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Ringal (a dwarf bamboo): Resource Use Pattern

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ABSTRACT: In this article the resource use pattern of *Ringal* (a dwarf bamboo) in district Rudraprayag (Garhwal Himalaya) has been discussed. Out of five species of *ringal*, only two species *Drepanostachyum falcatum* and *Thamnocalamus pathiflorus* are commonly used for making baskets, mats, flowerpots and other products. [Report and Opinion. 2009;1(4):1-5]. (ISSN 1553-9873).

Keywords: Ringal, natural resource, use of ringal, Rudraprayag

INTRODUCTION

The natural resources form the major livelihood base for the downtrodden communities in the remote villages of hilly state Uttarakhand. Forests are the most important natural resources in Uttarakhand providing fuel wood, fodder, biomass and other major and minor forest produces. *Ringal* (a dwarf bamboo) and natural fiber, medicinal & aromatic plants are one among the potential resources available in different villages and adjoining forests in state Uttarakhand. A number of communities are involved in dwarf bamboo (*ringal*) and natural fiber crafts work for their survival.

Ringal (dwarf bamboo) in India is harvested traditionally from the temperate regions of Himalayas and used indigenously for preparation of baskets, mats, brooms etc. In the local language *ringal* is known as *Ningaw*. In the district Rudraprayag (Garhwal) *ringal* is part of life of the local tribal population. Although *ringal* has played a vital role in the day-to-day activities of the inhabitants, it has never achieved a status of commercially used resource due to lack of knowledge and awareness among the local people.

Ringal provides livelihood requirements to a considerable number of forest fringe communities, especially socially backward communities. There is such a sustainable demand for dwarf bamboos resources from traditional artisans (*Rudhiya*) that in the years to come, the requirement would outscore the stock and the pressure on the resources might deplete the existing patches of *ringal*. The indiscriminate extraction from natural populations coupled with large-scale habitats loss has seriously endangered the dwarf bamboo (*ringal*) genetic resource.

In this article the author has described the resource use pattern of some *ringal* species in the Rudraprayag district Garhwal (Uttarakhand).

METERIALS AND METHODS

Study area: District Rudraprayag (Garhwal) of Uttarakhand state is the remote area in terms of lifestyle and is also rich in botanical resources like *ringal* resource. All three blocks (Ukhimath, Jakholi & Agustamuni) of the district has been covered in the present study. From three blocks total seven villages were selected for conducting the *ringal* study on the basis of availability of *ringal* resource, weavers and remoteness. All the selected areas were similar in *ringal* diversity and its biomass, but different in its resource use pattern.

A. Reconnaissance Survey: The reconnaissance survey was conducted for knowing the traditional method of *ringal* harvesting and

involvement of *ringal* stakeholders (called *ringal bunkers*) of different rivals of the area. In Rudraprayag district, *ringal* is traditionally harvested by the *ringal* weavers of Mansuna, Khod, Karandhar, Bhanaj, Sari, Makhanda and Makku villages. These areas come under the Kedarnath forest division. These areas falls within the Garhwal Himalaya region and the forests are dominated with *Quercus semecarpifolia* (brown oak), *Q. floribunda* (green oak) and *Q. leucotrichophora* (white oak) and lies between 1300m to 3000m altitudes of Mandakini valley of district Rudraprayag. Oak forests of the area are rich in *ringal* diversity and biomass.

The traditional weavers harvest *ringal* from the oak forests and prepare the *ringal* products like Kanda, Solta, Supa and Changra for collecting fodder, fuel, grains and manure. Weavers also sell the *ringal* products at local market like Ukhimath, Agustamuni and Rudraprayag. Some small villagers also sell the products at Rishikesh market of the state. Similarly some weavers also sell the *ringal* products in neighbouring villages of the area.

During the field visit author have interviewed with some *ringal* harvesters and weavers to assess the information about species wise resource use pattern of *ringal*.

B. Questionnaire Design: The questionnaire was designed keeping in mind some tasks related to species wise use of *ringal* and type of products and ecological impacts of *ringal*, which is always ignored by various workers.

C. Questionnaire Sampling and Selection of the Respondent: The survey was carried out during August 2007. The questionnaire was used to gather information on species wise use of ringal and also use of different products of *ringal*. The respondents from the area were selected randomly on the basis of their involvement in the *ringal* activity as traditional harvester; trackers (transpiring *ringal* from forest to weaving point/store house), local traders etc. and they were the respondents of the ideal questionnaire.

D. *Process of Questionnaire Filling:* All questionnaires were filled throughout a long discussion along with the respondent.

RESULTS

Total five species of *ringal* viz. *Drepanostachyum falcatum* (Golu/ Garh/ Garila ringal), *Thamnocalamus pathiflorus* (Dev ringal), *T. jonsarensis* (Tham ringal), *Arundineria falcate* (Sararu ringal) and Bhatputra (locally identified) has been recorded from the study area (district Rudraprayag). Table 1 represents the investigated villages according to availability of *ringal* species and table 2 represents the species wise use of *ringal* and also use of ringal products and their description.

Table 1. List of investigated villages according to availability of ringal species

Sl. No.	Name of Village	Altitudes (m) a.m.s.l.	*Ringal* species used
1.	Mansuna	1000-2000	*Drepanostachyum falcatum* (Golu ringal)
2.	Karandhar	1000-2000	
3.	Maikhanda	1000-2000	
4.	Makku	2000- >	*Thamnocalamus pathiflorus* (Dev ringal)
5.	Bhanaj	2000- >	
6.	Khod	2000- >	
7.	Sari	2000- >	

Table 1: Species wise use of Ringal in the study area district Rudraprayag

Sl. No.	Local name of product	English name of products	Product description	Local uses	Type of *Ringal* species used				
					Drepanostachyum falcatum (Golu)	*Thamnocalamus pathiflorus* (Dev)	*T. jonsarensis* (Tham)	*Arundineria falcate* (Sararu)	Bhatputra (Locally identified)
1.	Kandi/ Odagi	A big basket	Large netted, cylindrical bucket shaped prepared by ringal sticks	Used for crop residue and manure collection	+	+	-	-	-
2.	Solta/ Malkhna	A big basket	Large netted, cylindrical bucket shaped prepared by ringal sticks	Used for fodder and litter collection	+	+	+	+	+
3.	Tokari	Basket	A round shaped vessel made of ringal fibril.	For keeping Chapati, fruits and flowers etc.	+	+	+	+	-
4.	Dalia	Porridge	A round shaped big basket made by ringal fibril	Used for fodder, fuel & crop residue and manure collection	+	+	-	-	-
5.	Supa	Winnower	A basket used for winnowing grains at home or in a paddy field	Winnowing grains	+	+	+	+	+
6.	Changera/ Bisala/ Dabolla	Basket	Dome shaped bucket basket like product made by ringal fibril	For storage of grains.	+	+	-	+	+
7.	Pastedan	Toothpaste stand	Glass shaped products prepared by ringal fibril	Keeping tooth brush, tooth paste etc.	+	+	-	+	+
8.	Fooldan	Flowerpot	A flowerpot made by ringal fibril	For decorating rooms and keeping flowers	+	+	-	+	+
10.	Thaali	Plate	A shallow round plate made by ringal fibril	Used in temples for keeping flowers, fruits, etc for offering to God and Goddess mostly in the Char Dham Yatra.	+	+	-	+	+
11.	Kalamdan	Pen-rack	Glass shaped products prepared by	Keeping pens etc.	+	+	-	+	+

			ringal fibril						
12.	Kudadan	Dustbin	A dome shaped basket like product prepared by ringal fibril	A container for keeping household rubbish	+	+	-	+	+
13.	Jild/ Chittha	File cover	Made by ringal fibril	Used for office file cover etc.	+	+	-	+	+
14.	Mothi/ Dan Chatai	Mat	A piece of woven or plaited floor material for wiping the shoes on or used primarily to cover floor.	Used for drying grains like paddy, wheat etc in the sun	+	+	+	+	+
15.	Tray	Tray	A flat, shallow, rimmed vessel	For keeping tea, snacks, papers and files etc.	+	-	-	-	-
16.	Hathkandi	Hand basket	A vessel for carrying goods	For shopping goods	+	+	-	-	+
17.	Balti	Bucket	A vessel used for collecting and carrying flowers	Decoration	-	+	-	-	-
18.	Baksa	Suitcase	A box prepared by ringal sticks	For keeping goods while travelling	-	+	-	-	-
19.	Jhaaru	Broom	A large brush made by ringal branches	For sweeping and cleaning floors	-	-	+	+	-
20.	Awan/ Jhatka	Log	A stick of ringal	For supporting climbers (vegetables)	+	-	+	+	+
21.	Chawai	Roofing	Ringal sticks with branches	Roofing of temporary houses at meadows	+	-	+	+	-
21.	Chaara	Fodder	Green leaves	Leaves are used as fodder for browsing animals	+	+	+	+	+
22.	Gherbar	Fencing	Old sticks	Used as fencing, mulching and covering material for nurseries.	+	+	-	+	+
23.	Idhan	Fuel	Dry sticks	For cooking	+	+	-	-	-
Percentage wise use of *Ringal* species					87	83	35	70	61

DISCUSSION

Ringal has commercial application and offer development opportunity for marginalized communities and provide off needed income and equitable distribution of income for livelihood. All five species of *ringal Drepanostachyum falcatum, Thamnocalamus pathiflorus, T. jonsarensis, Arundineria falcate* and Bhatputra (locally identified) are used by the villagers or weavers. First two *Drepanostachyum falcatum, Thamnocalamus pathiflorus* are popularly considered species of ringal for making various articles like table lamp, flowerpot and other products. Due to easy availability of *Drepanostachyum falcatum* (Golu ringal) in lower altitudes (1000-2000m) it is used maximally (87%) and on high altitudinal regions (above 2000m) *Thamnocalamus pathiflorus* (Dev ringal) is used maximally (83%), however *Arundineria falcate* (Sararu ringal) and Bhattputra (locally identified) are also used 70% and 61%). Due to less availability of *T. jonsarensis* (Tham ringal) it is used minimum (35%) in high altitudes.

The weavers of district Rudraprayag is state that the high altitudinal *ringal* is considered as very strong and durable. Therefore *T. jonsarensis* (sticks of Tham ringal) are used for supporting the climbers of some pulses crop and some time for fencing and mulching of nurseries and roofing of temporary huts at meadows.

Training and awareness programs should be conducted for *Ringal* weavers for making fancy and modern articles of *Ringal* like flowerpots, small baskets, pen stands, file covers, fancy bags etc. and production of traditional products like Kanda, Solta, Changra etc. should be stopped. Since too much quantity of *Ringal* (20-40 sticks) is used to prepare traditional products (Kanda, Solta, Changra etc.) that too at low cost and through long time taking process therefore the *Ringal* weavers should prepare modern products in which less quantity of *Ringal* (about 2-3 sticks) is used and they can earn too much money in very short time.

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Biodiversity Conservation and Sustainable Rural Development in the Garhwal Himalaya

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Abstract: In the present paper we have reviewed the link between socio-economic conditions of the villagers in the Garhwal Himalaya with forest resources. Well being of Local people and forest are intricately linked with each other. Increased resource dependency on surrounding forests and unplanned extraction is negatively affecting the biodiversity of the region. Lack of employment opportunities is the major cause of dependency of rural people on forest for livelihood, which is causing degradation of forest and forcing people to migrate to cities in search of jobs. Proper planning and management by Government in association with local people in tapping forest resources like medicinal plants and NTFP's will certainly improve socio-economic conditions of the people and reduce unnecessary pressure on the forest resources. [Report and Opinion. 2009;1(4):6-12]. (ISSN: 1553-9873).

Keywords: Traditional knowledge, Non-timber forest products, Biodiversity, Socio-economic conditions.

1. Introduction

The Indian Himalayan region occupies a special place in the mountain ecosystems of the world. These geodynamically young mountains are not only important from the stand point of climate and as a provider of life, giving water to a large part of the Indian subcontinent, but they also harbor a rich variety of flora, fauna, human communities and cultural diversity (Singh, 2006). The Himalayan mountain system covers only 18% of the geographical area of India, but accounts for more than 50% of India's forest cover and for 40% of the species endemic to the Indian subcontinent. Himalayan resources and ecosystem services are critical, not only for the sustainable livelihood of 115 million mountain people but also for a much larger population inhabiting the adjoining Indo-Gangetic plains (Rao et al., 2003). The Uttarakhand State of India is located between 28° 30'- 31° 30' N latitudes and 77°-81° E longitudes, which covers and area of 55,491 Km^2, of which 90 % (about 50,000 Km^2) lies in the Central Himalayan region (Nag, 2001). About 64% of total geographical area of Uttarakhand is covered with forest (FSI, 2003). The state is undergoing an economic transition phase, and due to population growth and increase in demands of various products, the natural resource exploitation has reached an unprecedented level.

2. Socio-economic Conditions

Dispersed small settlements and terraced agricultural fields carved out of the hill slopes for raising crops, with numerous multipurpose tree species growing particularly on the boundaries of rain fed terraces are typical features in the temperate area of Garhwal Himalaya. Agriculture is the main occupation of about 80% people of western and central Himalaya (Sharma et al., 1999). It is also essential for accelerating the process of rural development as it plays a critical role in providing food and employment to the people and raw materials to the industries. Most of the farmers (above 70%) have small land holdings (less than 1ha). Average cultivated land per farmer in the central Himalaya is 0.5ha, but its production is supplemented from the adjacent forest ecosystem (Tewari et al., 2003). Traditionally the agricultural activities are concentrated between 1000-2000m elevations, often called as the agricultural or populated zone (Tewari et al., 2003). The farming systems in Garhwal Himalaya are basically of three types viz., (i) Livestock farming representing nomadism, (ii) mix livestock-crop farming (semi-nomadism) and (iii) mix crop-livestock farming (settled agriculture). The agricultural lands, which in fact represent an extensive form of an agri-silvi-horticultural system, accounts for about 7,000 Km^2 or nearly 15% of the total geographical area (Pant and Singh, 1987). Crop cultivation, animal husbandry, wild biodiversity and rural economy are subsystems of the integrated traditional resource management system (Figure 1). Numerous people in this region still live in far-flung remote and almost isolated areas where they maintain their own economy and science. They are almost completely dependent on nature for their needs

like food, cloth, medicine or articles for religious rites. Maximum agricultural works is carried out by women folks, as male migrates to plains in search of jobs.

Figure 1. Agriculture is main occupation of people living in Garhwal region.

3. Biodiversity and people conflict

Biodiversity is essential for human survival and economic well being and for the ecosystem function and stability (Singh, 2002). The current biological diversity is a product of millions of years of evolution (Wilson, 1992). Over the past few decades, the Himalaya has experienced unprecedented land use changes, driven by rapid human population growth and intensified human activities, such as intense agriculture practice and expanding human settlements. Forest areas in the proximity of the population centres/villages are reported to be shrinking and degrading faster due to collection of fuel wood, fodder (Figure 2) and cattle/sheep grazing (Figure 3), etc, as compared to forests situated away from the population centres and located in inaccessible areas (FSI, 2000). The forest resources have also become unsustainable due to conventional management practices, which have resulted in to alienation of local population from forest and consequently in overall degradation of forests (Ghildiyal et al., 1998; Khanduri et al., 2002). These Himalayan mid-elevational anthropogenic landscapes now function as complex agro-ecosystems, and therefore management and conservation practices should be aimed in such a way so that conservation of biodiversity and sustainable use of the natural resources could be ascertained for future users (Maren and Vetaas, 2007).

Figure 2. Girl extracting fodder from the forest.

Singh et al. (1984) reported that in Central Himalayan farming systems, each unit of agricultural crop energy produced entails an input of about seven units of energy from the adjacent forests in terms of fodder, fuel wood and litter (for manure). The link between forest management and the well-being of communities in forested areas has traditionally been defined by forest sector employment opportunities (Sharma and Gairola, 2007). The dependency of the continually growing population on finite resources, lack of viable technologies to mitigate the mountain specificities and enhanced production to meet the demands are depleting the resources along with increasing marginality of farmers, ultimately promoting poverty (Samal et al., 2003). Depletion of forest cover, biodiversity and terrestrial carbon stock, declining farm productivity, increasing hydrological imbalance and soil erosion are interconnected problems and therefore are the root-causes for the poor economy of the hill people (Chipika and Kowero, 2000). Because of the limited employment opportunities in the rural areas of the Garhwal Himalaya, people either migrate to plains in search of jobs or solely depend on forests and small scale agriculture for their livelihood. Human activity and unsustainable harvesting in the wild have been identified as one of the biggest causes of reported phenomenal loss of species (Wilson, 1988).

Figure 3. Grazing by sheep is common phenomenon in Alpine pastures of Garhwal Himalaya.

4. Medicinal Plants

Herbal medicine system has an important role in all the societies throughout the world. The use of folk medicines still occurs among different communities and the maintenance of their health even now is based on traditional system by the utilization of plant species. This folk knowledge provides an idea of conservation and search for new resources. One of the major sectors of natural resources in region is 'medicinal plants' (Adhikari et al., 2003). Medicinal plants have attracted considerable global interests in recent years. In the USA alone traditional drugs and preparation worth several hundred million dollars are imported from other countries especially India and China (Singh et al., 2005). India has a rich heritage of herbal medicines and an ethno-pharmocological tradition which has developed into an established scientific faculty dealing in plant-based Medicare, called Ayurveda (Mahapatra and Panda, 2002). The description of Himalayan medicinal plants can be seen in ancient as well as modern literature including those dealing with Ayurveda, Yunani, Tibetan, Chinese and Western system of medicine. It is believed that out of over 1600 species of medicinal plants traditionally used in India (Uniyal et al., 2002), more than 50% species come from the Himalayan region. About 2,500 wild plant species are reported in use for medicinal purposes in Indian sub-continent, of which, possibly about 300 taxa are used in 8,000 licensed pharmaceuticals in India (Ahmad, 1993).

Indigenous people have a vast knowledge of, and capacity for, developing innovative practices and products from their environment. Indigenous knowledge grows from close interdependence between knowledge, land, environment and other aspects of culture in indigenous societies, and the oral transmission of knowledge in accordance with well understood cultural principles and rules regarding secrecy and sacredness that govern the management of knowledge (Tripathi et al., 2000). Ethnobotanical studies typically focus on recording the knowledge of traditional societies in remote places (Hodges and Bennett, 2006). Studies by Jin et al. (1999) and Luoga et al. (2000) have showed that documenting indigenous knowledge through ethnobotanical studies is important for the conservation of biological and cultural diversities as well as sustainable utilization of resources. Maintaining traditional knowledge in the face of sweeping modern medicine and diminishing folklore is imperative (Abbas et al., 1992) as such wisdom in the past has proved to be the key for inventing wonder drugs for diseases once considered incurable. Identification of key habitats for conservation (Campbell, 1994) and integrating the ethanobotanical knowledge of forest users into conservation initiatives (Martin, 1995) can assist successful implementation of biodiversity plans and programmes. It is important to make strategies for the conservation of biological resources and to document the folk knowledge for the benefit of mankind. Such studies are beneficial in reducing the exploitation of product through the discoveries of new resources and will provide scope for the economic prosperity of the region.

5. Traditional Knowledge

Traditional botanical knowledge of indigenous communities relating to the uses and management of wild plant resources is extensive (Cotton, 1997). Turner et al. (2000) review showed that traditional ecological knowledge of indigenous people has fundamental importance in the management of local resources, in the husbandry of the world's biodiversity, and in providing locally valid models fro sustainable life. This conservation and sustainable resource use will not be successful without the full participation of indigenous people and the application of their ethnobotanical and ecological knowledge. Rural people not only depend on wild plants as sources of food, medicine, fodder and fuel, but also developed methods of resource management, which may be fundamental to the

conservation of some of the world's important habitats (Cotton, 1997). Indigenous knowledge of these local communities includes a system of self-management that governs resource use (Laird and Neejovich, 2002).

6. Non-timber Forest Products

Medicinal and aromatic plants, as part of forest products other than fuelwood, fodder and timber, have been usually referred to as non-timber forest products (NTFPs) (Figure 4). The economic contribution of timber products, specifically in temperate forests and developed world, is fairly well understood, quantified, and recorded. Hence, normally, policy makers often assume that forests are of no economic value unless they are harvested (Greene et al., 2000). However, non-timber forest products (NTFPs), that include all biological products other than timber, are a traditional source of household income in rural areas around the world. NTFPs have always been and continue to be an important element of the forest resources in India; however, they have not received due attention. Extraction of non-timber forest products (NTFP) has assumed considerable significance in global efforts to conserve biodiversity (Godoy and Bawa, 1993). Judicious harvest of plant parts can be more sustainable than the harvest of whole adults, as is often the case when timber is harvested. The extraction of a wide variety of products can also result in greater economic diversification than the extraction of a single or a few products (Hegde et al., 1996).

Figure 4. Hand woven basket made from bamboos extracted from forest.

NTFP provide a wide range of goods for domestic use and for the market, which includes fruit, nuts, medicinal herbs, forage and thatch and are available in open-access or semi-open access circumstances, particularly for the resource poor people (Singh et al., 2005). From a positive perspective, NTFPs can be viewed as a safety net because these serve as a source of emergency sustenance in times of hardship when crops fail, when economic crises hit, in times of conflict or war, or when floods was away homes (FAO, 2001). The value of NTFPs exceeds that of timber and economic systems and needs to be considered in full valuation of forest products (Jansen et al., 1991).

7. Conclusion

It is generally assumed that the sustained extraction and processing of non-timber forest products by local people can enhance their cash income and provide an alternative to tropical deforestation (Hegde et al., 1996). Sustainable extraction of NTFPs depends upon harvesting a small fraction of the total productivity. Over-exploitation can lead to a loss of biodiversity, but a low level of extraction, without value addition at the point of origin, is usually no economically feasible for extractors (Shankar et al., 1996). Levels of extraction resulting in resource depletion are not uncommon for many NTFPs in the tropics (Homma, 1992). Sustainable harvest of renewable natural capital like NTFPs can contribute to the economic well being of the forest people and involve them in conservation of biodiversity (Shankar et al., 1996). Sustainable harvest is defined here as the level of harvest that does not impair the ability of the harvested population to replace itself (Hall and Bawa, 1993). There is strong need to conserve over exploited species due to large scale collection form natural habitats. Conservation strategy has to build on by involving local people and all stakeholders for achieving a long lasting solution. The NTFPs have a huge potential that could lead to generate huge employment and revenue. In hilly areas, where the traditional agriculture could not match with the per unit area production with the plain areas, cultivation of medicinal plants could bring substantial benefit to local communities (Sundriyal, 2005). If the development interests of local people are marginalized for a long period of time, they might adopt actions detrimental to the goal of conservation. Capitalizing on the positive dimensions of traditional knowledge and overcoming its negative dimensions through conventional science-based inputs could ease the difficult process of securing

people's participation in environmental conservation together with the socio-economic development of local communities (Rao et al., 2003). Finally to avert negative outcomes of excessive species use integrated efforts that involve local people in the sustainable use of their resources should be made. Experienced and knowledgeable members of the community should participate in this process. Indigenous knowledge of local people on use and management of their plant resources is a valuable source of information for conservation and sustainable utilization of the plant biodiversity and, hence, conservation based on indigenous knowledge is recommended.

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The real Cause for relative motion of bodies - force or energy?

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Abstract: Energy is the real physical quantity for the law of inertia. In this short paper a theoretical close up and analysis is made to show that bodies will change their relative position if and only if external energy is applied on them and that Newton's 2nd law of motion has some inconsistency with the law of energy conservation when describing motion of bodies. It also aims to show that it is not only the physical quantity force alone that is responsible for the relative change in position of bodies but also the distance the force moves. Distance is a necessary physical quantity to determine the acceleration of the body. Motion is the process by which bodies try to balance the excess energy applied on them, whether the bodies are small (particles) or large (stone). The well accepted physical law, energy conservation law, is taken as the basis for the verification of this idea. When bodies move, linearly, rotationally, etc, energy is conserved. Simple graphical analysis of the physical parameters involved in the motion of bodies using examples illustrates these claims. It is, therefore, possible to say that this could lead to further reconsideration of classical mechanics when describing the concept of force-motion relationship.
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Key words: Force; energy; motion

1. Introduction

Almost everything in the universe, small or large, relatively moves. It is difficult to find an object that is absolutely stationary. Relative motion (change in position) is a very inherent characteristic of matter. Planets move, particles move , animals move etc. It is very natural and primary, therefore, to examine what really causes the motion of bodies and try to formulate laws of motion. Philosophers and scientists are on the front line in the business of describing what motion is, what its root cause is and come up with the laws of classical dynamics. Ilya Prigogine (1980) said "it is very unfortunate that most college and university text books present classical dynamics as if it is a closed subject. In fact it is a subject in rapid evolution. Classical dynamics, perhaps the most elaborated of all theoretical sciences is not a closed science. We can pose meaningful questions to which it yields no answer". The primary objective of this report is therefore to pose such questions on seemingly simple, well accepted laws of classical dynamics-Newton's law of inertia and 2nd law of motion. According to Newton's 1st law of inertia, a body which is relatively at rest will change its position if an external force acts on it. In other words force is the cause for relative motion. When a force is applied on a body, it will begin to accelerate. However what is applied on it? Force or energy?. For the founders of modern physics the only change that could be expressed in precise mathematical terms was then acceleration, the variation in the state of motion (Prigogine 1980). This finally led Newton to develop the fundamental equation of classical mechanics which relates acceleration to the applied force /Prigogine 1980/

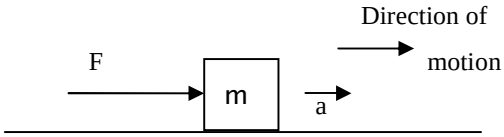
i.e : $F = ma$

A second type of description of motion is suggested in Einstein's general theory of relativity. According to this theory motion is (or can be) caused by space –time curvature. Planets (the earth for instance) is kept in orbit around the sun because it rolls along a valley in a warped spatial fabric (Greene 1999). It follows a "path of least resistance" in the distorted region around the sun (Greene, 1999).

A third opinion for the cause of motion is suggested by this report-Energy. Whether small or large a certain mass in relative rest will change position only if energy is applied on it. This is invariant to the type of motion – linear, rotational, gravitational etc. If a body is in motion, then we are sure that there must be a certain quantity of energy applied on it before it begins the motion (by energy conservation law). From the equivalence of the applied energy before motion and the energy of motion (Kinetic energy) it is possible to show the inconsistency between 2nd law of classical mechanics (F = ma) and the energy conservation law.

2. Inconsistency between Energy conservation law and Newton's 2nd law of motion (F = ma)

In colleges and universities we all learnt that acceleration of a body is related to the force applied on it by Newton's 2nd law of motion (F=ma). Acceleration is directly proportional to the force applied and inversely proportional to the mass. And graphically represented as follows:



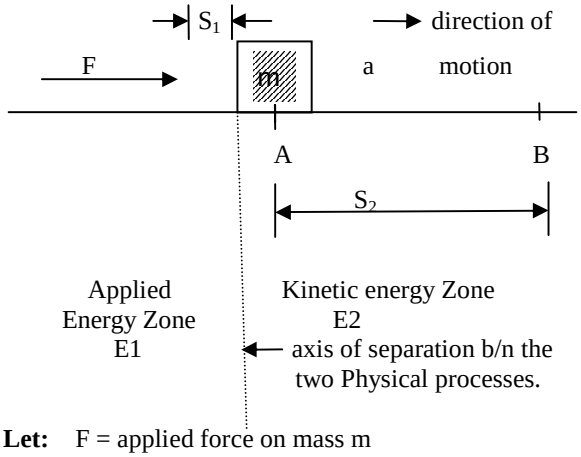
If: F = force applied

m = mass of the body

a = acceleration of the body

Then F = ma

Here, acceleration is the result of the applied force F only. But looking at the process closely, it is very difficult to imagine the application of F with out a definite distance F moves before it touches the mass. In reality F moves a definite distance, S_1 before it touches the mass (M). When F moves distance S_1, work is done and the applied physical quantity becomes Energy. Diagrammatically, the analysis is as follows:



Let: F = applied force on mass m

S_1 = distance the force F move before it touches the mass (m).

m = the mass of the body

a = the acceleration of the body after the Force F touches the mass

S_2 = total distance travelled by the mass between points A and B after the force is applied. Assuming that the surface of motion is frictionless, energy must be conserved for the whole system. i.e.:

Applied Energy = Kinetic energy

$E_1 = E_2 = \frac{(v^2)}{2}m$

But for the zone of the kinetic energy

$V^2 = \cancel{U^2} + 2as_2$

$\frac{V}{2} = aS_2$

$E2 = mas_2$ ------- ------ ---- 1

The applied energy is expressed as the work done by the force F:

$E1 = FS_1$ - - - - - - - - - - - - - - - 2

But $E_1 = E_2$

This implies

$FS_1 = maS_2$ Better describes the system. But it is very clear that distance moved by the force F and distance moved by the mass M are not necessarily equal.

i.e. $S_1 \neq S_2$

We therefore conclude that $F \neq ma$; the applied force on the mass M is not equal to the mass times the acceleration of the body as suggested by Newton's 2nd law of motion.

The relationship $FS_1 = maS_2$ suggests that the magnitude of acceleration is governed by the two physical quantities together force & distance the force moves.

From $FS_1 = maS_2$

$$a = (F/m)\,(S_1/S_2)$$

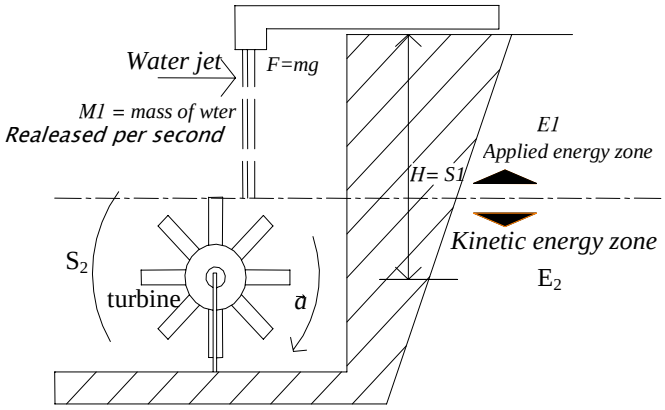
; S_1/S_2 is the remaining multiplication factor to be added in the 2nd law to be consistent with energy conservation law. If S1/S2 = k; then

$a = kF/m \longrightarrow F = kma$

It is only when $S_1 = S_2$; as in the case of pushing a mass from rest to its destination point ; freely sliding mass on an inclined plane; free fall etc; k = 1 and a = F/m. Note also that if S1 = 0, F cannot be applied . For motion to exist S1 should always be greater than zero.

The inconsistency of the 2nd law can also be explained in gravitational field motion as follows:

Let's consider the motion of a simple water turbine as an example



Let jet of water is released from a height (h) to accelerate a turbine below which is at rest.

Let: m1 = the mass of water released per second; F=mg

S1 = h is the distance the weight of water moves before it touches the turbine.

a = rotational acceleration of the turbine

m2 = mass of turbine

S2= the rotational distance moved by the turbine.

Then the energy conservation for the whole system shall be:

Applied [Potential] rotational [Kinetic energy]

Energy energy = energy of turbine

The potential energy can generally be given as: $E_1 = FS_1$

The kinetic energy (rotational energy) can generally be given as:

$E2 = m_2aS_2$

$E_1 = E_2$ By conservation law; therefore

$FS_1 = m_2aS_2$

We know that $S1 \neq S_2$. It implies then that $F \neq m_2a$; the applied force on a turbine of mass m2 is not equivalent to the mass of the turbine times its rotational acceleration. It is also possible to recognize that the physical quantity energy (the potential energy) is responsible for the rotational acceleration of the turbine from rest. The magnitude of the acceleration depends both on F and the distance F moves (S_1). If $S_1 = 0$ we cannot apply F = mg on the turbine. If we cannot apply F with out S_1; one cannot say that F is responsible for the motion of the turbine.

3. Conclusions

In this short analysis (using conventional examples); it has been realized that the physical quantity energy is responsible for the relative motion of bodies. And therefore, some adjustments have to be made to rectify the 2nd law of motion /F = ma/ to be consistent against the law of conservation of energy. This could have greater implications on the previous description of motion of bodies. According to this report if any physical entity in this universe moves, we are sure that there must be pre applied energy on the mass to bring it in motion. Cars move because of and equivalent to the energy applied on them; stones roll because of and equivalent to the energy applied on them; planets move around the sun and on their axis because of and equivalent to the energy applied on them etc. And motion can be described as the flow of energy from one form to the other. What is this physical quantity energy is then? No one knows what it exactly is (Richard P. Feynman 1996). What we know is its role in moving objects of the physical world. We don't know exactly from where for instance the initial energy that is

responsible and equivalent to the rotational or revolutional energy of the planets comes from. The concept of energy as the initial cause for the motion of bodies and as the physical quantity for the law of inertia can, for example, be extended to explain rotation and revolution of objects like planets .It is very difficult to imagine that the solar energy that falls on the surface of planets for millions, billions of years doesn't have a significant effect on their motion in space-time (revolution and rotation). We know that a rotating spin suspended in air has a tendency of revolution in elliptical path. This can be, true phenomenon for big bodies like planets. The point therefore will be to find the source of the pre applied energy which is the cause for rotational kinetic energy of planets; from where it comes?

The validity of the idea that only energy is the cause for motion of bodies, can lead to the redefinition of some of the classical dynamic norms.

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An Investigation into the Potentials of Dactyladenia bacteri; Dialum guineense; and Anthonota macrophylia for Paper Pulp Production.

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Abstract: An assessment of the wood of *Dactyladenia barteri, Anthonota macrophylla* and *Dialium guineense* for paper pulp production was carried out. Indices of assessment comprise (a) constant availability of wood material; (b) fibers yield of the wood material; (c) the Runkel ratio of the fibers; (d) the flexibility co-efficient of the fibers and (e) the relative fibers length. Results reveal that the three species are widely cultivated by every farming communities in Igbo land and beyond. They are maintained and protected as fallow crops and staking materials. After harvest, the stems (now dry) are cut down, sold as firewood and new plantations established. They are fast growing and early maturing (in 3-5 years). They therefore constitute the dominant species on the farmlands. Vast plantations for paper pulp industry can easily be produced. For fibers yield, the frequency of fibers obtained per unit area was 114, 105, and 67 for *Dactyladenia barteri, Anthonota macrophylla* and *Dalium guineense* respectively. The Runkel ratio was 0.86, 0.56 and 0.99 for *Dacyledenia barteri, Anthonota macrophylla* and *Dialium guineense* respectively. Flexibility co-efficient for *Dactyladenia barteri, Anthonota macrophylla* and *Dialium guineense* were 0.16, 0.24 and 0.12 respectively. The relative fibers length was 37.08, 32.63 and 46.37 for *Dactyledenia barteri, Anthonota macrophylla* and *Dalium guineense* respectively. The implications of the above results were discussed. [Report and Opinion. 2009;1(4):18-25]. (ISSN: 1553-9873).

Key words: Potential, *Dactyladenia bacteri, Dialum guineense, Anthonota macrophylia*, paper, pulp,

1. INTRODUCTION

Dactyladenia barteri belongs to the family Rosaceae, while *Anthonota macrophylla and Dialium guineense* are in the family Leguminosae. The two families (Rosaceae and Leguminosae) are grouped in the order Rosales (Benson, 1957; Longman and Jenik, 1974). The Rosales are herbs, shrubs or trees. Leaves are simple or compound and about half of the 15 families comprising the order are stipulate. The fruits are in legumes, follicles, achenes, drupes, capsules, pomes or berries. About 13,000 of the 18,000 species are in the pea family (Leguminosae). The Rosaceae, according to Dutta (1995) are herbs, shrubs or trees or sometimes vines. Leaves are simple, pinnate, practically alternate and stipulate. Flowers are bisexual or rarely symmetrical, perigynous or epigynous. Fruits are indehiscent and in achenes, follicles, druopes or pomes. Seeds are usually without endosperm.

The family is large including more than 100 genera, one of which is *Dactyladenia* and probably 2000 to 3000 species including *D. barteri* which is more prominently distributed in the North Temperate regions than in the tropics.

Dactyladenia barteri has been characterized by Hutchinson and Dalziel (1958) as shrubs or small trees, branches slender or climbing, leaves dark glossy green, reddish brown when dry. Flowers greenish white and fragrant. Fruits long, green, turgid, more or less pea shaped and pointed, sometimes cultivated. *Dactyladenia barteri* and other members of the Rosaceae family are used by the local people for agricultural and domestic purposes and also have immense industrial and commercial and medicinal uses according to Igbokwe, U.M (1993) and Okeke, S.E (2002).

The Leguminosae on the other hand are herbs, vines, shrubs and trees. They are cosmopolitan in distribution and made up of about 18,000 species (Good, R, 1974). Leaves are pinnate to tripinnate, trifoliate or sometimes simple. Flowers are usually bisexual, actinomorphic to zygomorphic. Fruits are usually in legumes, follicles, schizocarps, achenes, drupes and berries. Seeds are non-endospermic and sometimes arilate. *Dalium* species according to Hutchinson and Dalziel (1958) is a forest tree up tom 40 meters high are also often shrubs persisting in Savanna vegetation. The flowers are small, petals whitish or pinkish. Fruits are black and seeds embedded in reddish pulp. Leaflets usually 5 rarely 3 or 7 usually alternate, sometimes sub opposite; stamens 4 to 5 filaments straight, while *Anthonota macrophylla* has been described as petals blue, stiple of ovary 10 to 12mm long; bracteoles 2.5cm or more long. Fruits without transverse ridges and petioles twisted.

Economically, the Leguminosae is of considerable

importance as a source of high protein food e.g. *Phaseolus vulgaris* and *Vigna spp*)Cowpea). Many members are sources of vegetables for human consumption and industrial use. Many members are important in agriculture as cover crops, as forage crops and as source of timber. During the early years of wood pulp industry, only the more suitable temperate species mainly spruce and fir were used. As the demand for pulp increased, more species became admitted into the wood species (including hard woods) accompanied by modifications of pulping techniques to accommodate those species which are more difficult to pulp.

Major breakthrough has been recorded in India in the use of materials other than timber for the manufacture of pulp. Plants like baggasse, bamboo, jute, hemp, straw became very suitable this wise (Britt, 1964, Oliver, 1971).

After many species have been identified as good sources of pulp fibers, the characteristics of suitable fibre became determined. Okeke and Ademiluyi (1977) included the following qualities and characteristics.

- Suitability of fibers for conversion into pulp.
- Fibre yield per unit volume of raw materials.
- Quality of the resulting pulp for paper making.
- Cost of collection, transportation and conversion.
- Degree of deterioration in storages. From the above parameters, it became known that wood which is light coloured, soft and with long fibers and free form extraneous materials is well suited for pulp making. Okeke (1977) reported three methods of quantitative assessment of fibers for suitability in pulp making as follows:
    a) Runkel ratio which is the ratio of a fiber wall divided by the lumen diameter and expressed as 2W/L. Runkel values are grouped as
    i. Fibers with ratio less than 1 are very good for pulp making.
    ii. Fibers with ratios about or equal to 1 are also good for pulp making.
    iii. Fibers with values greater than 1 are poor for pulp making.
    b) Flexibility co-efficient. This is lumen diameter. Results indicate that the higher the flexibility co-efficient of the wood fibers, the higher is the tensile strength of the pulp and paper product of the species.
    c) Realtive fiber length: This expresses the ration of fibers length to its diameter. It also expresses the slenderness of the fiber. The higher the relative fibre length, the higher is the resistance to tear of the paper product.

When Ademiluyi and okeke (1973, 1977) applied the above techniques to *Bambosa vulgaris* and fourteen other savanna species, they came to the conclusion that all the species involved in the study are well suited to pulp production. This method of assessment is now used universally to assess wood fibers for pulp making.

Nigeria had some time ago (1975-1980) intended to establish mills in the country. The plan was that plantations of *Pinus* spp and *Gmelina arborea* would be established in the country as the source of fibers for the project. The plan failed owing partly to the non-establishment of the imported *Pinus* seedlings into seeds.

Attempts are being made recently to revive the same plan. No attempts have however been made to commission a study of the suitability of Nigeria tree species for pulp making. The results obtained by Ademiluyi and okeke, (1973, 1977) have been found encouraging to warrant a follow up study. An investigation into the potential of *Dactyladenia barteri, Dialium guineense* and *Anthonota macrophylla* for paper pulp production is therefore undertaken in this study. This is motivated by the huge amount of foreign exchange gulped by the dependence of the Federal Government on foreign plant species for paper mills.

2. MATERIALS AND METHOD

Stems from mature (flowering and fruiting parts) of *Dactyladenia barteri* and *Anthonota macrophylla* were cut from farmland in Umuokirika (Ahiazu Local Government Area) and Ikenazizi (Obowo L.G.A) respectively, while stems of *Dialium guineensis* were collected from Egbeada in Mbaitoli L.G.A.

The stems were cut into short pieces each 10cm long and sun dried for one month. Each piece was split open into two equal parts by means of a short kitchen knife. Each half stem pieces (silvers), each equal to the size of a match stick, and put into open container according to the species and brought outside for proper sun drying. Two hundred silvers were selected from each species, put in specimen bottles and labeled accordingly.

The equipment (microscope slides, cover slips, 250ml beakers, Petri dishes, forceps and spatula) were thoroughly washed in distilled water and kept in laboratory benches to dry.

Maceration: The maceration techniques of Schuliz as described by Dutta (1995) was used. Silvers of one locality before of the other localities were taken up. Following the process, 5-10 silvers from one species were introduced into a test tube. One gram of Pottasium Chlorate was added and finally concentrated Nitric acid was introduced just enough to cover the silvers by means of a drop-tube. This started a reaction that yielded large quantities of fumes. The experiment was carried out in a fume chamber. After fuming, the contents of the test tube were poured into a 250ml

beaker half full of water. The silvers were washed in two changes of water to stop the reaction and to properly remove traces of Pottasium Chlorate and concentrated Nitric acid. The silvers were then left in a Petri dish and covered with water.

To study the fibres, one silver was brought out at a time using a forceps, placed on a clean slide and gentle taps on the silver by means of a needle. The taps made the component cells of the wood to fall apart. The taps were continued until the cells became completely separated. Even spreading of the cells was carried out using the mounting needle. Thereafter, 2-3 drops of water were made to cover the cells before a cover slip was gently placed on top of the cells.

The slides were mounted on a microscope and the contents examined. Observations regarding the shape of each xylem element (vessels, parenchyma, fibres) were made. The length, width, lumen diameter and wall thickness of each fibre were measured and recorded. From the measurement, the Runkel ratio, flexibility co-efficient and the relative fibre length were calculated. The frequency of each xylem element (vessels, parenchyma and fibres) per unit area was determined from the average of ten different fields. For this purpose, unit area used is the field of the microscope x 10 occular and x10 objective. One hundred cells of each vessel and parenchyma elements were equally measured with regard to the length, lumen diameter and wall thickness including the average of each (Dabs, 1963, Ruthenber, 1980).

All measurements were carried out by means of a micrometer for each calculation. The distance from one caliberation of the micrometer to the next is 14.3µ to get the figure for a particular measurement. The total number of caliberations measured is multiplied by 14.3 µ. All silvers of the same and the different species were subjected to above processes. The results were recorded and averages (where necessary) determined. After all determinations, the accruing data were collated and presented in tables. Photographs of the various cell types were also produced and presented.

Assessment for pulp making:

Figures determined for the Runkel ratio (2xwall thickness divided by lumen diameter), flexibility co-efficient = lumen diameter divided by fibre diameter) and relative fiber length=fibre length divided by fibre diameter were employed in assessing the suitability of the three species for pulp making.

3. RESULTS

The comparative results of this investigation on *D. barteri, A. macrophylla* and *D. guineense* are presented below in tables 1,2,3 and 4 showing values of the various features of fibres, vessels and parenchyma for three species respectively (tables 1,2 and 3) and the fibre dimension and characteristics of the three species (table 4). Only three elements (vessels, fibres and parenchyma) were onserved during the study. No tracheids were observed. The dimensions of the three cell types are presented species by species in tables 1,2,3 and 4. the photographic representation of fibre lengths for the three species are also presented in figures 1(a,b and c,), 2(a, b, and c) and 3 (a,b,and c). also the comparative photographic representation of parenchyma cells of the three species are represented in figure 4 as (a) for *D. barteri* (b) for *A. macrophylla* (c) for *D. guineense*.

Table 1: Values of the various features of fiber, vessels and parenchyma of *D. barteri*

Xylem Cells	Length (µ)	Fiber diameter(µ)	Wall thickness(µ)	Lumen diameter(µ)	Frequency Per unit area*
Fiber	858.0-1043.9 (96.4)	21.43-28.60 (26)	2.63-2.81 (2.72)	3.05-5.03 (4.04)	81-47 (114)
Vessels	42.9-64.35 (53.63)	20.03-27.17 (24)	4.29-7.15 (6)	17.16-28.6 (22.90)	25-53 (29)
Parenchyma	25.74-35.75 (30.75)	7.15-11.44 (9.30)	1.43-2.86 (2.15)	8.58-12.87 (10.78)	16-20 (18)

*Unit area is the field of view of the microscope at x40 objective.

Table 2: Values of the various features of fiber, vessels and parenchyma of *A. macrophylla*

Xylem Cells	Length (µ)	Fiber diameter(µ)	Wall thickness(µ)	Lumen diameter(µ)	Frequency Per unit area*
Fiber	8430.0-1043.9 (881)	21.45-35.75 (27)	1.59-1.99 (1.79)	4.84-8.04 6.44)	75-135 (105)
Vessels	42.9-57.2 (50.10)	14.3-28.6 (21.43)	1.43-4.29 (2.86)	14.3-24.31 19.31)	14-24 (19)
Parenchyma	14.3-35.75 (25.03)	10.10-14.3 12.16)	1.43-2.86 (2.15)	7.15-10.01 (8.58)	10-18 (14)

*Unit area is the field of view of the microscope at x40 objective.

Table 3: Values of the various features of fiber, vessels and parenchyma of *D. guineense*

Xylem Cells	Length (µ)	Fiber diameter(µ)	Wall thickness(µ)	Lumen diameter(µ)	Frequency Per unit area*
Fiber	1101.1-1569.4 (1252)	14.30-35.75 (27)	1.66-1.80 (1.73)	2.20-4.16 3.18)	60-74 (67)
Vessels	42.9-57.2 (50.10)	14.3-28.6 (21.43)	1.43-4.29 (2.86)	14.3-24.31 (19.31)	22-28 (25)
Parenchyma	14.3-35.75 (25.03)	10.01-14.3 (12.16)	1.43-2.86 (2.15)	7.15-10.01 (8.58)	3-17 (15)

*Unit area is the field of view of the microscope at x40 objective.

Table 4: Fiber dimension and characteristics of *Dactyladenia barteri, Dalium guineense and Anthonota macrophylla*

Species	Fiber Length (µ)	Fiber diameter (µ)	Wall thickness(µ)	Lumen diameter(µ)	Ronkel* ratio(µ)	Flexibility** co-efficient	Relative*** fiber length
A.							
Macrophylla	843-943.8	21.43-35.73	1.59-1.99	4.84-8.04	0.56	0.24	32.63
	(88.1)	(27)	(1.79)	(6.44)			
Dactyladenia	858.0-1043.9	21.45-28.60	2.63-2.81	3.05-5.03	0.86	0.16	37.08
Barteri	(964)	(26)	(2.72)	(4.04)			
Dalium	1101.1-1569.4	14.30-35.75	1.66-1.80	2.20-4.16	0.99	0.12	46.37
Guineense	(125.2)	(27)	(1.73)	(3.18)			

* Ronkel Ratio= $\frac{2 \text{ (wall thickness)}}{\text{Lumen diameter}}$

** Flexibility Co-efficient = $\frac{\text{Lumen diameter}}{\text{Fiber diameter}}$

*** Relative fiber length = $\frac{\text{Fiber diameter}}{\text{Fiber diameter}}$

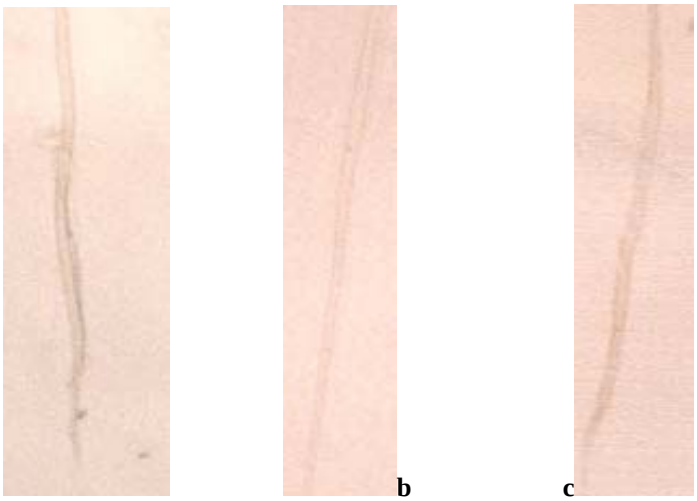
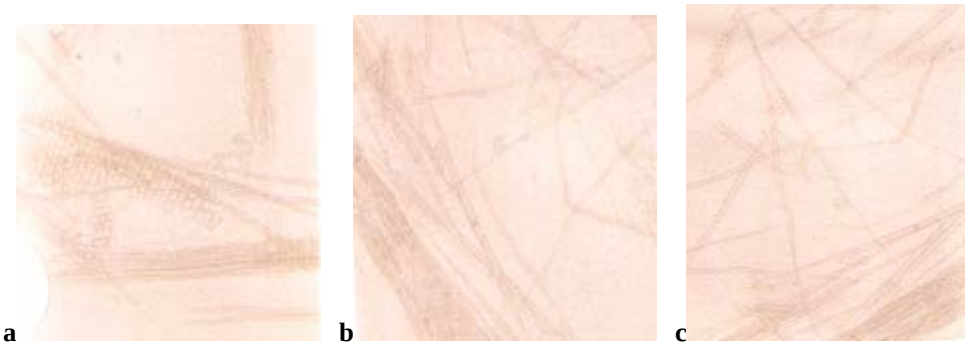
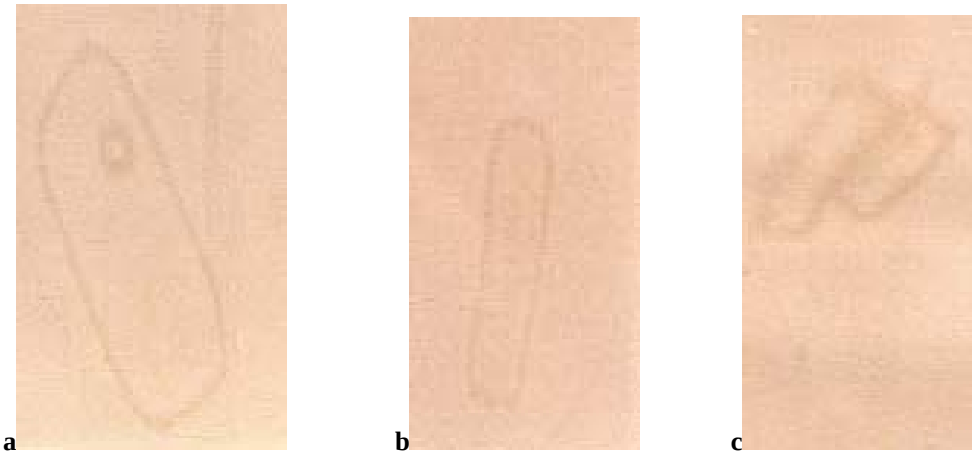


Fig 1: Photographic representation of fiber length of (a) *D. barteri* *(b) Anthonota macrophylla (c) Dalium guineense*



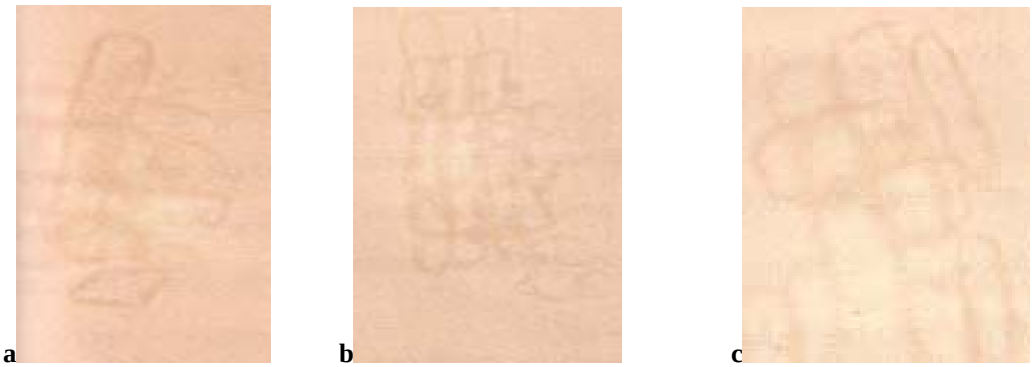
a **b** **c**

Fig 2: Photographic representation of many fiber of (a) *D. barteri (b) Anthonota macrophylla (c) Dalium guineense*



a **b** **c**

Fig 3: Photographic representation of vessels of (a) *D. barteri (b) Anthonota macrophylla (c) Dalium guineense*



a **b** **c**

Fig 4: Photographic representation of parenchyma of (a) *D. barteri (b) Anthonota macrophylla (c) Dalium guineense*

4 DISCUSSION

Wood elements present in the three species *Dactyladenia barteri*, *Anthonota macrophylla* and *Dialium guineense* comprise the three types found in dicotyledons. These include vessels, parenchyma and fibres. Trachieds are usually absent as the four wood elements do not occur in only wood materials.

One interesting result of this study is that fibres are the most abundant vessels element present in each of the three species. This is demonstrated by their highest frequency per unit are recorded (Tables 1,2 and 3; also fig 1). By their abundance, each species satisfies one of the provisions that determine the utility of a given material for pulp making-fibres yield per unit volume (Britt, 1964; Dass, 1963; Ademiluyi and okeke, 1973, 1977; Keay, R.W, 1964 and UNDP, 1995).

The Runkel ratio value is one of the factors considered in the assessments of the three species for pulp making. The values obtained for each species is 0.86µ for *D. barteri*,0.56 µ for *A. macrophylla* and 0.99 µ for *D. guineese*. The stipulation is that when the figures is below 1 or above 1, the fibre are good for pulp making. But when it is above 1, the fibres are not suitable for pulp making. The results of this study show that the Runkel ratio of each species is below 1 in *D. barteri* and *A. macrophylla*, but about 1 in *D. guineense*. The fibres are therefore good for pulp making. When Ademiluyi (1977) assessed fourteen Nigeria savanna tree species for pulp making, they obtained Runkell ratio between 0.6688 and 0.9829, and considered the fibres of each species very good for pulp making.

Calculation of the flexibility co-efficient of the three species under assessment herein yielded 0.16 for *D. barteri*, 0.24 for *A. Macrophylla* and 0.12 for *D. guineense*. Again by the stipulations, these figures indicate the suitability of fibres of the three species for pulp maiking (Dass, 1963, Hutchinson and dalziel, 1954).

Relative fibres length is yet another factor, the values obtained are 37.08 µ for *D. barteri*, 33.63 µ for *A. macrophylla* and 46.37 µ for *Dialium guineense* (table 4). These figures are very high thus meet very well the expectations of fibres for pulp making (Dass, 1963).

Finally, the three species are readily available. They are cultivated/maintained in fallow farmlands in Igbo land (Okeke, 2001). They provide almost all the firewood used in Igbo land. Large scale plantations can therefore be easily raised for commercial pulp making in Nigeria. The above assessment indicates that the three species satisfy all the requirements of species for pulp making. Nigeria should therefore look more inwards while planning to obtain raw materials e.g. pulp for any paper mill industry in the country. `This study suggest that fibres of the species *Dactyladenia barteri*, *Anthonota macrophylla* and *Dialium guineense* are very good for pulp making.

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Cassava Production Systems Improved With Groundnut And Poultry Manure.

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Abstract: Cassava is predominantly grown as an intercrop with maize with little or no fertilizer resulting in rapid decline in soil fertility and crop yields. High yields to feed the growing cassava processing industry could be sustained through the introduction of groundnut and poultry manure. The study was conducted at Ohaji, Imo State, Nigeria, to develop a stable and high productive cassava/maize/groundnut system with an optimum rate of poultry manure for high cassava for high cassava root yields. A split-plot treatment arrangement fitted in a randomized complete block design with 3 replications was used. Time of planting groundnut (same time maize planting and after maize harvest) formed the main plot, rates of poultry manure (0,5,10 t ha^{-1}) formed the sub plots and number of rows of groundnut (1,2,3 rows) constitute the sub-sub-plot. Productivity of all the intercrops was high (land equivalent ration of 1.11 – 1.88) with high maximum cassava yield (56.4 – 69 t ha^{-1}). Productivity of all the intercrops was high (land equivalent ration of 1.11 -1.88) with high maximum cassava yield (56.4 – 69 t ha^{-1}) and stability in a system when groundnut is planted in 2 or 3 rows between 2 rows of cassava (1 x 1m) after maize harvest with 10 t ha^{-1} of poultry manure application. Thus a cassava/maize/groundnut being planted at 62,500 and 111,111 stands t ha^{-1}, after maize harvest is recommended for high cassava component yield. [Report and Opinion. 2009;1(4):26-31]. (ISSN: 1553-9873).

Key words: Cassava, Production, System, Groundnut, Poult, Manure

1. INTRODUCTION

Cassava (*manihot esculentus)* is among the major staple food crops in developing countries. It is an excellent source of carbohydrate (Willey, 1979). It is processed in households mainly into “garri” (fermented and roasted flour), “fufu” (fermented cassava root) and cassava flour for human consumption. A recent major government policy is the production of cassava by small scale farmers for processing into industrial starch. This calls for development of cassava production system that gives high yield, high productivity, sustainable and profitable production of the raw roots of cassava to feed the processing industry.

In Nigerian farming system, cassava is predominantly grown as intercrops with maize (*Zea mays)* usually with little or no fertilizers (Ikereogu *et al* 1989). This, coupled with annual slash and burn results in rapid decline in crop yield and a fast rate of shifting cultivation. Originally fields are cropped for 2-5 years and left under natural fallow to regain fertility. With increasing population pressure, fallow periods are shorter than needed to regain fertility as more continuous cropping is norm in Nigeria.

The development of productive cassava-based cropping system that ensure high cassava yield is of paramount importance. One approach is to exploit the biological nitrogen fixing (BNF) capacity of leguminous crops by using maize and groundnut (*Arachis hypogeae)* rotation and poultry manure in a maize/cassava intercropping system. Estimate of the amount of nitrogen fixed by cowpea (73-354 kgn/la), pigeon pea (168-208 kg N la-1), Bambara (40-65 kg N ha-1) etc had been reported by Norman (1976).

It has been observed that most of the cassava farmers spread house hold refuse or poultry manure in their farms as an alternative fertilizer since chemical fertilizer is no more available to them as a result of its exorbitant price. Unfortunately, some of them obtain low yield from cassava because little information is available as the best combination of minor crops, manures and planting pattern of these crops which vary in their combination involving roots cereals, legumes and vegetables, (Willey, 1979).

The objective of this study was to develop agronomic practices that will ensure stable and highly productive cassava/maize/groundnut intercropping system with high cassava yields.

2. MATERIALS AND METHOD

The study was carried out at the Imo State Polytechnic, Imo State, Nigeria, during the 2007 and 2008 cropping seasons respectively. The climate of the area is a humid

tropical type characterized by wet and dry seasons. The mean annual rainfall is about 2500mm and is bimodal with peaks in July and September (Nwosu, 1981).

The minimum and maximum temperatures are 20^0c and 32^0c respectively. The area has rainforest vegetation and the soil is characterized by deep porous red soils derived from sandy deposits in the coastal plane which are highly weathered, low in mineral and natural fertility, hence farmers in the area practice bush fallowing as a means of improving soil fertility (Ononiwu, 1990). Data on the soil before planting commenced is shown in table 1.

The cassava (*Manihot esculentus)* variety (TMS419) used for the trial is an improved IITA cultivar. The variety is very high yielding early maturing sweet cassava, low in HCN content (3.3 mg/100g), branching pattern is sparse and has about 44.4% dry matter content and is resistant to Cassava Mosaic Virus (CMV), Cassava Bacterial Blight (CBB) and Cassava Mealybug.

Experimental Design

A 2x3x3 split-plot treatment arrangement fitted into Randomized Complete Block Design (RCBD) with 3 replications was used in the trial. Main-plot was times of planting groundnut; planted at the same time with maize (PST) and planting after maize harvest (AMH). Sub-plot treatments were the 3 rates of poultry manure, 0, 5 and 10tha-1 while the sub-sub plots were number of rows of groundnut within 2 rows of cassava (1,2,3 rows). Thus a total of 18 plots was used in the trial. Each plot containing six rows of cassava measured 4x4m. In both seasons, cassava was planted in April and maize intercropped 2 weeks later. In some plots maize was planted at the same time with groundnut but in some, groundnut was planted after maize harvest. Planting spacing for maize was 0.9m x 0.9m giving a population of 12,346 stands/ha. Some plots contained 1 row of groundnut planted at the spacing of 0.5x0.5m, while some contained 2 rows of groundnut at the spacing of 0.3x0.3m giving populations of 20,000, 65,500 and 111,111 stands per hectare, respectively.

For 5 tha1 of poultry manure, a plot received 8kg whilke for 10 t ha1, a plot received 16kg. Based on the treatment randoimization scheme, already established, the various manure rates were spread uniformly on appropriate plots and then manually incorporated into the soil. Planting was done 4 days after manure application thereby allowing manure to set properly. Sole crop of each crop was included as a check. Varieties used were the Downy Mildew Resistant, Early Streak Resistant Yellow (60 days) maize and react or bunchy type groundnut. Weeding was done 2 times, 3 times after planting and during the harvesting of maize.

Statistical Analysis System (SAS) was used for data analysis, each parameter was subjected to analysis of variance and treatment means were separated using LSD. Land Equivalent Ratio (LER) defined asa the total land area required under sole cropping to yields obtained in the intercropping was used as an index of intercrop productivity.

3. RESULTS

The effects of poultry manure and variation in the number of rows of groundnut on root yield of cassava was significant ($p>0.05$) (Table 2). Application of poultry manure increased root yield of cassava, (Table 2). The yield of cassava stands given poultry manure was 54% higher than those that were not treated with poultry manure in 2007 and 60% in 2008. this marked difference in root yield with application of poultry manure was an indication that the poor state of the soil as evidenced in the preliminary soil analysis (Table 1) has been improved as indicated in the post-harvest soil physico-chemical analysis (Table 6). Hussein (1997) reported that poultry manure application increased soil ph, organic matter, available phosphorus, microbial activity in nutrient metabolism.

Table 1: Pre-planting soil physico-chemical properties at the face 0-15cm at the experimental site, 2007

Properties	Value
Sand (%)	80.0
Silt (%)	3.0
Clay (%)	12.0
Ph (H_2O)	4.5
Organic matter (%)	1.20
Total N (%)	0.09
Available P (ppm)	5.08

Exch. Cations (Cmol/kg)	
Ca^{2+}	0.81
Mg^{2+}	0.64
K^{+}	0.09
CEC	3.08
Base Saturation (%)	33.8

Table 2: Root yield of cassava as affected by phased planting of groundnut and poultry manure.

Poultry Manure Rate t/ha	**No. of of rows groundnut**	**Root yield tha^{-1} 2007**					
		GPWM	**GPAMH**	**X**	**GPWM**	**GPAMH**	**X**
0	1	12.7	14.4	13.6	10.8	15.6	13.2
0	2	15.6	18.4	17	14.8	19.3	17.1
0	3	18.6	20.7	19.7	18.6	21.4	20.0
5	1	20.5	28.6	24.6	21.2	26.4	23.8
5	2	23.6	34.5	29.6	26.7	34.7	30.7
5	3	23.8	36.8	30.3	24.3	37.3	30.8
10	1	23.4	26.7	25.1	28.7	36.9	32.8
10	2	25.6	34.7	30.2	42.6	56.4	49.5
10	3	23.8	36.6	30.2	43.8	69.5	56.7
0	0	-	-	8.5	-	-	8.8
SOLE CASSAVA							
0	-	-	-	8.6	-	-	8.8
5	-	-	-	27.3	-	-	27.8
10	-	-	-	28.9	-	-	36.4
Mean		24.3	32.7	-	25.7	35.3	
LSDP>0.05			3.052			3.633	

GPWM = Groundnut planted same time with maize

GPAMH = Groundnut planted after maize harvest

Significant Interaction PxRxT

P = Poultry manure

R = Rows of groundnut

T = Time of planting groundnut

Table 3: Grain yield of maize as affected by poultry manure and groundnut

Poultry Manure Rates t ha-1	Groundnut row arrangement	grain yield t ha-1 2007	2008
0	1	0.6	0.8
0	2	0.73	1.12
0	3	1.14	1.18
5	1	2.4	2.3
5	2	2.6	2.9

5	3	3.0	2.8
10	1	3.4	3.5
10	2	3.8	3.8
10	3	4.2	3.9
Sole Maize			
0	-	0.4	0.34
5	-	2.4	2.5
10	-	3.2	3.5
LSD P>0.05		1.083	

Table 4: Seed yield of groundnut in the Cassava/Maize/Groundnut mixture with poultry manure application poultry manure application poultry manure application.

Poultry Manure Rate t/ha	**No. of of rows groundnut**	**Root yield tha^{-1} MPWM**	**GPAMH**	**X**	**GPWM**	**GPAMH**	**X**
0	1	0.114	0.101	0.102	0.261	0.243	0.252
0	2	0.314	0.311	0.313	0.344	0.288	0.316
0	3	0.512	0.489	0.501	0.664	0.428	0.546
5	1	0.322	0.268	0.295	0.315	0.311	0.313
5	2	0.841	0.898	0.870	0.883	0.868	0.876
5	3	0.700	0.742	0.721	0.625	0.644	0.645
10	1	0.261	0.134	0.198	0.380	0.411	0.396
10	2	0.341	0.236	0.289	0.721	0.722	0.722
10	3	0.240	0.240	0.240	0.645	0.721	0.683
SOLE CASSAVA							
0	-	-	-	0.431	-	-	0.461
5	-	-	-	0.880	-	-	0.941
10	-	-	-	0.720	-	-	0.783
LSDP>0.05		0.101			0.148		

Table 5: Mixture productivity of the various crops as affected by poultry manure and cassava/maize/groundnut mixture.

Poultry Manure Rates t ha-1	Groundnut row arrangement	grain yield t ha-1 2007	2008
0	1	1.11	1.13
0	2	1.18	1.20
0	3	1.22	1.23
5	1	1.24	1.27
5	2	1.34	1.45
5	3	1.48	1.59
10	1	1.33	1.45
10	2	1.57	1.62
10	3	1.62	1.88
Sole cassava		1.00	1.00
Sole maize		1.00	1.00
Sole groundnut		1.00	1.00

Table 6: Post harvest soil physico-chemical properties as affected by poultry and row arrangement of groundnut in cassava/maize/mixture

Poultry Manure Rate t/ha	No. of of rows groundnut	Ph	% Total N	Avail P(ppm)	Exch K+	Exch Mg2+	Org M	CEC	Sand	Silt	Clay
0	1	4.4	0.07	4.34	0.07	0.63	1.21	3.21	82	3.0	12.47
0	2	4.5	0.07	4.52	0.09	0.64	1.23	3.68	82	3.0	12.17
0	3	4.5	0.07	4.56	0.09	0.64	1.23	4.74	82	3.1	11.28
5	1	5.0	0.26	5.01	0.11	0.71	1.59	4.82	82	3.2	12.17
5	2	5.0	0.28	5.60	0.13	0.74	1.61	4.21	82	3	12.20
5	3	5.3	0.31	5.68	0.14	0.76	1.871	4.68	82	3	12.21
10	1	5.4	0.61	5.21	0.16	0.75	1.69	4.77	82.	5.3	12.15
10	2	5.5	0.62	5.68	0.19	0.78	2.03	4.62	82	3.1	12.17
10	3	5.5	0.64	5.77	0.20	0.81	2.21	5.01	82	3.2	11.81
0	1	4.5	0.07	4.41	0.08	0.66	1.24	5.21	82	3.2	11.6
0	2	4.6	0.09	4.08	0.10	0.67	1.25	3.51	82	3	12.41
0	3	4.7	0.58	4.66	0.12	0.67	1.25	3.78	82	3	12.11
5	1	5.3	0.63	5.78	0.15	0.75	1.87	4.21	82	3	11.60
5	2	5.3	0.64	6.11	0.18	0.78	2.22	4.72	82	3.2	12.64
5	3	5.3	0.65	6.74	0.23	0.93	2.22	4.72	82	3.2	12.64
10	1	5.6	0.65	5.81	0.20	1.24	2.46	5.88	84	3.3	11.81
10	2	5.7	0.81	6.88	0.23	1.46	2.72	6.33	80	3.2	12.30
10	3	5.7	0.82	6.97	0.25	1.47	2.73	6.62	80	3.2	12.61

4 DISCUSSION

Generally, introduction of groundnut into the system improved cassava root yield. Stands intercropped with groundnut irrespective of number of rows, produced higher yields, 48% higher than those with maize intercrop in 2007 and 42% in 2008. It is worthy to note that where cassava rows were more closely associated with groundnut (2 and 3 rows arrangements) intercropped cassava yielded more than sole cassava. Apparently, both fixed nitrogen and non-nitrogen benefits (such as increased moisture retention, improved soil structure, weed control) are often reported in legume/non-legume association and rotation, (Nguyen *et al.*, 2001, Tran and Nguyen, 2007, Wiley, 1979, Richard, 2005) and could account for this. In the two years of trial, the root yield of cassava was significantly higher ($p>0.05$) higher when groundnut was planted after maize harvest. Perhaps the removal of maize (regarded as aggressive in food competition) from the system has (not only reduced inter-specific competition among the crops) given cassava 100% assess to the nutritional contribution of the legume component and the applied poultry manure. Fagbamiye and Ikerogu (1984) reported that the growth cycles of the associated crops in cassava-based system are rather short, that when they are harvested, all the available nutrients including those added by the remains of the component crops, are left at the disposal of cassava.

The root yield of cassava was significantly ($p>0.05$) higher in 2008 (14%) than in 2007, especially in areas that received 10 t ha^1 of poultry manure application. Perhaps, this may be attributed to residual effects of the manure. In 2007, poultry manure at much higher rates (10-50 t ha^{-1}) have been reported to give optimum response of marketable yield of cabbage (Hochmuth, 1997), pepper, egg plant, tomatoes and okra (Maynard, 1991). Hussein (1997) indicated that application of poultry manure at higher rates ensures sustainability in the system. The highest root yield of cassava were obtained when groundnut was planted in 2 and 3 rows respectively between two rows of cassava after maize harvest at 10 t ha-1 of manure application (Table 2).

The grain yield of maize increased linearly with increase in the rate of poultry manure application in the two years of the trial (table 3). Increasing the number of rows of groundnut did not affect maize yield significantly ($p>0.05$). The yield of maize in the system was generally low. Inter specific competitions in the mixture may have contributed to it.

The seed yield of groundnut planted at the same time with maize was statistically ($p>0.05$) the same as those planted after maize harvest (Table 4). Highest seed yield of groundnut (0.870 in 2007 and 0.876 in 2008) irrespective of time of planting, were obtained when groundnut was planted at 2 rows between rows of cassava with 5 t ha^{-1} of poultry manure application. Perhaps, 5 t ha-1 was the optimum level of manure that groundnut could tolerate to boost its nitrogen fixing

ability. The yield of groundnut generally was lower in the intercrop plots than in solecrop plots. This may be attributed to the shading and competition arising from close association among intercrop in both systems. The low yield of cowpea/cassava mixture was attributed to shading competition (IITA, 1978).

The land equivalent ratios of cropping systems were all above 1 and on the average ranged from 1.11 to 1.88 across in both 2007/2008 (Table 5). This implies that the three crop systems involving maize, cassava and groundnut both in rotations and intercrops was found to be 11-88% more productive than the solecrops. This study showed that introducing groundnut and poultry manure into the cassavas/maize intercrop system, resulted in increased crop productivity evidenced by high LERs. Some reported gains in productivity involving legumes in intercrops are 13.8-40.6% cassava/flamingia (Richard, 2005), 50-80% cassava/cowpea (Tran and Ngumen, 2001). The yield or cassava root in 2008 was 14% higher than in 2007. Mixture productivity as expressed was also higher in 2008 than in 2007. Yield or productivity stability is the yield response to variations in environments due to years or locations. Post-harvest soil analysis showed that the nutrient status of the soil was maintained for the two years of trials. Thus in introducing poultry manure and groundnut in cassava/maize intercrop system ensures yield stability and sustainability. Targeting high and stable yields of cassava components to feed the cassava processing industries, a cassava/maize/groundnut mixture with 10 t ha^{-1} of poultry manure application, groundnut being planted at 20,000 or 62,500 stands ha^{-1}, after maize harvest is recommended.

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Proximate Analysis and Mineral Composition of Edible Mushrooms in Parts of South Eastern Nigeria

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Abstract: Proximate and mineral analysis of three species of mushroom, *Plerotus tuber-regium*, *Plerotus squariosulus* and *Auricularia auricula* were examined in this work to determine their nutritional value. These mushrooms were found to contain on the average 4.54-6.54% of crude fiber; 5.84-7.25% of ash; 1.29-3.73% of fats and oil; 19.47-22.76% of protein; 11.25-12.88% of moisture and 31.31-36.25 cal of carbohydrate. The average mineral element content of the mushrooms were found to be 0.59-0.92% of potassium; 0.57-0.74% of sodium; 0.52-0.63% of calcium; 0.24-0.36% of magnesium; 0.28-0.37% of phosphorus and 3.115-3.635% of Nitrogen. These results show that these species of mushroom are highly nutritive. These findings were discussed in line with the importance and implications of the uses of edible mushrooms to man. [Report and Opinion. 2009;1(4):32-36]. (ISSN: 1553-9873).

Keywords: Proximate Analysis, Mineral Composition, Edible, Mushroom, South Eastern, Nigeria

1. INTRODUCTION

Mushroom is a fleshy, spore bearing fruiting body, a fungus, typically produced above ground on soil or on its food source. Mushroom is most often applied to fungi (Basidiomycota, Agaricomycetes, order Boletales and family Boletaceae) that have stem (stipe), a cap (Pileus) and gills (Lamellae) on the other side of the cap. Mushrooms can be found in the forest around the country (Zoberi, 1985). Mushrooms such as the Pleurotus species are known to be among the largest fungi or saprophytic eukaryotes composed of hyphae filament that thrives very well in damp or moist condition (Mirko, 1985). According to Mirko (1985), some mushrooms especially members of the genus Amanita (*Amanita* species) are extremely poisonous.

Mushroom cultivation serves as the most efficient and economically viable biotechnology for the conversion of liqnocellulus waste materials into high quality protein food (Sohi, 1990). Mushrooms are found in areas with range of temperatures 20-40^{O}C and grow well in agricultural wastes (Soberi, 1985). They require a moderate rainfall and PH range of 3-10 for growth (Chang and Feinandez, 1980). *Plerotus tuber-regium* is the most edible mushroom in Nigeria.

Clara (2001) reported that *Plerotus tuber-regium* is highly nutritive and very rich in protein and also eaten for its flavour and beneficial medicinal effect. The protein content of edible mushrooms is equal to that of corn, milk and legumes (Clara, 2001). Mushrooms have been food supplement in various cultures and they are cultivated and eaten for their edibility and delicacy considered as sources of proteins, vitamins, fats, carbohydrates, amino acids and minerals (Clara, 2001).

Mushrooms have been considered healthy food because they contain high quality protein which contains all the essential amino acids, vitamins B, B_2, C and D and minerals such as A, K, Zn, Na, Fe, Mg, P and low fat (Bano, 1993).

Despite the medicinal, nutritional and economic importance of mushrooms as indicated by various authors and researchers, the nutritional values of some tropical edible mushrooms that are indigenous to South Eastern Nigeria have not been determined. This situation infers that people eat edible mushrooms without knowing their nutritional values. This justification informs this study whose aim is to determine the proximate values and mineral composition of three species of edible mushroom in parts of South Eastern Nigeria to be able to make deductions for general consumption on their food and mineral element values as well as their species differences as food items.

2. MATERIALS AND METHOD

Thirty (30) healthy, fresh and succulent mushrooms from the three species *Plerotus tuber-regium*, *Plerotus squariosulus* and *Auricularia auricular* were collected from Owerri and Orlu markets of Imo State, ten from each species. The samples were preserved in the chemistry laboratory of Imo State University, Owerri.

Proximate Analysis

The three edible mushroom species were analyzed for food composition according to the Association of

Official Analytical Chemists (AOAC, 1995). These include the determination of crude fiber, Ash, Crude Protein, Fat, Carbohydrate and Moisture content.

The moisture content was determined by gravimetric method and calculated as follows:

$$\% \text{ moisture} = \frac{W_2 - W_2}{W_2 - W_1} \times \frac{100}{1}$$

Where W_1 = Wt of empty moisture can
W_2 = Wt of can before drying
W_3 = Wt of can + sample after drying to a constant weight

The protein content was determined by Kjeldahl method. The total nitrogen was determined and multiplied with the factor 6.25 to obtain the protein as follows:

Equal wt of $W_2 = 14$
Let the titre blank value be x
1ml of 0.02N H_2SO4 -14 x 0.02MgN
1ml of 0.2N H_2SO4 = 14 x 0.28 MgN
This was contained in 10mls digest
50ml digest will contain 0.28 x 50 MgN
This was contained in 0.2g sample

$$\% N = \frac{0.28 \times 50m}{10} \times \frac{1}{103} \times \frac{100}{0.2}$$

N = 0.7 x
% crude protein = 0.7x X 6.25
The x will be determined

The crude fiber was determined by the Weende method and calculated gravimetrically as % crude fiber as follows:

$$\text{Crude fiber} = \frac{W_2 - W_3}{\text{Wt of Sample}} \times \frac{100}{1}$$

Where W_2 = weight of crucible + sample after washing and drying in oven.

W_3 = Weight = Weight of crucible + sample as ash

The total ash was done using the furnace incineration gravimetric method (AOAC, 1995) and the weight of ash obtained in percentage as follows:

$$\% \text{ Ash} = \frac{W_2 - W_3}{\text{Wt of Sample}} \times \frac{100}{1}$$

Where W_1 = wt of crucible
W_2 = wt of crucible + material

The fat content was determined by the continous solvent extraction method using a Soxhlet apparatus and calculated as

$$\% \text{ Fat} = \frac{W_2 - W_1}{\text{Wt of Sample}} \times \frac{100}{1}$$

Where W_1 = wt of empty extraction flask
W_2 = wt of flask and oil extract

The carbohydrate content was calculated by difference as the Nitrogen Free Extractive (NFE) as
% NFE = 100% (a + b + c + d + e) where
a = Protein
b = Fat
c = Fiber
d = Ash
e = Moisture

The mineral elements were dwetermined by the Dry Ash Extraction method of AOAC (1995) at National Root Crop Research Institute, Umudike as follows:

- Pottasium and Sodium by flame photosynthetic method
- Nitrogen by Kjeldahl method
- Phosphurus by the Vanadomolybdate (yellow) spectrometry method

Phosphurus content was given by the formula g/100g = 100/WxAU/ASxUF/VA where W = wt. of sample analysed
AU = Absorbance of test sample
AS = Assorbance of standard solution
VF = Total volume of filtrate
VA = Volume of filtrate analyzed

Percentage calcium and magnesium was calculated as follows

$$\frac{100}{W} \times \frac{EW \times W}{100} \times \frac{VF\ T}{VA}$$

The nitrogen content was determined by Kjedahl method as follows
Molecular wt. of $N_2 = 14$
Let the titre blank value be x
1 ml of $1NH_2SO_4 = 14gN$
Xml of 0.2N H_2SO_4 = 0.28 x MgN
This was contained in 0.2g sample

$$\%N = \frac{0.20 \times 50\ m}{10} \times \frac{1}{10^3} \times \frac{100}{0.2}$$

%N = 0.7x. The X will be determined.

3. RESULTS

The results of the investigation are presented here according to the parameters investigated. The moisture content is highest in *A. auricular* (12.88%) followed by *Plerotus squarrosulus* (11.85%) and least in *Plerotus tuber-regium* (11.25%). Fig 1

The crude protein content is highest in *A. auricular* (6.54%) and lowest in *P. tuber-regium* (4.8%) fig 3. Ash content is highest in *P. tuber-regium* (7.25%) with least content in *A. auricular,* fig 4. Crude fibre is more in *A. auricular* and least in *P. tuber-regium*. Fig 3.

The highest fat content is found in *P. tuber-regium* (3.73%) and the least found in *A. auricular* (1.29%) fig 5. The highest carbohydrate content is found in *P. tuber-regium* (36.25%) and lowest in *A. auricular* (31.31%) fig 6.

The highest potassium content is found in *P. tuber-regium* (0.9%) and lowest in *P. squarrosulus* (0.59%) fig 7. *P. squarrosulus* has the highest sodium content (0.74%) while *P. tuber regium* has the least (0.57%) fig 8. Calcium was more in *P. tuber regium*

(0.6%) and least in *A. auricular* (0.52%) fig 9. Magnesium content was highest in *A. auricular* (0.36%) and least in *P. tuber regium* (0.24%) fig 10. Phosphurus is highest in *P. tuber regium* (0.37%) and least in *A. auricular* (0.28%) fig 11. The nitrogen content is highest in *P. tuber regium* (3.65%) and lowest in *P. squarrosulus* (3.11%) fig 12.

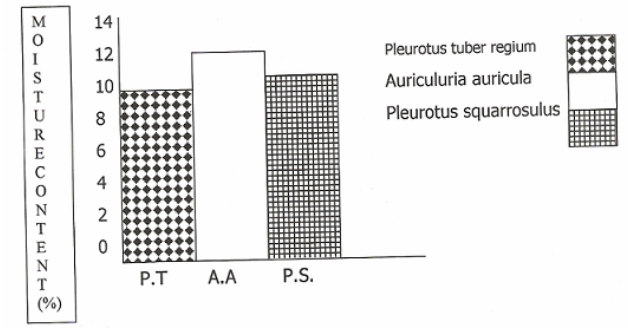

Fig 1: Moisture content of three mushroom species

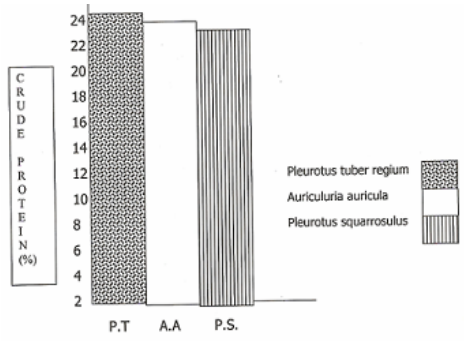

Fig 2: Crude protein content

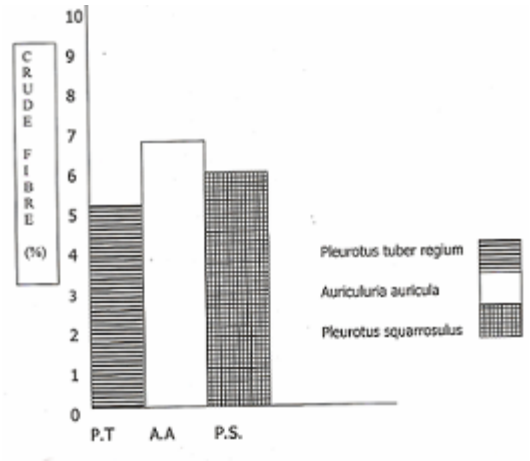

Fig 3: Crude fiber content

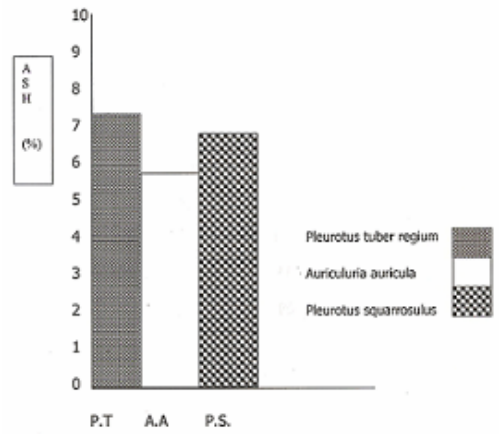

Fig 4: Ash content

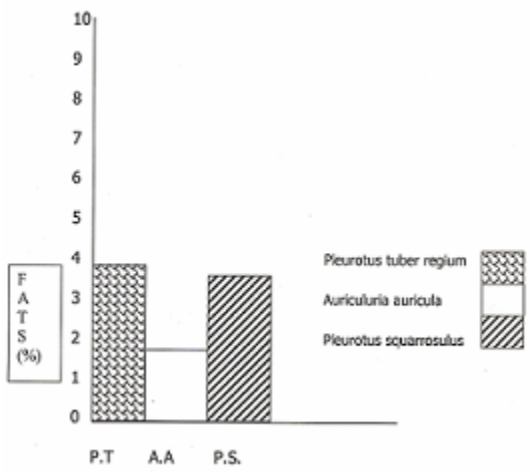

Fig 5: Fat content

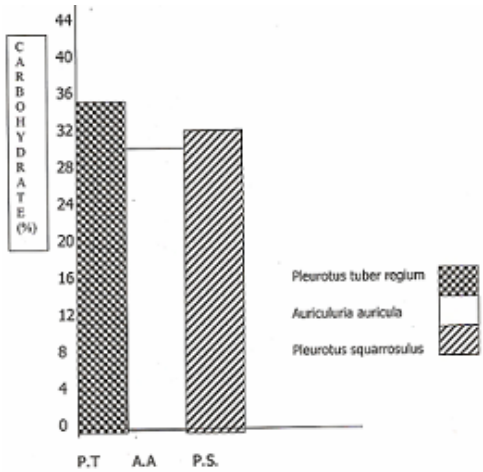

Fig 6: Carbohydrate content

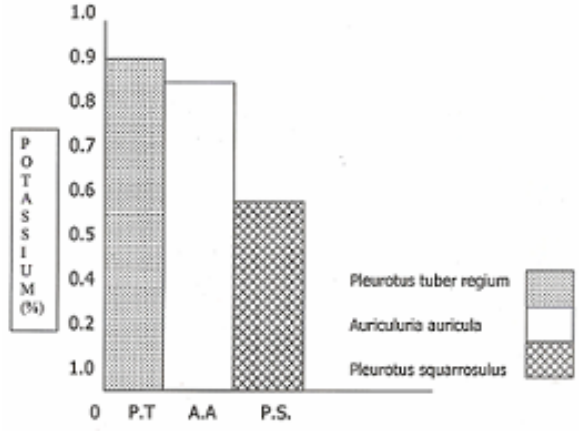

Fig 7: Pottasium content

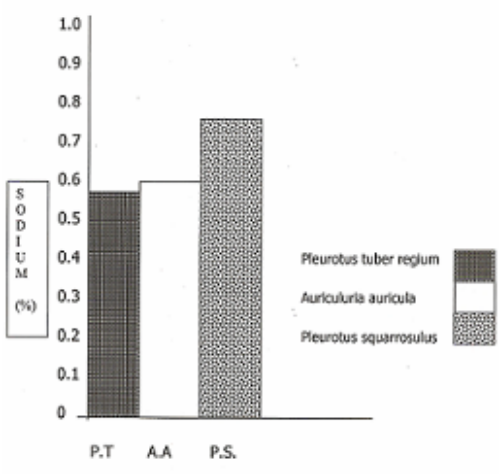

Fig 8: Sodium content

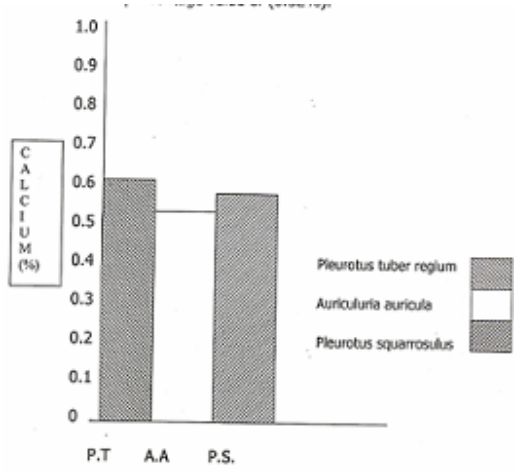

Fig 9: Calcium content

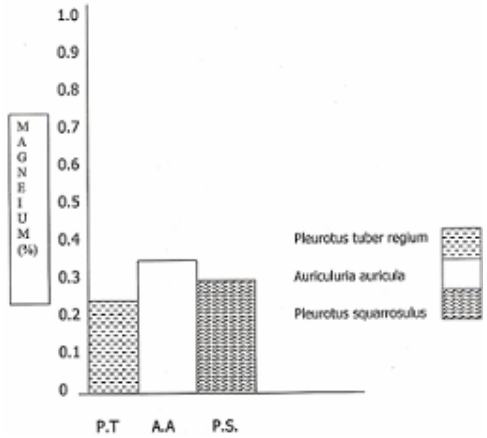

Fig 10: Magnesium content

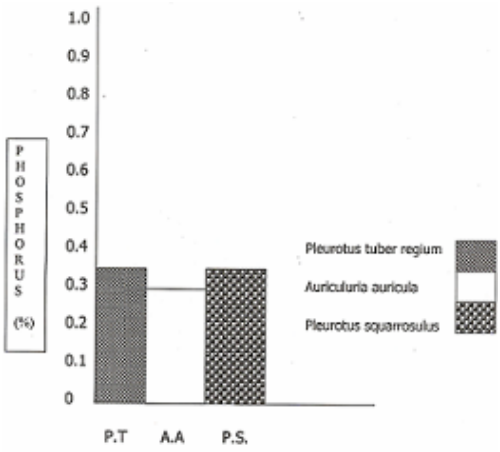

Fig 11: Phosphorus content

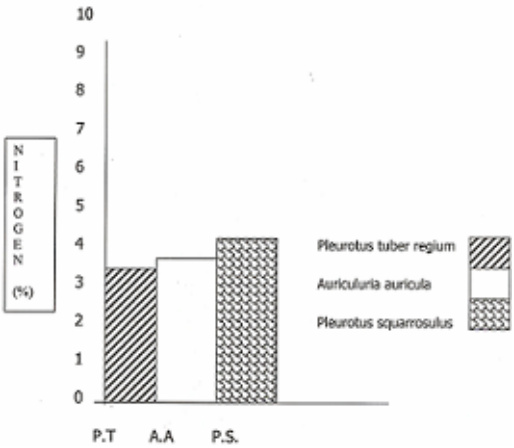

Fig 12: Nitrogen content

4. DISCUSSION

The results of the proximate analysis of the three species of edible mushroom show that the mushroom are richly endowed with protein fibre, ash, moisture, fat, carbohydrates and mineral elements. This agrees with the finding of Moore and Chi (2005) that edible mushrooms have high nutritional attributes and potential applications in industries.

Plerotus tuber-regium has the highest protein content though low in crude fiber content of the three species. *Plerotus tuber-regium* also has the highest ash, fat and moisture content. This is in conformity with the findings of Bano (1993) who studied *T. robustus* and *P. atroumbonata*. *Auricularia auricular* and *P. squarrosulus* recorded low protein, ash, fat and carbohydrate contents when compared with *P. tuber-regium*. The relative high carbohydrate content as well as food energy values in these mushrooms suggests that they are food items (Chukwu, 2000). The high moisture content of protein especially in *A. auricula* suggests that great care must be taken in their handling and presentation as high moisture contents promote susceptibility to microbial growth and enzyme activity (Chukwu, 2000).

The results show that the three species of mushrooms were rich in Nitrogen and were found to contain reasonable levels of Pottasium, Sodium and calcium. This is in agreement with results of the study of some cultivated mushrooms(*Agaricus bisporus* and *Pleurotus osterotus*) (Edogo and Gomina 2000). They also reported that mushrooms are considered as sources of proteins, vitamins, fats, carbohydrates, amino acids and minerals. However, the three species of mushrooms studied here presented low levels of magnesium and phosphorus and these minerals are required for metabolic reactions.

5. Conclusion

The results of the proximate analysis of the three species showed that *P. tuber regium* had the highest levels of crude protein, ash, fat and carbohydrate. *A. auricula* recorded the highest moisture an fibre contents. It can be reasonably concluded following the results of this study that these edible mushrooms hold tremendous promise in complementing the protein and minerals supply deficiencies prevalent in developing countries like ours.

The results of the study showed appreciable levels of fibre which is known as anti-tumorigenic and hypochlestrolaemic agent. This implies that mushrooms hold special attraction and may be recommended for people with Cholesterol related ailment (Kadiri and Fasidi 1990). Due to high level of most mineral elements in the species, the three mushrooms can be essential for normal metabolic reaction, transmission of nerve impulse, regulation of water and salt balance and rigid bone formation.

The results suggest that the mushrooms hold great promise of alleviating the problem of protein supply deficit prevalent in this country since mushrooms are highly nutritional and can compare favourably with egg, meat and milk. However, for the nutritional potentioal of mushrooms to be realized, sustained efforts must be geared towards the husbandry (cultivation) and popularization of the more nutritious species like *P. tuber regium, A. auricula* and *P. squarrosulus*.

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Comparative Effect of Poultry Manure and Urea on the Growth and Yield of Maize (*Zea mays*).

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Abstract: A comparative study on the effect of poultry manure and urea on the growth and yield of maize was carried out at Imo State University Botanical garden. The plant height, leaf area, stem diameter, number of leaves and fruit biomass (dry weight) parameters were measured. The results showed that poultry manure encouraged early flowering, fruiting and highest vegetative growth and fruit biomass/dry weight when compared with urea and control. The results also indicated that poultry manure is significantly different from control in all the parameters, but not significantly ($P \leq 0.5$) different from urea in number of leaf, with urea significantly different from control in stem diameter, leaf area and drey weight. Since maize is mainly grown for consumption and medicinal value, poultry manure is preferred for its production on the basis of this investigation. [Report and Opinion. 2009;1(4):37-40]. (ISSN: 1553-9873).

Key words: Effects, Poultry, Manure, Urea, Growth, *Zea mays*,

1. INTRODUCTION

Maize is an annual cereal crop which belongs to the family Poaceae. It grows up to 1-3m height producing a single upright stem with about ten to fourteen leaves inserted alternatively. Maize originated from central America and spread to the rest of the world following the discovery of America.

The crop has been in existence in Nigeria for more than 400 years, since its introduction by early explorers-the Portugueese. Although the cultivation of maize in Nigeria has assumed a wider proportion due to its high adaptability to this area, available information still indicates that majority of the crop production comes from the peasant farmers who have little or no knowledge of nutrient status present in a given soil prior to planting and the appropriate form required of the essential plant nutrient by plant. The essential plant nutrient supply especially that of Nitrogen can influence the growth and distribution of plant (Grigon and Rorison, 1972; Havill *et al;* 1974 and Richard, 2005).

Although plants take up Nitrogen in form of NO_3 and NH_4 under natural conditions, they can also take up N in form of Urea (Hayness and Goh, 1978). Urea is however converted to ammonia by urease in the soil; it can also be absorbed directly by plants (Mengel and Kirkby, 1979). Poultry farmers in the country tend to generate large amount of poultry manure which contains essential plant nutrients likely to be an asset to crop production. Poultry manure is a natural fertilizer which possess high nitrogen content and other essential plant nutrients, and serves as soil amendment by adding organic matter (Hussein, 1997).

Besides, due to the economic importance of this crop to the nation during this era of global food crisis and for the fact that majority of its production comes from peasant farmers who have little or no knowledge of the appropriate form required of essential plant nutrients (i.e. Nitrogen) by the crop, it is therefore necessary to assess the effect of poultry manure and urea on the growth and yield of maize. This paper also examined the economy of using poultry manure as an alternative to urea fertilizer for maize production and make recommendations to local farmers on how best to go about maize production.

2. MATERIALS AND METHODS

Experimental Location:

The experiment was conducted in the Botanical Garden of Imo State University, Owerri which is geographically located at latitude 5^0N and Longitude 7^0E in Imo State at South Eastern Nigeria.

Source of planting materials

The maize variety (Oba super-two) and urea used were obtained from imo Agricultural Development Programme (Imo ADP) Owerri, Imo State while the poultry manure was obtained from a local poultry farm at Orji in Owerri North L.G.A and analyzed to obtain its % Nitrogen content in the soil Science Laboratory of National root Crop Research Institute (NRCRI)

Umudike. Besides, the experimental soil samples were taken from different locations at the experimental site and analyzed also at NRCRI Umudike for physical and chemical properties.

Table 1: Pre-Experimental Analysis of Soil

Parameters	Values
Colour	Dark
Texture	Sandy loam
pH	5.20
% Sand	76.4
% Silk	9.4
% Clay	14.20
% Organic carbon	0.57
% Organic Matter	0.99
% P	55.64
% N	0.04
% Ca	3.20
% Mg	2.40
% K	0.03
% Na	0.096

Experimental design

The experiment was a Randomized Complete Block design (RCBD) with four plots. The experimental land was divided into four plots of 9.5 x 1.5m (14.25M^2) each . The plots were further laid out into three blocks measuring 2.5 x 1.5m (3.7m^2) each, thus giving a total of 12 blocks on which the treatments were randomly distributed. Both the plots and the blocks were separated one meter (1m) apart. The data obtained were subjected to analysis of variance (Anova) and Duncan New Multiple range Test was used to test for mean comparison.

Cultural Condition

After the blocks were properly ploughed into beds, 16 holes were made on each bed with a planting space of 75 x 30 cm^2 between the holes. The maize were planted three seeds per hole and ten days after germination, they were thinned down to one seedling per stand, thus giving a total of 16 maize seedlings per bed. The early rapid weed germination was controlled by weeding after which the treatments (urea and poultry manure) were applied at the third week after planting. The dried poultry manure was applied by broadcasting method while the urea was applied in granulated solid form in about 2cm deep circular trenches made away from the seedlings to avoid contact with them and covered with thin mantle of soil to avoid evaporation and leaching.

Table 2: Different Nitrogen Source and the level of application (i) g.N/block (ii) g. compound N fertilizer/block

Nitrogen Source	% N content	Level applied
Urea – N-	46.00	(i) 4.69 (ii) 10.2
Poultry manure	0.33	(i) 4.69 (ii) 14.21

Parameters Measured

The parameters measured during the experiment include- number of leaves per plant, total plant height, stem diameter and leaf area which were measured at weekly interval starting from 4th week after planting to 7th week after planting and fruit biomass (dry weight) which is measured after three weeks of air drying the harvested maize cobs. Number of leaves is measured by counting, stem diameter with venier caliper while plant height and leaf diameter were measured with tape.

3. RESULTS

The results of this investigation are reported here in accordance with the number of parameters investigated.

Total Height Growth (cm)

Table 3 shows the effect of poultry manure and urea on the total height growth of maize plants on sandy loam. The result showed no significance difference in urea and control but in poultry manure at 5% level of significance. Fig 1.

Table 3: Mean value of Total Height Growth (cm)

Treatments	Mean/Value
Poultry manure	1.32^a
Urea	0.85^b
Control	0.74^b

(Mean with same letters are not significantly different)

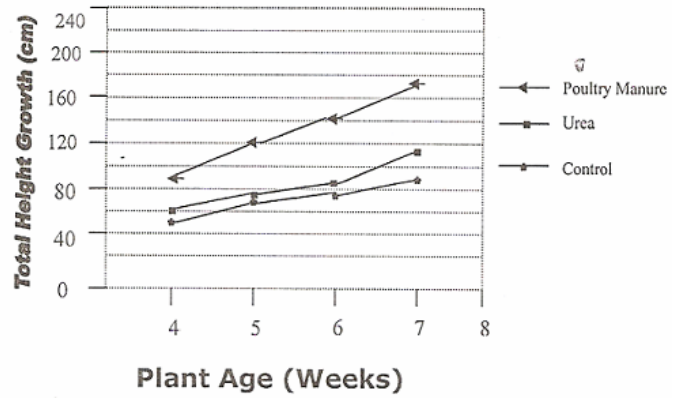

Fig 1: Effect of Poultry manure and Urea on Total Height growth of maize

Stem Diameter

The Analysis of Variance of Variance of the effect on stem diameter showed significant difference (P≤0.050 among the treatments. This is shown in table 4, Fig 2.

Table 4: Mean value of Stem Diameter (cm)

Treatments	Mean/Value
Poultry manure	9.13[a]
Urea	6.93[b]
Control	5.8[c]

(Mean with same letters are not significantly different)

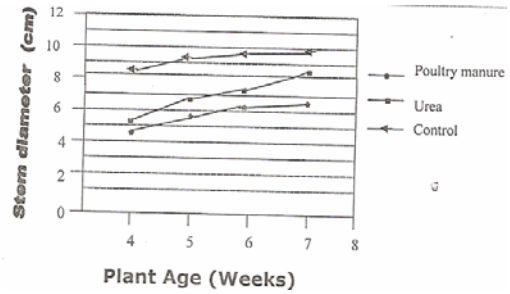

Fig 2: Effect of Poultry manure and Urea on Stem Diameter growth of maize

Number of Leaves

Table 5 shows the effect of poultry manure and urea on number of leaves produced by the plants. The highest number of leaves was recorded in poultry manure while control recorded the least. Analysis of variance showed that poultry manure is significant from control but urea is neither significant from poultry manure nor from control, Fig 3

Table 5: Mean value of Number of Leaves

Treatments	Mean/Value
Poultry manure	12.11[a]
Urea	9.73[ab]
Control	8.73[b]

(Mean with same letters are not significantly different)

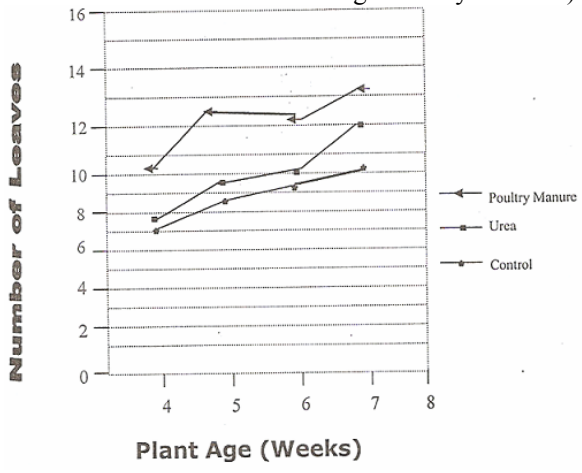

Fig 1: Effect of Poultry manure and Urea on Number of Leaves of maize

Leaf Area

Table 6 show the effect of poultry manure and urea on leaf of the investigated maize plant. Analysis of Variance showed significant differences among the treatments with poultry manure recording the highest mean while control recorded the least. Fig 4

Table 6: Mean value of Leaf Area (cm)

Treatments	Mean/Value
Poultry manure	7.41[a]
Urea	6.18[b]
Control	5.23[c]

(Mean with same letters are not significantly different)

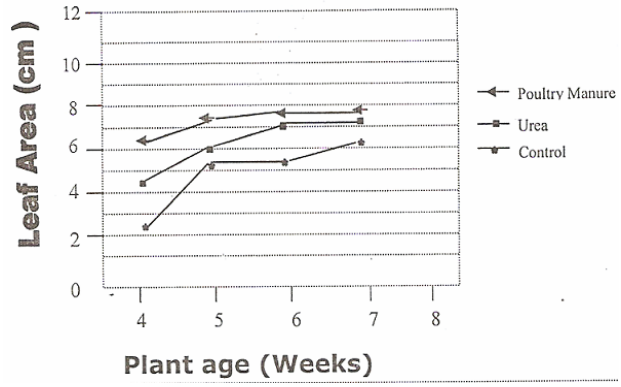

Fig 4: Effect of Poultry manure and Urea on Leaf Area of the maize plants

Dry Weight

Table 7 shows the effect of poultry manure and urea on dry weight of the maize cobs (fruits). The Analysis of variance showed significant difference (P≤0.05) in the treatments used. Fig 5

Table 7: Mean value of Dry weight

Treatments	Mean/Value
Poultry manure	121.88[a]
Urea	75[b]
Control	35.5[c]

(Mean with same letters are not significantly different).

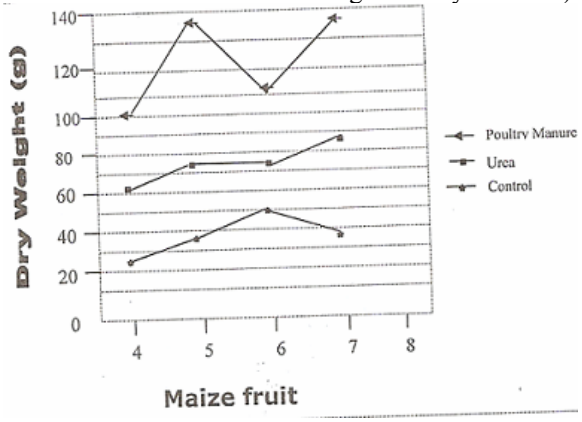

Fig 5: Effect of Poultry manure and Urea on Dry Weight of the maize fruits

4. DISCUSSION

The result of this investigation showed clearly that there was a significant difference among the treatments in stem diameter and leaf area while there was no significant difference among urea and control but in poultry manure at 5% level of significvance for total height growth of maize plants.

Also in number of leaves, poultry manure was significantly differenct from control while urea was non-significant ($p \leq 0.05$) to both poultry manure and control. The highest number of leaves was produced by plants treated with poultry manure (12.10) followed by those with urea (9.73) and the least is control (8.73). This was stressed by John et al (1992) that in addition to macro and micronutrients, organic manure improves soil physical condition and stimulates beneficial microorganisms. Thus improving the pore-space relationship on heavier soil that urea cannot do.

Plants treated with poultry manure started flowering in 6^{th} week whereas those treated with urea and no treatment at all started in 7^{th} and 8^{th} week respectively. This is probably because poultry manure contains phosphorus which is responsible for early maturity (Sylvia, 1985).

However, the results obtained in this research work indicated that poultry manure did not only produce vegetative growth more than the control and urea but equally encouraged early fruiting of maize plants on the sandy loam soil. This is because poultry manure contains essential elements necessary for growth like nitrogen, phosphorus, calcium, magnesium and potassium unlike urea that is a single fertilizer containing only nitrogen as the essential element. This agrees with the report by Obi and Ebo (1995) that poultry manure as organic matter improves the chemical and biological qualities of the soil which increases crop productivity than chemical fertilizers.

Poultry manure recorded the highest dry weight/biomass of the cobs followed by urea with control having the lowest. The better performances associated with the poultry manure over other manures has been shown by many agronomic plants (Cooke, 1982 and Hussein, 1997). Poultry manure is well known organic matter which prevents acidification and helps in checking soil erosion by improving the soil structure (Bounchee *et al*, 1993). The enhancing of growth and yield by this fertilizer could by due to the neutralizing effect on sandy loam with the resultant release of other nutrients particularly phosphorus (Djokoto and Stephen, 1961).

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Toxin Production By Fungi Isolated From Rotten Pawpaw Fruits In Parts Of Imo And Abia States Of Nigeria

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Abstract: Culture filtrates of *B. theobromae, A. niger, A. flavus* and *R. oryzae* isolated in parts of Imo and Abia states of Nigeria contained toxic metabolites which elicited electrolyte leakages and discoloration on young leaf discs of pawpaw. Procedures for extraction of the metabolites based on solvent extraction are described. The sensitivity of the pawpaw leaf discs to the toxic metabolite preparations corresponded to the conductances and discolorations inferring their susceptibility to the pathogens in the bioassays conducted.
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Key words: Toxin, Fungi, PawPaw, Imo, Abia, Nigeria

1. INTRODUCTION

A great deal of information on toxins has been obtained from investigations of relatively serious from investigations of relatively serious plant pathogen relationships. Fungi noted for their saprophytic activity and weak parasites has received little attention. However some toxic metabolites cause disease symptoms on host plants and host plant parts in bioassay. *Aspergillus niger* have been known to produce Aflatoxins (Wogan, 1973) which induced electrolyte leakage in living plant tissues and altered cell permeability, (Kohmoto et. al; 1976). The principle of conductivity has been used in toxin detection due to the increase in electrolyte presence caused by the leakage of ions from host plant tissues attributed to the metabolite (Vidhyase Karan et. al; 1986).

In a survey of the prevalence of post-harvest fruit rots of *Asmila tribola* (pawpaw) in Imo and Abia States of Nigeria, *Aspergillus flavus, Aspergillus niger, Botryodiplodia theobromae* and *Rhizopus oryzae* were constantly isolated from affected fruits and individually produced fruit rots in inoculation exercise (Ezeibekwe, 1993).

The production of toxins by these isolates was studied using the principle of electrolyte conductivity in bioassay.

2. MATERIALS AND METHOD

Culture Medium and Extraction of Toxic Metabolite

Pawpaw 200g was washed with clean water, peeled and sliced for preparation of pawpaw broth. The slices were boiled until they become soft and then strained through cheese cloth. Dextrose 20g was added and the extract made up to one litre with distilled water. The medium (30ml) was dispensed in Erlen meyer flasks, and sterilized in the autoclave at 121^{o}C for 15 minutes.

The medium was inoculated with mycelial discs 8mm with each of *B. theobromae, R. oryzae, A. niger* and *A. flavus* isolated from infected pawpaw fruits. Potato dextrose agar discs 8mm were put into the control flasks. Each set up was in three replicates. After two weeks of incubation at 25^{o}C, the cultures were filtered with No. 1 filter paper and the filtrate stored in MacCarthney bottles at 10^{o}C.

The culture filtrate was extracted with two volumes of acetone. The acetone supernatant was decanted and the precipate left in the test tube. Any acetone left on the precipitate was removed by evaporation at 30^{o}C. The supernatant was evaporated in a water bath at 30^{o}C and the precipitate redissolved in methanol (10mls).

The supernatant and the precipitate were each diluted with 5ml of deionized water and tested fro toxin activity. The controls were similarly treated.

Test For Toxin Activity (Bioassay)

Young fully expanded leaf, 21 days old was used. The leaf was cut into small discs 1 cm by 5mm in size and rinsed in several changes of distilled water. The extract 1ml from each isolate was diluted with 50ml of deionized water and put in sterile test tubes.

A leaf disc was put in each test tube and incubated for 30 minutes at 25^{o}C on a shaker set at 100 strokes per minute. Five hours after, conductance of the ambient solution was determined with a conductivity meter.

The control and water blank were subjected to the same screening. The conductance in umhos of the blank (water) was subtracted from those of the control and the toxin infiltrated leaves to determine the increase in the electrolyte leakage induced by toxin. All tests were conducted in three replications.

Extraction Of Toxin Fro[illegible] Infected [illegible]paws F[illegible]

[illegible]Healthy pawpaw[illegible]its we[illegible]oculate[illegible] isolat[illegible]s [illegible] *A.* [illegible]*r* and *A*[illegible]*vus*. T[illegible] mature [illegible] fruits were su[illegible]e steril[illegible] by the[illegible]nly scr[illegible] their surfaces [illegible]h cotto[illegible]ool so[illegible] with [illegible] hypochlorite [illegible]ed w[illegible]r [illegible] ch[illegible]s of [illegible] water and allo[illegible] to [illegible]u[illegible]y. [illegible] health[illegible] were used for [illegible] pat[illegible]t [illegible]re[illegible]ions.

Cylin[illegible]al di[illegible] [illegible]p [illegible] remove[illegible] the fruits wit[illegible] 10m[illegible] [illegible]il[illegible]or[illegible]r. T[illegible] discs of five [illegible]old [illegible]y [illegible]w[illegible]ngal [illegible] were introduc[illegible]nto [illegible]a[illegible] in[illegible]uits. paraffin wax [illegible] appl[illegible]e[illegible]oin[illegible] inocula[illegible] exclude extra[illegible]s pat[illegible]

Disc[illegible]hon [illegible]l[illegible]d [illegible]) PD[illegible] used in the co[illegible]l ex[illegible] T[illegible]culate[illegible]uits were each enc[illegible]ed in [illegible]icro[illegible]aidity [illegible]vironment of a polythene [illegible] c[illegible]ing a [illegible]aked [illegible]eptic [illegible]tton wool for seve[illegible]ays. [illegible]

Discs 10mm [illegible]re[illegible] [illegible] a ster[illegible] cork [illegible]rers from the following [illegible] inoculated and control fruits:-

Zone 1:- Completely rotted area, close to point of inoculation.

Zone 2: - Apparently healthy [illegible] spar[illegible].

Each disc was [illegible] with sterile motar washed into a test tube and made up to 10ml with deionized water. Each solution was extracted with two volumes of acetone as previously [illegible]

Bioas[illegible] were conducted on the extracts.

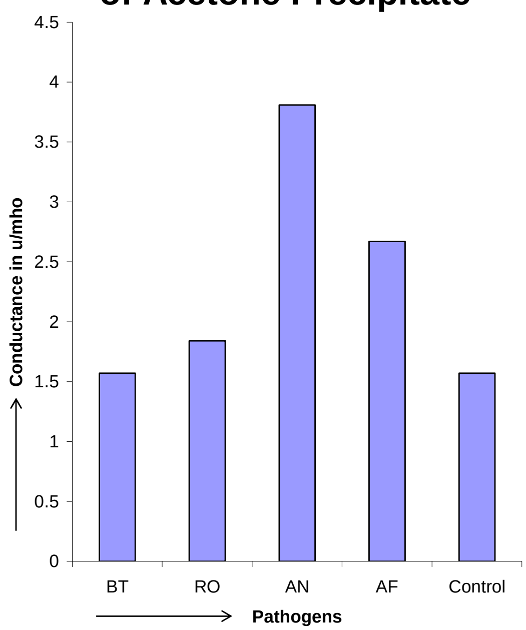
3. [illegible]ULTS

[illegible]Extracts of the culture filtrates obtained from the i[illegible]s caused electrolyte leakages in leaf disc bioas[illegible] Conductivity determinations recorded from the e[illegible]s of *A.* [illegible] and *A. flavus* culture filtrates w[illegible]ficantly ([illegible]0.05) greater than those of *B.* *t*[illegible]*e* and *R.* [illegible]. Figs. 1 and 2.

[illegible]he condu[illegible]y of the acetone precipitate r[illegible]om bioa[illegible] with the extracts of *A. niger* a[illegible]*vus* diffe[illegible]ignificantly (p.0.05) from the c[illegible]

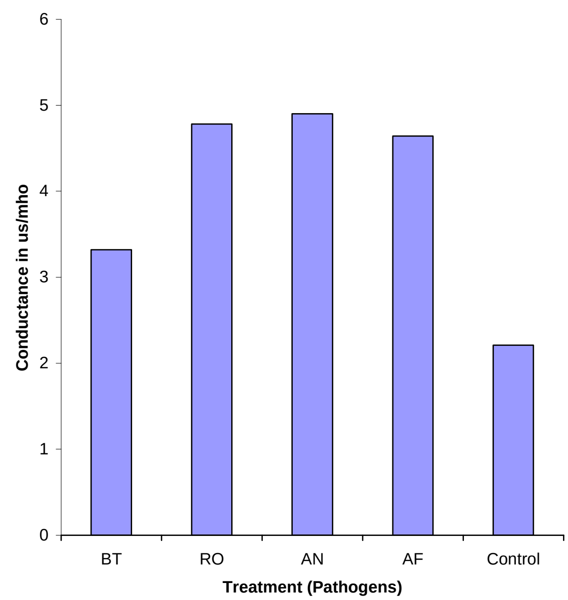
[illegible]uctivity [illegible]ings of the extracts from *B.* *t*[illegible]*e* and *R.* [illegible]*ae* acetone precipitates did not d[illegible]ficantly f[illegible]he controls (p = 0.05). Fig. 1. Differences between conductivities of the supernatants and their controls were highly significant (p = 0.05). Figs. 1 and 2.

Extraction of toxins from infected pawpaw fruits inoculated with *A. niger* and *A. flavus* and their conductivities in leaf disc bioassays are presented in tables 1 and 2. The results in tables 1 show that the acetone supernatant was more toxic resulting in greater conductivity leakages (p = 0.05, F = 2.4) than the acetone precipitate (F = 0.25) for *A. niger*. The same trend was also observed in *A. flavus* with the acetone supernatant proving more toxic (p = 0.05, F = 1.02) than the acetone precipitate (F = 0.10) table 2.



BT. *Botryodiplodia theobromae*
RO. *Rhizopus oryzae*
AN. *Aspergillus niger*
AF. *Aspergillus flavus*

Fig. 1: Bioassay with Pawpaw Leaf Discs Conductivity of Acetone Precipitate



BT. *Botryodiplodia theobromae*
RO. *Rhizopus oryzae*
AN. *Aspergillus niger*
AF. *Aspergillus flavus*

Fig. 2: Bioassay with Pawpaw Leaf Discs Conductivity of the Acetone supernatant.

Table 1: Effect of Metabolite Extracted from Pawpaw Fruit Inoculated with *Asperillus niger* on Pawpaw Leaf Discs

Electrolyte leakage test by conductance
Anova table

Source of Variation	df	ss	ms	f	f	
Acetone Supernatant	2	0.84	0.42	2.4	0.05*	0.01**
Acetone Precipitate	2	0.56	0.28	0.23	0.05*	0.01**
Errow	4	0.70	0.175			
Total	**8**	**2.10**				

* non significant ($P < 0.05$, $V_1 = 2$, $V_2 = 4$ df)
** Highly insignificant ($P > 0.01$, $V_1 = 2$, $V_2 = 4$ df)

Table 2: Effects of Metabolite Extracted from Pawpaw Fruit Inoculated with *A. flavus* on Pawpaw Leaf Discs
Electrolyte leakage test by conductance

Amova table

Source of Variation	df	ss	ms	f	f	
Acetone Supernatant	2	0.90	0.45	1.2	0.05*	0.01**
Acetone Precipitate	2	0.11	0.55	0.10	0.05*	0.01**
Errow	4	2.20	0.55			
Total	**8**	**3.21**				

* non significant ($P < 0.05$, $V_1 = 2$, $V_2 = 4$ df)
** Highly insignificant ($P > 0.01$, $V_1 = 2$, $V_2 = 4$ df)

4. DISCUSSION

The results of the investigation on bioassays involving the four pathogens show a significant variation in their toxic effects as revealed by the electrolyte leakages, figures 1 and 2. *A. niger* and *A. flavus* generally appeared to produce more toxic effect than B. *theobromae* and *R. oryzae*. Fig. 1 and 2. The result of the bioassay work using extracts from the various zones on and around the inoculation points show observable differences in toxicity effect between replicates in both the experimental and the controls. Vidhyase Karen et. al; (1986) stated that the maximum dilutions at which visible symptoms were noticed was considered as the dilution and point of activity of the toxin and the minimum concentration required, to induce brown spot symptoms on rice by toxin extracted from *Helminthosporium oryzae* was 1.04 ug/ml when purified with chloroform and 0.63 ug/ml when purified with charcoal. In the same work they held that in electrolyte leakage bioassays, the effectiveness of each step in removing contaminating materials from the toxins whose action was seen to have increased with each step of purification the conductance of a solution is the sum of the contributions of all the ionic species present, and hence not only depend on the species for which one is analyzing. This explains part of the factors that likely affected the purity and the effect of the target metabolite phytotoxins.

The toxic metabolite extracts showed an ability of eliciting electrolyte leakages in leaf discs biossay at varying depress. The invitro extracts from the pathogens revealed significant differences in toxicity. There were no significant differences in toxicity between the zonal extractions in the invivo tests, P = 0.05.

5. CONCLUSION

The production of toxic metabolites by the fungal associates of pawpaw rots appeared to be important in the mechanism of disease spread. Although the toxic extracts need to be subjected to further purification, Aflatoxin is known to be produced by *A. flavus*.

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Response of Benthic Macroinvertebrate Community to Salinity Gradient in a Sandwiched Coastal Lagoon

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Abstract: Salinity has been implicated as a major factor affecting the biotic composition of estuarine ecosystems. To investigate the response of benthic macroinvertebrate community to salinity gradient in a sandwiched lagoon in Nigeria, three replicate Van Veen grab ($0.1m^2$) samples of benthic macroinvertebrates were collected at 8 different locations covering the whole length of the lagoon for 24 months (Sept., 2004 - Aug., 2006). In a total of 576 samples, there were 17,712 specimens belonging to 45 taxa. Molluscs constituted the highest percentage (98.43%) of the animal population, followed by Annelida (1.16%), Arthropoda (0.32%), Nermertina (0.04%), Chordata and Porifera (0.02%) respectively, and Echinodermata (0.005%). There were strong similarities in the values obtained for monthly fauna abundance, species richness, diversity and evenness for wet and dry seasons, indicating no strong seasonal influence. However, the benthic macroinvertebrate abundance and distribution suggested strong influence by the salinity gradient. The values of benthic macroinvertebrate abundance were higher in locations with mean salinity >0.34ppt while low abundance occurred in areas with mean salinity <0.09ppt. The highest number (33) of taxa was observed in station G which had the highest mean salinity (3.44ppt). Physico-chemical parameters such as total dissolved solids (TDS), Total organic content (TOC) of sediment, percentage sand and mud in sediment were also investigated in the respective stations. Salinity, conductivity and total dissolved solids showed increasing graduation in concentration downstream. There was significant difference (ANOVA, $P<0.05$) in all the parameters investigated at the study stations. The salinity at the upstream stations A to F were similar (DMRT, $P<0.05$) and significantly lower than those at downstream stations (G and H) which were also similar (DMRT, $P<0.05$). Index of similarity was higher between stations within close proximity and subsequently having close salinity values.. [Report and Opinion. 2009; 1(4):45-55]. (ISSN: 1553-9873)

Key words: benthic macroinvertebrate; salinity gradient; sandwiched lagoon**.**

1. Introduction

Estuaries are characterized by the presence of a longitudinal gradient in salinity with which other gradients in physico-chemical parameters, such as conductivity and concentration of total dissolved solids are associated (Nybakken, 1988; Tait and Dipper, 1998; Catsro and Huber, 2005). In estuarine lagoons, these environmental parameters may fluctuate at any point according to displacements of the longitudinal gradient induced by factors such as tides and river discharge (Rejean and Julian, 1993).These fluctuations in abiotic conditions may cause major physiological problems for animals (Beadle, 1972; Odiete, 1999).

Studies on pattern of salinity variation in estuaries have demonstrated that fluctuations may have major effects on growth, reproduction and ultimately survival because osmotic and thermal stresses cause changes in basal metabolic rate, which reduces surplus energy available for other activities (Odiete, 1999). These observations have led to the widely accepted concept that estuarine ecosystems are variable (or unstable) environments (Nybakken, 1988; Tait and Dipper, 1998; Catsro and Huber, 2005). This concept has played a fundamental role in estuarine ecology and constitutes one of the principal assumptions of several hypotheses that explain a whole range of observations. For example, fluctuation in salinity may constitute a major factor controlling the distribution of estuarine animals (Rejean and Julian, 1993). Burrowing in the sediment has been reported as an adaptation to reduce tidal salinity fluctuations.

Environmental variability may be responsible for the lower diversity of estuarine organisms compared to marine and limnitic environments, few species being adapted to tolerate rapid changes in abiotic conditions (Miller et al., 1985). Estuarine communities may be mainly 'physically controlled' in opposition to the 'biologically accommodated' communities found in areas where physical conditions are constant and uniform for long periods of time (Rejean and Julian, 1993). These hypotheses including others assume that estuarine animals are subjected to fluctuations in environmental conditions. The mechanism that generates environmental variability for animals in estuaries may be reduced to two components (Rejean and Julian, 1993; Agard et al., 1993). The first component corresponds to the presence of longitudinal and vertical gradients in physico-chemical parameters. The second component is dynamic: environmental variability resulting from the movement of animals against the spatial gradients. The speed and direction of this movement determine the rate and the direction of changes in abiotic conditions an individual experiences.

Most of the information available on the nature of environmental variability experienced by estuarine animals comes from studies of benthic organisms. This stems from the fact that these animals are

affected by the periodic longitudinal displacement of the horizontal gradient in physico-chemical conditions caused by tides and freshwater discharge. Sessile animals are exposed to the whole range of fluctuations observed at one geographic point in the estuary, unless adaptations such as living in interstitial waters or in a shell reduce the range of fluctuations experienced by an individual (Odiete, 1999).

Benthological studies in Nigeria including Ajao and Fagade (1990), Brown (2000) and Edokpayi et al. (2004), have centered majorly on general species composition and distribution, not much has been documented on the role of some tidal related variables such as salinity in determining benthic macroinvertebrates population, distribution, diversity and community structure. This has made it difficult to explain the roles of these variables in spatiotemporal interpretation of the observed pattern of distribution of benthic invertebrates in coastal hydro ecosystems. This present paper examines the relationship between pattern in benthic macroinvertebrates characteristics and the salinity gradient in Epe lagoon.

2. Materials and Methods

2.1. Description of Study Area

Epe lagoon (Fig. 1) lies between latitudes $3^0$50' – $4^0$10'N and longitudes $5^0$30' – $5^0$40'E. It has a surface area of about 243km^2, and is sandwiched between two other lagoons, the Lekki lagoon (freshwater) in the east and Lagos lagoon (brackish water) in the west. It is situated in the rain forest region of Nigeria which experiences long period of rainy season and short dry period. The lagoon experiences lowland fresh water input during the rains.

The vegetation of the area consists primarily of Raphia palms (*Raphia sudanica*) and oil palms (*Elaeis guineensis*), coconut palms (*Cocos nucifera*) which are widespread in the surrounding villages. Swards of floating aquatic macrophytes occur throughout the length of the lagoon. Notable among these plants are water hyacinth (*Eichhornia crassipes*), water lettus (*Pistia stratiotes, Ipomea aquatica, Salvinia nymphellula, Lemna* sp., and *Hydrocharis marsus-renae.*

Within the study area the lagoon water tends towards fresh in the wet season but assume a higher salinity status in the dry season. Seawater incursion in the study area is considerably low as fresh water input from streams and land runoff is comparably stronger. The salinity gradient observed in the lagoon is a reflection of its sandwiched position. Human activities in the area include fishing, sand mining and boat traffic. Eight study stations (Fig. 1) were selected based on accessibility for this study.

2.2. Field Investigation

Water, sediment and benthic macroinvertebrate samples were collected monthly in all the eight stations from Sept., 2004 to August, 2006. Samples were collected between 0900 and 1500h on each occasion.

Water samples for chemical analyses were collected in pre-washed 1litre plastic bottles. Sediment samples were collected using a Van Veen grab (0.1m^2). The sediment samples collected at each station were placed in labeled polyethylene bags for analysis in the laboratory. The samples were stored in the refrigerator prior to analysis. Three grab hauls for benthic samples were also taken from each station and the collected materials washed through a 0.5mm mesh sieve. The residue in the sieve for each station was preserved in 10% formalin solution and kept in labeled plastic containers for further laboratory analysis.

2.3. Laboratory Investigations

The conductivity and TDS of the water samples were measured in the laboratory using a Portable combined Total Dissolved Solids, Electrical conductivity, Temperature meter, HM Digital COM – 100. The salinity of the water samples were measured using a portable salinity meter, Hiener instrument, Model HI991301. Sediment grain size analysis was performed using the direct method for separating sediment into grain size fractions (Oyenekan, 1988). Air dried samples were passed through a graded series of standard sieves. Griffin SIH – 310-V sieving outfit was used. The fractions of sand and mud obtained were recorded in percentages. The TOC of the sediment was estimated by loss of weight on ignition in muffle furnace at 555^0C as employed by Oyenekan (1988).

Preserved benthic samples were washed with tap water to remove the preservative and any remaining sediment for easy sorting. The animals were sorted into different taxonomic groups using suitable identification manuals including Yankson and Kendall (2001). The numbers of taxa and individuals for each station were counted and recorded for all the sampling months.

2.4 Data Analysis

All statistical analyses were performed with the Statistical Package for Social Sciences (SPSS). One-Way analysis of variance (ANOVA) was used to determine the significance difference (P=0.05) that exist at the study stations for each physico-chemical parameter. When significant variations are detected, a *post hoc test* using Duncan New Multiple Range Test (DMRT) was performed to determine the locations of significant differences. Simple linear regression model was used to determine the relationship between benthic macroinvertebrates' metrics (Y) and salinity (X).

Margalef's index of taxa richness (d), Shannon-Weiner's index (H) of general diversity and Equitability index (E) were used to determine taxa richness, species diversity and evenness respectively. Sorenson's index (Stephen, 2000) of similarity was calculated to compare overlap of species between each pair of study stations using the formula

$2C / A + B$

Where;

A = number of species in sample A.

B = number of species in sample B.

C = number of species common to both samples.

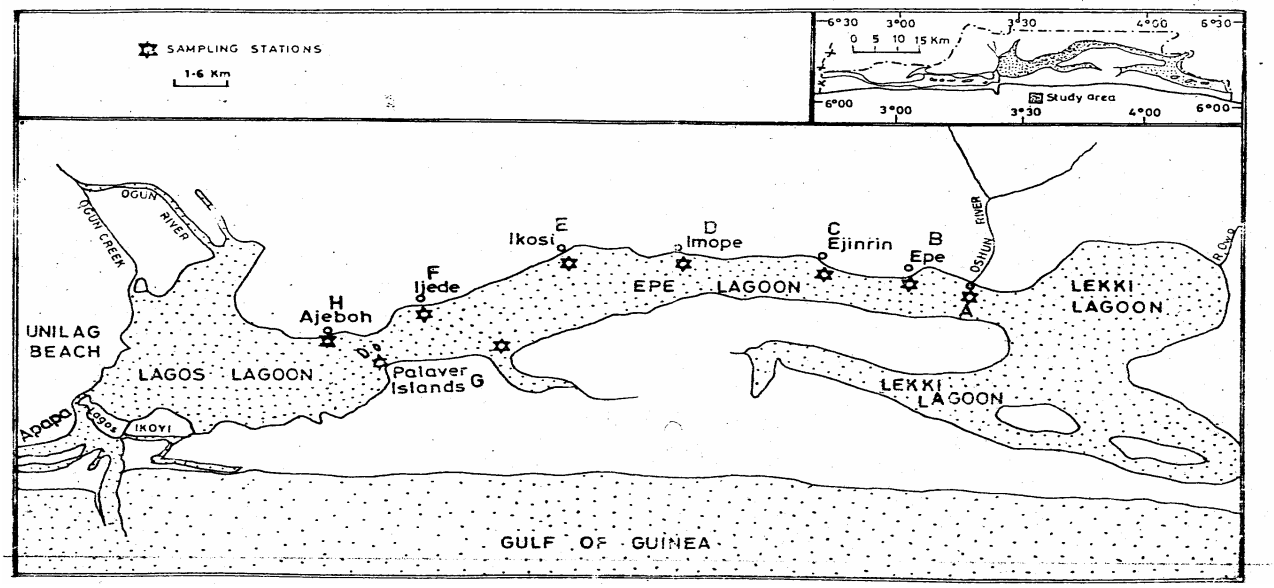

Figure 1. Map Showing Lagos, Epe and Lekki Lagoons as well as the Sampling Stations

3. Results

3.1. Physico-chemical Conditions

Table 1 summarizes the physico-chemical conditions at the study stations. Salinity, conductivity and TDS values were higher at the downstream stations and each had elevated values in the dry than in the wet season. There was significant difference (ANOVA, $P<0.05$) in these parameters at the study stations. The salinity at the upstream stations A to F were similar (DMRT, $P<0.05$) and significantly lower than those at downstream stations (G and H) which had similar (DMRT, $P<0.05$) salinity. The study area was predominantly sand intermixed with varying proportions of mud in the stations sampled. The highest value of sand fraction (93.6%) recorded occurred in station E, while the least (54.4%) was recorded in station C. The highest amount (44.6%) of mud in sediment was recorded at station C.

3.2. Benthic Macroinvertebrates

3.2.1. Abundance and Diversity

Table 2 shows the summary of the benthic macroinvertebrates' metrics at the study stations in Epe lagoon. The total population density of sampling stations ranged from 87indm^{-2} (station C) to a maximum density of 3855indm^{-2} (station H). The remaining six stations recorded densities >1000indm^{-2}. Abundance of macrobenthic invertebrates were mainly determined by molluscs (98.23% of the total population), especially the gastropod *Pachymelania aurita* (44.33% of the total population) and the bivalve *Macoma cumana* (28.89% of the total population). Trend in macrobenthic invertebrates' characteristics in the lagoon was closely linked with salinity during the study period (Figure 2).

Of the 45 taxaspecies observed, 35.6% were Arthropods, 27% Molluscs, 22.2% Annelids, 4.44% Nemertina and Porifera respectively, and 2.2% Chordate and Ehinodermata respectively. Molluscs were present in all the study stations, *P. aurita* and *M. cumana* had the widest distribution with representations in all the stations. Benthic macroinvertebrates' species richness, abundance, and diversity showed positive correlations with salinity (Table 3). To a less extent the percentage sand in sediment showed a positive correlation with species richness (r=0.64), diversity (r=0.046) and Margalef's index of species richness(r=0.083).

The mean number of taxa per sampling station remained relatively constant in the upstream and downstream stations, but clearly declined in the middle area. The same pattern was shown by the diversity index. Upstream stations recorded majorly freshwater species, while in downstream stations brackish and marine species were observed. Monthly diversity and species richness indices recorded at the study stations were significantly different (ANOVA, $P<0.05$). Similarity (DMRT, $P>0.05$) existed among the study stations except in station C which was significantly lower. Regressions between abundance, species richness, diversity, Margalef's index of species richness and salinity were significant ($P<0.05$), indicating that salinity of water was a very good predictor of the trend in benthic macroinvertebrates characteristics in the lagoon (Table 3, Figure 3). The relations between total abundance, total species richness and average salinity at the study stations are shown in figure 4.

Table 1: Summary of Values of Physico-chemical Characteristics of Water and Sediment at the Study Stations (Sept. 2004 – Aug. 2006)

Parameter	**A**			**B**			**C**			**D**			**E**			**F**			**G**			**H**			
	Max	Min	Mean SD	Max	Min	Mean ± SD	Max	Min	Mean ± SD	Max	Min	Mean ± SD	Max	Min	Mean ± SD	Max	Min	Mean ± SD	Max	Min	Mean ± SD	Max	Min	Mean ± SD	F-VALUE
Water																									
Salinity(ppt)	0.35	0.00	0.06k± 0.08	0.24	0.00	0.07k± 0.08	0.28	0.00	0.09k± 0.08	1.77	0.01	0.34k± 0.69	3.62	0.01	0.39k± 0.74	8.37	0.01	1.70± 2.25	19.30	0.06	3.44m± 5.78	19.72	0.04	3.19 m± 5.29	5.893*
TDS (mg/L)	350	70	173r± 86.23	340	80	172r± 67.23	1860	30	267r± 453.75	1270	70	398r± 437.39	1400	71	448r± 475.48	6852	82	1388t± 1501.71	10932	77	1883t± 2587.57	15200	75	2067 t± 3591 .728	5.290*
Conductivity (µS/cm)	799	165	481n± 185.67	710	225	547n± 156.26	710	230	548n± 165.29	3100	150	971n± 808.90	3220	211	1103n± 960.51	13352	229	2923p± 3777.63	29200	252	4098p± 6281.90	33253	162	4410 p± 7266 .33	4.674*
Sediment																									
Sand (%)	92.2	79		87.4	61.4		89.4	54.4		85.4	65.4		93.6	71.4		92.2	73.6		89	65.8		92.4	73.5		
Mud (%)	21	7.8		28.6	11.4		44.6	9.4		27.6	14.6		28.6	6.5		26	7.8		29	11		26.5	7.6		
TOC (%)	8.61	2.11		8.22	2.10		10.45	3.51		7.50	1.01		7.30	1.02		7.50	1.01		6.00	1.01		6.30	1.01		

N= 24 (no. samples); lower case alphabets indicate no significance (P>0.05: Duncan Multiple Range Test) *significance (P<0.05)

3.2.2. Change Along the Estuarine Gradient

The values of similarity between study stations during sampling months as computed using Sorensen index are presented in table 4. The following ranges were recorded between stations; 0 – 1 (A versus B), 0 – 0.67 (B Versus C), 0 – 0.90 (C versus D), 0.22 – 0.94 (D Versus E), 0.40 – 0.92 (E versus F), 0.33 – 1.00 (F versus G), 0.40 – 1.00 (G versus H), 0 –0. 67 (H versus A), 0 – 0.86 (H versus A) and 0.22 – 1.00 (H versus E). It was observed that greater fauna similarity existed between stations close to each other. It was clear that especially towards the oligohaline zone, the benthic community abruptly changed. The similarity pattern observed shows a more or less gradual and continual change in assemblage along the estuarine gradient. The rate of change in the benthic coenocline of the lagoon was mainly determined by differences in salinity.

3.2.3. Community Structure

Community structure analysis shows that the 3 most upstream stations situated in freshwater zone (oligohaline zone) was characterized by a very impoverished benthic fauna population with only one taxon (*M. cumana*) dominating. The species recorded here were mainly arthropods, including; *Gammarus fasciatus*, *Gomphus vulgatissimus*, *Libellula luctosa* and *Beatis muticus*. The mid and downstream stations (D, E, F, G, and H) comprised brackish water species which are able to survive in mesohaline waters. In station G organisms able to survive in low polyhaline conditions were also observed. The total number of observed taxa as well as the mean number of taxa per sampling station were clearly higher for the brackish water species and stations than those of freshwater.

The dominance of Molluscs was the major feature of brackish water species community. Characteristic species of this group were *M. cumana, Aloides trigona, Neritina glabarata, Tellina nymphalis, P. aurita, N. kuramoensis, Tympanotonus fusatus, T. fuscatus var radula. Pachymelania aurita contributed* most to the total population of the brackish water part. With a mean density of 982indm^{-2}, the organism penetrated the lagoon up to the freshwater part, but here few individuals were observed. *Macoma cumana* was another very common species, that also had a wide distribution. Its highest density (13470 indm $^{-2}$) occurred at station H, but was poorly represented in stations F and G. In this group arthropods were represented by the crabs; *Ocypoda cursor, O. africana, Uca tangeri, Penaeus notialis, Clibanarius africana, C. senegalensis, C. chapini* and *Sersema huzardi* which occurred only in station G.

Table 2: Summary of the Benthic Macroinvertebrates' Metrics at the Study Stations in Epe Lagoon (Sept. 2004 – Aug. 2006). Lower case alphabets indicate no significant difference (P>0.05) *DMRT (P<0.05)

Metric	Stations							
	A (Mouth of Oshun River)	B (Epe jetty)	C (Ejirin)	D (Imope)	E (Ikosi)	F (Egbin Power station)	G (Palava Island)	H (Ajebo)
Number of samples	72	72	72	72	72	72	72	72
Number of taxa	23	23m	11	12j	18k	12m	32k	18j
Number of individuals	191h	1045h	87h	3312i	3611i	3120i	2489i	3855i
Margalef's Index of species richness (*d*)	4.37d	3.30c	2.46c	1.60d	2.32d	1.37c	4.09	2.18d
Shannon-wiener diversity index (H')	1.06f	0.34f	0.77	0.61g	0.60g	0.62f	0.60	0.66g
Evenness (E)	0.33a	0.10a	0.31	0.24a	0.19a	0.25a	0.20a	0.22a

Table 3. Regressions Between Benthic Macroinvertebrates' Metrics and Salinity. *significant (P<0.05)

	Model	r	df	F	P
Abundance	Y= 87.864 + 3.8166X	0.128	191	3.173	0.05*
Species richness	Y= 4.355 + 0.125X	0.146	191	4.003	0.05*
Shannon-Wiener	Y= 0.395 + 0.0275X	0.312	191	20.527	0.05*
Margalef	Y= 1.718 + 0.065X	0.176	191	6.044	0.05*

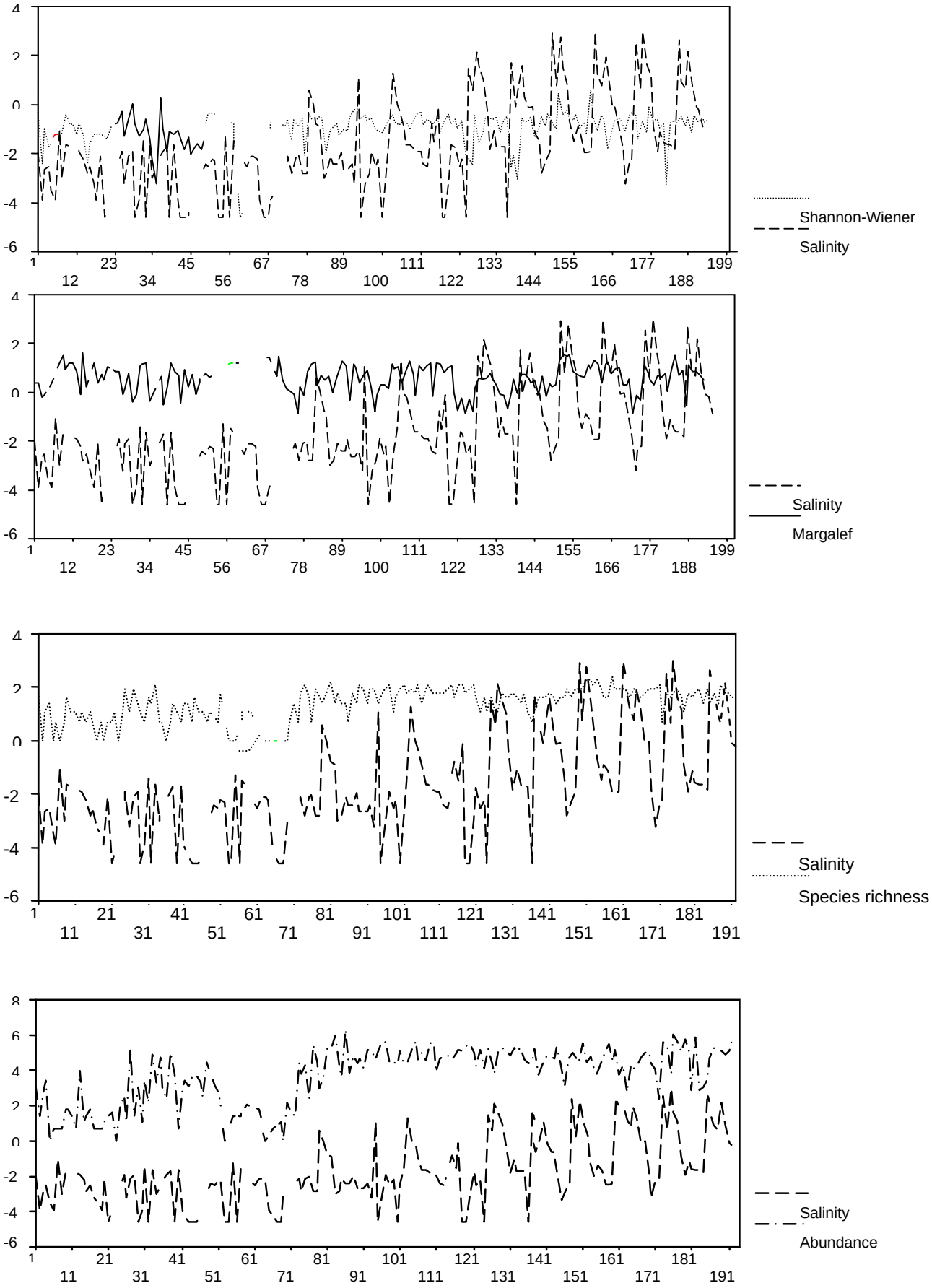

Figure 2. Sequence Charts Showing the Links Between Macrobenthic Invertebrates' Metrics and Salinity.

Several species were common to both freshwater and brackish water groups, but were very low in abundance, notably *Heteromastus filiformis, Nereis diversicolor, N. succinea, N. lamellosa* and *Chironomus plumosus*. Some species like *Notomastus hemipodus, Lumbrinerides cingulata* and *Lumbrineriopsis paradoxa* were also common in both the freshwater and brackish part, but were less abundant than the species mentioned above. Polyhaline species notably; *Brachiostoma nigeriense, Cucumaria conicospermium, Adocia cinerea* and *Tetilla monodii* were recorded only in station G.

It can be concluded from the results recorded in this study that the stations were separated in groups closely linked with the salinity gradient of the lagoon. However, since many dominant species were common in both the fresh and brackish water parts, the distinguished groups are likely to be variants of one community type, rather than that of a clear distinction into two totally different benthic communities.

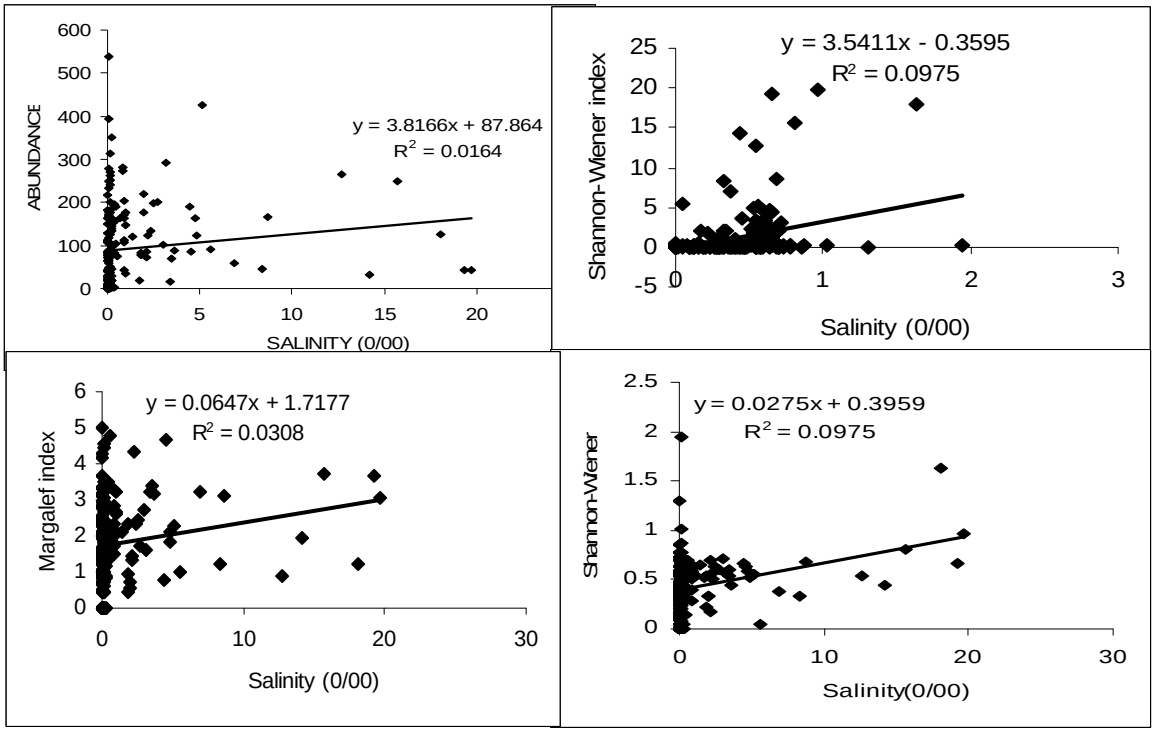

Figure 3. Relationships Between Macrobenthic Invertebrates' Metrics and Salinity.

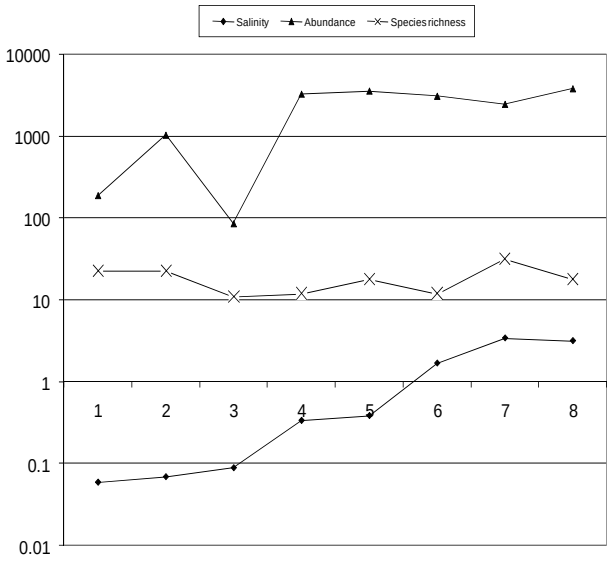

Figure 4. Variations in the Means of Species Richness, Abundance and Salinity in the Study Stations

Discussion

Tidal incursion through the Lagos harbour as well as freshwater input from run offs and river inflow are the major factors controlling the salinity of lagoons of south-western Nigeria (Nwankwo, 1998). Epe lagoon sandwiched between two lagoons, the Lagos and Lekki lagoons is weakly influenced by tidal water input through the Lagos lagoon. Higher salinities values occur in study stations close to the Lagos lagoon than those close to Lekki lagoon and the discharge points of Oshun and Oni rivers.

This study is one of the first on a sandwiched lagoon in south-western Nigeria investigating the benthic macroinvertebrates along an estuarine gradient. Previous studies (Sandison and Hill, 1966; Brown, 2000; Edokpayi et al., 2004) on the benthic macroinvertebrates in south-western Nigeria aquatic systems never emphasized a gradient along the study area. However, in these studies benthic communities, besides those described here were recorded. The differences are due mainly to salinity variations. Sandison and Hill (1966) described the epifauna *Balanus pallidus* Darwin, *Graphea gazar* Dautzenburg, *Mercierella enigmatica* Linneaus and *Hydroides uncinata* L. and their distribution in relation to seasonal salinity changes. They reported that the two salinity regimes in the Lagos lagoon affected the distribution of the benthos. Salinity has also been reported to affect the life cycles of *Ballanus pallidus* (Sandison, 1966) and *Tympanotonus fuscatus* var *radula* (Egonmwan and Odiete, 1983). The community types described in this study are both freshwater species *(e.g.* insect larvae) and marine/brackish water species *(e.g. Brachiostoma nigeriense).* The sizes of the brackish water species recorded in this study were smaller than those encountered in the Lagos lagoon (Ajao and Fagade, 1990).

Estuaries and the nearby coastal zones are characterized by steep gradients in chemical, physical and biological features. In estuaries the oligohaline and freshwater tidal parts are characterized by relatively low species richness, with Oligochaeta and chironomids, and to a less extent amphipods and molluscs as the dominating species (Montague and Ley, 1993; Odum et al, 1988). Reduction of species diversity with fluctuations in salinity results from osmotic stress experienced by organisms (Tait and Dipper, 1988; Odiete, 1999). External salinities changes usually produce corresponding changes in the concentration of internal fluid by passage of water into or out of the body (osmotic adjustment) to preserve the osmotic equilibrium and these changes are often accompanied by alteration in the proportions of the constituent ions of the internal fluids (Tait and Dipper, 1988; Odiete, 1999). By these limits which often differ for different species, departure from the normal concentration and composition of the internal medium cause metabolic disturbances and eventual death. This constraint imposed by wide salinity fluctuations in estuarine ecosystems accounts to a large extent for the low biodiversity of estuaries. Only species that can survive wide fluctuations in salinity can thrive in the estuaries. This study observed the occurrence of *P. aurita* and *M. cumana* in all the study stations with poor repreentations in the stations A to C. These two species have been reported as truly euryhaline organisms (Egonmwan, 2007). This may have accounted for their wide distribution in the study area

A number of studies have reported the impact of unstable salinity on benthic organisms. *Terebelid* polychaetes and *sipunculids* were found to be adversely affected by salinity fluctuations (Ferraris et al., 1994). The growth and development of the marine polychaete *Arenicola cristata* and the gastropod *Ilyanassa obsolata* were both found to be impacted by periodic reductions in ambient salinity (Richmond and Woodin, 1999). Populations of the soft clam *Mulinia lateralis* perished and the amphipod *Ampelisca abdita* emigrated from the area during a three week exposure to freshwater discharges which lowered salinities in the St. Lucie Estuary from 18-30 ppt to 0.5-5.0 ppt (Haunert and Startzman, 1985). Richmond and Woodin (1999) reported that the growth of the hard clam, *Mercenaria mercenaria*, was inhibited at salinities less than 20 ppt and mortality of adults and juveniles increased when exposed to salinities less than 15 ppt for greater than 12 days. Development and survival of some grapsid crabs was found to be related to salinity stability (Spivak, 1999), and the behavior of newly recruited xanthid crab larvae has been found to be very sensitive to salinity gradients (Forward, 1989). Larvae of two species of xanthid crabs were shown to ascend or descend in the water column dependent upon salinity. Sudden decreases in salinity may cause these crab larvae to sink at a rate which causes them to prematurely settle on inappropriate bottom habitats, resulting in increased mortality (Forward, 1989).

Death and/or impairment have been documented in many species exposed to salinities outside their ideal ranges (Odiete, 1999). Organisms may potentially

Table 4: Values of Sorensen Index of Similarity Between Study Stations During the Sampling Months (Sept., 2004 - Aug., 206).

Compared stations	2004				2005												2006							
	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.
A and B	0.31	0.8	0.8	0.5	0	1	0.33	0.67	0.77	0.4	0.66	0	0	0.33	0.5	0	0	0.33	0.5	0.29	0.4	0.67	0.66	0.57
B and C	0	0.22	0.62	0	0	0	0.33	0	0.6	0	0.4	0	0	0.4	0	0	0	0.4	0	0.25	0	0.67	0.33	0.33
C and D	0	0.77	0.73	0	0.3	0	0	0	0.5	0	0.44	0	0	0.25	0	0.4	0	0.3	0	0.4	0.25	0.57	0.9	0.44
D and E	0.86	0.75	0.75	0.22	0.93	0.91	0.55	0.83	0.94	0.75	0.92	0.7	0.8	0.62	0.5	0.8	0.94	0.93	0.67	0.67	0.93	0.8	0.83	0.93
E and F	0.86	0.67	0.6	0.4	0.77	0.67	0.4	0.91	0.77	1	0.92	0.77	0.8	0.83	0.55	0.5	0.67	0.77	0.8	0.62	0.86	0.8	0.73	0.78
F and G	0.55	0.6	0.8	0.4	0.5	0.6	0.46	0.63	0.4	0.67	1	0.6	0.75	0.5	0.5	0.5	0.33	0.5	0.4	0.67	0.62	0.8	0.6	0.5
G and H	0.62	0.29	0.46	0.44	0.77	0.83	0.63	0.71	0.53	0.57	1	0.9	0.73	0.56	0.62	0.31	0.62	0.77	0.44	0.8	0.62	0.91	0.73	0.4
H and A	0.29	0.2	0.33	0	0.29	0	0	0.44	0.6	0.29	0	0.33	0.4	0.4	0.36	0.22	0	0.5	0.67	0.2	0.5	0.4	0	0.44
H and B	0.53	0.22	0.67	0	0.44	0	0.36	0.55	0.77	0.33	0.22	0.4	0.22	0.73	0.67	0.44	0.4	0.8	0.86	0.77	0.67	0.4	0.29	0.22
H and E	0.63	0.4	0.33	0.22	0.86	0.56	0.62	0.62	0.77	0.75	1	0.77	0.67	0.77	0.5	0.31	0.62	0.86	0.67	0.88	0.86	1	0.83	0.77

avoid the low salinity area, and thus delay settling in nursery habitats (and therefore may be exposed to enhanced risk of predation), or they may die or suffer reduced fitness due to exposure to deleterious salinity levels. Low salinity exposure may cause eggs or larvae to settle prematurely in inappropriate habitats, leading to reduced fitness or death (Forward, 1989).

The observed species distribution in this study follows the classical concepts of species response to salinity gradients (Ferraris et al., 1994; Chindah, 2004). Every estuary has its own physical and therefore ecological characteristics (Meire et al, 1991; Warwick et al., 1991). For instance, how far a marine species is able to penetrate into an estuary largely depends on the amount and variability of the freshwater discharge, relative to the tidal inflow of sea water. The oligohaline zone, which is both a physical and a biological buffer, is in estuaries characterized by the lowest species richness. This is true of the study area as few numbers (12 to 24) of taxa and individuals (87 to 1045) were recorded in oligohaline and mesohaline areas, while 33 taxa and number of individuals >2000 were recorded in station G with a relatively higher salinity condition.

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Feeding Management Practices of Small holder Turkey Farmers in the Warm Wet Tropical Environment of Imo State, Nigeria

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Abstract: Primary data were generated from field surveys conducted with the aid of questionnaires, personal interviews, field measurements and conversation between May and August, 2005 on the feeding management practices of 90 smaller holder turkey farmers in Imo State. All of the farmers fed their turkeys with commercial chicken feeds. Fifty (50.00%) of the farmers used chicken layer rations for their breeder turkey, another 30(33.33%) used breeder ration and 15 (16.67%) fed any ration available in the market. Sixty (66.67%) farmers did not observe influence on feed consumption, while thirty (33.33%) observed seasonal influence on feed consumption. Thirty (33.33%) each of the farmers fed their turkeys twice and thrice, while 15(16.67%) each fed theirs *ad libitum* and once daily. Another 45 (50.00%) each of the farmers used broiler starter and chicks mash to raise their turkey from day old to 8 weeks, while 90(100.00%) used grower ration to feed their turkey to maturity. These results proved that the small holder turkey farmers do not fully understand the nutritional requirements and appropriate feeding management of turkeys at different stages of growth. [Report and Opinion. 2009;1(4):56-58]. (ISSN: 1553-9873).

Keywords: Turkey, chicken feed, management, small holder farmers, Nigeria

1. Introduction

Turkey production in Nigeria has largely remained at the smallholder level due to high cost of feed, inconsistency in feeding programmes, as well as lack of knowledge of the adequate levels of nutrient requirement (Ojewola et al., 2002). Research into nutritional aspect of turkey production in Nigeria is however beginning to receive attention (Ojewola et al., 2002; Tanko and Ojewola, 2003; Etuk, 2007). Usually, farmers who are unable to mix their own feeds may rely on feeds originally formulated for chickens to raise their turkey (Okeudo, 2004; Okoli, 2005). As a result, there seems to be a gradual assumption that feed formulated for chickens could be used for turkeys with the same or better result. This assumption is not only misleading but also dangerous, especially as turkey production enterprise begins to attract considerable investment attention (Etuk, 2007).

There is a dearth of information on the nutrient requirement of turkeys especially the local turkey being raised in tropical environments. This is evidenced by the conspicuous absence of turkey feeds from commercial feed millers in the country (Ojewola et al., 2002). Lack of knowledge of limitations of feed ingredients used in turkey feeds leads to poor growth (Etuk, 2005). Proper nutrition is a basic pre-requisite for successful poultry production (Kekeocha, 1984), since it increases the resistance of poultry to diseases and also allows the producer to optimize the genetic potentials of birds (FAO, 1971). Since feed cost represents over 70% of the cost of production, special care should therefore be taken in providing the most suitable diet and safeguarding feed quality (Cobb Breeding Company Limited, 1988).

This study was designed to investigate the feeding management practices of smallholder turkey farmers in Imo State, Nigeria.

2. Materials and Methods

Study area: This study was carried out in Imo State, which is situated in the Southeastern vegetation belt of Nigeria and lies between latitude $5^0\ 4^I$ and $6^0\ 3^I$ N and longitude $6^0\ 15^I$ and $7^0\ 34^I$ E. The agro-ecological characteristics of the area have been reported (Okoli, 2003). The state is divided into 27 Local Government Areas (LGA), which are further divided into three agricultural zones namely; Owerri, Orlu and Okigwe.
Poultry production in the study area could be a combination of extensive, semi-intensive and intensive systems. The greatest population of poultry in the study area constitutes local chickens and is reared by rural households under the extensive production systems (Okeudo, 2004). Commercial intensive poultry production includes eggs, broilers, parent stock, hatchery, turkey, started chicks and poults production. These poultry operations are distributed over urban, sub-urban and rural areas.

Data collection: The primary data used in this study were generated from field surveys conducted between May and August, 2005.The study was preceded by a preliminary informal survey of the study area through which the researchers became familiarized with the nature of turkey production in the area and explained the purpose of the study to the participants. Data were generated with the aid of questionnaires, personal interviews, field measurements and observations.

Information was elicited from the respondents with the aid of structured questionnaires as the need arose. One hundred (100) questionnaires were distributed among turkey farmers in the three agricultural zones of Imo State, targeting their major towns. In Orlu zone, Orlu town, Mgbidi, and Mgbirichi were purposely selected for the study because they are known to represent areas of high turkey production.In

Okigwe zone, Amaraku, Okigwe town and Okwelle were selected, while from Owerri zone, Owerri Municipal, Nguru and Ahiara were selected. Smallholder turkey farmers who stocked at least ten turkeys were identified and selected for the study. Where the farmer is not literate, the researchers interpreted the questionnaire and filled in the answers accordingly. Personal interviews were conducted where appropriate and observations were made during field visits to each of the participating farms

The respondents were selected based on their willingness to participate in the research and supply the required information. To ensure consistency in data quality, the same researcher performed all the interviews. Ninety (90) of the distributed questionnaires were laid.

Data generated were analyzed using simple descriptive statistics such as frequency distributions percentages and tables.

3. Results and Discussion

Table 1 showed the type of feeds offered to the turkeys. All the farmers fed their turkeys with commercial feeds. Farmers are unable to formulate their own ration thereby relying on rations originally formulated for chicken, with the assumption that all feedstuffs used for chicken could also be used for turkey with the same or better results (Etuk, 2005).

Forty-five (50%) of turkey farmers used ordinary chicken layer ration for their breeder turkeys, 30 (33.33%) made use of broiler breeder ration and 15(16.67%) fed any available ration. The farmers fed their breeder turkeys with different classes of commercial chicken feed probably because of insufficient knowledge of the levels of nutrient requirements of breeder turkeys (Ojewola et al., 2002).

Table 2 showed feeding regime and seasonal effects on feed consumption. Thirty (33.33%) each of the farmers fed their turkeys twice and thrice a day respectively, while those that fed *ad-libitum* and once a day were each also fifteen (16.67) each. Restricted feeding should be practiced, with the breeder birds to prevent them from accumulating fat. Sixty (66.67%) farmers reported no seasonal influence on the feed consumption while thirty (33.33%) farmers agreed that there is seasonal influence on feed consumption especially during the cooler months of the year.

Table 3 showed the types of feed offered at the different stages of development of turkeys. Forty-five (50%) each of the farmers offered broiler starter and chick mash to raise their turkey poults from 0-8 weeks of age, while all of the farmers reported that they used chicken growers mash to feed their turkeys from 8 weeks to maturity. The farmers preferred growers ration to any other class of feed because of its availability and low cost.

Table 1: The types of feed offered to turkeys

Type of feed	**Frequency**	**Percentages (%)**
Commercial feed	90	100.00
Home made feed	0	0.00
Type of commercial feed offered		
Any feed available	15	16.67
Breeder layer rations	30	33.33
Layer ration	45	50.00

Table 2: Feeding regime and seasonal influence on feed consumption

Feeding regime	**Frequency**	**Percentages (%)**
Ad-libitum	15	16.68
Once a day	15	16.68
Twice a day	30	33.33
Thrice a day	30	33.33
Seasonal influence		
Yes	30	33.33
No	60	66.67

Table 3: Types of feed offered to the turkeys at the different stages of development

Feed consumed 0-8 weeks	**Frequency**	**Percentages (%)**
Broiler starter ration	45	50.00
Chicks mash	45	50.00
Grower mash	0	00.00
Broiler finisher ration	0	00.00
Feed 8 weeks to maturity		
Layer ration	0	00.00
Broiler finisher ration	0	00.00
Grower ration	90	100.00
Home made feed	0	00.00

According to Peter (2006), turkeys have a strong aversion to any change in their feeding routine and nature of their feed. Poults up to 10 weeks of age require ration containing approximately 23% crude protein (CP).The CP content of the ration should be gradually reduced to about 15% for mature turkeys. For the breeder hen, diets low in protein 914%) and low in energy (2600 Kcal/Kg ME or 10.8 MJ/Kg) is required and also the hatchability of turkey eggs and quality of the poults depends greatly on the quality of feed given to them (Peter, 2006). The average daily feed intakes of light and heavy breeds of turkeys are 113 and 284 g respectively. In the tropics approximately 23 kg of feed is required to produce a 6.4 kg turkey at 24 weeks of age provided the birds were properly managed (Williamson and Payne, 1978). Heavy hens at 14 weeks of age, weighing 7.7 kg would usually consume 17.4 kg of feed for feed conversion of 2.35 kg of feed for 1 kg of weight gain. Heavy toms at 16 weeks of age, weighing 12.30 kg would consume 28.85 kg of feed for a feed conversion of 2.29 kg of feed for 1 kg weight gain (Anon, 2005). The implication is that turkeys have specific nutritional needs (ARC, 1975; Maynard et al., 1979; Aduku, 1993), which are somewhat different from that of broilers and growers on which most farmers base their turkey feeding.

4. Conclusion

These results suggest that smallholder turkey farmers in Imo State have not fully understood the nutritional requirements and appropriate feeding practices at the different stages of development of turkeys. There is therefore the need to develop appropriate nutritional and feeding management practices for turkey production in the warm wet tropical environment of Imo State and disseminate such information to smallholder farmers for efficient turkey production.

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Socio-cultural Characteristics of Educated Small Holder Pig Farmers and the Effects of Their Feeding Practices on the Performance of Pigs in Imo State, Nigeria

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Abstract: Five smallholder piggery farms (A, B, C, D and E) were used to determine the socio cultural characteristics of educated smallholder pig farmers and the effects of their choice of feeding practices on the performance of pigs during a 14 weeks study period. The farms were categorized into small, medium and large size farms, with small farms stocking 70-80, medium 120 – 130 and larger 230-270 pigs. Scheduled interviews were used to elicit information on socio cultural characteristics of the farmers and their farms. In each farm, six weaner pigs of Large white, Landrace and Duroc breeds were selected on their weaning days and their ages and initial body weights determined. The feeds offered to the weaners were physically characterized for their ingredient contents. Thereafter, representative samples of the feeds were subjected to proximate analysis on the first, seventh and thirteenth weeks of the study. The study revealed that the small, medium and large sized farms were managed by men aged between 40 and 56 years. Four out of the five had their degrees in agriculture and had farming experiences of 1 to12 years. The farms had been in existences for mostly 12-22 years. Corrugated iron roofing and concrete flooring were common. All the farms utilized palm kernel cake as their major energy feedstuffs, in addition to soy bean, cattle blood, local fish meal and vitamins premix. The mean crude protein values of the feed samples were of similar range (13.49-14.20%), while crude fiber and ether extract values were very high. Calculated metabolizable energy values were also relatively low for growing pigs. There were significant ($p<0.05$) differences in the final body weights of the grower pigs after 14 weeks of feeding across the farms. However, there was no significant ($p>0.05$) difference in weight gain, with farm A, B, C, D and E returning 33.84, 33.72, 32.99, 31 86 and 33.69 kg mean weights respectively. The feed conversion ratio across the different farms was 5.0, 4.5, 5.1, 3.9 and 5.0 for farms A, B, C, D and E respectively. The 3.9 feed conversion ratio returned for duroc breed in farm D, indicted superior performance of the breed under the feeding and management practices investigated. While growth performance and proximate values of on-farm formulated feeds obtained tended to be lower then those obtained from experimental stations, the educated farmers studied here seemed to prefer their present performance results. There is need to evaluate the production components that drive this choice in order to properly situate small holder pig production and performance in the study area. [Report and Opinion. 2009;1(4):59-65]. (ISSN: 1553-9873).

Keywords: Pigs, educated farmers, feed, feeding practices, Nigeria

1. Introduction

A feed of good quality is usually formulated to meet the nutritive requirements of a given class and specie of livestock under specific environmental situation (Iyayi, 2004). Feed represents 55-85% of the total cost of commercial swine production, in most tropical countries (Izunobi, 2006). The economics of feeding pigs apart from depending on availability of feedstuff also depends on competition for the feedstuff between human and other animals found in the same locality (Okoli, 2005). The range of feedstuffs that tropical farmers can offer to their livestock is often less limited, but it is vital that the right feed proportions are fed to the animals. A deficiency of an item in the diet may cause ill-health and hence low productivity (Okoli *et al.*, 2004). For a feed to be regarded as being of good quality, it must contain appropriate levels of carbohydrates, proteins, fats, vitamins and minerals among others. Other secondary considerations include content of anti-nutritional factors and fiber levels (Esonu, 2006). A feed may however contain adequate amount of nutrients in balanced proportions, yet these nutrients may not be available to the animals (Iyayi, 2004).

Many studies have implicated deficiencies of various trace minerals and vitamins, inadequate intake of carbohydrates and protein imbalance as major contributions to poor growth performance in tropical livestock (Lanyasunya *et al.*, 2005; Esonu, 2006; Izunobi, 2006). Availability of these nutrients depends on their voluntary intake. For this reason, feed intake is one of the most important factors determining both productivity and growth performance of livestock (Lanyasunya *et al.*, 2005). By ingesting sufficient quality feed, the animals will be able to deposit sufficient nutrients in their body to support vital body maintenance processes, growth, milk production and reproduction (Fanimo *et al.*, 2002).

The caloric density of feeds affects the intake of other nutrients in pig rations, since theoretically monogastrics

in general eat primarily to satisfy their energy needs (Esonu, 2006). Inadequacy of calories derived from carbohydrates and fats will therefore affect overall productivity of pigs. Similarly, adequate calorie to proteins ratio has been verified to remarkably affect the physiological well-being, productivity and carcass compositions of animals, especially monogastrics (Ikani *et al.*, 2001).

Serious investigation into local production paradigms of nutrition, diseases, disease treatment and socio-economic aspects of animal husbandry geared towards proper understanding of animal production systems of southeastern Nigeria and proposing of appropriate solutions has been shown by Okoli *et al.* (2001), Okoli *et al.* (2002) Okoli *et al.* (2003), Okoli *et al.* (2004) and Nwodu (2005) to be imperative. Such information does not only promote the development of useful concepts in animal production but also encourages the maintenance of bio-cultural diversity (Okoli *et al.*, 2002).

There is the need to understand the feeding practices of small–holder pig farmers in Nigeria, since recent studies on poultry have revealed some inadequacies in the field (Okoli *et al.*, 2004; Okoli, 2005; Nwodu, 2005). Furthermore, it has been speculated that the involvement of educated or scientific farmers in farming could make significant impact on the farming processes and output of the region and the tropics in general (Okoli, 2005). This is especially imperative now that the world is continually shrinking and becoming truly a global village, and import barriers as well as trade restrictions are being lifted and replaced with a system of production environment certification. This is to ensure that exporting countries have established a minimum of animal production services and an active disease surveillance network required to protect importing countries from the possible introduction of unwholesome animals and their products (Okoli, 2005). In view of this, any effort made, including the development of appropriate production objective driven animal industry is a welcome development.

This paper assesses the socio-cultural characteristics of educated small holder pig farmers and the effects of their feeding practices on the performance of pigs in Imo state, Nigeria

2. Materials and Methods

The study area: This study was carried out in Imo State, which is situated in the southeastern region of Nigeria. The vegetation is typically rainforest with two seasons, the rainy and dry seasons. The period of rainy season is from the mouth of April to October, while the dry season runs through November to March. The temperature and humidity ranges from 25-30^{0}C and 70 – 80% respectively. Population density of the area ranges from 500 – 2000 person per Km^2 (NNIC, 1991). People in the rural and semi urban areas keep livestock, such as pigs, cattle, sheep, goat and poultry (Agboola, 1979). They also cultivate crops like yam, maize, cassava, cocoyam, and vegetables among others. Pig production in the area is a combination of semi-intensive and intensive system. The pigs are mainly exotic breeds and their crosses and few indigenous breeds.

The study farms: An informal diagnostic survey was carried out during which the smallholder pig farms in the study area were identified and their operators informed on the nature of the study. Based on the result of the informal diagnostic survey, five farms managed by educated persons were purposively chosen for the study, based on the willingness of their operators to participate in the study. An educated farmer was determined to be a person having formal tertiary education culminating in the award of a diploma or university degree.

The five selected farms were made up of two small, one medium and two large sized farms. In the present study, small size farms were those that stocked from 70 to 80 pigs, medium sized had between 110 and120 pigs, while large sized had from 230 to 260 pigs. The five farms were identified as treatment A, B, C, D and E. respectively, with farms C and D being small sized, A, medium size and B and E, large sized.

Farm A is located at Ihagwa, in Owerri West Local Government Area (LGA). The farm was established in 1983. It is privately operated and has two piggery houses. Farm B is a private farm located at Okpala, in Ngor Okpala LGA. The farm was established in 1994 and has currently seven piggery houses. Farm C is located at Amauzari, in Isala Mbano local LGA. It was established in 2005. It has two piggery houses and is privately operated. Farm D is located at Umuagwo in Ohaji LGA. The farm was established in 1984 and has two piggery houses. Farm E on the other hand is located at Nekede in Owerri West LGA. The pig farm was established in 1994.

Farm data collection: Primary data used in this study were collected through interviews, field observations and measurements. Interviews were carried out orally twice every month at the study sites. The pig farmers were interviewed on their socio-economic and cultural backgrounds, and their production characteristics among others.

The pig farms were visited twice every month to take production measurements using appropriate measuring instruments such as weighing scale and scale rule. The parameters measured included, daily feed intake of the pigs over a period of 14 weeks. Body weights of young animals were measured using a platform scale (Avery®, England) according to the method previously described by Obikonu *et al.* (2004), while in the case of larger animals, body weights were determined with the aid of a standardized body weight tape. Other parameters, such as breeds of pigs in the farm, parity status of the dam, birth weight, weaning weight as well as husbandry practices and animal building characteristic and measurements were also recorded.

Growth performance determination: In each farm, 6 weaner pigs were selected for the study of growth performance. The weaning age and weight of the selected weaners were recorded. The feeds offered to the weaners were physically characterized to determine the common feedstuff used in formulating them. Thereafter, representative samples of the feeds were collected on the first, seventh and thirteenth weeks of the study for proximate analysis. At each of the two weekly visits**,** the sub-samples of feed collected were homogenized to make a single representation of the feed sample. They were collected in a clean polythene bags and labeled properly.

Similarly, the daily feed intakes of the animals were determined by weighing the amount of feed offered per day. The experimental animals were also weighed every two weeks and at the end of the 14 weeks period. Weight gain and feed conversion ratio were calculated.

Laboratory analysis: The feeds samples were taken to the Animal Science and Technology Laboratory of the Federal University Technology, Owerri and analyzed for their proximate biochemical compositions, according to the methods of (AOAC, 1990). The metabolizable energy values were calculated using the prediction equation of Morgan *et al.* (1975), based on the proximate composition.

Data analysis: All the quantitative data obtained were subjected to analysis of variance (ANOVA) and where statistical significance was observed, the means were compared using the Duncan Multiple Range Test (Steel and Torrie, 1980).

3. Results and Discussion

The information in table 1 indicated that the pig farmers were all male with their ages ranging from 40 – 56 years and were educated and married. This is in agreement with the earlier reported of Okoli *et al.* (2004) that in Imo state younger people are not actively involved in piggery or any other type of commercial livestock farming. Most of these pig farmers used hired labors in their farms and these laborers were found to be illiterate. The farms had been in existences for mostly 12-22 years except one that was started the previous years. The two small sized farms had 60 and 75 pigs, while the medium sized has 110 and the two large sized had 207 and 256.

The result in table 2 showed that large white and landrace breeds were mostly preferred by farmers than duroc breeds. Weaning age ranged from 46-56 days with the weaned animals weighing between 8.72 and 10.29 kg. The large white and landrace breed had visual weaning size advantage over the duroc and may be part of the reasons why the farmers preferred them. This is in agreement with the reported characteristics of these animals (Devendra and Fuller, 1979).

Table 1: Socio cultural characteristic of the educated farmers

Farms	Age of farmers	Sex	Age of farm	Ed. of farmer	Marital status	No of children	Years of experience	No of pigs	Labor
C	50	M	1	B.Sc / Chart Acct.	Married	5	1	60	self
D	52	M	22	B. Sc Agric	Married	3	5	75	Hired
A	40	M	22	OND Agric	Married	3	5	110	Hired
B	56	M	12	BSc MGT	Married	4	12	207	Hired
E	47	M	22	MSc Agric	Married	3	7	256	Hired

Table 3 showed that all the farms had concrete floor pen. Concrete floor in a piggery house reduces helminthes infestations and makes it easy for cleaning and sanitation (Izunobi, 2006). Corrugated iron sheet was used in roofing most of the farm structures. This has also been observed by Okoli *et al.* (2004), in poultry farms in the study areas. However, when the height of floor to roof is low, radiation heat from corrugated iron roofs have been shown to course heat stress to livestock (Izunobi, 2006). Most of the farms studied provided essential rearing equipment like feeding, drinking and wallowing troughs.

Table 4 showed that most of the farms fed their animals twice daily. Twice daily feeding enhances growth and reproduction among other good benefits. This agrees with the report of Fanimo *et al.* (2002) that the methods of feeding greatly influence the feed efficiencies, growth rate, breeding efficiency, carcass quality and the general health of animals. Most of the farms included fodder in the feeding of pigs. Inclusion of fodder plants in the feeding of animals helps to control some disease and supplies essential vitamins and minerals (Okoli *et al.*, 2002).

Similarly, the representation in table 5 implied that PKC is the most common energy feed used by all the farmers. This is probably because PKC is a readily available industrial by-product to the farmers, since Imo state is situated within the palm oil tree belt of Nigeria. Soybean meal, vitamins and mineral premix and local fishmeal were also in common use. These constitute indispensable feedstuff for profitable intensive production of monogastric animals (Esonu, 2006).

Table 2: Characteristic of the weaner pigs used in the growth performance study

	Farm	No of pigs	Breed	Dam parity status	Weaning age (days)	Weaning weight
SS	C	6	LW	1	56	9.96
	D	6	D	2	49	8.72
Subtotal		12				
MS	A	6	LR	2	46	9.89
Subtotal		6				
LS	B	6	LW	2	56	10.29
	E	6	LR	2	56	10.27
Subtotal		12				
Grand Total		30				

Note: SS = Small size, MS = Medium size, LS = large size, LW = Large white, LR = Landrace, D = Duroc.

Table 3: Characteristics of housing and equipment of small holder farms in Imo State

	Farm	Roof materials	Floor type	Feeding trough	Water trough	Wallowing trough
SS	C	CIS	Concrete	-	+	-
	D	CIS	Concrete	+	+	+
MS	A	CAS	Concrete	+	+	+
LS	B	CIS	Concrete	+	+	+
	E	CAS	Concrete	+	+	+

Key: CIS = Corrugated iron sheet
CAS = Corrugated asbestos sheet
SS = Small size,
MS = medium size,
LS = Large size

Table 4: Feeding practices by small holder farms in Imo State

	Farm	Once feeding	Twice feeding	3 time feeding	Fodder
SS	C	-	+	-	-
	D	+	-	-	+
MS	A	-	+	-	+
LS	B	-	+	-	+
	E	-	+	-	+

Table 6 showed the husbandry practices of the farmers. In all the farms, wastes were removed early in the morning since the farmers saw the need to protect their animals from infections caused by contamination with dung (Izunobi, 2006). Medium and large sized farms applied the same type of routine management. Only large sized farms allowed veterinary visits probably because the number of animals they have will be able to pay the cost of veterinary services (Okoli *et al.*, 2002).

Table 7 showed the means of proximate compositions of feed samples collected from farm A, B, C, D and E. The crude protein content of the feed samples was similar (13.49 – 14.20%). These figures are relatively low when compared with previous published result (Devendra and Fuller, 1979; Izunobi, 2006). The values are normal for the first few weeks of weaning, but do not agree with range of crude protein suggested for growing pigs in the literature (Izunobi, 2006).

Table 5: Types of feedstuffs utilized by small holder farms in Imo State

	Treatment	Pkc	Sg	Wo	Mo	M	GNC	BM	SBM	LFM	SAA	A.o	VMP	GP	EE
SS	C	+	+	-	-	+	-	+	+	+	-	-	+	-	-
	D	+	-	-	-	-	-	-	+	+	-	-	+	-	-
MS	A	+	+	-	-	-	-	-	+	+	-	-	+	-	-
LS	B	+	-	+	-	-	+	+	+	+	-	-	+	-	-
	W	+	-	+	+	-	+	+	+	+	-	+	+	-	-

Note: PKC = palm kernel cake
SG = spent grain, GNC = Groundnut cake
Wo = wheat offal, LFM = Local Fish meal
MO = Maize offal, VMP = vitamins mineral premise
M = Maize, A O = Anti Oxidant,
SBM = Soya bean meal, SAA; Saturated amino acids.
GP = Growth Promoter, EE Additive enzyme

Table 6: Husbandry practices by smallholder farmers in Imo state

	Treatment	Intensive	Time removal of waste	Routine mgt	Farm record	Vet visit	Castration	Tail duckling teeth clipping
SS	C	+	Early Morning	DIA	+	-	-	-
	D	+	"	DIA	+	-	-	-
MS	A	+	"	DIAE	+	-	-	+
LS	B	+	"	DIAE	+	-	-	-
	E	+	"	DIAE	+	+	-	-

Note: D = Deworning, I= iron ingection, A = Anitibiotics, E = Ectoparastic control, .

Table 7: Mean proximate composition of feed sample collected from the different farms

Parameters	Farm A	Farm B	Farm C	Farm D	Farm F
DM	92.39±1.46	93.24±0.27	94.48±1.27	93.06±1.77	93.40±0.20
CP	19.34±0.30	14.01±0.72	13.60±0.05	13.49±0.06	14.20±0.04
CF	19.34± 0.07	19.42±0.59	19.12± 0.18	19.37±0.03	19.37±0.66
Ash	2.89± 0.01	3.06±0.13	3.02±0.17	2.98±0.12	3.08±0.08
EE	8.80±0.10	8.73± 0.13	8.83±0.30	8.93± 0.10	9.09± 0.02
NFE	47.54± 0.91	47.69± 1.07	47.24±1.90	47.94± 0.07	46.65± 0.47
ME	1989.33±3.72	2043.5±4.63	1977.38 ±3.19	93.06±1.77	2009.24± 2.46

DM = Dry matter; CP = crude protein; CF = crude fiber; EE = Ether Extract; NFE = nitrogen free extract; ME = metabolizable energy

The crude fiber content was high for monogastric animals like pigs, which means that the proteins are probably locked up in these fiber materials of the feeds and can only be released with the aid of appropriate additive enzymes (Okoli, 2005). Calculated metabolizable energy values of feed were also relatively lower for growing pigs and may also have contributed to the lower growth performance obtained in the present study. The Ether Extract content of the feed sample was very high and would be of benefit to the animals. High fat content can also predispose feedstuff to rancidity.

Performance of the grower pigs presented in table 8 showed that weight gains were not significantly ($p>0.05$) difference among the treatments. There were however significant ($p<0.05$) differences in the final body weights among the treatments. Similarly, the feed conversion ratio of the animals ranged from the 3.9 recorded in farm D, to 5.1 recorded in farm C. The animals in farm D therefore utilized their feeds better than all the other farms. The lower weight gain of the growers may be due to inefficient utilization of the constituent nutrients in the feeds (Fanimo *et al.*, 2002).

Table 8: Performance of the grower pigs at the different farms

Parameters	A	B	C	D	E	SEM
No of animals	6	6	6	6	6	
Initial body weight (kg)	9.89[a]	10.29[a]	9.96[a]	8.72[b]	10.27[a]	0.21
Feed intake (kg)	2.0	1.8	2.0	1.5	2.0	
Final body weight (kg)	43.73[a]	44.01[a]	42.95[a]	40.58[b]	43.96[a]	0.55
Weight gain (kg)	33.84	33.72	32.99	31.86	33.69	2.5NS
Daily weight gain (kg)	0.40	0.40	0.39	0.38	0.40	0.1NS
Feed conversion ratio	5.0	4.5	5.1	3.9	50	

ab means within a row with different superscript is significantly difference ($p< 0.05$).
NS: Different between means are not statistically significant.

Table 9 showed breed comparison of the performance characteristics and proximate composition of feeds offered the animals. The weight gain obtained in the study area agrees with the range reported by Williamson and Payne (1978) and Izunobi, (2006) but did not agreed with the range reported by Orheruata (2001) and Fanimo *et al.* (2002).

The present result also showed that the breed that recorded 3.9 feed conversion ratio was duroc. This result is interesting because most of the farmers showed preference for lager white and landrace breeds over duroc. It would seem from the present study that duroc should be the preferred animal under the type of feeding managements practices in the study area.

Table 9: A comparison of performance of breeds and feed characteristic of growers pigs

Farm	Final weight (kg)	Weight gain (kg)	FCR	CP	ME	Breed.
A	43.73	33.84	5.0	13.49	1989.33	LR
B	44.01	33.72	4.5	14.01	2043.50	LW
C	42.95	32.99	5.1	13.60	1977.38	LW
D	40.58	31.86	3.9	13.49	2041.91	D
E	43.96	33.69	5.0	14.20	2009.24	LR

LW = Large white; LR = Landrace; D = Duroc; FCR = Feed conversion ratio; CP= Crude protein; ME= metabolizable energy

4. Conclusion

Generally, it would seem from this study that even though the persons involved in pig farming in the study area are educated, accumulated field experiences has tended to tailor their choices of feedstuffs, feeding standard and breed of pigs among others away from official standards approved for tropical environment (Okoli, 2005). While growth performance and proximate values of feedstuff tended to be lower than those obtained from experimental stations, these educated farmers seemed to prefer their present performance results.

There is the need to evaluate the production components that derive this choice in order to properly situate pigs production and performance in the study area.

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Toxicity of solvents exposure on the neuroendocrine system in rats: Role of amino acids supplementation

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Abstract: The goal of this study was to elucidate the neurotoxic effects of repeated exposure to gasoline, perchloroethylene or toluene on male rats, in addition to evaluate the interventive role of certain nutraceuticals against the neurodegenerative insult produced by inhalants abuse. The experimental groups were assigned as follows: Gp(1) control; Gp (2) exposed to gasoline vapors (3200 ppm) for quarter an hour/day; Gp(3) exposed to vapors of gasoline and treated orally with tyrosine (400 mg/kg b.wt.) with subsequent intraperitoneal injection with tryptophan (400 mg/Kg b.wt.); Gp(4) exposed to perchloroethylene vapors (800 ppm) for quarter an hour/day; Gp(5) exposed to vapors of perchloroethylene and treated with tyrosine and tryptophan; Gp(6) exposed to toluene vapors (1000 ppm) for quater an hour/day; Gp(7) exposed to vapors of toluene and treated with tyrosine and tryptophan. The experiment was extended for 45 days. Brain lipid peroxidation, reduced glutathione, serotonin, dopamine and GABA were determined, plasma testosterone, DHEA-S, T_3 and T_4 were determined. In addition to the histopathological investigations which were carried out. The results demonstrated that inhalation of gasoline, perchloroethylene or toluene caused elevation of brain lipid peroxidation, GABA and plasma DHEA-S levels. However, these inhalants induced depletion of brain glutathione, serotonin, dopamine as well as plasma testosterone, total triiodothyronine (T_3) and total thyroxin (T_4) levels. Histopathological alterations in the brain of the rats exposed to inhalants were also observed. On the other hand, marked improvement was detected on the treatment of exposed rats with tyrosine and tryptophan. Tyrosine and tryptophan supplementation exerted a modulatory effect on the most of biochemical parameters. Histopathological investigation of the brain revealed that the treatment of rats with tyrosine and tryptophan produced pronounced modulatory effect as indicated by the appearance of healthy neurons. In conclusion, the current study clearly indicated the serious effect of inhalants on the central nervous system of rats and the neuroprotective effect of tyrosine and tryptophan against inhalant neurotoxicity. [Report and Opinion. 2009;1(4):66-83]. (ISSN: 1553-9873).

Keywords: Gasoline, Perchloroethylene, Toluene, Inhalation, Tyrosine, Tryptophan and Neurodegeneration.

1.Introduction

Inhalants are substances that generally fall into one of several chemical families including aliphatic hydrocarbons, alkyl halides, aromatic hydrocarbons and nitrates (Linden,1990) Inhalant abuse is the deliberate inhalation of vapor of the inhalants (volatile substance of abuse) with the intention to alter one's consciousness. The abuse of inhalants continues to be a significant problem among our country's children and youth. Inhalant abuse can result in serious organ system dysfunction and central nervous system (CNS) disorder or even sudden death (Kurtzman et al,2001).

Gasoline is an aliphatic hydrocarbon commercial product (Mckee et al,2000) It has been reported that the inhalation of gasoline is a major route for exposure for human and animals (Hong et al,1997). Ritchie,et al (2001) reported that the exposure to hydrocarbon fuel produces neurotoxicity and neurobehavioral concequences.

With the exception of a reduction in psychotic symptoms, the effects of sniffing unleaded petrol are similar to the effect of sniffing leaded petrol (Tenenbein,1997).The specific components included in gasoline (gasoline ethers) are methyl tertiary butyl ether, ethyl tertiary butyl ether, tertiary amyl methyl ether, butadiene, benzene, xylene, toluene, methyl alcohol and ethyl alcohol. All of these components are neurotoxic (Burbacher TM.,1993). Neuroimaging and neuropathological studies in individuals with gasoline sniffing have identified abnormalities in the cerebral cortex, cerebellum, hippocampus, basal ganglia and brain stem (Roger et al,1990) . Also, significant CNS damage may occur in individuals who abuse gasoline before they become

encephalopathic. Thus, the chronic exposure of individuals to gasoline causes cognitive deficit that includes apathy, poor concentration, memory loss, visual spatial dysfunction and decreased speed of processing complex linguistic material (Maruff,et al,1998).

Perchloroethylene (PCE) is a colorless, volatile organic liquid with an ether-like odour. It is widely used in dry cleaning, metal degreasing and printing industry as fat solvent. It is a solvent in adhesives, textile manufacturing and paint stripping (Ebrahim,1996). The symptoms associated with the exposure to PCE include depression of the central nervous system, damage to the liver and kidneys, impairment of memory, confusion, dizziness, headache, drowness and eye, nose as well as throat irritation (NIOSH,2000).Ebrahim and Sakthisekaran,1997 demonstrated the defective antioxidant defense system in PCE exposed rats. Beliles,(2000) stated that PCE affects dopamine metabolism in a plausible mode of action for some types of neurotoxicity. Also, PCE potentiates the function of inhibitory receptors of γ-aminobutyric acid type A ($GABA_A$) and glycine receptors (Beckstead,2000). Toluene (methyl benzene) is a volatile organic solvent commonly found in a variety of commercial, industrial and household products such as adhesive varnish, glue and paint thinners (Arlien-Spborg et al,1992). Toluene is a neurotoxic chemical that has been shown to have neurobehavioral and electrophysiological effects (Gotohda,2000).Exposure to toluene is known to result principally in central nervous system dysfunctin (Ogata et al,1999). These neurological changes were detected at prefrontal cortex, cerebellum and hippocampus which showed varying degrees of neuronal degeneration to necrosis [Saavedra,1996). Acute toluene inhalation in adults includes harmful effects on GABAergic, glutaminergic, serotonergic and dopaminergic systems (Filley et al,2004). In animals, exposure to toluene disrupts neurotransmitter systems in the brain stem and cerebellum specifically it alters dopamine (Riegel and French,1999), γ-amino butyric acid (GABA) and glutamate levels (Stengard and O'cconnor,1994). Toluene has an anti-gonadotropic effect and may cause long-term endocrine disturbances in males (Yilmaz et al,2001).

Tyrosine is a nonessential amino acid that is synthesized in the body from phenylalanine. Tyrosine is needed to make epinephrine, norepinephrine, serotonin and dopamine. Because tyrosine binds unstable molecules (free radicals) that can potentially cause damage to the cells and tissues, it is considered as a mild antioxidant. Tyrosine and tryptophan are precursors to neurotransmitters and are transported from plasma into the brain (Voog and Eriksson,1984). A combination of 5-hydroxytryptophan (5-HTP), serotonin precursor, and tyrosine, dopamine precursor, in the treatment of CNS depression has been reported (Van praag,1984).

2.Aim of the work

The objectives of the current study were to elucidate the neurotoxic effects of repeated exposure to the inhalants; gasoline, perchloroethylene or toluene on male rats. These inhalants are the most common substances abused by children and adolescent in our population. The study was extended to evaluate the potential role of tyrosine and tryptophan as neuroprotective agents against the neurodegenerative impact produced by chronic exposure to the inhalants.

3.Materials and Methods

(1)Chemicals:

1- Gasoline (C_8 H_{18}), Perchloroethylene (C_2Cl_4) and Toluene ($C_6H_5CH_3$) were purchased from Fluka Chemica Co., GmbH (Germany) and the purity was above 99 %.

2- L-Tyrosine (C_9 H_{11} O_3), L-tryptophan (C_{11} H_{12} N_2 O_2) were purchased from Aldrich Chemica Co., GmbH (Germany).

(2)Experimental animals

Seventy male Sprague Dawley rats weighing 100-120 g were obtained from the Animal House Colony of the National Research Centre, Cairo, Egypt. The animals were maintained on standard laboratory diet and water *ad libitum*. After an acclimation period of one week, the animals were distributed into ten groups (10 rats/group) and housed in stainless steel cages in a temperature controlled (23 ± 1ºC) and artificially illuminated (12 h dark/light cycle) room free from any source of chemical contamination. All animals received human care and use according to the guide lines for Animal Experiments which were approved by the Ethical Committee of Medical Research, National Research Centre, Egypt.The seven experimental groups were assigned as follows: group (1) Control group treated with 1ml/rat corn oil; group (2) The rats in this group were exposed to vapors of gasoline (3200 ppm) for quarter an hour/day (Poon et al,1995) for 45 days; group (3) The rats in this group were exposed to vapors of gasoline and treated orally with tyrosine (400 mg/kg b.wt.) with subsequent intraperitoneal injection with tryptophan (400 mg/Kg b.wt.) (Ng and Anderson,1992) for 45 days; group (4) The

rats in this group were exposed to vapors of perchloroethylene (800 ppm) for quarter an hour/day (Mattsson et al ,1998) for 45 days; group (5) The rats in this group were exposed to vapors of perchloroethylene and treated orally with tyrosine with subsequent intraperitoneal injection with tryptophan for 45 days; group (6) The rats in this group were exposed to vapors of toluene (1000 ppm) for quater an hour/day (Bjornaes et al 1988) for 45 days; group (7) The rats in this group were exposed to vapors of perchloroethylene and treated orally with tyrosine with subsequent intraperitoneal injection with tryptophan for 45 days.

(3)Inhalation protocol

All rats had access to food and water in their home cages but not for the brief periods in the inhalation chambers. For each daily inhalation, the rats were transported from the vivarium to the lab, in their home cages and placed into an inhalation chamber. Inhalation of gasoline, toluene and perchloroethylene were conducted once a day for 15 min to mimic the high-dose "binge" inhalation seen in human abusers. Vapors inhalation was given in sealed 36-l cylindrical glass jars with acrylic lids (similar to description in Bowen and Balster) (1998). The lids were equipped with injection ports, a fan and a stainless steel mesh box holding filter paper. During gasoline, toluene and perchloroethylene inhalation, one dam was placed onto a grid floor 20 cm from the bottom and 30 cm from the filter paper in the lid of the chamber. The lid was replaced and a calculated amount of solvent was injected onto filter paper from which the fan volatilized the solvent. At the end of the inhalation period, the rats were removed immediately and returned to their home cages to a wait the next inhalation period, with the same procedure repeated daily for forty five days (Bowen et al,2005). The inhalation dose of gasoline, toluene and perchloroethylene were calculated as follows:

ppm = (mg solute / 10^6 mg water) = (mg solute / liter solution)

Volume ml = (weight of solute / density of solution)

At the end of the experimental period, the animals were kept fasting for 12 hours and the blood samples were collected from the retro-orbital venous plexus under diethyl ether anesthesia. Blood sample of each animal was received in EDTA-containing tubes and plasma was separated after centrifugation at 3000 rpm for 15 min. at 4°C. Plasma was used for determination of total testosterone, DHEA-S, T_3 and T_4.

After blood collection, the rats were killed and the whole brain of each animal was rapidly dissected, thoroughly washed with isotonic saline dried and then weighed. Each brain was homogenized immediately to give 10% (w/v) homogenate in ice-cold medium containing 50 mM Tris-Hcl (pH 7.4) and 300 mM sucrose (Tsakiris et al,2004). The homogenate was centrifuged at 3000 rpm for 10 min. at 4 ºC. The supernatant (10%) was used for the determination of Brain lipid peroxidation, reduced glutathione, serotonin, dopamine and GABA.

A colormetric method for quantitative determination of total protein in brain homogenate using Folin phenol reagent [Folin-Ciocalteu (Lowry)] was carried out according to Lowry et al (1951). Quantitative determination of lipid peroxidation in brain homogenate was performed according to the method described by Esterbauer and Cheeseman (1990). Reduced glutathione in brain homogenate was determined colorimetrically as described by Beutler et al (1963). Enzyme Immunsorbentassay (ELISA) technique was used for quantitative determination of serotonin in brain homogenate as described by Harenberg et al (2000). A fluorometric method was applied for quantitative determination of dopamine level in brain homogenate according to Ciarlone (1978) method. HPLC method was applied for quantitative determination of GABA in brain homogenate according to the method described by Seiler (1970). Quantitative determination of total testosterone in plasma was done using ELISA method as described by Joshi et al (1979). ELISA method for quantitative determination of dehydroepiandrosterone-sulphate (DHEA-S) in plasma was applied according to the method described by Tietz (1968). Quantitative determination of plasma T_3 was done using ELISA method as described by Wisdom (1976).

(3)Statistical analysis

All values are expressed as mean ± standard error (SE). Statistical differences were determined by using student t-test for the data according to the method of Snedecor and Cochran (1967). A probability value $P < 0.05$ was considered to be statistically significant while that corresponding to $P < 0.01$ was considered to be highly significant and that $P > 0.05$ was considered to be non significant.

4.Results

Table (1) illustrated the results of the effect of treatment with tyrosine and tryptophan against gasoline, perchloroethylene and toluene

inhalation-induced disturbance in brain lipid peroxidation and reduced glutathione levels. Inhalation of 3200 ppm gasoline for quarter an hour/day for 45 days produced significant increase ($P < 0.01$) in brain lipid peroxidation level whereas, it produced significant decrease ($P < 0.01$) in brain glutathione level as compared to control group. Treatment of rats exposed to gasoline and received tyrosine and tryptophan showed modulatory positive action on lipid peroxidation and glutathione levels as indicated by Significant decrease ($P < 0.01$) in brain lipid peroxidation level and Significant increase ($P < 0.05$) in brain glutathione as compared to rats exposed to gasoline.

The results in Table (1) revealed significant increase ($P < 0.01$) in brain lipid peroxidation level in rats exposed to perchloroethylene in a dose of 800 ppm for quarter an hour / day for 45 days as compared to control group. In contrast, significant decrease ($P < 0.01$) in brain glutathione level was detected in the same group compared to control group as compared to control group. Supplementation with tyrosine and tryptophan to rats exposed to perchloroethylene caused significant depletion ($P < 0.01$) in brain lipid peroxidation level and nonsignificant increase ($P > 0.05$) in brain glutathione level as compared to group of rats exposed to perchloroethylene.

Inhalation of 1000 ppm toluene, for quarter an hour/ day for 45 days produced significant increase ($P < 0.01$) in brain lipid peroxidation level with concomitant significant reduction ($P < 0.01$) in brain glutathione levels as compared to control group. Supplementation with tyrosine and tryptophan combination to rats exposed to toluene caused significant reduction ($P < 0.01$) in brain lipid peroxidation level and nonsignificant elevation ($P > 0.05$) in brain glutathione level as compared to rats exposed to toluene (Table 1).

The data in Table (2) revealed inhibition in brain serotonin and dopamine levels ($P < 0.01$) in animals exposed to gasoline compared to control group. Treatment of rats exposed to gasoline with tyrosine and tryptophan resulted in significant increase ($P < 0.01$) in brain serotonin level and nonsignificant increase ($P > 0.05$) in brain dopamine level as compared to the group of those exposed to gasoline.

Concerning the group of animals exposed to perchloroethylene, significant decrease in brain serotonin and dopamine levels ($P < 0.01$) was detected as compared to control group (Table 2). However, significant elevation in brain serotonin and dopamine levels ($P < 0.01$) was demonstrated in rats exposed to perchloroethylene and supplemented with either tyrosine and tryptophan as compared to those exposed to perchloroethylene.

Toluene inhalation produces significant decrease in each of brain serotonin and dopamine levels ($P < 0.01$) as compared to control group (Table 2). supplementation with tyrosine and tryptophan to rats exposed to toluene caused nonsignificant increase ($P > 0.05$) in brain serotonin and significant decrease ($P < 0.01$) in brain dopamine level as compared to rats exposed to toluene.

The results in Table (3) show significant decrease in plasma total testosterone level ($P < 0.01$) and significant increase in plasma DHEA-S level ($P < 0.05$) in animals exposed to gasoline as compared to control group. Nonsignificant increase ($P > 0.05$) in plasma total testosterone level was detected in rats exposed to gasoline and treated with tyrosine and tryptophan as compared to those exposed to gasoline. In contrast, significant decrease ($P < 0.01$) in plasma DHEA-S level was detected in case of treatment of gasoline exposed rats with tyrosine and tryptophan as compared to rats exposed to gasoline.

Perchloroethylene inhalation induces significant decrease in plasma total testosterone and significant increase in plasma DHEA-S levels ($P < 0.01$) as compared to control group. Significant increase ($P < 0.05$) in plasma total testosterone level accompanied with Significant decrease ($P < 0.01$) in plasma DHEA-S level was detected in rats administered with tyrosine and tryptophan when exposed to perchloroethylene as compared to those exposed to perchoroethylene. (Table 3).

Inhalation of toluene produces significant decrease in plasma total testosterone and significant increase in plasma DHEA-S levels ($P < 0.01$) as compared to control group (Table 3). Treatment of animals exposed to toluene with tyrosine and tryptophan showed significant increase ($P < 0.01$) in plasma total testosterone level in concomitant with significant decrease ($P < 0.01$) in plasma DHEA-S level as compared those exposed to toluene.

The effect of gasoline, perchloroethylene or toluene inhalation with or without melatonin, tyrosine and tryptophan or a combination of folic acid and vitamin B_{12} treatment on plasma triiodothyronine (T_3) and thyroxin (T_4) levels is shown in Table (4). The data revealed that gasoline inhalation produced significant decrease ($P < 0.01$) in plasma T_3 and T_4 levels as compared to the control group. Administration of tyrosine and tryptophan together with gasoline inhalation

resulted in significant elevation in plasma T_3 ($P < 0.05$) and T_4 ($P < 0.01$) levels as compared to gasoline exposed group.

Significant depletion in plasma T_3 and T_4 levels ($P < 0.01$) was detected in rats exposed to perchloroethylene as compared to the control group. Treatment of perchloroethylene exposed rats with tyrosine and tryptophan resulted in significant increase in plasma T_3 and T_4 ($P < 0.01$) levels as compared to perchloroethylene exposed rats.

Toluene inhalation induced significant decrease ($P < 0.01$) in plasma T_3 and $_{T4}$ levels as compared to control group. However, significant increase ($P < 0.01$) in plasma T_3 level accompanied with nonsignificant increase ($P > 0.05$) in plasma T_4 level was demonstrated in rats exposed to toluene and treated with tyrosine and tryptophan as compared toluene exposed rats (Table 4).

Data presented in Figure (1) show the effect of gasoline, perchloroethylene and toluene inhalation as well as treatment with tyrosine and tryprophan on brain GABA concentration. The results revealed that the inhalation of either of gasoline, perchloroethylene or toluene increases brain GABA concentration as compared to control group. Treatment with tyrosine and tryptophan caused pronounced increase in brain GABA concentration as compared to the groups exposed to the selected inhalants.

Among groups that exposed to gasoline, a slight increase in brain GABA concentration was demonstrated in the group exposed to gasoline and treated with tyrosine and tryptophan compared to that exposed to gasoline (Figure 1a).

Among groups that exposed to perchloroethylene, the treatment with tyrosine and tryptophan caused marked increase in brain GABA concentration as compared to that exposed to perchloroethylene (Figure 1b).

Among groups exposed to toluene, treatment with tyrosine and tryptophan caused considerable increase in brain GABA concentration as compared to group exposed to toluene (Figure 1c).

5.Histopathological Investigation

Microscopic examination of brain section of control rat shows the neuron with huge nuclei in comparison with those of surrounding supporting cells. These nuclei show dispersed chromatin and prominent nucleoli. The cytoplasm is basophilic. Oligodendrocytes and astrocytes have been found (Figure 2).

Gasoline inhalation in a dose equivalent to 3200 ppm, quarter an hour/day for 45 days produces earlier phase of coagulative necrosis in the brain. In some neurons, the nuclei show pale staining. Congested blood vessel surrounded by a clear Virchow-Robin space has been found (Figure 3).

Microscopic investigation of brain section of rat after inhalation of gasoline and treatment with tyrosine (400 mg/kg b.wt.) and tryptophan (400 mg /kg b.wt.) showed some dead neurons and the other neurons revealed pink-staining. The surrounding cells showed pyknosis (Figure 4).

Perchloroethylene inhalation in a dose equivalent to 800 ppm, quarter an hour/day for 45 days causes complete degeneration of the neurons. Some of the neurons show partial degeneration associated with pyknotic nuclei (Figure 5).

Examination of brain sections of rat after inhalation of perchloroethylene and treatment with tyrosine and tryptophan revealed the appearance of neurons in a healthy form. Few of them showed pyknosis (Figure 6).

In case of the inhalation of toluene at a dose equivalent to 1000 ppm, quarter an hour/day for 45 days, the brain section of rat shows severe coagulative necrosis and the nuclei of the neurons show a degree of pyknosis. Congested blood vessel has been also found (Figure 7).

The brain section of rat that exposed to toluene and treated with tyrosine and tryptophan showed normal neurons as well as the surrounding cells. Binuclear form appeared in many of the neurons (Figure 8).

Table 1. Effect of repeated gasoline, perchloroethylene or toluene inhlalation with or without tyrosine& tryptophan on brain oxidant/antioxidant status of male rats.

parameter / Groups	Malondoaldehyde (nmol / mg protein)	Reduced glutathione (mg / g brain tissue)
Control	60.441 ± 1.24	3.60 ± 0.24
Gasoline inhalation	89.36 ± 2.5^{a**}	2.20 ± 0.15^{a**}
Gasoline inhalation+Tyrosine &tryptophan	72.50 ± 2.9 ^{b**}	2.70 ± 0.11^{b*}

Perchloroethylene inhalation	$80.7 \pm 1.27^{a**}$	$1.26 \pm 0.13^{a**}$
Perchloroethylene inhalation+ Tyrosine &tryptophan	$68.6 \pm 2.6^{c**}$	1.33 ± 0.06^{NS}
Toluene inhalation	$80.2 \pm 3.6^{a**}$	$1.82 \pm 0.35^{a**}$
Toluene inhalation + Tyrosine &tryptophan	$60.6 \pm 2.04^{d**}$	1.93 ± 0.3^{NS}

Data are expressed as means ± standard error SE for 8 animals/group.
*: Significant change at $P < 0.05$
** : Significant change at $P < 0.01$
NS : Non significant change at $P \geq 0.05$
a : Differences as compared to control
b : Differences as compared to gasoline exposed group
c: Differences as compared to perchloroethylene exposed group
d : Differences as compared to toluene exposed group.

Table 2. Effect of repeated gasoline, perchloroethylene or toluene inhlalation with or without tyrosine& tryptophan on brain neurotransmitters levels of male rats.

Parameter / Groups	Serotonin (ng / g brain tissue)	Dopamine (µg / g brain tissue)
Control	2941 ± 91.1	278 ± 11.50
Gasoline inhalation	$2166 \pm 139.6^{a**}$	$215.8 \pm 7.50^{a**}$
Gasoline inhalation + Tyrosine &tryptophan	$2732 \pm 57.4^{b**}$	239.9 ± 8.50^{NS}
Perchloroethylene inhalation	$1552 \pm 96.8^{a**}$	$228.4 \pm 5.80^{a**}$
Perchloroethylene inhalation+ Tyrosine &tryptophan	$2917 \pm 194.9^{c**}$	$276.2 \pm 6.30^{c**}$
Toluene inhalation	$2524 \pm 13.9^{a**}$	$204.6 \pm 10.70^{a**}$
Toluene inhalation + Tyrosine &tryptophan	2716 ± 223.3^{NS}	$255.6 \pm 12.19^{d**}$

Data are expressed as means ± standard error SE for 8 animals/group.
* : Significant change at $P < 0.05$
** : Significant change at $P < 0.01$
NS : Non significant change at $P \geq 0.05$
a : Differences as compared to control
b : Differences as compared to gasoline exposed group
c : Differences as compared to perchloroethylene exposed group
d : Differences as compared to toluene exposed group.

Table 3.Effect of repeated gasoline, perchloroethylene or toluene inhlalation with or without tyrosine& tryptophan on plasma steroid hormones level of male rats.

Parameters / Groups	Total testosterone (ng / ml)	DHEA-S (µg / ml)
Control	9.3 ± 0.53	1.81 ± 0.01
Gasoline inhalation	$6.1 \pm 0.26^{a**}$	$1.86 \pm 0.02^{a*}$
Gasoline inhalation + Tyrosine &tryptophan	7.3 ± 0.64^{NS}	$1.42 \pm 0.05^{b**}$
Perchloroethylene inhalation	$6.3 \pm 0.35^{a**}$	$1.92 \pm 0.02^{a**}$
Perchloroethylene inhalation+ Tyrosine &tryptophan	$7.8 \pm 0.48^{c*}$	$1.60 \pm 0.10^{c**}$
Toluene inhalation	$5.05 \pm 0.46^{a**}$	$1.87 \pm 0.02^{a**}$
Toluene inhalation + Tyrosine &tryptophan	$7.2 \pm 0.56^{d*}$	$1.53 \pm 0.12^{d**}$

Data are expressed as means ± standard error (SE) for 8 animals / group.
* : Significant change at $P < 0.05$
** : Significant change at $P < 0.01$

NS : Non significant change at $P \geq 0.05$
a : Differences as compared to control
b : Differences as compared to gasoline exposed group
c : Differences as compared to perchloroethylene exposed group
d : Differences as compared to toluene exposed group.

Table 4. Effect of repeated inhlalation of gasoline, perchloroethylene or toluene with or without tyrosine & tryptophan on plasma thyroid hormones level of male rats.

parameter / Groups	T_3 (ng /ml)	T_4 (µg / dl)
Control	2.10 ± 0.23	7.4 ± 0.3
Gasoline inhalation	$0.86 \pm 0.05^{a**}$	$4.9 \pm 0.28^{a**}$
Gasoline inhalation+Tyrosine &tryptophan	$1.00 \pm 0.02^{b*}$	$6.3 \pm 0.30^{b**}$
Perchloroethylene inhalation	$0.81 \pm 0.05^{a**}$	$4.9 \pm 0.30^{a**}$
Perchloroethylene inhalation+ Tyrosine &tryptophan	$1.80 \pm 0.10^{c**}$	$7.3 \pm 0.60^{c**}$
Toluene inhalation	$0.88 \pm 0.06^{a**}$	$6.0 \pm 0.05^{a**}$
Toluene inhalation + Tyrosine &tryptophan	$2.00 \pm 0.09^{d**}$	7.2 ± 0.30^{NS}

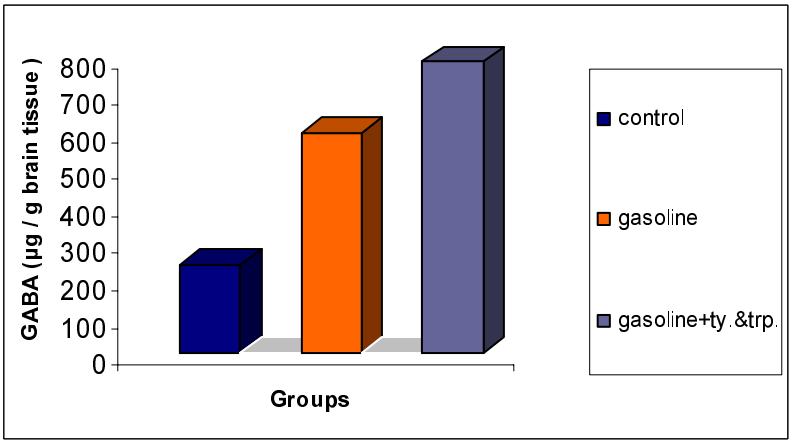

Figure (1a)

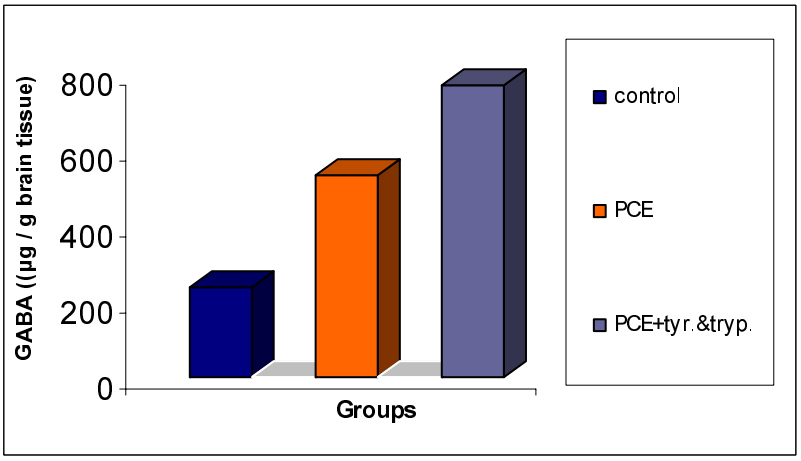

Figure (1b)

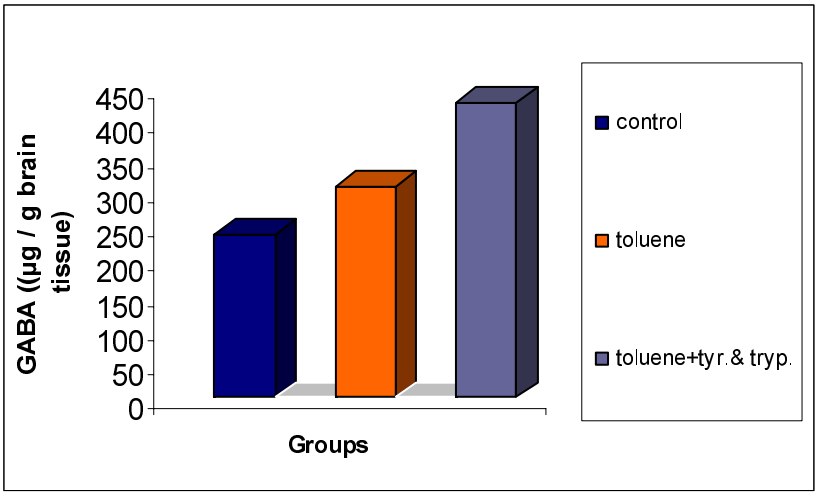

Figure (1c)

Figure 1: 1a) Effect of repeated gasoline inhalation with or without tyrosine& tryptophan on brain γ-amino butyric acid (GABA) of male rats. 1b) Effect of repeated perchloroethylene inhalation with or without tyrosine& tryptophan on brain GABA of male rats. 1c) Effect of repeated toluene inhalation with or without tyrosine& tryptophan on brain GABA of male rats.

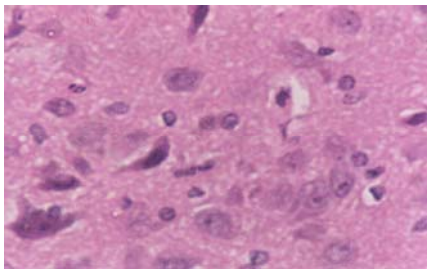

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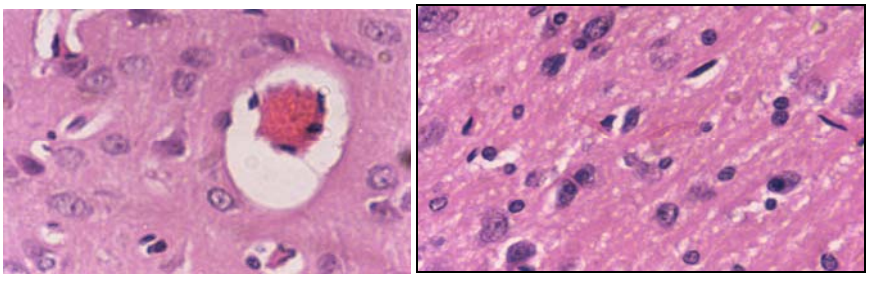
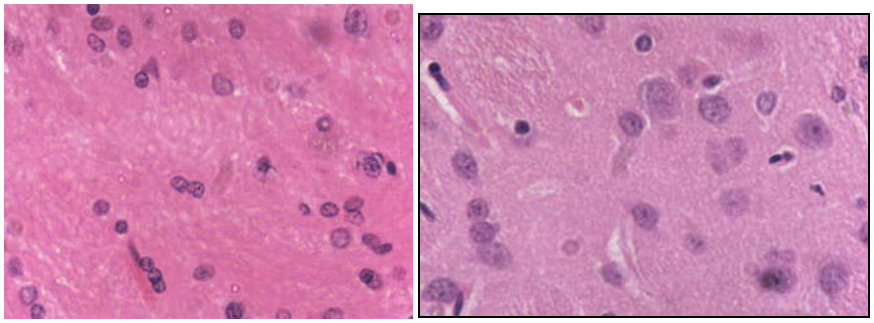
Figure (2): Photomicrograph of brain of control rat shows the neuron with huge nuclei. These nuclei show dispersed chromatin and prominent nucleoli. The cytoplasm is basophilic. Oligodendrocytes and astrocytes can be seen (H& E X 400).



3 4

Figure (3): Photomicrograph of rat brain after gasoline inhalation shows earlier phase of coagulative necrosis. In some neurons, the nuclei show pale staining. Congested blood vessel surrounded by a clear Virchow-Robin space has been appeared (H & E X 400)

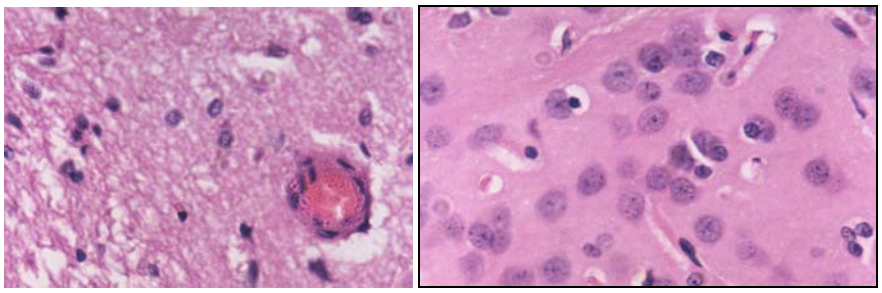
Figure (4): Photomicrograph of rat brain after inhalation of gasoline and treatment with tyrosine and tryptophan shows some dead neurons and another revealed pink-staining cell depress. The surrounded cells show pyknosis. (H & E X 400).



5 6

Figure (5): Photomicrograph of rat brain after inhalation of perchloroethylene shows complete degeneration of the neurons. Some of the neurons show partial degeneration associated with pyknotic nuclei (H & E X 400).

Figure (6): Photomicrograph of rat brain after inhalation of perchloroethylene and treated with tyrosine and tryptophan shows the neurons that revealed a healthy form. Few of them show pyknosis (H& E X400).



7 8

Figure (7): Photomicrograph of rat brain after inhalation of toluene shows severe coagulative necrosis. The nuclei of the neuron show a degree of pyknosis. Congested blood vessel is seen (H & E X 400).

Figure (8): Photomicrograph of rat brain after inhalation of toluene and treatment with tyrosine and tryptophan shows normal neurons as well as the surrounding cells. Binuclear form appears in many of them (H &E X 400).

6.Discussion

Inhalation results in serious organ system dysfunction. Airborne chemicals and volatile molecules enter the nose and can interact with chemoreceptors in the nasal cavity, especially trigeminal and olfactory receptors (Gobba,2003). Most solvents are easily absorbed from the blood into lipid-rich tissues and can cause widespread damage. The current results reveal that gasoline inhalation for 45 days causes significant increase in brain lipid peroxidation. This finding is in agreement with Ulakoğlu et al (1998) who demonstrated an increase in brain lipid peroxidation after inhalation of gasoline and/or its additives. Moreover, Lolin (1998) stated that the inhalation of gasoline additive which is called methyl tertiary-butyl ether (MTBE) induces an elevation in brain lipid peroxidation level in experimental animals. The increment in lipid peroxidation could be attributed to that gasoline expresses its toxicity via the production of reactive oxygen species (ROS) which causes cell damage (Ulakoğlu et al,1998).

The present study reveals that perchloroethylene significantly increases brain lipid peroxidation. Perchloroethylene (PCE) is oxidized by cytochrome P_{450} (CYP_{450}) to produce trichloroacetyle chloride, trichloroethanol and trichloroacetic acid (TCA) (Birner et al 1994).

In both human and experimental animals (Volk et al,1998), TCA induces lipid peroxidation and oxidative DNA damage (Austin et al,1996). The toxicity of PCE to mammalian tissue depends mainly on cytochrome P_{450}-mediated oxidation as well as glutathione (GSH) conjugation (Lash et al,1998). Thus, PCE vapor produces dose-dependent increase in cellular H_2O_2 resulting in lipid peroxidation (Chen et al ,2002). Furthermore, PCE exposure leads to glutathione depletion and accumulation of hydrogen peroxide as well as its distal reaction products that can induce lipid peroxidation and cellular toxicity (Salahudeen,1995).

The present data indicate that toluene inhalation induces significant increase in brain lipid peroxidation. Toluene inhalation stimulates

reactive oxygen species formation (Burmistrov et al,2001). This is the most important pathway of toluene neurotoxicity by which it induces oxidative damage to lipids, proteins and nucleic acids (Mattia et al,1993). Keeping on our results, Halifeoglu et al (2000) reported that toluene elevates the level of malondialdehyde in the brain. Also, toluene exposure causes significant elevation in the level of lipid breakdown products in several brain regions in rats due to the generation of reactive oxygen species, which causes neurodegeneration, and cognitive deficits (Baydas et al,2005).

Brain glutathione (GSH) shows significant decrease in the animals exposed to gasoline. This result is supported by the previous study of Raza et al (1995) who found a decrease in brain GSH with concomitant increase in brain lipid peroxidation levels after gasoline exposure in rats.

The present study reveals that perchloroethylene significantly decreases brain glutathione. Ebrahim and Sakthisekaran (1997)found a defect in the antioxidant defense system after PCE inhalation in rats. This was evidenced by low level of enzymatic antioxidants: superoxid dismutase (SOD) and catalase and non enzymatic antioxidants including glutathione, ascorbic acid and vitamin E with simultaneous increase in lipid peroxidation level.

The current data indicate that toluene inhalation induces significant decrease in brain glutathione level. As opposed to increasing lipid peroxidation level, a decrease in superoxide dismutase activity and glutathione level were developed (Ulakoğlu et al,1998).

Herein, the lowering glutathione level as a result of toluene inhalation is attributed to the oxidative stress induced by toluene (Fechter et al,2007).

The present study demonstrated that the treatment of rats exposed to gasoline, perchloroethylene or toluene with tyrosine and tryptophan combination causes significant depletion in brain lipid peroxidation level. Behland Moosmann Cadenas et al., (1989) and (2000) reported that Long-chain acylated tyrosine and tryptophan or short-chain acylated derivatives are potent inhibitors of lipid peroxidation and oxidative cell death. The antioxidant properties of tyrosine and tryptophan provide a specific explanation for their protective action on neuronal membranes against oxidative stress. Recent study has been shown that serotonin and its precursor (tryptophan) have powerful antioxidant properties and the recovery of neurotransmitter concentration in brain is related to the reduction of lipid peroxide generation and improves antioxidant status of the brain (Munoz-castaneda et al,2009).

Treatment of rats exposed to gasoline, perchloroethylene or toluene with tyrosine and tryptophan induced remarkable increase in brain glutathione level. Casarejos et al. (2005) demonstrated an elevation in brain glutathione level in case of treatment with tyrosine metabolite. They explained this phenomenon as a compensatory mechanism of tyrosine metabolite to protect dopamine neurons from neural death.

In the current study gasoline inhalation reduces brain serotonin (5-HT) and dopamine (DA) levels significantly as shown in Table (2). Gasoline inhalation is associated with neurocognitive deficits including memory loss and poor concentration (Maruff,et al,1998) which reflect the imbalance between the neuromodulatory effects of monoamines and acetylcholine. Memory impairment is linked to low serotonin level in the neocortex which is related to the focal hippocampal dysfunction (Vakalopoulos,2007). This interpretation supports the previous report of Yamazaki et al (1989) who stated that the central serotonergic dysfunction leads to learning retardation. Moser et al (1995) stated that exposure to gasoline and /or its additives shows some markers of neurotoxicity which represented by brain dopamine depletion in concomitant with elevation of brain GABA level.

Perchloroethylene inhalation significantly decreases each of brain serotonin and dopamine levels. A growing body of evidence demonstrated that the exposure to chlorinated hydrocarbon compounds including perchloro-ethylene produces various degrees of central nervous system depression (Cummings et al,2000). This property of perchloroethylene results in a depletion in serotonin level in brain stem (Nilsson,1986). Moreover, Seegal et al (1986) supported this fact as they stated that this type of chlorinated hydrocarbons could reduce serotonin concentration in frontal cortex and hippocampus. Additionally, the ratio of serotonin metabolite (5-hydroxyindolacetic acid) to serotonin was elevated in most brain areas following exposure of rats to chlorinated hydrocarbons. This means that the exposure to chlorinated hydrocarbons such as perchloroethylene affects each of serotonin concentration and metabolism (Seegal et al.1986). The reduction in brain dopamine level in animals exposed to perchloroethylene is greatly supported by the study of Goodwill et al (2007). They demonstrated that the exposure to chlorinated hydrocarbons results in peripheral inflammatory response associated with striatal terminal degeneration which in turn leads to dopaminergic loss in the striatum. In fact, chlorinated hydrocarbons could significantly

reduce striatal dopamine, tyrosine hydroxylase, dopamine transporter and synaptophysin concentrations (Goodwill et al,2007) in addition to their reducing effect on the number of dopamine neurons in the ventral mesencephalon (Lyng et al,2007).

Toluene produces significant reduction in each of brain serotonin and dopamine level (Table 2). Toluene has high lipid solubility and no protein binding capability, so that it distributes according to lipid contents of the brain (Kiriu et al,1990). Repeated toluene inhalation has been shown to induce permenant changes in brain which correlated with neural dysfunction (Hass et al,1996). This is indicated by DA and 5-HT turnover in the caudate-putamen, nucleus accumbens, hippocampus, prefrontal cortex and cerebellum (Moser et al,1995). Subchronic exposure to toluene significantly results in sensitization to toluene-induced necrosis and alteration in DA and 5-HT transmissions. These events demonstrate that subchronic toluene exposure may lead to adverse effects on neurobehavioral and neurochemical functioning (Moser et al,1995). Moreover, a reduction in catecholaminergic neurons was previously detected in the brain stem of rats after toluene exposure (Bjornaes et al 1988). Furthermore, there is an evidence showed that the repeated toluene exposure results in alteration in dopaminergic transmission (Yamazaki et al,1989). The inhalation of toluene caused a decrease in noradrenaline (NA) level in the dorsal part of rat pons, rich in locus coeruleus and dopamine level in the hypothalamus and ventral part of the rat midbrain, rich in substantia nigra (Kiriu et al,1990).

Our results revealed that treatment of rats exposed to gasoline, perchloroethylene or toluene with tyrosine and tryptophan results in general increase in brain serotonin level. These results are in agreement with Denoyer et al. (1989); Arai et al. (1995) and Kitahama et al. (2002) who demonstrated that treatment with tryptophan and / or its derivatives can raise serotonin level in CNS. L-tryptophan administration can enhance serotonin release (Young,1996. Tryptophan is converted into serotonin in serotonergic neurons by the enzyme called aromatic amino acid decarboxylase (AADC) (Zhu and Juorio, 1995; Growdon et al,1982). Similarly, treatment of rats exposed to the different inhalants with tyrosine and tryptophan produces considerable increase in brain dopamine level. Dietary L-tyrosine administration can enhance dopamine synthesis and Thurmond,in human as it does in rats (Narahashi et al,1989). AADC is Brown,1984; also present in catecholaminergic neurons, where it normally converts tyrosine into dopamine (Arai et al,1995).General anesthetics enhance central inhibitory neurotransmission-mediated by $GABA_A$ receptor-channel complex (Narahashi,1998). These CNS depressants are known to produce their effects in part by modulating $GABA_A$ receptor function (Mihic et al,1997). Gasoline inhalation causes marked increase in brain GABA level. This finding coincides with that of Moser et al (1995). Such result indicates the potential role of GABA and its receptor (A) in the neurotoxic effects of gasoline and / or its additives (Martin et al,2004).

Martin et al (2002)demonstrated that the oxygenated gasoline additives and their metabolites reduce the density of the convulsant binding site on $GABA_A$ receptor in rat brain.

Perchloroethylene inhalation moderately increases brain GABA level in rats. It has been demonstrated that perchloroethylene inhibits the function of excitatory receptors N-methyl-D-aspartate (NMDA) (Cruz et al,2000), nicotinic acetylcholine receptor (nAchR) (Vakalopoulos,2007) and potentiates the function of inhibitory receptors γ-aminobutyric acid type A ($GABA_A$) as well as glycine receptors(Beckstead,2000). The activation of GABAergic neurons in the forebrain of rats due to exposure to perchloroethylene (Chen et al ,2002) may be contributed in the increased brain GABA level in the present study.

Toluene inhalation produces non appreciable increase in rat brain GABA level. This result is in agreement with Stengard and O'connor (1994) who stated that toluene exposure causes moderate increase in striatal GABA level. Toluene enhances $GABA_A$ receptor function (Beckstead,2000).

Devaud et al (1997) and Charlton et al (1997) reported that $GABA_A$ α-1 subunit may be an important target for the neurobehavioral and cellular actions of toluene.

Treatment of the group of animals exposed to gasoline, perchloroethylene or toluene with tyrosine and tryptophan caused significant increase in brain GABA level. It has been reported that tyrosine and tryptophan increase the potency of GABA (Schofield and Harrison, 2005). Soghomonian et al. (1996) suggested that tryptophan could increase GABAergic activity in the brain.

In the present study, gasoline induces significant decrease in plasma testosterone level. In general, organic solvents have negative influence on male reproductive functions through their action at the hypothalamo-hypophyseal level (Yilmaz et al,2001).

Moreover, gasoline and its additives, methyl tert-butyl ether (MTBE), could reduce plasma testosterone level in male rats due to their ability

to accelerate the metabolism of endogenous testosterone and hence its clearance. This could be done via stimulation of some enzymes (cytochrome P_{450} and testosterone hydroxylase) that involved in testosterone metabolism (Williams and Borghoff ,2000). Histological study of el Feki et al (2000) revealed an atrophy of the testicle, seminal vesicle and epididym in concomitant with a decrease in plasma testosterone level in male rats exposed to gasoline.

Gasoline inhalation causes significant increase in plasma DHEA-S level. It has been reported that unleaded petrol and related volatile organic compounds activates rat hypothalamo-pituitary-thyroid-adrenal system (Karuri et al,1998). Seitz et al (1985) and Vyskocil et al (1986) found that the exposure to organic volatile compounds leads to significant increase in plasma dehydroepiandrosterone (DHEA) which follows the elevation of plasma corticosterone level. This is because of DHEA is closely followed the secretory profile of corticosterone (Vyskocil et al,1986). This may explain the elevation in plasma DHEA-S level of rats exposed to gasoline in the current study.

Perchloroethylene inhalation significantly decreases plasma testosterone level. Perchloroethylene is well known as a reproductive toxicant which affects the hypothalamic pituitary gonadal axis (Reader et al,1991).

More recent study revealed that perchloroethylene has a direct inhibitory action on testicular testosterone biosynthesis (Klaunig et al,2003).

Plasma DHEA-S shows significant increase due to perchloroethylene inhalation. This finding agrees with that of Chia et al (1997) who detected an increase in plasma DHEA-S level as a result of perchloroethylene exposure. This could be attributed to that perchloroethylene may disrupt peripheral endocrine function, perhaps through its peroxisome proliferator potential activity. Perchloroethylene and related hydrocarbons constitute an important class of environmental pollutants whose adverse effects on liver, kidney and other tissues may be mediated by peroxisome proliferator-activated receptors (PPARs) and ligand-activated transcription factors belonging to the steroid receptor superfamily. In addition, it is conceivable that trichloroethylene, one of perchloroethylene metabolites may compete with DHEA-S for binding to PPAR and this ultimately leads to the elevation of plasma DHEA-S as a

Zhou andcompensatory response (.,1998). Waxman

Significant decrease in plasma testosterone level due to toluene inhalation is demonstrated in the current study. On line with this finding, Yilmaz et al (2006) reported that toluene inhalation affects testosterone synthesis and secretion in male rats via a direct action on the Leydig cells. Moreover, toluene causes a reduction in leutinizing hormone (LH) secretion from the anterior pituitary which in turn inhibits testosterone production (Yamada,1993). Another report suggested that toluene inhibits testosterone secretion through its action on the gonadotropin releasing hormone (GnRH) neurons or through its inhibitory effect on pituitary responsiveness to GnRH. It has been suggested that toluene has an anti-gonadotropic effect and it may cause long-term endocrine disturbances in male rats (Yilmaz et al,2001).

The present data reveal that toluene inhalation produces an increase in plasma DHEA-S level. Gotohda et al (2005) demonstrated significant increase in the weight of adrenal gland, hypertrophy of the adrenal cortex and expansion of the corticosterone-positive area in rats exposed to toluene. Also, toluene inhalation causes an increase in serum corticosterone level. This is due to the indirect effect of toluene on microphage/ lymphocyte activity via stress induction and hence a secretion of ACTH and corticosterone (Palermo et al,2001). Since DHEA is closely followed the secretory profile of corticosterone (Vyskocil et al,1986), the observed increase in plasma level of DHEA-S due to toluene inhalation is a consequence of corticosterone elevation.

Treatment of the group of animals exposed to gasoline, perchloroethylene or toluene with tyrosine and tryptophan resulted in marked increase in plasma testosterone level. Shishkina and Dygal (2000) reported that the administration of tryptophan and / or its derivatives increases plasma testosterone level in male rats. The suggesting mechanism of this action was reported by Pinilla et al. (1997) who stated that administration of serotonin precursor stimulates gonadotropins (FSH and LH) secretion.

Significant decrease in plasma DHEA-S level was detected in the present study in gasoline, perchloroethylene or toluene exposed rats treated with tyrosine and tryptophan. The suppressing effect of dopamine, a tyrosine product, on serum DHEA-S level was previously reported by Van den Berghe et al. (1995). The lowering effect of dopamine on DHEA-S level could be linked to the suppression of circulationg prolactin level.

In the current study gasoline inhalation caused significant depletion in each of plasma triiodothyronine (T_3) and thyroxine (T_4) levels. These results are in agreement with Singh et al. (2000) who reported that petrol exposure

enhances the pituitary release of TSH and reduces serum T_3 and T_4 levels. This means that gasoline inhalation affects pituitary thyroid axis and inhibits response of thyroid to thyroid stimulating hormone (TSH). Moreover, it has been stated that gasoline and /or its additives cause changes in thyroid, liver and bone marrow (Poon et al,2005). Moreover, 1,6-dimethoxyhexane (gasoline additive) has been shown to reduce colloidal density and accelerate papillary proliferation of the follicular epithelium, which indicates of a mild degree of thyroid hyperplasia. Additionally, thyroid follicular-cell adenomas was detected in rats exposed to tertiary-butyl ether (other gasoline additive) (McGregor,2006), which indicates the alteration in T_3 and T_4 synthesis in rats exposed to gasoline.

Our study revealed significant decrease in plasma T_3 and T_4 levels in the group of animals exposed to perchloroethylene. These results agree well with the National Toxicology Program (2006) which revealed that the exposure to halogenated hydrocarbons causes significant decrease in serum total thyroxin (T_4), free T_4 and T_3. Halogenated hydrocarbons have a direct effect on the releasing efficacy of thyroid gland.

Toluene inhalation caused significant decrease in each of plasma T_3 and T_4 in the present study. This result consides with that of Chen et al (National Toxicology Program,2003) who stated that the exposure to glue solvent reveals significant depletion in serum T_4, T_3 and free T_4 levels. Low serum T_3 and T_4 levels that associated with glue sniffing were compatible with central hypothyroidism. Furthermore, toluene has been shown to affect dopaminergic and adrenergic turnover within various parts of the brain. This neurotransmitter affection leads to abnormal secretion of pituitary hormones resulting in transient central hypothyroidism (National Toxicology Program,2003).

The current study demonstrated that the treatment of rats exposed to gasoline, perchloroethylene or toluene with tyrosine and tryptophan results in marked increase in each of plasma T_3 and T_4 level. Morley et al. (1980) suggested that repeated dose loading of tryptophan or 5-hydroxytryptophan (5-HTP) increases plasma serotonin and T_3 levels and decreases plasma TSH level. Serotonin affects thyroid gland to produce T3 (Morley et al,1980). Moreover, Tahara et al (1988) reported that supplementation with tyrosine results in rapid increase in serum T_4, T_3 and free T_4 levels. These results could be explained by the action of dopaminergic system on both thyrotropin releasing hormone (TRH) and thyroid releasing hormone (TSH) release (Morley et al,1981).

Gasoline inhalation produces histopathological changes in the brain of rats. These are mainly represented in coagulative necrosis. These findings are, at least in part, in agreement with Salehi et al (2001) who found significant neural cell loss in globus pallidus and caudate putamen as well as in the frontal cortex in the brain of rats exposed to gasoline and/or its additives.

Perchloroethylene inhalation causes general degeneration of the neurons. This finding agrees with that of Wang et al (1993) who indicated that the exposure to perchloroethylene greatly reduces the number of brain cells, possibly glial cells.

The histopathological alterations associated with toluene inhalation include severe coagulative necrosis. Several pathological effects of toluene on the central nervous system have been previously described. These effects include neurovascular complications such as microvascular ischemic changes or ischemic stroke. Other neurological complication includes central atrophy (Borne et al,2005.

The histopathological investigation of the brain of rats exposed to gasoline and treated with tyrosine and tryptophan revealed the death of some neurons but many neurons still survive and reveal pink-staining. Tyrosine and tryptophan administration to rats exposed to perchloroethylene or toluene resulted in the appearance of neurons in a healthy manner. Strazielle et al. (1996) stated that the activation of serotonergic system by tryptophan modulates brain cell structure. Moreover, Ikemoto (2000) reported that dopamine protects brain neurons against degeneration.

Conclusion

In conclusion the repeated exposure to inhalants (gasoline, perchloroethylene or toluene) induced many deleterious effects on the central nervous system of male rats. Treatment with either tyrosine and tryptophan revealed significant ameliorative effect against inhalant neurotoxicity.

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Comparative Evaluation of Three Commercial feeds on the performance of Broilers

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Abstract: An 8-week study was carried out to compare the quality of three commercial feeds in order to ascertain the extent to which they meet the nutritional requirements of broilers. One hundred and twenty (120) Hybro broilers were raised for one week on the same brand of commercial starter feed. A formulated Starter and Finisher control feeds (CF) and commercial VF, GF and NF feeds were respectively fed to four groups of broilers, each divided into three (3) replicates of ten birds in a Completely Randomized Design (CRD) experiment. Feed and water were provided *ad-libitum.* The result obtained indicated that CF, VF and NF performed better than GF in terms of daily weight gain, both in the starter and finisher phases. However, birds on CF achieved highest daily weight gain in the starter phase but lower values than birds on VF and NF in the finisher phase. VF and NF indicated a better balance in nutrients than GF among the commercial feeds. Feed conversion ratio was similar ($p>0.05$) in the starter phase for all the treatment groups but birds on GF recorded the highest FCR in the finisher phase. However, VF was the cheapest in terms of feed cost/kg meat produced, amounting to ₦118.60 and ₦160.38 for starter and finisher respectively, when compared to the other commercial feeds and the control diet. The varied performance of the birds on the different commercial feeds is an evidence of variability in nutrient composition of the commercial feeds; and this is an important factor to be considered by farmers in the choice of feeds for broiler production. [Report and Opinion. 2009;1(4):84-89]. (ISSN: 1553-9873).

Key words: broilers, commercial feeds, feed cost, nutrient value, performance.

1. Introduction

The general objective of poultry nutrition is to maximize the economic production performance of birds. Diets are formulated to provide specific level of nutrients that are needed for optimum performance. The main production criteria looked into are feed conversion ratio, growth rate, health of the birds and their body conformation. The major determinants of these are the energy, protein and amino acids contents of the diets. For broilers, diets of high energy content promote fast growth, and therefore their metabolizable energy (ME) contents should generally not be less than 12.2MJ/kg (Whitehead,2002).

Oyediji (2001) reported that feed accounts for not less than 70% of the cost of production in livestock enterprises. Therefore there is the need to focus on efficient feed utilization, in order to maximize profits and avoid losses.

Given the increasing number of people venturing into poultry business, there is no doubt, that there is a high demand for commercial feeds. There is now the tendency for feed manufacturers to produce substandard feeds, especially as the quality control agencies in Nigeria are non-existent or non-functional (Okoli *et al.,* 2007; Omede, 2008., Okoli, et al., 2009). It appears that the farmer, consumer and the public at large are left at the mercy of commercial feed millers and feed raw materials producers and processors.

Ordinarily, it appears that most poultry feeds are similar in composition and as such will meet the nutrient requirements of the birds to which they are fed. However, the feeds offered to birds are varied mixtures of ingredients, and considering the tendency of feed producers to maximize profit, there might be differences in the quality of the manufactured feeds sold in the market. It is important therefore, to ensure that quality compound feeds with appropriate nutritional values capable of achieving efficient production performance are patronized by the farmers.

The objective of this study therefore is to compare the performance of broilers fed different commercial feeds coded VF, GF, and NF and to evaluate the economic implication of using these feeds.

2. Materials and Methods

Experimental Materials and Diets

The feeds used for this experiment were different commercial broiler feeds produced by different feed manufacturing companies in Nigeria, bought from their various distributors in Owerri, Imo State, Nigeria. Treatment 1 (T_1) was the formulated control feed (CF) while treatments 2, 3 and 4 were commercial feeds

manufactured in Nigeria coded VF, GF and NF, respectively. The composition of the feeds are given in Tables 1,2 and 3.

Experimental Birds

One-Hundred and twenty (120) Hybro broiler chicks bought at day old from Owerri were fed on a commercial broiler starter feed for a period of one week before the commencement of the experiment. The birds were randomly divided into 4 treatment groups, each group was further divided into 3 replicates of 10 birds each. The four groups were randomly assigned to the experimental diets in a completely randomized design (CRD) experiment. Starter diets were fed for the first 4 weeks after which finisher diets were fed for another 4 weeks.

The birds were housed in a deep litter system and subjected to the same experimental and management conditions. Water and feed were provided *ad-libitum*. The experiment lasted for 8 weeks. (4 weeks each for starter and finisher phases).

Data Collection and Statistical Analysis

Data were collected on initial body weight and final body weights, weight gain and feed intake. Data on feed intake and weight gain were used to calculate feed conversion ratio (FCR).Feed cost/kg and feed cost/kg weight gain were calculated based on the prevailing market prices of the feed ingredients and the commercial feeds.

Data collected were subjected to analysis of variance (ANOVA) and the difference among means were compared using Duncan's New Multiple Range Test (Steel and Torrie, 1980)

3. Results and Discussion

Chemical composition of experimental diets

The chemical composition of the experimental diets is presented in Table 1.

The metabolizable energy values of the starter diets VF and GF ranged from 2700- 2800 Kcal/kg for starter broilers and 2850-2900Kcal/kg for finisher broilers. The crude protein values for all the commercial feeds ranged from 18.50-21.00% for starter diets and 18-19% for finisher diets. The crude fibre values of 4.40-5.55 % for starter broilers and 5-5.55 % for finisher broilers were recorded for the commercial feeds. There is a slight difference between some of this declared nutrient values and the recommended nutrient requirement. According to Obioha (1992), the recommended ME,CP and CF values for starter broilers are respectively 2850 Kcal/kg, 22%, 5%, and 2900 Kcal/kg, 20%, 5.5% respectively, for finisher broilers. Aduku (2005) reported 2800Kcal/kg ME and 3000Kcal/kg ME requirement for starter and finisher broilers, respectively.

The general nutrients recommended for broiler starter are 2800-3000 Kcal/kg ME, 22-24 % CP and ≤ 5% CF; for finisher broilers it is 2800-3000 Kcal/kg ME, 19-21% CP and ≤ 5% CF. It can be seen that the ME value (2700 Kcal/kg) of GF is below the recommended level (2800-3000 Kcal/kg) and its crude protein (21%) slightly below the recommended level (22-24% CP).The crude fibre (4.40%) of GF is within the recommended value (≤ 5%). But for the slight drop in CP (21%) from the recommended value, Vital feed had a ME value (2800Kcal/kg) that met the recommended ME value (2800-3000Kcal/kg).The crude protein value (18.50%) of NF is quite lower than the recommended value (22-24%) for starter broilers. The ME value for NF was not reported. Apart from NF with 18% CP, crude protein values of other diets met the recommended values (18-21%).The energy values of GF (2850Kcal/kg) and VF (2900Kcak/kg) met the recommended level (2800-3000Kcal/kg). NF had no ME value indicated on its label for finisher broilers.

Performance of Experimental birds

Data on the performance of the experimental birds are shown in Tables 2 and 3.

Feed Intake of Starter/Finisher Broilers

In the starter phase, feed intake of birds on diet VF, although lowest numerically, was similar ($p > 0.05$) to those on diets GF and NF, but significantly ($p < 0.05$) lower than those on the control feed. In the finisher phase, birds on diet VF also recorded the lowest feed intake which however was similar ($p>0.05$) to those on diet CF and GF. Birds on diet NF consumed significantly ($p < 0.05$) more feeds than those on other treatments. The low feed intake of birds on VF relative to those on GF and NF might have resulted from the higher ME value of diet VF, as birds eat to satisfy their energy requirement (Leeson and Caston, 1993). It has also been reported that birds overeat under moderate protein insufficiency, which is not necessarily a craving for protein per se, but a compensatory increase in feed intake in response to the deficient essential nutrients (Lipstein and Bronstein, 1975).

Growth rate of Starter/Finisher Broilers

The growth rate of VF, GF and NF starter birds were similar ($p>0.05$) and significantly ($p<0.05$) lower than those on the control (CF).

The lower performance of the broilers observed at the starter phase with commercial feed (VF, GF and NF) could be a reflection of the stringent requirement for essential nutrients (Protein and energy at this stage of life). It has been reported that birds on high fibre diets are unable to completely satisfy their energy and protein intake due to limitation imposed by the fibre in the diet(Hocking, 2006,Newcombe and Summers, 1985).

At the finisher phase, there was a general improvement in the growth rate of the birds placed on the commercial feeds. Birds on VF, NF and CF had significantly ($p<0.05$) higher growth rate than those on GF. This implies that but for GF; all the other feeds (CF, VF and NF) met the nutrient requirement of the birds.

Feed Conversion Ratio for Starter/Finisher Broilers

At the starter phase, the feed conversion ratio of birds on CF, VF and NF were similar ($p>0.05$) and significantly ($p<0.05$) lower than those on GF. At the finisher phase, birds on CF, VF and NF also recorded similar ($p>0.05$) and significantly lower FCR than those on GF. This implies that among the commercial feeds, VF and NF are better utilized than GF. This may have resulted from the likelihood that the manufacturers of VF and NF used better and utilizable feed raw materials for compounding their feeds.

Mortality

There was no mortality in the CF, but one mortality each was recorded for the other treatments at the starter phase. There was no record of mortality at the finisher phase.

Feed cost

The result shows that in the starter phase, the cheapest commercial feed was VF (N 54.40/kg feed). NF recorded the highest feed cost (N 58.00/kg feed) for starter feeds. For the finisher diets, CF was the cheapest (N 52.22/kg feed) while NF had the highest feed cost (N 56.00/kg feed). In terms of cost of feed per kg broiler meat produced, VF achieved the least cost (N 118.60) .GF recorded the highest cost (N 165.80) for the broiler starter diets. In the finisher diets, VF achieved the least cost (N 160.38/kg broiler). GF also recorded the highest cost (N 322.38/kg broiler). From the economic point of view, it seems that GF would increase production cost for the poultry meat producer considering that already feeding is known to take up to 70% production cost in livestock production.

Table 1: Gross Composition of experimental diets

Ingredients	Broiler Starter diets (%)				Broiler Finisher diets (%)			
	CF	VF	GF	NF	CF	VF	GF	NF
Maize	60.00	N/S	N/S	N/S	60.00	N/S	N/S	N/S
Soybean	24.00	N/S	N/S	N/S	16.00	N/S	N/S	N/S
Palm kernel cake	2.00	N/S	N/S	N/S	4.00	N/S	N/S	N/S
Wheat offal	3.00	N/S	N/S	N/S	10.00	N/S	N/S	N/S
Fishmeal	4.00	N/S	N/S	N/S	3.00	N/S	N/S	N/S
Blood meal	3.00	N/S	N/S	N/S	3.00	N/S	N/S	N/S
Bone meal	2.00	N/S	N/S	N/S	2.00	N/S	N/S	N/S
Oyster shell	1.00	N/S	N/S	N/S	1.00	N/S	N/S	N/S
L-Lysine	0.25	N/S	N/S	N/S	0.25	N/S	N/S	N/S
L-Methioinine	0.25	N/S	N/S	N/S	0.25	N/S	N/S	N/S
Vit/Min premix	0.25	N/S	N/S	N/S	0.25	N/S	N/S	N/S
Salt	0.25	N/S	N/S	N/S	0.25	N/S	N/S	N/S
Total	100	N/S	N/S	N/S	0.25	N/S	N/S	N/S
Nutrient Composition of Experimental diets (%)								
ME(Kcal/kg)	2932.31	2800.00	2700.00	N/S	2887.01	2900.00	2850.00	N/S
ME (MJ/kg)	12.27	11.72	11.30	N/S	12.08	12.13	11.92	N/S
Crude Protein	21.59	21.00	21.00	18.50	20.48	19.00	19.00	18.00
Crude Fibre	3.80	5.00	4.40	5.50	4.24	5.40	5.00	5.55
Ether Extract	3.86	8.50	7.00	N/S	4.12	8.60	5.00	1.00
Calcium	-	1.20	1.00	1.00	-	1.20	1.10	-
Phosphorus	-	0.45	0.65	N/S	-	0.41	0.60	-

N.B. Nutrient composition for CF is based on calculated values while those of the commercial feeds (VF, GF and

NF) are based on values declared by manufacturers on their feed labels. N/S = Not stated.

Table 2: Performance of Starter Broilers fed different Commercial Diets

Parameters	CF	VF	GF	NF	SEM
Initial body wt(g)	125.00[b]	135.00[ab]	145.00[a]	129.00[b]	4.36
Final body wt (g)	1279.00[a]	807.78[b]	807.50[b]	874.40[b]	113.57
Daily wt gain (g/day)	41.21[a]	24.02[b]	23.66[b]	26.62[b]	4.17
Daily feed intake (g/day)	89.00[a]	52.47[b]	69.20[ab]	68.20[ab]	7.50
Feed conversion Ratio (g feed/g gain)	2.16[b]	2.18[b]	2.92	2.56[ab]	0.18
Mortality (No)	--	1	1	1	
Feed cost (₦/kg)	55.00	54.40	56.80	58.00	
Feed cost/kg wt. gain (₦)	118.80	118.60	165.86	148.48	

[ab] Means within a row with different superscript are significantly ($p<0.05$) different.

Table 3: Performance of Finisher Broilers fed differently Commercial Diets

Parameters	CF	VF	GF	NF	SEM
Initial body wt(g)	1279.00[a]	807.78[ab]	807.50[b]	874.40[b]	113.57
Final body wt (g)	2510.42[a]	2381.38[a]	1649.72[b]	2412.50[a]	198.52
Daily wt gain (g/day)	43.97[ab]	56.20[a]	30.10[b]	54.93[a]	6.07
Daily feed intake (g/day)	165.50[b]	166.90[b]	179.70[ab]	199.00[a]	7.53
Feed conversion Ratio (g feed/g gain)	3.81[b]	2.97[b]	5.97[a]	3.62[b]	0.66
Mortality (No)	2	1	1	1	
Feed cost (₦/kg)	52.22	54.00	54.00	56.00	
Feed cost/kg wt. gain (₦)	198.96	160.38	322.38	202.72	

[ab] Means within a row with different superscript are significantly ($p<0.05$) different.

4. Conclusion

GF seems to be the poorest from results obtained in this study especially in terms of weight gain and feed utilization. VF was the cheapest of the three commercial feeds while GF is the costliest in terms of the cost of feed used to produce 1kg of broiler meat. The farmer, who depends on commercial feeds and who wants his birds to reach market weight at the shortest possible time should consider VF and NF feeds. However, the only possible explanation to significantly poor performance of commercial diets in comparison to the control diet could be that feed manufacturers are only interested in profit maximization than meeting the needed requirements for their products. Variability in the nutrient contents of commercial feeds appeared to be an important factor that resulted to performance differences observed in this study.

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Comparative Study Of Some Macrofauna In Sugarcane'Fadama' And Savanna Upland Soils

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Abstract: Soil Macro fauna were extracted from Cultivated Sugarcane 'fadama' Soils, Using the Tullgren Funnel Method. Soil characteristics, such as Ph, Particle size and moisture content were determined. The Macro fauna of the two sites were dominated by two ant species, *Camponotus acvapimensis* and *Phiedole species*, although these species were generally fewer in Sugar cane 'fadama' soils. Finally the effects of the P^H, Particle sizes and moisture content on these organisms, as well as the roles they play in the soil were discussed. [Report and Opinion. 2009;1(4):90-93]. (ISSN: 1553-9873).

Key Words: Comparative, Macrofauna, Fadama, Savanna, Soils.

Introduction

Over the last decades there has been an increased interest in Soil Zoology, particularly in Europe and more recently in U.S.S.R, but little work has been done in soils of tropical regions Junk (1975).This interest has also to be sustained in Africa, particularly in the area of boosting the soil for agricultural production, a key to achieving the millennium development goals.

Soil in its widest sense is defined as the materials in which plants grow, (Madge&Sharma, 1969), and consists of both top and subsoils.The top soil is formed as a result of physiological, biochemical and biological processes .While the subsoil is formed as a result of the disintegration of parent rock into separate mineral particles, which are irregular in size and fit loosely together. These soils are also inhabited soil organisms and according to Wallwork (1970), and Okwakol (1980) the most widely used criterion in their classification is body size. He asserted that different soil organisms could either be classified as:

-Soil Microbiota: Those with body size less than 20um, e.g. soil protozoa, actinomagates, soil fungi and algae.

-Soil Mesobiota: Those with body size greater than 2oum, but less than
1cm e.g. nematodes, acari e.t.c.

-Soil Macroboita: Those with body size greater than 1 cm, e.g. Annelids, Mollusca, Athropods e.t.c.

This research is a contribution to the study of macro fauna found in sugarcane "fadama" soils and savanna upland soils with a view of establishing the roles they play in these soils.

Materials and Methods

Field Sampling:

Samples were obtained from cultivated sugar cane "fadama" soil located behind ICSA hall and savanna upland soil located at the botanical garden all within the confines of Ahmadu Bello University Zaria, Kaduna State, Nigeria. The soil samples were collected in the months of February, April and May. The samples were collected from the two sites by using a garden trowel to a depth of 10cm. Thereafter the samples were then placed in clean labeled polytene bags and transferred to the laboratory for the extraction of the macro fauna, and soil analysis

Extraction:

The macro fauna were isolated using Tullgren funnel method. The funnel consists of a glass funnel fixed to a retort stand and a sieve placed into it. 100gms of the soil sample was then transferred into the sieve. A collecting tube partially filled with 70% alcohol, was then fitted to the lower end of the funnel and stuck with a stopper. A 100 watt electric bulb was then fixed about 25cm above the sample. This concentrates heat and light on the sample. The set up was left undisturbed for 24hrs, after which the light was switched off and the tube underneath removed. The contents of the tube were then washed into a Petri dish containing 70% alcohol. The soil macro fauna obtained were examined and identified under a binocular microscope.

Determination of Soil Characteristics

1. **Determination of soil P^H:**

   5ogms of each soil obtained from the two different sites, were put into two separate 250ml beakers. Thereafter 100ml of deionized water was then added to each of the soils in the beakers. The contents were stirred with glass rods intermittently every

five to thirty minutes. The soil solutions were then left to settle for about thirty minutes after which the supernatants were decanted into two separate beakers. The ^{pH} was then read using a $_{p}H$ scale.

2. Determination of soil moisture:

20gm each of soils of the two different sites were transferred into two separate glass crucibles. The crucibles and their contents were then placed in an oven at 90 ^{o}c for twenty four hours. At the expiration of this period the crucible and their contents were removed and cooled in a dessicator, until there was no more change in weight.

The moisture content was calculated by using the following formula:

$$A = \frac{(a-b)*100}{b-c}$$

Where:

A= Air dried content in percentage of dry soil weight.

a=Weight of the crucible with air dry soil.

b= Weight of the crucible with oven dried soil.

C= weight of the crucible

3. Determination of particle size:

Soils of the two sites used for the determination of particle size were first loosened. After which 50gm of each of the soil samples were passed through sieves of different mesh sizes. The proportion of weight retained on each sieve was calculated.

Results:

During the course of this study, two species of ants were identified, these were, *Camponotus acvapimensis* (major) and *Pheidole species* (minor).

Table 1: Number and Macro fauna Obtained from the two different sites

Test Number	Savanna Upland Soil							Cultivated Sugar Cane "Fadama" Soil							
	Feb.	Apr.	May.					Feb.	Apr.	May					
1.	10	15	14					01	08	10					
2.	-	11	15					-	07	12					
3.	-	-	18					-	-	10					
Total	10		26		47		GT=83		01		15		32	GT=48	
Macro Fauna	CA	P	CA	P	CA	P	CA=53 P=30	%=64 %=36	CA	P	CA	P	CA	P	CA=31 P=17	%=54 %=46
	07	03	15	11	31	16			01	-	10	10	15	12		

Key: CA = *Camponotus acvapimensis*
P = *pheidole spp*
GT = Grand Total

Table 1, above shows that savanna upland soil had the highest number Of macro fauna (83), as against cultivated sugar cane “fadama” soil with (48). It also showed that Camponotus acvapimensis was higher in Number in the two different, sites 64% and 54%, respectively.

Table 2: Mean comparison of macro fauna obtained from the two different sites.

Test Month	Savanna Upland Soil	Cultivated Sugar Cane "Fadama" Soil
Feb.	10	01
Apr.	26	16
May.	47	32
Total	83	49
Mean	28	17

Table 2 above showed that throughout the period of sampling Savanna upland soil had mean number of macro fauna of (28), while Cultivated sugarcane "fadama" had (17).

Table 3: Showing the soil type of the two different sites.

Mesh Size (mm)	Cultivated Savanna Upland Soil Weight in (grams)	Sugar Cane "Fadama" Soil Weight in (grams)
1.700	35.9	16.30
0.710	7.95	7.59
0.600	0.75	1.1
0.500	0.69	1.1
0.212	1.60	4.1
<0.212	3.11	19.73

According to the international system of soil classification.

Coarse sand: 2.0-0.2mm
Fine sand : 0.2-0.2mm
Silt : 0.02-0.002mm
Clay : less than 0.002mm

Table 3, above has distinctly placed savanna upland soils as Sandy and Cultivated sugarcane "fadama" soils as clay soil.

Table 4: P^H

Soil Type	P^H
Savanna Upland Soil	5.55
Cultivated Sugar Cane "Fadama" Soil	5.25

Table 4, above shows that both soils as being slightly alkaline.

Table 5: Moisture content

Soil Type	Moisture Content % Dry Weight
Savanna Upland Soil	1.3
Cultivated Sugar Cane "Fadama" Soil	4.6

Table 5, above shows that cultivated sugarcane "fadama" soil having more % dry weight of moisture than savanna upland soils.

Discussion:

In the course of this study, two ant species were identified from the two sites, i.e. cultivated sugar cane "fadama" and savanna upland soils. These are *Camponotus acvapimensis*, and *pheidole species.* Ants are very common and wide spread species organisms and occur particularly wherever there is terrestrial habitat. They form a large family of insects called *formicidae, and order: Hymenoptera* (Borror, 1976 and Levienx, 1980). *Camponotus acvapimensis*, belongs to the family *camponitae*, while *pheidole specie*, and belongs to the family *myrinicinae.*

Both species i.e. *Camponotus acvapimensis* and *Pheidole species*, obtained from savanna upland soil were more in number than those obtained from sugar cane "fadama" soil (see table 2), and this agrees with(Edwards & Loffty,1969),who noted that these ants dislike living in dry and friable soils, which was the case with savanna upland soil which was slightly sandy soil(see table3). These ant species apart from being

more numerically in terms of species, were also more in number in savanna upland soil than in cultivated sugar cane "fadama" soil (see table 3),which shows that it is a distinctly sandy soil. This is so because according to Wheeler (1960) and Kayani et al., (1979), this species of ants prefer to nest in soils devoid of stones and are best developed in sandy soils.

Cursory glance at (table 1) shows that for savanna soil, there was a rise in the number of these ant species in the months of April and May, with the coming of the rains and this shows
the importance of moisture in their development (Flogates & Blandin, 1985), while in the cultivated sugar cane "fadama" for the same months there was a slight decline. This could be attributed to the slightly sticky nature of the soil, clayey making the ants stick to the soil there by reducing their chances of emerging to the soil surface (see table 5).

Although there are certain soil macro fauna that have deleterious effects on the soil, these species of ants are important in the soil according to (Wheeler, 1960) in three different ways. Firstly their importance lies in their ability to hasten the decomposition of organic matter. Secondly they also act as predators by destroying certain pest and lastly their activities most especially *Pheidole species* to excavate the soil has a very useful effect, because large quantities of subsoil which is spread over the surface for plant use.

Finally the distribution of these macro fauna was not only affected by soil type, moisture content but also the time of sampling had a significant effect on the number and type of macro fauna obtained from the two areas of study as agreed with the assertion of (Brand,1979)

Recommendations:

4. Efforts by researchers should be intensified in the studies of both micro and macro fauna of soil of different region of the world and not only my country Nigeria, determining roles they play in soils and fertility as a key to achieving millennium development goals in agriculture and food sufficiency.
5. These macro fauna identified can be cultured and introduced into soils where the rate of decomposition of organic matter that is very useful for plant growth is slow.
6. They can also be introduced into soils which have poor aeration, to improve it by their excavating activities and ability to bring to the surface subsoil, which is rich in plant nutrients.

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