Sokoto Journal of Medical Laboratory Science 2021; 6(3): 74 - 80

SJMLS - 6 (3) - 010

Studies on some Biochemical Parameters among Charcoal (*Physiculus nematopus*) Traders in Swali Market Yenagoa Bayelsa State

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https://dx.doi.org/10.4314/sokjmls.v6i3.10

Abstract

The aim of this study was to assess some biochemical parameters among charcoal (*Physiculus nematopus*) traders in Swali market Yenagoa Bayelsa State, Nigeria. Five milliliter of blood specimens was collected from each of the fifteen charcoal (*Physiculus nematopus*) traders with <5 years working experience (experimental group one), fifteen charcoal (*Physiculus nematopus*) traders with ⩾ 5 years working experience (experimental group two) and fifteen non charcoal traders (control group) into lithium heparin anti-coagulated bottles respectively. Thereafter alanine aminotransferase (ALT), aspartate aminotransferase (AST), urea, creatinine and C-reactive protein (CRP) were measured quantitatively. The results of charcoal traders in experimental group one showed no statistically significant differences ($p>0.05$) in all the measured biochemical parameters ALT (7.26U/I), AST (5.61U/I), CRP (2.48mg/L), urea (8.68mmol/L), creatinine (82.14µmol/L) as compared to that of the control group (7.22U/I), (5.58U/I), (2.47mg/L), (8.65mmo/L), (82.10µmol/L) respectively while that of experimental group two showed statistically significant differences ($p<0.05$) in alanine aminotransferase (20.40U/I), aspartate aminotransferase (16.20U/I) and C-reactive protein (22.42mg/L) as compared to that of the control group (7.22U/I), (5.58U/I), (2.47mg/L) respectively. However, urea (8.68mmol/L) and creatinine (82.25µmol/L) showed no statistically significant differences ($p>0.05$) as compared to that of the control group (8.65mmol/L), (82.10µmol/L) respectively. In conclusion alanine aminotransferase, aspartate aminotransferase and C-reactive protein may be altered in charcoal (*Physiculus nematopus*) traders exposed to charcoal dust for ⩾ 5 years. It is therefore recommended that charcoal traders in this category should embark on hepato-inflammatory biochemical parameters investigation intermittently in any registered and licensed Medical Laboratory facility so as to monitor the concentrations of these parameters.

Keywords: *Charcoal (Physiculus nematopus) traders, Biochemical parameters, Swali market, Yenagoa, Bayelsa State, Nigeria*

Introduction

Charcoal is a black carbon residue which is very light in weight and produced by slow pyrolysis. This process which consists mainly of carbon is known as charcoal burning which has advantage of the absence of water and other components over burning wood thus allowing charcoal to burn at higher temperatures with the giving off of very little smoke as compared with wood which releases quite a significant amount of organic volatiles, steam as well as un-burnt carbon particles in its smoke when burnt completely.

Charcoal which is also known as the impure form of graphite carbon is obtained in the form of a residue when materials that are carbonaceous in nature are burnt or heated with limited access to air. Coke, soot and carbon black are regarded as forms of charcoal while other forms are designated based on the materials from which they are derived such as wood, bone, blood etc. Before now, charcoal production from wood was an important

source of acetone, methyl alcohol and acetic acid, but this has now been replaced and produced from other raw materials (Gloria, 2020).

Charcoal has been reported by few researchers to contain a high content of carbon with a chemical composition to coal dust (Eileen *et al.,* 2009). Individuals that are occupationally exposed to its fine particulate matter may be at the risks of reduced lung capacity as well as poor respiratory health with chronic lung diseases such as pneumoconiosis and chronic obstructive pulmonary disease (Mamuya *et al.,* 2007).

Literatures related to the occupational exposure and health risks of charcoal production workers are limited. However, a Brazilian study among charcoal production workers reported a prevalence of 35.8% of upper airways symptoms (sneezing and nasal secretion), cough (22.3%), rhinitis (20.8%), asthma (5.97%) and chronic obstructive pulmonary disease (5.97%). The processing of charcoal production is associated with charcoal dust exposure which may trigger adverse respiratory outcomes among workers (De-Souza *et al.,* 2010).

There are so many documented literatures on the effects of coal dust on coal workers, but there is paucity of literature related to the effects of charcoal (*Physiculus nematopus*) dust on its traders who are frequently exposed to toxic chemicals generated from its dust on daily basis by virtue of their occupation which may in turn have adverse effect on their health. Hence, this study which is aimed on assessment of some biochemical parameters among charcoal (*Physiculus nematopus*) traders in Swali market Yenagoa Bayelsa State Nigeria was embarked on in order to ascertain further the effects of this charcoal dust on some biochemical parameters such as alanine aminotransferase, aspartate aminotransferase (liver enzyme biomarkers), urea and creatinine (renal biomarkers) and C-reactive protein (inflammatory biomarker) among charcoal (*Physiculus nematopus*) traders.

Materials and Methods

Study area

This study was carried out in Swali market, Yenagoa, Bayelsa State, Nigeria.

Ethical clearance

Ethical approval to carry out this study was obtained from the ethical committee of Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria. The study was carried out strictly in compliance with the Principle of Helsinki declaration of 1975 as revised in 2008. Verbal approval was also obtained from the leaders of the charcoal (*Physiculus nematopus*) traders' union, Bayelsa State branch. Besides, informed oral consent was obtained from all the recruited volunteers who were made to know the reasons why their blood specimens were needed for this research.

Scope of experimental design

This study was carried out on forty-five (45) apparently healthy volunteers who were randomly recruited and subsequently categorized into three (3) groups as shown:

Control group: This group consisted of fifteen (15) apparently healthy non-charcoal (*Physiculus nematopus*) traders within the age range of 25-45 years who by virtue of their profession are white collar job workers.

Experimental group one: This group consisted of fifteen (15) apparently healthy charcoal (*Physiculus nematopus*) traders with < 5 years working experience within the age range of 25-45 years.

Experimental group two: This group consisted of fifteen (15) apparently healthy charcoal (*Physiculus nematopus*) traders with ⩾ 5 years working experience within the age range of 25-45 years.

As at the time of carrying out this research work all the recruited volunteers in both the control and experimental groups were free from any ailment(s) and were not addicted to cigarette smoking, snuffing and drugs thus ruling out the likely effects of these lifestyle variables on the obtained results.

Sample collection

Five (5) milliliters blood specimen were withdrawn from each of the recruited volunteers (control and experimental groups) via a syringe and dispensed into lithium heparin anti-

coagulated bottles respectively. The blood specimen in each bottle was mixed carefully so as to ensure homogeneity and prevention of blood coagulation and thereafter spun for ten (10) minutes at 1,500 revolution/minute using Gulfex Medical and Scientific microcentrifuge model 800D England. The separated plasma was pipette into a plain bottle and subsequently used for the quantitative measurement of the following biochemical parameters: alanine aminotransferase, aspartate aminotransferase, urea, creatinine and C-reactive protein using a S23A13192 model spectrophotometer.

Laboratory procedures

All the reagents used for this research work were commercially purchased and the manufacturers' standard operational procedures (SOPs) were strictly followed. The following biochemical parameters as shown below were analyzed:

Alanine aminotransferase: This was measured in accordance with the colorimetric method as described by Egoro *et al. (*2020), using reagents manufactured by Randox Laboratories Limited, 55, Diamond Road, Crumlin County, Antrim, BT294QY, United Kingdom.

Aspartate aminotransferase: This was measured in accordance with the colorimetric method as described by Emmanuel *et al. (*2017), using reagents manufactured by Randox Laboratories Limited, 55, Diamond Road, Crumlin County, Antrim, BT294QY, United Kingdom.

Urea: This was measured in accordance with the Urease-Berthelot method as described by George *et al. (*2014), using reagents manufactured by Randox Laboratories Limited, 55, Diamond Road, Crumlin County, Antrim, BT294QY, United Kingdom.

Creatinine: This was measured in accordance with the Jaffe reaction method as described by Obodo *et al. (*2020), using reagents manufactured by Randox Laboratories Limited, 55, Diamond Road, Crumlin County, Antrim, BT294QY, United Kingdom.

C-reactive protein: This was measured in accordance with the turbidimetry method as described by Kari (2007), using reagents manufactured by Spin-react diagnostic kit (Spain).

Statistical analysis

The compliance data with safety measures obtained from the charcoal (*Physiculus nematopus*) traders with <5 years and ⩾ 5 years working experience respectively via questionnaire were analyzed using descriptive statistic of frequency and percentage while the results obtained from the control and experimental groups were expressed as mean and standard deviation with the differences between the groups compared using the student's "t" tests. A p-value of $p<0.05$ was considered statistically significant.

Results and Discussion

Charcoal (*Physiculus nematopus*) is produced by incomplete combustion of wood and used more often because it is light in weight and releases low amounts of smoke during combustion. Charcoal traders are prone to the chemical toxicity of its dust due to their constant exposure to it. The harmful effects of this dust, coupled with gross non- compliance with safety measures by majority of the charcoal (*Physiculus nematopus*) traders constitute a health menace that requires urgent attention.

Data on compliance with safety measures during trading were obtained from the recruited volunteers in experimental groups one and two respectively via a structured questionnaire as shown in Tables 1 and 2 respectively. The data revealed that 100% of these volunteers are non-compliant with the use of leather gloves, nose mask, long sleeve jacket, faceplate and goggles. These findings as established in this study may expose the traders to the harmful effects of charcoal (*Physiculus nematopus*) dust, thus putting them at the risk of health challenges.

In this study the mean values of biochemical parameters like alanine aminotransferase, aspartate aminotransferase, urea, creatinine and C-reactive protein of charcoal (*Physiculus nematopus*) traders with < 5 years working experience (experimental group one) and ⩾ 5 years working experience (experimental group two) respectively were compared with non-

charcoal (*Physiculus nematopus*) traders (control group).

The results of charcoal (*Physiculus nematopus*) traders with < 5 years working experience (experimental group one) as shown in Table 3 revealed no statistically significant differences ($p>0.05$) in the mean values of alanine aminotransferase, aspartate aminotransferase, urea, creatinine and C-reactive protein as compared to that of the control group. These findings as established in this study may suggest that exposure to charcoal (*Physiculus nematopus*) dust for a period of < 5 years may not pose hepato-renal and inflammatory disorders on the health status of charcoal (*Physiculus nematopus*) traders.

The results of charcoal traders with ⩾ 5 years working experience (experimental group two) as shown in Table 4 revealed statistically significant differences ($p<0.05$) in the mean values of alanine aminotransferase, aspartate aminotransferase and C-reactive protein as compared to that of the control group respectively, while that of urea and creatinine showed no statistically significant differences ($p>0.05$) as compared to that of the control group respectively. These findings as established in this study is suggestive that exposure to charcoal (*Physiculus nematopus*) dust for a period of ⩾ 5 years may put the traders at the risk of hepato-inflammatory disorders.

The mechanism for the hepatic disorder may be attributed to the ability of the charcoal (*Physiculus nematopus*) dust particles which are extremely fine to pass through the nostrils and trachea without being filtered by the cilia and mucus respectively thus getting to the lungs where it further passes through its blood barrier to organs such as liver and kidneys. The liver being the primary organ for the detoxification of toxins becomes damaged during the course of trying to detoxify the toxins in the dust which has persistently accumulated as a result of the prolonged exposure (⩾ 5 years) thus triggering and inducing free radicals with the subsequent release of these liver enzymes: alanine aminotransferase and aspartate aminotransferase into the plasma which accounts for their elevations.

The mechanism for the inflammatory disorder is presumed to be associated with prolonged persistence of the charcoal dust in the system of these traders which may have triggered the release of inflammatory cells like lymphocytes and inflammatory mediators such as cytokines (tumour necrosis factor alpha, interleukin 6 and 15) and chemokines (interleukin 8) by the liver thus leading to increase synthesis of C-reactive protein and its release into the plasma.

Conclusion

In conclusion, this study has established that inhalation of charcoal (*Physiculus nematopus*) dust by charcoal traders with < 5 years working experience coupled with total non-compliance with safety measures revealed no significant adverse effects. However, inhalation of charcoal (*Physiculus nematopus*) dust for a period of ⩾ 5 years coupled with total non-compliance with safety measures revealed hepato-inflammatory disorders.

Recommendations

Based on the findings from this study, it is recommended that:

(i) The use of safety gadgets such as nose mask, leather gloves, faceplate, goggles and long sleeve jacket should be strictly adhered to by charcoal (*Physiculus nematopus*) traders so as to reduce the risk associated with exposure to charcoal dust.

(ii) Charcoal (*Physiculus nematopus*) traders with ⩾ 5 years working experience should intermittently be assessed for plasma alanine aminotransferase, plasma aspartate aminotransferase and plasma C-reactive protein in any registered and licensed Medical Laboratory facility.

Table 1: Compliance with Safety Measures by Charcoal (*Physiculus nematopus*) Traders with < 5 years Working Experience (experimental group one)

Safety measures	Response	Frequency (n=15)	Percentage
Use of leather gloves	Yes	0	0 %
	No	15	100 %
Use of nose mask	Yes	0	0 %
	No		15 100%
Use of long-sleeve jacket	Yes	0	0 %
	No		15 100%
Use of faceplate	Yes	0	0 %
	No		15 100%
Use of goggles	Yes	0	0 %
	No		15 100%

Table 2: Compliance with Safety Measures by Charcoal (*Physiculus nematopus*) Traders with ⩾ 5 years Working Experience (experimental group two)

Safety measures	Response	Frequency (n=15)	Percentage
Use of leather gloves	Yes	0	0 %
	No	15	100 %
Use of nose mask	Yes	0	0 %
	No		15 100%
Use of long-sleeve jacket	Yes	0	0 %
	No		15 100%
Use of faceplate	Yes	0	0 %
	No		15 100%
Use of goggles	Yes	0	0 %
	No		15 100%

Table 3: Mean values of Biochemical Parameters measured in Control group as compared to Charcoal (*Physiculus nematopus*) Traders with < 5 years Working Experience (experimental group one)

Parameters	Control group (n=15)	Experimental group (n=15)	p -value	Remark
ALT (U/I)	7.22 ± 0.98	7.26 ± 1.02	p>0.05	NS
AST (U/I)	5.58 ± 0.72	5.61 ± 0.74	p>0.05	NS
CRP (mg/L)	2.47 ± 0.17	2.48 ± 0.19	p>0.05	NS
Urea (mmol/L)	8.65 ± 1.02	8.67 ± 1.04	p>0.05	NS
Creatinine (µmol/L)	82.10 ± 0.71	82.14 ± 0.74	p>0.05	NS

Values are expressed as mean ± S.D.
Keys
ALT = alanine aminotransferase
AST = aspartate aminotransferase
CRP = C-reactive protein
NS = not statistically significant
n = number of volunteers

Table 4: Mean values of Biochemical Parameters measured in Control group as compared to Charcoal (*Physiculus nematopus*) Traders with ⩾ 5 years Working Experience (experimental group two)

Parameters	Control group (n=15)	Experimental group (n=15)	p-value	Remark
ALT (U/I)	7.22 ± 0.98	20.40 ± 2.04	p<0.05	S
AST (U/I)	5.58 ± 0.72	16.20 ± 1.82	p<0.05	S
CRP (mg/L)	2.47 ± 0.17	22.42 ± 2.10	p<0.05	S
Urea (mmol/L)	8.65 ± 1.02	8.68 ± 1.06	p>0.05	NS
Creatinine (µmol/L)	82.10 ± 0.71	82.25 ± 0.75	p>0.05	NS

Values are expressed as mean ± S.D.
Keys
ALT = alanine aminotransferase
AST = aspartate aminotransferase
CRP = C-reactive protein
NS = not statistically significant
S = statistically significant
n = number of volunteers

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Citation: Egoro, E.T., Oni E.S., Otaraku J.O. and John D.E. Studies on some Biochemical Parameters among Charcoal (*Physiculus nematopus*) Traders in Swali Market Yenagoa Bayelsa State. ***Sokoto Journal of Medical Laboratory Science; 6(2): 74 - 80.***