Austin Journal of Cancer and Clinical Research

Open Access

Austin Publishing Group

Research Article

Oral Supplements Modulation of Dietary Polyaromatic Hydrocarbon Levels in Prostate Cancer Patients in Ibadan, Nigeria

Adedapo KS[1]*, Anjorin FF[1], Adediwura DE[1] and Kareem OI[2]

[1]Department of Chemical Pathology, University of Ibadan, Nigeria

[2]Department of Nuclear Medicine, University College Hospital Ibadan, Nigeria

***Corresponding author:** Adedapo KS, Department of Chemical Pathology, University College Hospital, Nigeria

Received: May 22, 2018; **Accepted:** June 04, 2018; **Published:** June 18, 2018

Abstract

The levels of dietary poly aromatic hydrocarbon and Total anti-oxidant Status (TAS) in the serum of 30 prostate cancer patients compared with 30 apparently healthy controls were measured to study the contribution of this toxicant in the aetiology of prostate cancer. Prostate Specific Antigen (PSA), Benzo {a} pyrene (BaP) and Total antioxidant Status (TAS) were analysed using standard methods. Benzo {a} pyrene was analyzed using high performance liquid chromatographic technique (HPLC).

The results showed significantly higher mean levels of PSA (ng/ml) (144.6 ± 556.0) in participants with prostate cancer compared to the controls (5.2 ± 9.7) respectively ($p<0.05$). Conversely, there was a significant decrease in the mean levels of BaP (µg/ml) (0.4 ± 0.2 versus 0.7 ± 0.2 and TAS (mmol/L) (11.7 ± 1.6 versus 12.9 ± 1.0)in participants with prostate cancer compared to the controls. There was a positive correlation of BaP with the frequency of smoked fish intake in participants with prostate cancer compared with the controls (0.630, $p < 0.000$ versus 0.117, $p <0.537$). A significantly reduced level of BaP was observed in participants and controls on oral supplements compared with those otherwise. Logistic regression to correct for supplement intake showed an indirect relationship with BaP (-6.367, $p <0.05$). There was no significant variation in the mean levels of all the anthropometric measurements between the cases and the controls ($p> 0.05$).

Increased consumption of smoked foods, reduced TAS and resultant oxidative stress may contribute to the aetiology of prostate cancer while supplements ingestion may ameliorate benzo (a) pyrene level in some individual.

Keywords: Prostate cancer; BaP; TAS; PSA

Introduction

Prostate cancer, whose risk increases with age remains the most frequently diagnosed malignancy and the second leading cause of cancer-related mortality among males [1]. It is the most diagnosed cancer among Nigerian men [2]. Since the incidence of cancer increases with age, the number of newly diagnosed cases and death continues to rise as the life expectancy of the general population increases.

Prostate cancer risk is associated with carcinogen exposure such as polycyclic aromatic hydrocarbons (PAHs), an environmental widespread contaminants resulting from the incomplete combustion of carbon-containing fuels such as diesel, tobacco, wood, or charbroiled meat Nelson et al. 2002. Poly aromatic hydrocarbon like, Benzo (a) pyrene, (BaP) is listed by the International Agency for Cancer Research on cancer (IARC) as a group-1 carcinogen, that is, carcinogenic to humans [3,4]. These molecules have been found to be associated with increased reactive oxygen species [5-7] that may overcome the protection afforded by antioxidant defence mechanisms.

The geographical difference in the rate of prostate cancer around the world appears to correlate with dietary intakes and lifestyle differences. It is long been thought that dietary and lifestyle-related factors may as well contribute to the risk of cancers. The accumulation of carcinogens during the cooking process and rising new cases of cancer especially that of the prostate may be attributed to chemical carcinogen exposures [8].

Despite the overwhelming literature on the carcinogenicity of PAHs, avoidable exposure to these compounds is on the rise. In prostate cancer, the identification of risk factors and the promotion of active preventive medicine can provide enormous benefits to the super-aging society of our future. Oxidative stress induced by PAH exposure may be an important determinant for the susceptibility to prostate cancer.

Antioxidant systems are part of the body's defence system that helps to scavenge the effect of reactive oxygen species generated as a result of accumulation of these mutagenic compounds [9]. Dietary/ Oral supplements which include vitamins, minerals and micronutrients as well as a wide variety of nonessential nutrients such as phytochemicals and herbs has been recommended in doses for cancer patients because of their beneficial roles [10].

Citation: Adedapo KS, Anjorin FF, Adediwura DE and Kareem OI. Oral Supplements Modulation of Dietary Polyaromatic Hydrocarbon Levels in Prostate Cancer Patients in Ibadan, Nigeria. Austin J Cancer Clin Res. 2018; 5(1): 1081.

Therefore the aim of this study was to determine the level of poly aromatic hydrocarbon exposure and total antioxidant status (TAS) in Nigerian men diagnosed with prostate cancer compared to apparently healthy age-matched controls.

Materials and Methods

Participants

The cross sectional case control study recruited thirty (30) patients diagnosed with prostate cancer between the ages of 55-85 from the surgical oncology clinics at the University College Hospital, Ibadan, Nigeria. The controls included age-matched 30 apparently healthy men recruited from members of staff of the University College, Ibadan, Nigeria. All study participants were asked to complete a self-administered questionnaire that included questions on demographic factors, dietary records, medical history and health related behaviour. In order to ensure uniformity, all patients and controls were chosen from the same ethnic (Yoruba) background and living in the same South Western part of Nigeria [as determined from their responses to questionnaires and clinical investigations]. The study was approved by the Joint University of Ibadan and University College Hospital Ethics Committee and informed consent form was duly signed by each of the participant. Patients or controls with any form of urogenital diseases, benign prostate hypertrophy or who history of rectal examination within the last 24 hours of recruitment were excluded from the study.

Outcome measures

Height: This was measured using a Stadiometer and the readings were recorded in meters.

Weight: This was taken with Omron weighing scale (HBF, 202) placed on a flat surface and the readings were recorded to the nearest 0.5 kg.

Body mass index (BMI): This was calculated from the height and weight of the participants using the formula:

$BMI\ (Kg/M^2) = Weight\ (Kg) / Height^2\ (M^2)$

Collection of blood samples and measurement of analytes not trace elements levels: Five ml of venous blood was obtained into plain sample bottle. The blood sample was allowed to clot and retract after which it was centrifuged in Centaur MSE centrifuge machine (Fisons, England) at 4000 rpm for 5 min to obtain serum which was stored at -20°C until ready for assay.

Serum concentrations of Benzo{a} pyrene (BaP), total antioxidant status (TAS) and Prostate Specific Antigen (PSA) were determined using high performance liquid chromatographic (HPLC) method [11], spectra photometric method [12] and immune radiometric assay respectively.

Statistical analysis

Data analysis was conducted using Statistical Package for Social Sciences (SPSS) version 21. Descriptive statistics such as means and standard deviation (SD) were used to evaluate the levels of the variables measured. Student's t-test was employed to determine differences in mean scores between test groups and controls. Correlation analysis was conducted to establish the association between the variables in the study. The level of significance was set at $p< 0.05$ for all statistical procedures.

Table 1: Comparison of anthropometric indices in study participants and control.

Variables	Study Participants (n=30)	Control (n=30)	t-value	p-value
Age (years)	69.90 ± 7.439	68.47 ± 8.403	0.698	0.487
SBP (mmHg)	128.17 ± 19.14	136.50 ± 18.623	-1.709	0.093
DBP (mmHg)	77.90 ± 12.51	80.33 ± 9.64	-0.844	0.402
Height (m)	1.7 ± 0.1	1.7 ± 0.1	-0.019	0.985
Weight (Kg)	66.1 ± 15.2	67.4 ± 9.1	-0.381	0.705
BMI (kg/m²)	23.6 ± 5.2	24.1 ± 4.0	-0.443	0.659

Table 2: Comparison of means of Biochemical parameters in study participants and control.

Variables	Study Participants (n=30)	Control (n=30)	t-value	p-value
PSA (ng/ml)	[a]16.0(7.7-52.2) 144.6 ± 556.0	[a]2.7(1.2-3.6) 5.2 ± 9.7	[b]-5.131	[b]0.000*
BaP (µg/ml)	0.4 ± 0.2	0.7 ± 0.2	-5.284	0.000*
TAS (mmol/l)	11.7 ± 1.6	12.9 ± 1.0	-3.385	0.001*

* = p<0.05 is significant
a = median- interquartile range
PSA = Prostate specific antigen
BaP = Benzo {a} pyrene
TAS = Total anti-oxidant status

Table 3: Pearson correlation of Benzo{a} pyrene with the frequency of smoked food intake in study participants and control.

Correlating pairs	Study Participants	Control
	r, p	r, p
Smoked fish	0.630, 0.000*	0.117, 0.537
Roasted yam	0.183, 0.334	0.002, 0.990
Roasted plantain	0.023, 0.906	-0.219, 0.245
Suya (Barbecued meat)	0.144, 0.446	0.170, 0.369
Roasted corn	0.053, 0.779	0.374, 0.042*
Groundnut	0.082, 0.667	-0.044, 0.815
Cashew nut	0.405, 0.027*	-0.156, 0.409

* = p<0.05 is significant

Results

A total of 30 prostate cancer patients and 30 apparently healthy age-matched controls were recruited. The mean age of the prostate cancer patients was 69.90 ± 7.4 years and that of controls was 68.47 ± 8.4 years.

Table 1: shows the comparison of the anthropometric measurement of prostate cancer patients with the controls. The mean age, SBP, DBP, height, weight and BMI, were not significantly different from the controls.

There was a significant increase in the serum levels of PSA in participants with prostate cancer compared with the controls while Bap and TAS were higher in the controls than in the cases (Table 2).

Table 3: shows the Pearson correlation of BaP with the frequency of smoked food intake in prostate cancer patients and the controls. There was a positive correlation between smoked fish and cashew nuts to the level of BaP in prostate cancer patients.

Compares the means of biochemical parameters of prostate cancer

Table 4: Comparison of means of biochemical parameters of prostate cancer participants on supplements with participants not on supplements.

Variables	Supplements (n=22)	Non-supplement (n=8)	t- value	P-value
PSA (ng/ml)	[a]21.85 (9.65-114.70) 192.84 ± 646.36	[a]10.95 (6.13-16.03) 11.93 ± 8.32	[b]1.900	[b]0.057
BaP (µg/ml)	0.37 ± 0.15	0.56 ± 0.22	-2.705	0.012*
TAS (mmol/l)	11.69 ± 1.63	11.81 ± 1.79	-0.176	0.861

*Significant at p<0.05; PSA= Prostate Specific Antigen, BaP= Benzo {a} pyrene and TAS=Total Antioxidant Status.
[a]median (interquartile range)
[b]Mann Whitney U test of significance

Table 5: Comparison of means of biochemical parameters of controls on supplements with controls not on supplement.

Variables	With Supplements (n=13)	Without Supplement (n=17)	t- value	P-value
PSA (ng/ml)	[a]2.50 (1.15-3.40) 3.53 ± 5.14	[a]3.20(1.35-3.75) 6.49 ± 12.10	[b]-0.545	[b]0.592
BaP (µg/ml)	0.61 ± 0.25	0.81 ± 0.22	-2.298	0.029*
TAS (mmol/l)	12..96 ± 1.03	12.89 ± 1.07	0.174	0.863

*Significant at p<0.05; PSA= Prostate Specific Antigen, BaP= Benzo {a} pyreneand TAS=Total Antioxidant Status.
[a]median (interquartile range)
[b]Mann Whitney U test of significance

participants on supplements with participants not on supplements. A significantly reduced level of Bap was observed in participants on supplements compared to those not on supplements. Similarly, a significantly reduced level of BaP was also observed in the controls on supplements (Table 4 and 5).

To further examine the relationship between supplement intake and the biochemical parameters (Benzo {a} pyrene and TAS), a logistics regression employed showed an indirect relationship between supplement intake and the level of benzo {a} pyrene in prostate cancer patients, (B=-6.367, p=0.038) while no such relationship was observed in that of the control group (B=-4.157, p=0.050).

Discussion

Prostate cancer continues as the leading cause of cancer- related deaths among men and the most diagnosed cancer among Nigerian men [2]. The relationship between diet and cancer incidence has been a major topic of cancer prevention, part of the risk has been found to be associated with the consumption of mutagenic substances (such as benzo {a} pyrene- a prototype of poly aromatic hydrocarbon) along with the foods.

Several compounds either present as dietary components or formed during food processing have been observed to play a role in cancer development [13]. Antioxidant supplement systems helps to scavenge the effect of reactive oxygen species generated as a result of accumulation of mutagenic compounds [9].

The finding of the mean serum level of prostate specific antigen (PSA) being significantly higher in patients with prostate cancer compared with the control is consistent with the trend observed in the study by [14].

The level of benzo {a} pyrene (BAP) a prototype of poly aromatic hydrocarbon (PAH) which has been implicated in carcinogenesis was found to be significantly higher in the control participants than in prostate cancer patient in this present study. PAHs like, benzo-pyrene, is listed by the International Agency for Cancer Research on cancer (IARC) as a group-1 carcinogen, *i.e.* carcinogenic to humans [3,4]. Enokida et al. [5] reported that these molecules may be associated with an increase of reactive oxygen species (ROS) that may in-turn overcome the protection afforded by antioxidant defence mechanisms; this condition can then lead to oxidative damage of biomolecules including DNA, proteins and lipids, supporting the hypothesis that PAHs are significant contributors to genotoxicity and carcinogenicity as well as the disturbance of several signal and metabolic pathways, in prostate cancer [15,16]. To further examine the reason for a higher level of BAP in the control participants as compared to the cases, a logistic regression was used to correct for supplement intake and it was found that there was an indirect relationship between supplement intake and the level of BaP in the study participants. A lesser percentage of the control participants were on supplements as compared to the cases and this could be a possible reason for a higher level of BAP in the control participants.

This present study showed a positive correlation of Benzo {a} pyrene with the frequency of smoked fish intake and this is similar to the trend observed in Gunier et al. 2006 study, It was observed that consumption of grilled, roasted or boiled meat significantly elevated the levels of PAHs. Viegas et al. 2012 also evaluated the effect of charcoal types and his research reveals that continuous and high temperature grilling, smoking was shown to directly contribute to increased PAHs accumulation in both fish and beef.

Joshi et al. 2012 also recorded that high fish intake was associated with an increased risk of advanced prostate cancer when cooked at high temperatures. This present study however showed that a larger percentage of prostate cancer patients fed on smoked foods particularly smoked fish but despite this fact, the control participant still had a significantly higher level of the toxicant (Benzo {a} Pyrene). This finding could also be linked to the role of endogenous antioxidant as well as the supplements ingested in the subjects.

In addition to the above, this study also reviewed the role of anti-oxidant vitamins taken in form of different supplements. This includes herbal supplements, Vitamin C, Vitamin E and a wide range of vitamins taken by the study participants. It is suspected that there was a change of lifestyle and dietary factors after the diagnosis of prostate cancer. This we believe underlie the fact that a significantly larger percentage of them took supplements when compared to the controls. This finding suggests that dietary supplement could control Benzo {a} pyrene levels.

However, this study observed a statistically significant higher level of TAS in the control compared to the prostate cancer patients. Decreased TAS in the subjects reflects reduced antioxidant capacity in response to increased generation of reactive oxygen species and free radicals. Excessive free radical generation and decreased antioxidant status is observed in cancer [17].

Benzo {a} pyrene was also found to be positively correlated to the frequency of intake of roasted corn ($p<0.05$) in the control participants and this same trend was observed in a study by Olabemiwo, (2013).

Conclusion

The presence of PAH in foods which has been linked with the various methods of food preparation may be a probable reason for reduced level of TAS observed in the cases. Significant reduction in the level of total antioxidant status is a probable indicator of metabolic response to oxidative stress in patients with prostate cancer. Supplements ingestion appeared useful in reducing the level of benzo a pyrene and may help mitigate the effect of this harmful compound in smoked foods.

References

1. Siegel R, Naishadham D, Jemal A. Cancer Statistics, 2012. CA Cancer J Clin. 2012; 62: 10-29.
2. Ferlay J, Shin HR, Bray F. Cancer incidence and epidemiology. Journal of National Cancer Institute. 2010; 97: 1768-1777.
3. Polynuclear Aromatic Compounds, Part 1. Chemical, Environmental and Experimental Data. IARC Monogr Eval Carcinog Risk Chem Hum. 1983; 32: 1-453.
4. IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. Some non-heterocyclic polycyclic aromatic hydrocarbons and some related exposures. IARC Monogr Eval Carcinog Risks Hum. 2010; 92: 1-853.
5. Enokida H, Shiina H, Urakami SM, Terashima M, Ogishima T, Li LC, et al. Smoking influences aberrant CpG hypermetilation of Multiple Genes in Human Prostate Carcinoma. Cancer. 2005. 106: 79-86.
6. Chaudhary A. Pechan T, Willett KL. Differential Protein Expression of Peroxidation I and II by Benzo (a) Pyrene and Quercetin Treatment in 22Rv1 and PrEC Prostate Cell Lines. Toxicology and Applied Pharmacology. 2006; 220: 197-210.
7. Singh R, Sramb RJ, Binkova B, Kalina I, Popov TA, Georgieva T, et al. The Relationship between Biomarkers of Oxidative DNA Damage, Polycyclic Aromatic Hydrocarbon DNA Ad- ducts, Antioxidant Status and Genetic Susceptibility Following Exposure to Environmental Air Pollution in Humans. Mutation Research. 2007; 620: 83-92.
8. Josh AD, John EM, Koo J, Ingles SA, Stern MC. Fish intake, cooking practices, and risk of prostate cancer: results from a multi-ethnic case-control study. Cancer Causes Control. 2012; 23: 405-420.
9. Halliwell B, Gutteridge JM. Role of free radicals and catalytic metal ions in human disease: an overview. Methods Enzymol. 1990; 186: 1-85.
10. National Research Council. Recommended Dietary Allowances. 10th ed. National Academy Press, Washington, DC. 1989.
11. Ali MN and Omar FAR. 2013. Development of a new modified method for polyaromatic Hydrocarbon (PAHs) measurement in sera samples of healthy individuals by High Performance Liquid Chromatographic Technique. Inter. Journal of research in pharmacy and Chemistry. 2013; 3: 2231-2781.
12. Koracevic D, Koracevic G, Djordjevic V, Andrejevic S, Cosic V. Method for the measurement of antioxidant activity in human fluids. J Clin Pathol. 2001; 54: 356-361.
13. Mukherjee S, Koner BC, Ray S, Ray A. Environmental contaminants in pathogenesis of breast cancer. Indian J Exp Biol. 2006; 44: 597-617.
14. Catalona WJ, Smith DS, Ratliff TL, Basler JW. Detection of organ-confined prostate cancer is increased through prostate-specific antigen-based screening. JAMA. 1993; 270: 948-954.
15. Pelicano H, Carney D, Huang P. ROS stress in cancer cells and therapeutic implications. Drug Resist Updat. 2004; 7: 97-110.
16. Clerkin JS, Naughton R, Quiney C, Cotter TG. Mechanisms of ROS modulated cell survival during carcinogenesis. Cancer Lett. 2008; 266: 30-36.
17. Tas F, Hansel H, Belce A, Ilvan S, Argon A, Camlica H, et al. Oxidative stress in breast cancer. Med Oncol. 2005; 22: 11-15.

Citation: Adedapo KS, Anjorin FF, Adediwura DE and Kareem OI. Oral Supplements Modulation of Dietary Polyaromatic Hydrocarbon Levels in Prostate Cancer Patients in Ibadan, Nigeria. Austin J Cancer Clin Res. 2018; 5(1): 1081.