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EFFECT OF OIL PRODUCING ACTIVITIES ON BIOCHEMICAL INDICES OF NIGERIAN DWARF GOAT

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The implication of crude oil producing activities on animals and humans in the Niger-Delta attracts the attention of various scientists. The aim of this investigation was to access the biochemical indices of native goat inhabiting crude oil producing environment using nondestructive sampling techniques. Similar aged matched goats from a non-oil producing environment were adopted as control. Blood samples from each set of goats were collected using hypodermal needle through the ear vein of each goat. The sera were prepared and used to determine NADPH oxidase activity, lipid peroxidation product (MDA), reduced glutathione (GSH) level, ascorbic acid (AA) level, and glucose-6-phosphate dehydrogenase (G6PD) activity. The results indicated that the activity of NADH oxidase activity and lipid peroxidation products were higher in goat obtained from the oil producing environment compared to values in goat from non-oil producing areas. This is against the reduced levels of antioxidant markers: GSH, AA and G6PD in goats inhabiting oil producing area relative to those in the non-oil producing region. This study thus concluded that animals living in area close to crude oil producing activities are faced with pollution stimulated health challenges.

Ascorbic acid – crude oil – glutathione – lactate dehydrogenase –
Glucose-6-phosphate dehydrogenase

Նիգեր-դելտայում կենդանիների և մարդկանց վրա հում նավթի արդյունահանման գործողությունների հետևանքները գրավում են տարբեր գիտնականների ուշադրությունը: Այս հետազոտության նպատակն էր մուտք գործել հում նավթ արտադրող միջավայրում բնակվող հայրենի այծի կենսաքիմիական ցուցանիշներ՝ օգտագործելով ոչ քանդման նմուշառման մեթոդներ: Յուղ չարտադրող միջավայրից նման տարիքի համապատասխանեցված այծերն ընդունվել են որպես հսկողություն: Յուրաքանչյուր այծի արյան նմուշները հավաքվում էին հիպոդերմիկ ասեղով՝ յուրաքանչյուր այծի ականջի միջոցով: Սերաները պատրաստվել և օգտագործվել են NADPH- ի օքսիդազի ակտիվությունը, լիպիդային պերօքսիդացման արտադրանքը (MDA), գլյուտաթիոն (GSH) մակարդակի իջեցումը, ասկորբինաթթվի (AA) մակարդակը և գլյուկոզա-6-ֆոսֆատ դեհիդրոգենազ (G6PD) գործունեությունը որոշելու համար: Արդյունքները ցույց են տվել, որ NADH-ի օքսիդազի գործունեության ակտիվությունը և լիպիդային պերօքսիդացման արտադրանքի ակտիվությունն ավելի բարձր են յուղ արտադրող միջավայրից ստացված այծի մեջ՝ համեմատած յուղ չարտադրող տարածքներից այծի արժեքների հետ: Սա դեմ է հակաօքսիդանտային մարկերների իջեցված մակարդակի. GSH, AA և G6PD՝ նավթարդյունահանող տարածք բնակեցրած այծերում, համեմատած նավթ չարտադրող տարածաշրջանում: Այս ուսումնասիրությունը եզրակացրեց, որ անմշակ յուղ արտադրող գործունեությանը հարող տարածքում ապրող կենդանիները բախվում են աղտոտման խթանման առողջության հետ կապված մարտահրավերներին:

Ասկորբինաթթու – չմշակված յուղ – գլուտաթիոն – կաթնաթթվային ջրազերծում –
գլյուկոզա-6-ֆոսֆատ դեհիդրոգենազ

Влияние деятельности по добыче сырой нефти на животных и людей в дельте реки Нигер привлекает внимание различных ученых. Цель этого исследования состояла в том, чтобы получить доступ к биохимическим показателям местных коз, обитающих в нефтедобывающей среде, с использованием методов неразрушающего отбора проб. Подобные состарившиеся козы из не нефтедобывающей среды были приняты в качестве контроля. Образцы крови из каждой группы коз отбирали с помощью иглы для подкожных инъекций через ушную вену каждой козы. Сыворотки готовили и использовали для определения активности NADPH-оксидазы, продукта перекисного окисления липидов (MDA), уровня глутатиона (GSH), уровня аскорбиновой кислоты (AA) и активности глюкозо-6-фосфатдегидрогеназы (G6PD). Результаты показали, что активность NADH-оксидазы и продуктов перекисного окисления липидов была выше у коз из нефтедобывающей среды, по сравнению со значениями у коз из не нефтедобывающих районов. Это противоречит снижению уровня антиоксидантных маркеров: GSH, AA и G6PD у коз, населяющих нефтедобывающий район, по сравнению с районами, не производящими нефть. Таким образом, это исследование пришло к выводу, что животные, живущие в районе, близком к добыче сырой нефти, сталкиваются с проблемами, вызванными загрязнением.

Аскорбиновая кислота – сырая нефть – глутатион – лактатдегидрогеназа – глюкозо-6-фосфатдегидрогеназа

During the exploration and production of crude oil, hydrocarbons of various sorts, carbon (IV) oxide, corrosive acid wastes, sulphur and toxic metals are released into the immediate surrounding [39]. The biological consequences of this have been monitored by field and laboratory studies [1, 22]. Some of the noxiousness on plants include induction of oxidative stress [1, 17]; alteration of growth and metabolic activities in plants [10, 13, 15, 16, 20]: induction of metabolic derangements in animals [1, 7, 9, 12, 16, 17].

Most importantly, the health implication of crude oil activities in the Niger Delta is enormous [26-28]. Also, environmentally mediated alterations in biochemical indices have been reported [9, 34]. Overall, crude oil pollution is a major threat to all shades of lives in the Niger Delta Region. That if adequate care is not taken may culminate in the extinction of some plants and animal species. Recently, the treat of industrial activities on biodiversity in Delta State was documented [25]. The focus of this investigation was to assess the effect of crude oil related activities on Nigerian dwarf goat.

Materials and methods. *Experimental Animals and collection of Samples*

Mature female goats, twelve from each location were used for this study. Nigerian goat inhabiting two regions: Okpai and its environs with a known history of oil activities in Ndokwa East Local Government Area, Delta State, Nigeria and Eziokpor and its environs in Ukwuani Local Government also in Delta State, Nigeria with no history of crude oil activities were chosen for the study. After due consent of the owners were sought, sterile hypodermal syringe were used to collect blood samples through the ear vein into sample containers and labeled appropriately. The samples were kept in ice and taken to the laboratory where they were stored at $4^{o}C$ and analyzed within forty eight hours.

Determination of Biochemical parameters

Red blood cells were isolated as described by George et al. [25] and used for NADPH oxidase was determined following the protocol of Jiang and Zhang [35]. Thiobarbituric acid-reactive substances (TBARS) formation was measured as index of lipid peroxidation [27].

Vitamin C was determined as reported by Achuba [18]. Serum reduced glutathione concentration was determined with the method of Ellman [33]. Blood GSSG was determined with the method described by Tietze [48]. The ratio of GSH/GSSG was evaluated with the equation = GSH-2GSSG/GSSG. Glucose-6 –phosphate dehydrogenase activity was determined by the method of Henry [33].

Results and Discussion. The ingestion of diet polluted by petroleum causes the release of reactive intermediates which induce changes in tissues of the organism in question [4, 43]. However, exposed organisms tend to adjust metabolic indices in a bid to cope with the effects of pollution. That the animals inhabiting the studied area are experiencing free radical toxicity is indicated by the upsurge in the activity of NADPH oxidase in areas associated with petroleum pollution (fig.1).

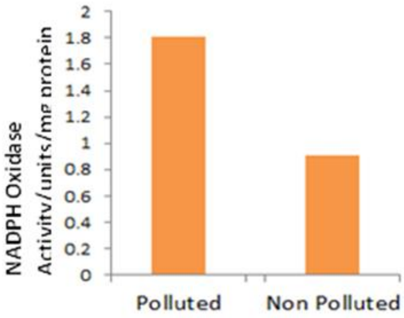

Fig. 1. NADPH oxidase activities in animals from polluted and non-polluted environments. The mean serum NADHPH oxidase activity of the animals differs significantly ($p < 0.05$) in relation to environments

This enzyme is a potent free radical generator [46]. Free radicals when produced in excess than the organism can contain results in biomembrane damages occasioned by radical mediated macromolecular damage. One such mediator in membrane damage is lipid peroxidation. Environment-mediated lipid peroxidation alterations had been reported [8]. It makes no surprise the increase in lipid peroxidation products in animals in the perceived polluted environment (fig. 2).

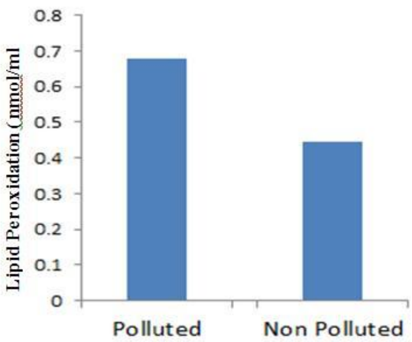

Fig. 2. Lipid peroxides products in animals from polluted and non-polluted environment. The mean serum lipid peroxides of the animals differs significantly ($p < 0.05$) in relation to environments

Lipid peroxidation has a very strong relationship with induction of disease cum enzyme modulations [1, 11]. One important enzyme that gives information on respiratory hiccups in aerobic organisms is lactate dehydrogenase (LDH). The activity of the enzyme increases when there is a shift towards anaerobiosis [23]. Therefore, the increase in LDH of animals from polluted environment is a reflection pollution–stimulated anaerobic respiration (fig. 3).

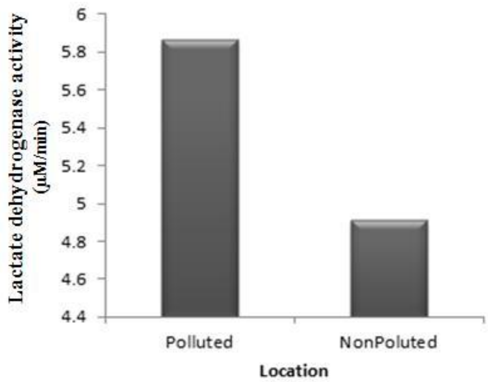

Fig. 3. Lactate dehydrogenase activities (µM/min) in animals from polluted and non-polluted environment. The mean serum lipid peroxides of the animals differs significantly ($p < 0.05$) in relation to environments

It is no gainsaying; therefore, that animals exposed to polluted environments are prone to infections since earlier report implicated LDH as a mediator in disease prognosis [47]. An array of non-enzymatic antioxidants such as vitamin C and glutathione are altered during oxidative insults [18, 44]. Ascorbic acid is a water-soluble antioxidant vitamin, which scavenges free radicals in the cytosol by donating electrons to free radicals to inactivate them [45]. This study indicated a reduction in serum ascorbic acid concentration in animals as a result of the polluted environment (fig. 4).

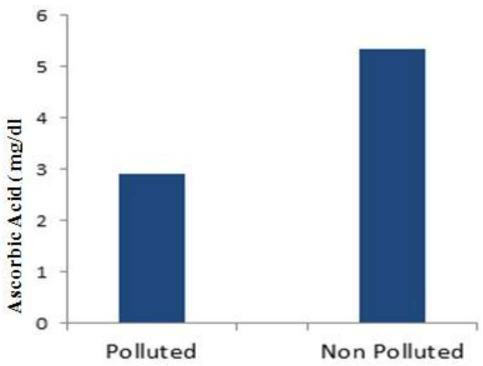

Fig.4. Level of ascorbic acid in the serum of animals from polluted and non-polluted environment. The mean serum ascorbic acid level of the animals differs significantly ($p < 0.05$) in relation to environments.

This observation is similar to previous report by Achuba [18]. This significant reduction in AA is no surprise putting into consideration the increase in serum lipid peroxidation product (fig. 3). It is pertinent to posits that the low level of AA in animals from the polluted areas is simply due to the utilization of ascorbic acid in scavenging the reactive intermediates generated in the tissue of animals exposed to pollution. Further depletion of the non-enzymatic antioxidant systems is also indicated by the depletion of GSH in animals obtained from the polluted area (fig. 5).

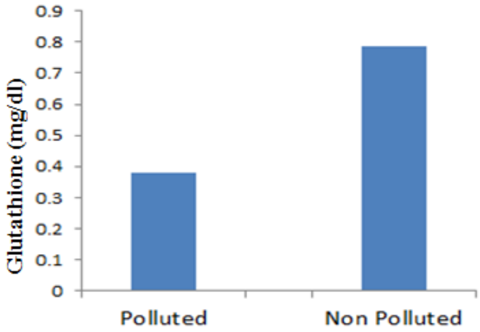

Fig.5. Level of reduced glutathione in the serum of animals from polluted and non-polluted environment. The mean serum reduced glutathione level of the animals differs significantly ($p < 0.05$) in relation to environments

This reduction could predispose the animals from polluted areas to oxidative damage. Similar in action but different in distribution, glutathione is abundant in the mitochondria and is the major soluble antioxidant in this cellular compartment [37]. In fact, glutathione level was affected by the pollution in the environment. Recently, Adeoye et al. [24] that pollution depletes the level of glutathione in inhabiting animals. Similar to AA, an upsurge in reactive intermediates in tissues of the animals due pollution might the basis for the displayed reduction in GSH concentrations and the concurrent decrease in GSH/ GSSG ratio in animals inhabiting the polluted environment (fig. 6).

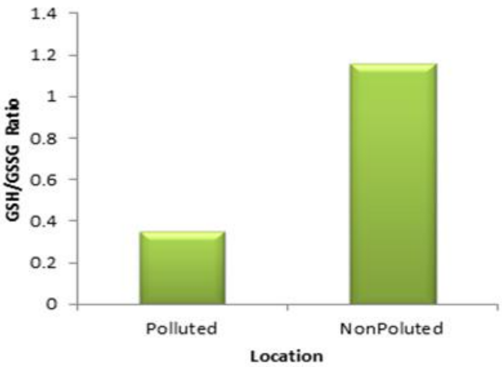

Fig. 6. GSH/ GSSG ratio in animals from polluted and non-polluted environment. The mean serum ratio of GSH/GSSG of the animals differs significantly ($P < 0.05$) in relation to environments.

The ratio of reduced glutathione (GSH)/ oxidized glutathione (GSSG) is a good candidate for measuring oxidative stress in living organisms. And increase in the ratio of GSSG/GSH portends oxidative stress [36, 38]. The decrease in the ratio of GSH/GSSG in animals in the polluted relative to animals in the non-polluted environment is indicative of pollution-stimulated oxidative stress.

Another important enzyme related to glutathione is G6PD whose activity was low in animals from the polluted sites relative to animals taken from the non-polluted regions (fig. 7).

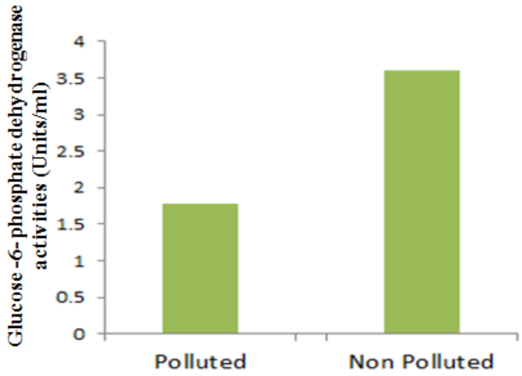

Fig. 7. Glucose -6- phosphate dehydrogenase activities in animals from polluted and non-polluted environment

G6PD is the first important enzyme in the pentose phosphate pathway that produces NADPH that is required for maintaining glutathione in its reduced state [32]. This may explain the crucial role of this enzyme in the prevention of oxidative damage [29, 40]. The reduced activity of this enzyme in animals from polluted environment further confirm the reason for reduced glutathione and the enhanced GSH/GSSG in animals in the polluted environment relative to animals in the non-polluted environment

The exposure to chronic petroleum pollution has an adverse biochemical consequence in animals inhabiting polluted environment. This is evidenced by the negative alterations of oxidative stress indices in animals used in this investigation.

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