. The magnesium concentration of soil decreased with increase in distance away from the dumpsite. The highest magnesium concentration was observed in soil sample I (2.06 cmol/kg) (dumpsite soil) while the lowest magnesium concentration was observed in soil sample 5 (0.83 cmol/kg) (soil at a distance of 2000 metres away from the dumpsite).

Table 5 shows the potassium concentration of soil samples. It was observed that the potassium concentration of soil decreased with increase in distance away from the dumpsite. The highest potassium concentration was observed in soil sample I (2.50 cmol/kg) (dumpsite soil) while the lowest potassium concentration was observed in soil sample 5 (0.03 cmol/kg) (soil at a distance of 2000 metres away from the dumpsite).

Table 6 shows the effective cation exchange capacity (ECEC) of soil samples. The effective cation exchange capacity (ECEC) is the capacity of the soil to adsorb nutrients in the form of cations. The effective cation exchange capacity (ECEC) of the soil decreased with increase in distance away from the dumpsite. The highest effective cation exchange capacity (ECEC) was observed in soil sample I (21.43 cmol/kg) (dumpsite soil) while the lowest effective cation exchange capacity (ECEC) was observed in soil sample 5 (2.50 cmol/kg) (soil at a distance of 2000 metres away from the dumpsite).

The results are in agreement with Ogunyemi *et al* (2003) who stated that dumpsitea are known to be rich in soil nutrients for plant growth and development because decayed and composted wastes enhance soil fertility.

CONCLUSION AND RECOMMENDATION

The study investigated the effect of waste dump in Ibienafe metropolis on nutrient composition of soil. It showed that the waste dump at Ibienafe metropolitan waste dumpsite increased the nutrient composition of the soil since the concentration of nutreints (Nitrogen, Phosphorus, Calcium, Magnesium and Potassium) decreased with increase in distance away from the dumpsite. It also showed that the waste dump at Ibienafe metropolitan waste dumpsite increased the effective cation exchange capacity (ECEC), which is the

capacity of the soil to adsorb nutrients in the form of cations, thereby increasing the fertility of the soil. However, researchers have reported that waste dump also increase the heavy metal content of the soil. It is therefore recommended that waste should be added to the soil to increase it fertility status if proper sorting and separation of hazardous substances is done. Screening programmes should be put in place by the government to ensure that only treated wastes that are free from poisonous substances are used by farmers for cultivation.

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IMPACT OF SOCIO-ECONOMIC FACTORS ON TOURISTS' PROPENSITY TO REVISIT INSOME ECO-TOURISM DESTINATIONS IN SOUTHWEST-NIGERIA

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Abstract

The economic value of tourism cannot be underestimated and per se benefits derivable from the tourism industry need to be constantly enhanced in the interest of the nation. This study examines impact of socio-economic factors on tourists' propensity to revisit in some eco-tourism destinations in Southwest-Nigeria. The area of study for the eco-tourism destinations covered in Southwest-Nigeria includes Old Oyo National Park Ikogosi, Warm Springs, Okomu National Park and Whispering Palms. Primary data were used for this study and the collected data were subjected to statistical analysis using frequency counts, percentages, weighted mean, chi-square test, correlation analysis and regression analysis. The result indicates that socio-economic factors like education of tourists demonstrated a positive correlation with propensity to revisit eco-destination. In terms of gender, male tourists displayed higher propensity to revisit a destination than the female tourists. Finally, the studyshowed that income level of tourists does not significantly affect propensity to revisit eco-destination but other factors.

Key words: Socio-economic; eco-tourism;propensity-to- revisit; Southwest-Nigeria

Introduction

According to the United Nation World Tourism Organization [UNWTO] (1997; 2012), tourism is describe as the whole world-wide industry of travels, hotels, transport and facilities that serve the needs and wants of travelers /visitors. The industry offers various services which have different impact on the patron's satisfaction and have an influence on various extents on decision making when it comes to the selection of destinations.Popular eco-tourism destinations in Southwest-Nigeria include Old Oyo National Park Ikogosi, Warm Springs, Okomu National Park and Whispering Palms. Old Oyo National Park is one of the seven national parks in Nigeria located across northern Oyo state and Southern Kwara State of Nigeria at Latitude 8^0 15' and 9^0 00N and Longitude 3^0 35' and 4^0 42'E (Nigeria National Park Services, 2014). The park is surrounded by eleven (11) Local Government Areas out of which Ten (10) falls within Oyo State and one (1) in Kwara State. The Administrative Head office is located in Oyo, Isokun area along Oyo–Iseyin road, where information and booking could be made. The park has total land mass of 2,512km, mostly of lowland plains at a height of 330m and 508m above sea level. The south part is drained by the Owu, Owe and Ogun Rivers, while the northern sector is drained by the Tessi River. Outcrops of granite are typical of the Northern Eastern zone of the park, including Oyo ile, with caves and rock shelters in the extreme north. The central part of the park has scattered hills, ridges and rock outcrops that are suitable for mountaineering (www. wikipedia.com).

The Ikogosi Warm Springs is a tourist attraction located at Ikogosi-Ekiti, a town in

Ekiti State, south western Nigeria. Ikogosi-Ekiti is a small community in terms of size and population with inhabitants predominantly farmers who engaged in planting of food crops (Coco-yam, Plantain, Maize, Yam, Cassava and Banana among others) and cash crops (cotton, cocoa, and coffee) (Okosun *et al*., 2016; Olaniyi and Atalor, 2018). There are rainy season (April–October) and the dry season (November–March). Temperature ranges between 21° and 28°C with high humidity. The south westerly wind and the northeast trade winds blow in the rainy and dry (Harmattan) seasons respectively. Tropical forest exists in the south, while savannah occupies the northern peripheries. Ikogosi has a good local natural environment combined with rich culture and history and these form the basis of what makes the community a tourists' destination (Godfrey and Clarke (2000). The measurement of the whole area of the spring is about 32 hectares. The Vegetation of this resort centre is a highly thick forest and this natural and rich vegetation is closely maintained and protected from arbitrary deforestation. The undulating topography of the entire tourist centre and the symmetry of the surrounding hills add more to the aesthetic beauty of this centre.

Whispering Palms is located at Iworo Village, after Aradagun, off Lagos Badagry Expressway, Lagos State Nigeria. It is about thirty minutes' drive from Agbara and about twenty minutes' drive from the Badagry roundabout. The ancient city of Badagry is located in South western part of Nigerian border with the Benin Republic. Badagry is located at latitude 6.5^{o}N of the Equator and longitude 3.25^{o}E of the Greenwich Meridian. It is bounded on the West by Porto Novo and Seme, on the North by Ilogbo, Ipokia, on the South by the Osa lagoon and the Atlantic Ocean on the East. Badagry has the Awori settlements of Ojo and Lagos. As a result of its strategic location, Badagry became a cultural transition zone at a time in its history. The municipality has a population of 241,093 and total land size of 441km^2. It offers beautiful greenery surrounded with aesthetic stunning designs and artworks. One unique thing about the Whispering palms is it offers competitive hotel rooms for different budget sizes making it not just an affordable but also a preferred and top-rated resort in Nigeria.Facilities at Whispering palms Resort include; Swimming Pool, Football field, Mini Golf course, Mini Zoo, Museum, Art gallery, Outdoor bar, Basketball court, Chalets, Volleyball court, Restaurants, Event halls, Pools and gym, Bicycle Ride, Spa, Boat Ride, Water sports activities, bicycle boats, pedal boats etc. The outdoor setting and relaxation arena is very appealing and beautiful. Beach huts, numerous mini gardens that host various Nigerian carvings and artworks, including bronze heads of various Yoruba deities and, the landscape of the resort. The landscape of the resort was beautifully designed with lush vegetation everywhere and largely dominated by palm trees.

Nigeria is endowed with a good number of tourism centres among which are ecotourism destinations. These tourist destinations just like other segments of hospitality industry are expected to contribute to economic growth and development of the community where they situated as well as the state and the country where they are located by providing jobs, internal revenue for the host communities through money generated from game reserves and inflow of tourists from foreign countries, revenue to the governments through tax and levies which can be used for further development of some facilities such as swimming pools, golf courses, restaurant and shopping facilities, attractions of industries owing to the quality of services and recreational resources provided (Ijeomah and Eniang, 2018; Ukabuilu*et al*., 2018). Therefore, this study

examines the impact of socio-economic factors on tourists' propensity to revisit in some eco-tourism destinations in Southwest-Nigeria.

Research Methodology

The study covered the Southwest Nigeria. The zone comprises of six states namely: Lagos, Oyo, Osun, Ogun, Ondo and Ekiti States. It is bounded in the East by Edo and Delta States, in the North by Kwara and Kogi States, in the West by the Republic of Benin and South by Gulf of Guinea. The people of this area are predominantly Yorubas. The research method employed is mixed method comprising of both case study and quantitative research

Methodology

Research Study Area

The area of study for the eco-tourism destinations covered in Southwest-Nigeria include Old Oyo National Park Ikogosi, Warm Springs, Okomu National Park and Whispering Palms.

Methods for Data Collection

This study employed descriptive survey research design. It combines both qualitative and quantitative method for collecting information from a pool of respondents by asking multiple survey questions. It includes the recruitment of individuals, collection, and analysis of data.

Study Population

The target populations for this study are the tourists that visit the selected eco-destinations in South west Nigeria.

Sampling Frame

The sampling frame for this study is the eco-tourists to the selected eco-destinations in the study areas. The four year average number of tourists that visited each of the selected destinations were computed and used as the sample frame. The figure stood at 1365, 3315, 10,000 and 1410 for Old Oyo National Park, Whispering Palms Resort, Ikogosi Warm Springs and Okomu National Park respectively.

Sample Size Determination

A total of 302, 346, 370 and 302 tourists were selected each from Old Oyo National Park, Whispering Palms Resort, Ikogosi Warm Springs and Okomu National Park respectively based on Krejcie and Morgan (1970) table of sample size determination. In all, a total of one thousand, three hundred and twenty (1320) eco-tourists were selected for the study (Table 1).

Table 1: Sample Size Selection

Destinations	Population (2019-2021)	Number selected
OONP	1365	302
IKWS	10,000	370
WP	3315	346
ONP	1410	302
Total	16,090	1320

Sampling Techniques

A two-stage sampling technique was used for the study. In the first stage, four (4) eco-destinations namely; Old Oyo National Park in Oyo State, Ikogosi Warm Springs in Ekiti State, Okomu National Park in Edo State and Whispering Palm Resorts in Lagos State were purposively selected. The major reason for their selection aside the eco-tourism resources found in them, is the fact that these destinations have lodging/accommodation for the tourists that visit them. In the second stage, a total of one thousand, three hundred and twenty (1320) tourists were selected using a convenience sampling technique. Convenience sampling was employed since the researcher cannot guarantee the cooperation of all the tourists that will be present at the time of data collection, hence only those who were willing to participate were included in the study.

Sources and Types of Data

Primary data were used for this study. Primary data is valuable because of the richness of the data and the directness of information from participants.

Instruments for Data Collection

(a) Questionnaire

This study employed the use of questionnaire to obtain relevant data required. The questionnaire contained both structured and unstructured in nature so as to capture all information necessary for the study. The questionnaire consists of five sections. The first selection focuses on tourists' demographic and travelling profiles. The second section was developed to identify the various services offered in the selected eco-tourism destinations. The third section focuses on tourists' perception of the food and services offered in the selected destinations. The fourth section was developed to access tourists' satisfaction towards the food and services in the selected eco-tourism destinations. The fifth section was developed to access tourists' future behavioural intention towards the selected eco-tourism destinations. A Five-point Likert Scale was constructed to determine the tourists' perception of food and services.

(b) Interview and Field Survey (Field observation)

Key informant interview and field observation were employed to gather information important for the objectives of the study. The key informants are the managers, tourism and information officers of the selected parks. The method helped in identifying the various services such as accommodation (eco-lodges), eco-attractions which are the nature-based tourism (flora and fauna) such as bird viewing, game viewing and other services which include sightseeing activities, recreational services, cultural facilities in the selected destinations. This was used to support and validate the information supplied through the questionnaire where necessary.

Validity and Reliability of the Instruments

Both face and content validity were carried out on the instrument for data collections by the experts in the area of my study; these include my supervisors. This was done to ensure the adequacy of the instrument. For reliability, a pilot study was done to ascertain the reliability of the questionnaire by distributing the questionnaire to selected visitors at a separate study area and the result was collated and subjected to reliability test through the determination of the Cronbach alpha coefficient. According to Nunnally and Bernstein (1994), items with Cronbach alpha coefficients; that is greater than 0.7 shows that the constructs are reliable.

Measurement of Variables

(a) Dependent variables

Perception towards services in the destinations e.g. food types, food quality, service quality e.t.c was constructed on a five-point Likert scale and was measured as Strongly Agree =5, Agree = 4, Undecided =3, Disagree =2, Strongly Disagree =1.

Food consumption and food preferences was constructed on a two-point scale and shall be measured as Yes =1, No =2

Re-visit intention was constructed on a two-point scale and shall be measured as Yes =1, No =2.

(b) Independent Variables

The independent variables were constructed as follows:

Gender as Male=1, Female=2

Marital Status as Single=1, Married=2, Divorced=3, Widowed=4

Age as <18=1, 18-25=2, 25-35=3, 36-45=4, >45=5

Level of Education as Primary Education=1, Secondary Education=2, Tertiary Education=3

Occupation as Business Executive=1, Student=2, Civil Servant=3, Private employee=4, Medical Practitioners=5, Others =6

Religion as Christian=1, Muslim=2, Traditional=3, Others=4

Income as <30,000=1, 31,000-50,000=2, 51,000-70,000=3, 71,000-90,000=4, >91,000=5

Method of Data Analysis

The collected data were subjected to statistical analysis using frequency counts, percentages, weighted mean, chi-square test, correlation analysis and regression analysis. The research was analyzed using regression analysis and hypotheses were tested using both chi-square test and simple linear regression analysis.

The Statistical Tools Employed

Weighted mean

The weighted mean on a 5-point scale with 5, 4, 3, 2 and 1 denoting Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree respectively would be computed

The pearson correlation coefficient was calculated using the formula below;

$$r = \frac{N\sum xy - \sum x \sum y}{\sqrt{N\sum x^2 - (\sum x)^2 . N\sum y^2 - (\sum y)^2}} \quad \text{(Eq. 1)}$$

Where, r = Correlation coefficient, x = Score of independent variable, y = Score of dependent variable, N = Number of observation

Chi-square model

$^2 = {}^2/2$

Where, O = Observed (actual) valueandE = Expected value

To determine the socio-economic factors that influence visitors' propensity to revisit the eco-tourism destinations, a multiple regression model of the form below was specified;

In implicit form, X_1

Explicitly, the equation becomes:

$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + e_1$..... (Eq.2)

Y= Propensity to revisit

X_1 =Age of respondent

X_2 = Education of respondent

X_3 = Income of respondent

X_4 = Gender of respondent

b_0-b_4= Regression coefficients

e_1 = error estimate

Results and Discussion

Various Services Offered in the Selected Destinations

Results of the study on tourists' attitudes and satisfaction towards services in some selected eco-destinations (Table 2) reveal that the various services offered in the destinations include the visitors' information centre, business/conference, guided tour services, food and beverage services, accommodation services, recreational and sport services were offered at OONP as attested to by the staff in the location. For example, OONP provides decent accommodation (Charlet) with adequate facilities to tourists for relaxation. Functional recreation facilities such as Swimming pool and Tennis court were also sighted during visit to the location. It is worthy of mentioning here that food and beverage services were available at the Sepeteri part of OONP but not at Ibuya camp which make tourists to make their own food and drink provisions. In addition to these, guided tour was available to assist

visitors during the course of their adventures. For IWS, the services offered include food and beverages, accommodation, recreation/sports, heritage/cultural display and business/conference services. Field observation and interview with staff revealed that the available accommodations at the location need to be improved upon to be able serve the purpose intended. Recreation facilities which include swimming pool, tennis court and playground for children were also seen by the researcher during visit to the destination. Standard restaurant where both local and continental dishes were offered was also seen at the location. At WPR, the services offered include visitors information centre, heritage and cultural display, wildlife/animal park and aquarium, business/conference activity, educational services, food and beverage services, accommodation services as well as recreational and sport services. Based on field observation, the destination provided decent accommodations with standard facilities to visitors / tourists. The type of services offered at ONP include visitors information centre, exhibition, heritage and cultural display, wild life/ animal park and aquarium, guided tour services, business/conference activities, as well as recreational and sports services. Information gathered during field observation and interview with some of the staff revealed that only beverages services were made available to the tourists but tourist have the option of sourcing for food outside or give money to the staffthat would then help in getting the food items and also assist in preparing the meal for them.

Table 2: Services Provided by the Destinations

Services provided	OONP	IWS	WPR	ONP
(1) Visitors information Centre	A	NA	A	A
(2) Exhibition	NA	NA	NA	A
(3) Convention and amusement/entertainment services	NA	NA	NA	NA
(4) Heritage and cultural display	NA	A	A	A
(5) Wildlife Animal park and aquarium	A	NA	A	A
(6) Guided tour services	A	NA		A
(7) Business/conference activity	A	A	A	A
(8) Educational services	NA	NA	A	A
(9) Food and beverages services	A	A	A	NA
(10) Accommodation services	A	A	A	A
(11) Recreational and sports services	A	A	A	A

Key: A = Available, NA = Not Available, Source: Field Survey, 2021**The Result of Reliability Test**

Internal reliability results of the constructs used for the rest of the aspect of the study are displayed in Table 5. The table shows that the estimated reliability coefficients range from 0.693-0.921. The values which are above 0.50 are acceptable and imply that the constructs are reliable since there is internal consistency (Hinton, McMurray, Browniow and Czens, 2004)

Table 3: Reliability coefficients

Variables	Alpha value	Items
Service quality	0.921	33

Tourism elements	0.879	13
Food consumption and preference	0.811	4
Behavioural intention	0.693	5
Challenges	0.789	7

Source: Researcher's computation, 2021

Tourists' Behavioural Intentions towards the Selected Destinations

Behavioural intentions towards the selected eco-destinations revealed that tourists are favourably disposed to re-visit the four destinations. In OONP, tourists agreed to four out of the five statements of intention presented with estimated weighted mean score ranging from 3.83-4.01; with the overall mean of 3.83 and standard deviation of 0.28. For IWS, tourists also agreed to four out of the five statements of intention presented to them with the estimated mean score ranging from 3.56-3.81 while the overall mean response score stood at 3.56 and standard deviation of 1.05. At WPR, tourists also agreed to three out of five re-visit statements with mean score that range from 4.08 to 4.09 and with the overall mean score of 3.76 and standard deviation of 0.55. For ONP, tourists acceded to all the five statements of intention with the estimated mean score that range from 3.79-4.46 and overall mean score of 4.14 and standard deviation of 0.79. In comparison, ONP was highest in terms of behavioural (revisit) intention, followed by OONP; WPR ranked third, while IWS has the least (Table 4).

Table 4: Tourists' Behavioural Intentions towards the Selected Destinations

	OONP		**IWS**		**WPR**		**ONP**		**Overall**	
Statements of Intention	Mean	St.dev	Mean	St.dev	Mean	St.dev	Mean	St.dev	**Mean**	**St.dev**
(1) I am willing to come back to this destination in the future	4.00	0.22	3.81	0.77	4.09	0.41	3.95	0.99	**3.96**	**0.68**
(2) I can recommend this destination to others	3.99	0.22	3.68	0.95	4.08	0.36	4.26	0.64	**3.99**	**0.66**
(3) I consider this eco-destination as my first choice compare to others	3.99	0.24	3.54	1.16	3.15	0.86	3.79	0.97	**3.60**	**0.95**
(4) This destination is suitable for recreational activities	3.15	0.46	3.34	1.24	4.08	0.39	4.25	0.7	**3.70**	**0.92**
(5) This destination is suitable for eco-tourism activities	4.01	0.27	3.41	1.15	3.38	0.73	4.46	0.67	**3.78**	**0.91**
Grand Mean Response	**3.83**	**0.28**	**3.56**	**1.05**	**3.76**	**0.55**	**4.14**	**0.79**		

Source: Field Survey, 2021

The socio-economic factors that Influence Visitors' Propensity to Re-visit the selected Eco-tourism Destinations.

On the socio-economic factors that influence visitors' propensity to re-visit the selected eco-tourism destinations, the result (Table 5) shows that the value of coefficient

of determination (R^2) is 0.028. This implies that about 2.8% of variation in tourist propensity to revisit an eco-destination is accounted for by all the included explanatory variables (i.e age, education, income and gender of tourists). The F-statistics value of 9.402 was found to be statistically significant at 1% level which implies that the fitted model is statistically significant (i.e it has a good fit). Hence we can gain confidence in the results of the model.

The regression coefficients show that age, education and income play significant roles in visitors' propensity to re-visit eco-destination. Age and income displayed inverse relationship with visitors' propensity to re-visit which is statistically significant at 1% level. Education on the other hand, had a direct relationship with propensity to re-visit eco-destination which is statistically significant at 5% level. In term of gender, the results show that the propensity to re-visit eco-destination is relatively higher in males compare to the females; although the relationship is not significant at the conventional 5% level.

Table 5: The Results of Multiple Regressions

Variables	Unstandardized Coefficients		Standardized Coefficients	t-value	p-value
	B	Std. Error	Beta		
(Constant)	3.854	0.084		45.668	0.000
Age	-0.062	0.024	-0.085	-2.597	0.010
Education	0.055	0.025	0.064	2.185	0.029
Income	-0.026	0.009	-0.095	-2.912	0.004
Gender	0.004	0.032	0.004	0.13	0.897

a. Dependent Variable: Propensity to revisit

b. $R^2 = 0.028$, $F(4) = 9.402$, $p = 0.000$

There is no significant relationship between tourists' socio-demographic characteristics and their propensity to revisit eco-tourism destination. The Chi-square tests carried out on reveals that there is a significant relationship between propensity to revisit eco-tourism destination and socio-demographic factors such as gender, age, occupation, education, marital status and income at 1% level of significance (Table 6).

Table 6: The Results of Chi-square Tests

Variables	Chi-Square	Df	p-value	Decision
Gender	24.912	3	0.000	Significant
Age	88.058	9	0.000	Significant
Occupation	67.989	6	0.000	Significant
Education	29.102	6	0.000	Significant
Marital status	49.85	9	0.000	Significant
Income	114.209	15	0.000	Significant

Computed from Field Survey, 2021

There is no significant influence of tourist satisfaction on propensity to revisit (revisit intention).The result of regression analysis carried out reveals that tourists' level of satisfaction has a positive and significant influence on propensity to revisit a destination at 1% level of significance (Table 7).

Table 7: The Result of Linear Regression Analysis

	Unstandardized Coefficients		Standardized Coefficients		
Variable	B	Std. Error	Beta	T	P-value
(Constant)	0.867	0.120		7.216	0.000
Satisfaction level	0.768	0.031	0.561	24.601	0.000

a. Dependent Variable: Propensity to revisit

b. $R = 0.561$, $R^2 = 0.315$, $F(1) = 605.221$, $p = 0.000$

Computed from Field Survey, 2021

In general,the finding that education of tourists displayed a positive relationship with propensity to revisit eco-destination may be explained in view of the fact that high level of research works are being carried out in these destinations by the academics from various higher institution of learning. This is in line with a study carried out by Oladeji *et al.,* (2012), who found out that students and researchers visit during study period is (41%) of the total number of tourists visiting Old Oyo National Park. It was also recorded by (TIES, 2006) that visit by ecotourists from higher education was reported in Europe. This is also in line with the statement of Han & Hsu, 2018 which states that tourists with higher education levels may be more environmental conscious and appreciate the educational aspects of ecotourism, potentially increasing their likelihood to revisit. It is worthy of note that age on the other hand had negative influence on tourists' propensity to revisit eco-destination. This development might be attributed to the fact that some level of activeness and agility are required by tourists to be able to cope with activities in the destinations which the relatively older people might not be able to displayed. This conforms to the study of Oluwakemi and Eveso, (2017) which pointed out that majority (74%) of the visitors at the Okomu National Park falls within the age bracket of 20-29 years which is the youths. In some cases, tourists have to go on foot during the course of their stay at the locations which can be strenuous and energy consuming. This is particularly true in places like OONP and ONP. Furthermore, the coefficient of gender which was positive and significant could be explained to mean that the male tourists have higher propensity to revisit a destination than the female tourists. Lastly, the coefficient of income was found to be negative which may imply that income level of tourists does not really play important role with respect to propensity to revisit eco-destination but other factors.

Conclusion and Recommendations

Conclusion

The socio-economic factors such as education of tourists displayed a positive relationship with propensity to revisit eco-destination. With respect to gender, the male tourists showed higher propensity to revisit a destination than the female tourists. The study also established that income level of tourists does not really play important role

with respect to propensity to revisit eco-destination but other factors.

Recommendations

From the findings of this study, the following are recommended:

(a) The setback of transportation should be looked into for tourists' convenience and to further improve on their tourism experience at the destinations

(b) There should be improvement on the service quality of the restaurants for tourists' satisfaction based on its low rating in some of the destinations

(c) Efforts should be intensified at enhancing the available services of the locations on internet so as to attract more tourists.

(d) Maintenance and sustenance of the existing safety and security should be enhanced for improved tourists patronage

(e) Service quality and delivery based on the low perception of service quality by the tourists should be improved by addressing them as they popu

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UV-VIS SPECTROPHOTOMETRIC DETERMINATION OF CAFFEINE IN SOME SELECTED TEA SAMPLES

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ABSTRACT

Caffeine a stimulant, mild additive drug with its medicinal properties is a bioactive ingredient present in some teas and coffee. It occurs naturally in leaves, seeds or fruits of tea, caffeine, cocoa etc. it serves as a boost of energy or a feeling of heightened alertness when taking moderately, but at high does, it could bring about conditions of anxiety and depressive neuroses. In this study the quantification of the caffeine level of seven teas and coffee brands commonly sold in Auchi town was determined by UV/Vis spectrophotometric method. Chloroformwasusedas thesolventand concentrations of caffeinemeasuredatthewavelength of274nm.Theresultsobtainedfortheselectedteaandcoffeesampleswere;11.56ppm,30.22 ppm, 78.22 ppm for the Top tea, Richmond tea and Lipton tea respectively. While the results for the coffee were 138.34 ppm, 324.33 ppm, 348.22 ppm and 388.12 ppm for the Nescafeclassic, NescafeMalty, Nescafeoriginal and Cowbell coffeerespectively. Amongthe analyzed tea samples the highest caffeine concentration was found in Cowbell Coffee (388.22 ppm) and the lowest in Top Tea (11.56 ppm). The results of this study gave preliminary information about caffeine levels in the often consumed teas drinks in Nigeria. TheFood and Drug Administration and Control recommended not more than five cups of tea or coffee containing caffeine (200 mg) per day.

Keywords:caffeine,coffee,tea,UV-VISSpectrophotometer

Introduction

Caffeine is a naturally occurring alkaloid methylxanthinefamily, found in the leaves,seeds and fruits of over 63 plants species worldwide It is a bitter white crystalline compound, with low solubility in water. Its chemical formula is $C_{18}H_{10}N_4O_2$,it systematic name is 1,2,3 trimethylxanthine.Ithasamolarmassof194.19 g/mol and a density of 1.2 g/ml (Aurnand 1987).Caffeine can befound in cola nuts, coffee beans, cocoa beans, tea leaves, mate leaves and other kinds of plants (Andrews *et at.*,.2007).Whilecoffeeandteabeveragesnaturallycontaincaffeineandotherm ethylxanthines,caffeineservesasaningredient in many carbonated soft drink including colas, pepper-type beverages,and citrus beverages

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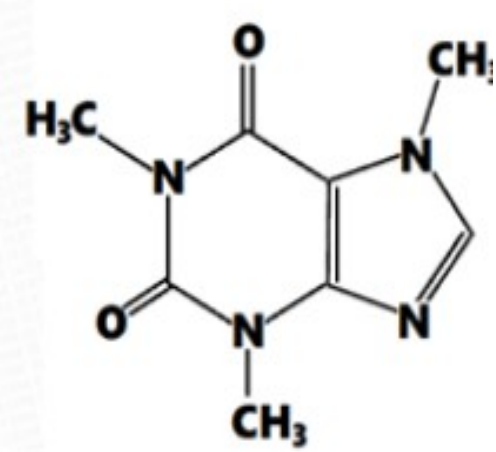

Figure1Structureof caffeine

Caffeineisregardedasapharmacological activesubstance,itdoesnotaccumulate overthecourseoftimeandisnormallyexcreted within hours of consumption (BaronandRoberts1996)andhastheability toserveasaboostofenergyorfeelingof heightenedalertness.Itisoftentakingto stay awake longer, gives a pleasant stimulating feeling but a high dosage it may cause psychological symptoms such as anxietyanddepressiveneuroses.People with more psychological problem may have theirsymptomsexaggeratedwithexcessive caffeine dose (Barone and Roberts 1996).) Highlevelsofcaffeineconsumptionhave been implicated in various disorder includinggastricacidsecretion,kidney malfunction,heartdiseaseanddisturbance ofthecentralnervoussystemsuchasseizuresan ddelirium.However,caffeine utilized as a co-adjuvant in many pharmaceuticalformulations(Bispo*etal*., 2002)

The quality control of products containing caffeine for health and optimal performance and regulation should always be upheld

MaterialsandMethods Materials

Thechemicalsandreagents;chloroform, sodiumcarbonates,caffeinestandardsused inthisstudywereofAnalyticalGrade productofSigma-Aldrich(UK).Adouble

Thereported caffeine contentin main dietarysourcesvariessignificantly93.0–163.5mgpercupininstantcoffee,30.2–76.4mgpercupinbagteaand0.32-.0.54mg/lindarksweetchocolate.These differenceshavebeenattributedtothevarietyof coffeebeanortealeaf,methodsof preparations (i.e. the brewery of coffee and tea) volume of a cup and analytical methods utilizedforcaffeinedetermination.Inthe case of carbonated beverages, the variability occursamongbrands,sincemostofthecaffeinec ontentintheseproductsisadded from other natural sources, less than 5% of thetotalpresentcaffeineisfromcolanut (Carmago *et al* 1999, Akinbile *et al* 2017) Coffee, tea and drink with caffeine artificiallystimulatethebodyandincrease theheartrate,theartificialstimulationtemporari lyarousetheintellectandfatigue seems to disappears, but its short lived. The excess stimulation depletes the body of vital energyasitstrugglestodealwithpoison that has entered its system (Khan *et al* 2006) In this study selected tea and coffee sample were analyzed quantitatively for their caffeine level

beam UV/Visible spectrophotometer (Jenway 6505), Quartz cuvette, Chemical balance (Metler Toledo AL240) measuring cylinder, magnetic stirrer, glass filter, beakers, thermometer, separatory funnel, funnel, ice bath, distilled water, chloroform (assay: 99.6%, Aldrich Germany), ethyl acetate (assay: 99%, Indian), caffeine(M.W. 194.19 g/mol, Aldrich Germany) **Method**

Extractionof CaffeinefromTea

The extraction of the caffeine was determinedaccordingtothemethodof Akinbile*etal.*(2017). Thecoffeeandtea samples(2g)wereeachweighedinto conicalflask,distilledwater(20mL)2 addedtoeachofthe sample and the content wereheatedandallowedtoboilfor10 min.Sodiumcarbonate(2g)wasaddedto eachsampletoprecipitatetannins.Thesample swerefilteredandthefiltrates concentratedto5 ml by heating, the were used at the course of the analytical procedure.

Seven brands of instant coffee and teas samples obtained from various sellingoutlets in Auchi were used for the study.The coffee and tea samples were kept at room temperature throughout the analysis. The caffeine levels were not indicated in their labels

concentrate was placed in a separating funnel, chloroform (5 ml) was added to extract the caffeine present in the samples. The lower layer containing the caffeinewas separated and the caffeine content determined with UV-visible spectrophotometer. The extracts (0.1 ml) were mixed with chloroform (10ml) and placed in quartz cuvette. The Absorbance was measured at a wavelength of274 nm

Caffeinestockpreparationanddetermination of Absorbance

Caffeine stock solution (100 ppm) was prepared by dissolving the caffeine (0.01g) inavolumetricflaskcontainingchloroform (100ml),fromthecaffeinestocksolution,1 ppm,5ppm,10ppm,20ppmand25ppm dilution were prepared. The absorbance of each was measured with a UV-VIS spectrophotometer (Janway6505 model) at thewavelengthof274nmusingquartzcurz

ResultsandDiscussions Results

Table1:AbsorbanceoftheCalibration SolutionofCaffeine

No.	Concentration(ppm)	Absorbance
1	1	0.016
2	5	0.019
3	10	0.028
4	15	0.034
5	20	0.048
6	25	0.058

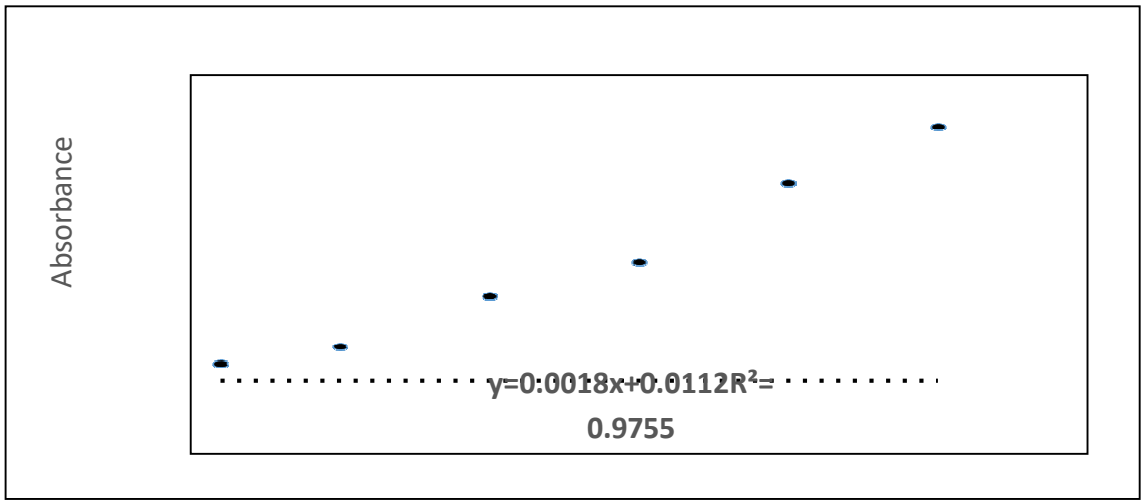

Figure1: Standardcalibrationcurveofcaffeine

Table2:CaffeineContentsofTeaandBeveragesSamples

Label	SampleName	3 Caffeine Concentration(ppm)	EFSA (ppm)
S1	Top Tea	11.56v	400
S2	RichmondTea	30.32	400
S3	LiptonTea	78.22	400
S4	NescafeClassic	138.34	400
S5	NescafeMalty	324.33	400
S6	NescafeOriginal	348.22	400
S7	CowbellCoffee	388.12	400

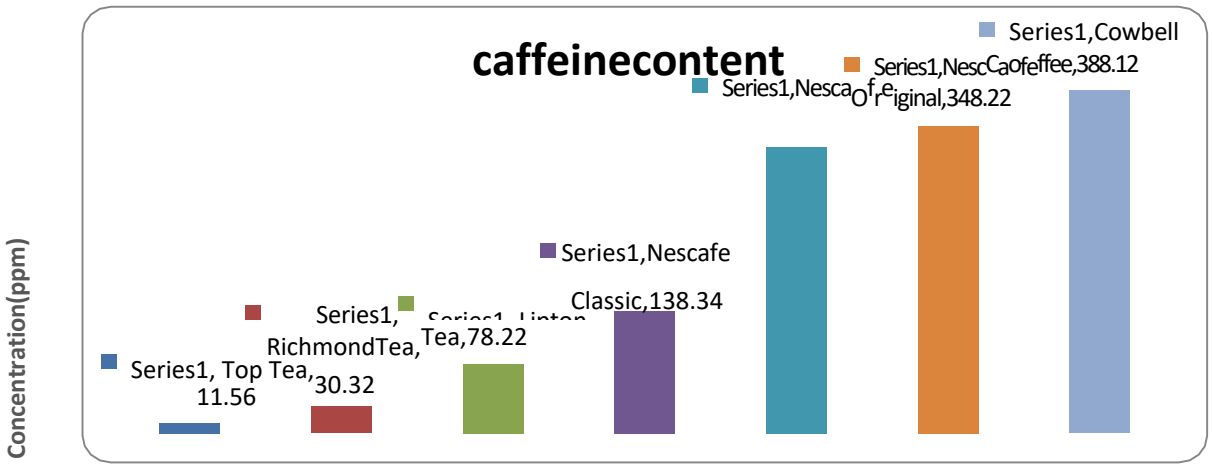

Figure2: Chartshowingcaffeinecontentintheteaandbeveragesamples

Discussion

The standard linear calibration curve obtained from the standard solutions of caffeineispresentedinTable1andFigure

It showed a good linear relation between the absorbance and concentrations of standardsolutions.Caffeinecontentlevelsin teasamplesarepresentedandillustratedin

Table2andFigure2. 4

The concentration of caffeine in tea sample wasintherangeof11.56ppmand

78.34 ppm, while the coffee samples had valu

es ranging from 324.33 ppm to 388.12 ppm. The highest caffeines concentration was measured in Cowbell Coffee and the lowest was measured inTop Tea.Theresults also indicated that the coffee samples had more caffeine content than the tea samples the results is in agreement with the study ofAkinbile et al, (2017)but not in agreement with Wanyika et al, (2010) their finding reveals higher values of caffeine for tea than coffee samplesobtained in Kenya market. As stated by Kaplan *et al.* (2011) growingnditionsProcessingconditionsandothervar iablesaffect

Conclusion andRecommendation

The results of this study gave preliminary information about the caffeine content in the selected teas and coffee. Caffeine was ndicated to be present in the samples use bu

caffeinecontentandthatcertaintypesoftea containssomewhatmorecaffeinethanother. Some of the factors that can have an effectontheamountofcaffeinecontentinclude strengthofthebrew,growingconditions, processingtechniquesandothervariables suchassoilchemistry,altitudeandposition ofleafontheteabush,typeofplantand theamountpresentwerenotspecified.cultivation practices. Caffeine contention also varies widely depending on the type of bean and the method of preparation used (Heckman *et al,* 2010).

According to the European Food Safety Authority (EFSA) (2015), single doses of caffeine that do not raise safety concerns recommended for adults are up to 200 mg. When healthy adults consume caffeine at a dose of 400 mg throughout the day (about 5.7 mg/kg per day) they do not need toworry about safety (Vuletic *et al*, 2021). Since caffeine content depends on the typeof tea and since portion size varies within and between countries one should be careful with caffeine intakes.

The results obtained showed that thecaffeine level were within the recommended limits. Caffeine content should be indicated on the

product labels especially due to th

caffeine-containing beverages. Since caffeine can be a cause for potential health concerns, precise quantities stated on the labels of caffeinated beverages should be highlightedintheinterestofthosewho drink them. It is necessary to work onraising awareness among those who drink caffeinated beverages about the amounts of caffeine they consume.

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EVALUATION OF THE LEVELS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN SOME SELECTED GRILLED, ROASTED AND SMOKED DELICACIES IN NORTHERN PART OF EDO STATE

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ABSTRACT

Polycyclic aromatic hydrocarbon (PAHs) are carcinogenic and mutagenic pollutants which get into foods during processing in spite of this, only a few studies have been carried out on some Nigerian delicacies. Therefore, this study investigated the levels of PAHs in some selected food samples which included roasted maize, roasted yam, roasted unripe plantain, roasted ripe plantain, smoked cat fish, mackerel fish, smoked herring fish, grilled chicken and grilled beef. The analysis was carried out using the Gas chromatography (GC) with Flame Ionization Detector (FID) for identification and concentration levels of PAHs in various samples. The result revealed the presence of PAHs in different food samples with varying concentrations. The result showed that roasted yam, unripe plantain and grilled chicken had the least trace of PAHs of 3.62, 0.19 and 4.91mg/kg respectively. Also, the roasted maize, roasted ripe plantain and grilled leaf had some quantity of total PAHs of 7.85, 9.28 and 9.88mg/kg respectively while the smoked cat fish, mackerel and herring had the highest concentration of total PAHs of 79.62, 69.95 and 99.04 respectively. Higher values were found in benzo (a) pyrene (BaP) for smoked herring and catfish as 10.13 and 9.20mg/kg respectively. The BaP is highly carcinogenic and with higher total PAHs concentration for the smoked fish; the food samples may pose some heath risk on humans. This study therefore compliment monitoring information on the levels of Polycyclic Aromatic Hydrocarbons (PAHs) occurrences in the different food samples under study.

KEYWORDS: Polycyclic Aromatic Hydrocarbons (PAHs), delicacies, carcinogenic, pollutants, Gas chromatography, concentrations

INTRODUCTION

Most of this stable food enjoyed by the populace are prepared by either roasting, grilling, or smoking method. The health risk associated with the use of these methods in food preparation, especially meat prepared at high temperature is that it can generate carcinogenic chemicals (Eze *at al.*, 2019). The two process that are thought to be responsible are the formation of heterocyclic amines (HCAs) which are formed when amino acids, sugars and creatine (a protein) react at high temperatures and polycyclic aromatic hydrocarbons (PAHs) which are formed when fat and juices from meat grilled directly over an open fire drip onto the fire which then causes flames. The flames contain PAHs that can then adhere to the surface of the meat (Cathy, 2017). Hence, PAHs are formed as a result of thermal decomposition of the organic materials. This result to pyrolysis of the fats (AmosTautua *et al.*, 2013).

Chemically, the term PAHs refers to compounds consisting of two or more benzene rings bounded in linear, cluster or angular arrangement (Silva*et al.*, 2011) or compound that have two or more fused aromatic rings with a pair of carbon atoms shared between rings in their molecules. PAHs containing up to six fused aromatic rings are often known as "small" PAHs, and those containing more than six aromatic rings are called "large" PAHs (IARC *et al.*, 2010).

In general, PAHs are not present individually but in mixtures. Sixteen PAHs that have been extensively monitored are the compounds included in the United States Environmental Protection agency (USEPA) list of priority organic pollutant (USEPA, 1994). Of these 16 PAHs, benzo (a) pyrene is probably the most studied and has been

described by the International Agency for Research on cancer (IARC) as probable human carcinogen in 1987 (IARC 1987). Thus, the determination of benzo (a) pyrene (BaP) has been widely used in environmental analysis as a marker for the entire PAHs content. These compounds show clear evidence of mutagenicity and carcinogenic effect in various types of bioassays in experimental animals (SCF, 2002).

Polycyclic aromatic hydrocarbons (PAHs) are pollutants which get into foods during processing. One of the major routes of human exposure to PAHs in non-smoking people is food. It has been found that raw food does not usually contain high level of PAHs (plaza-Bolanos *et al*, 2010). Presence of PAHs uncooked foods such as vegetables, seeds and grains have been found to accumulate on the waxy surface of many vegetables and fruits. On the other hand, PAHs are found in foods as a result of certain industrial food processing methods such as smoke curing, boiling, roasting and grilling over open fire or charcoal, which permit the direct contact between foods and combustion products (silva*et al*, 2011). Therefore, the analysis of PAHs in food is a matter of concern.

MATERIALS AND METHODS

Collection of Materials

Samples of food for study were collected from three randomly selected sales spots in northern part of Edo state of Nigeria. The samples were obtained at Uchi market. The samples were immediately taken to the laboratory for analysis

Preparation of Samples The maize, yam, unripe and ripped plantains were peel to remove the bark and roasted by the open charcoal pot flame method. Cat fish, mackerel and herring fish were smoked in an open fire drum method as used by the traditional people by placing the fish over a grid of flame from firewood, while the chicken and the beef were grilled by placing them on grill over a smoky flame of firewood (Amos-Tautua *et al,* 2013).

Extraction of Food Samples for PAHs Analysis

2g of each of the homogenized food samples was thoroughly mixed with anhydrous Na_2So_4 salt to absorb moisture and then extracted with a quantity of analytical grade dichloromethane (CH_2Cl_2). The dichloromethane extract was cleaned up by passing through a column packed with anhydrous Na_2SO_4 salt. The resulting extract was concentrated on a rotatory evaporator to give an oily residue which was again dissolved in 1ml CH_2Cl_2 to be used for analysis. (Amos-Tautua *et al,* 2013)

Analysis of Sample Extract for PAHs Concentration

The gas chromatography (GC) used was Hewlett packed 589 O series 11, coupled with flame ionization detector (FID) (Hewlett Packard, Wilmington DE USA). INL was injected into the G C for analysis. The Identification of PAHs was based on comparison of the retention times of the peaks with those obtained from standard mixture of PAHs (Standard are supplies by instrument manufacturer). Quantification was based on external calibration curves prepared from the standard solution of each of the PAHs (Amos-Tautua *et al,* 2013)

RESULTS AND DISCUSSION

Results

The result of the study is showed in the table 1 below:

Discussion

Table1: concentration level of PAHs in some selected delicacies (mg/kg)

PARAMETER	SAMPLE								
	Roasted unripe plantain	Roasted yam	Grilled chicken	Roasted maize	Roasted ripe plantain	Grilled beef	Smoked mackerel	Smoked catfish	Smoked herring
Napthalene	——	0.62	——	1.73	——	0.02	1.11	1.13	1.72
Acenaphthylene	——	——	——	0.70	0.50	0.02	4.26	4.30	15.60
Acenaphthene	——	——	0.12	1.12	——	0.05	6.84	2.12	0.95
Flourene	——	1.51	0.24	0.85	0.78	——	4.84	0.34	3.02
Phenanthrene	——	0.14	——	0.16	0.26	——	1.64	1.29	1.46
Anthrancene	0.11	0.35	0.87	——	0.66	1.03	12.94	1.21	16.72
Fluoranthene	——	——	——	O.61	0.67	——	3.73	22.08	6.89
Pyrene	——	0.45	——	0.35	0.65	2.15	7.39	12.40	16.77
Benzo(a)authrancene	——	0.16	0.89	0.07	0.61	0.01	5.78	4.43	2.62
Chrysene	——	0.07	——	0.05	0.61	5.12	1.42	6.94	6.25
Benzo(b)fluoranthene	0.08	0.31	0.63	0.37	1.31	0.06	6.63	2.48	6.73
Benzo(K)fluoranthene	——	——	0.71	0.28	0.67	0.02	1.91	5.60	1.45
Benzo(a)pyrene	——	——	0.53	——	——	——	2.90	9.20	10.13
Dibenzo(a,h)anthrancene	——	——	——	1.56	1.40	0.01	1.81	2.01	1.44
Benzo(g,h,i)pyrene	——	——	0.74	——	0.56	1.19	2.43	2.33	2.73
Indeno(1,2,3cd)pyrene	——	——	0.18	——	0.60	1.20	5.04	1.76	4.56
TOTAL PAHs	**0.19**	**3.61**	**4.91**	**7.85**	**9.28**	**9.88**	**69.95**	**79.62**	**99.08**

Discussion

A summary of the occurrence of various PAHs present in all the food samples is shown in table **1.** It showed the 16 PAHs and the total PAHs for all the samples. They were reasonably detected in the fish samples, while trace quantities were found in roasted yam, roasted unripe plantain and grilled chicken and some quantities were found in roasted maize, roasted ripe plantain and beef (suya). After thorough research, we found that these observations agreed with other inference made by other researchers that these PAHs are formed during the processing of food (Amos-Tantua *et al.*, 2013).

In table **1**, the concentration of the PAHs in the smoked fishes ranged between 69.95mg/kg and 99.08mg/kg, while the grilled chicken and beef ranged between 4.91mg/kg to 9.88mg/kg. From the observation, the average total PAHs level of suya (9.88mg/kg) was far lower than that of smoked herring fish (99.08mg/kg). This could be ascribed to the high fat content of the fish samples as compared to the chicken and the beef. Akpan *at al.,* (1994) reported that strong correlation exists between fish liquid and PAHs compounds; since the PAHs compounds are stored in the fatty fish tissue. The PAHs with the maximum concentration, flourathene (22.08mg/kg) was detected in catfish. As for the other food samples; roasted maize, roasted yam, roasted unripe plantain and ripe plantain were having lower PAHs values of 7.85, 3.61 ,0.19 and 9.28mg/kg respectively.

Benzo(a) pyrene (BaP) is the most studied carcinogenic PAHs (Collins *et al*, 1991). The levels of BaP found in smoked cat fish, mackerel and herring with the concentration 9.20, 2.90 and 10.13mg/kg were for higher than the recommended maximum permissible concentration of 5.0µ/kg or 0.005mg/kg fixed for BaP in smoked meat, fish and fishery

products (JECFA, 2005). Surprisingly, BaP was not detected in other samples including the beef (suya) in our study. This, the smoke fish may pose some health risk to the people of Edo state North of Edo state Nigeria

CONCLUSION

From this study, since benzo (a) pyrene which is considered as a marker of carcinogenic PAHs is not detected in many of the food samples, it can be assumed that those foods do not represent health risk for human. However, it should be noted that the benzo (a) pyreneof the fish samples and the total PAHs concentrations are relatively too high. This call for some concern that they may pose some health risk.

RECOMMEDATION

Considering the carcinogenic potential of the PAHs and there is the need to reduce the levels of PAHs in foods; the following recommendation are made:

i. Special attention must be given to smoked, roasted and grilled foods.
ii. Indirect cooking methods should be used with foods placed in a chamber heated from the outside.
iii. Direct cooking methods can be done with heat from a clean combustion.
iv. Moderate cooking temperature of about 80-100°C should be used in other to avoid pyrolysis.
v. Public enlightenment should be used to sensitize people about the potential risks of PAHs.
vi. Further studies should be carried out on these pollutants.

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