

Evaluating The Impact of Agricultural Waste Management on Food Production and The Physical Environment, Enugu A Case Study.

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Abstract

The paper is a logical and systematic presentation of the impacts of agricultural wastes on agricultural production and the physical environment. Wastes have been seen as extremely harmful substances without any positive impact on the environment or agriculture. This study determines the impact of tiger nut chaff and poultry manure on livestock, plants and the physical environment. The research objectives formulated were to identify the constituents of Tiger nut chaff and poultry manure, and to determine the impact of the waste management on the physical environment. Experimental research and Survey research design was adopted for the study. Based on empirical analyses, dry tiger nut chaff and poultry manure was subjected to experimental test to determine the constituent nutrients. The crushed dried Tiger nut chaff was (hydrolysed using 4% H₂SO₄) heated on the hotplate at 600degrees Celsius reaction temperature for 4hours with potassium methoxide catalyst. About a sample size of 20 respondents were randomly and purposive interviewed through focus group discussion and face to face interview This study detailed the positive effects of tiger nuts for livestock consumption due to the presence of Carbohydrate, 27.52%, Protein 7.23%, Crude fiber 44.27%, Fat and Oil 13.34%, Moisture 5.65%, Ash 1.99%, Energy value (kcal kg⁻¹) 259.06% and vitamin A, B1, B2, B3, C, D3. The presence of monomeric sugars in tiger nut waste can be used to produce bio-fuels for industrial purposes. Soil with poultry manure was found to be of very positive impact on plants as nutrients like nitrogen, phosphorus, potassium and organic carbon are found in larger quantities. Thee study also shows a Clean and healthy environment as the waste are being utilized. The finding promotes the concept of waste to wealth and protect the citizens from environmental hazards associated with waste disposal.

Keywords: Wastee Management, Clean environment, Waste to wealth, poultry Manure, Tiger-nut

Introduction

Waste is becoming a complex term. Wastes can be seen as materials that are not prime products (that is products produced for the market) for which the generator has no further use in terms of production, transformation or consumption and is disposed (UNSD, 2011). Wastes are things we consider as unfit, unwanted and discarded due to economic reasons or ignorance of alternative technologies to re-use them (Adeyemi,2001). Waste is referred to a substance (solid, liquid or gaseous) generated directly or indirectly by living organisms which can be of value or without value (harmful) to the environment (living organisms and the general society). Tiger nut chaff and poultry manure are Agricultural waste. Agriculture is the life wire of any nation or society. Food scarcity is a major challenge to environmental sustainability. Low yield of agricultural production is one of the major causes of food crises in the world particularly developing countries like Nigeria, and most of agricultural wastes are disposed in the environment improperly, leading to various types of pollution.

The research is significant as the normal notion encompassing wastes seems to have deviated from its traditional stem to a more contemporary stem as a result of the various activities and actions being carried out day-by-day. Agricultural waste could be a useful substance if properly managed and rekeyed use of wastes helps in agricultural production and for other domestic uses. The poultry industry is generating large quantity of waste from chicken droppings that are abundant in microbes, macro- and micro nutrients suitable for manure. (Lorimor and Xin, 1999) discovered that Poultry manure has traditionally been treated as a waste product and applied to surrounding crop and pasture lands to recycle nutrients. Though, the agronomic benefits are well established but, the environmental aspects of poultry manure management have primarily focused on water quality (Harmel et al., 2009; Vervoort et al., 1998). As essential as this research thrust is to the overall benefits of global development in terms of provision of food sustainability of health livestock and gainful management of agricultural wastes for a clan and health environment, the process of achieving this task is still challenging. Most of the farmers of and traders of agricultural produce and livestock inherited it from their ancestors. It is like a means of cultural livelihood (AIC, 2005, Ellis 2000, Carney D 1998, Duxbury, 2016.)

Though some scholars such as, Ewulo, B. S.et, al 2008, have debated on the usefulness of poultry manure and tiger nut waste on soil and crop yield but there is still limited study on poultry manure and tiger nut waste especially to empirically and qualitatively evaluate the impact of tiger nut chaff and poultry waste on the livestock, soil, and on the physical environment which is the focus of this study. The study objectives therefore include; (i) to ascertain the chemical composition (nutritional constitute of the tiger nut chaff, (ii). To determine the chemical, constitute of poultry manure (iii) to examine the environmental impact of waste (Poultry manure and Tiger- nut chaff) management on the physical environment. The hypothesis raised is that there is no significance difference between soil with poultry manure and soil without poultry manure. This study will provide a reliable knowledge to the general public especially farmers on the usefulness of tiger-nut chaff and poultry manure for increase agricultural production. It will also provide a guide for urban planners

and policy makers on how waste can be effectively managed. It will serve as a reference material for researchers.

Tiger-nut (*Cyperus esculentus*) according to (Devries and Feuke, 1999) is a tuber that belongs to the family of Cyperaceae. It is cultivated in the northern part of Nigeria, some parts of Africa, parts of Europe, particularly Spain as well as in the Arabian Peninsula (Abaejoh et al., 2006). Tiger-nut has been cultivated both as livestock feed and for human consumption. Ekeanyanwu, R.C., Ononogbu, C.L. (2010), analysis showed that the nut contains: Moisture 3.50- 3.78%, Crude Protein 7.15 -9.70%, Lipid 32.13- 35.43%, Crude Fibre 6.26 -5.62%, Carbohydrates 46.99-41.22%, Ash 3.97- 4.25%, Energy (kJ) 1343- 1511 Tiger-nuts have excellent nutritional qualities with a fat composition similar to olives. Since the tubers contain 20 – 36% oil, *Cyperus esculentus* has been suggested as a potential crop for the production of biodiesel (Zhang et al., 1996; Ugheoke et al., 2007). One of the secondary waste products of *Cyperus esculentus* is the chaff. Tiger-nut chaff is potentially a rich source of fiber which can be converted to value added products after the milk and oil have been removed from the tubers.

Poultry manure application to pasture and cropland has long been documented as a contributing source of non-point source (NPS) pollutants N and P to downstream waters through surface pathways (Eteshola, and Oraedu, (1996); Soupier et al., 2006). Reported increased productivity from poultry manure amended soils likely indicates that repeated application to cropland has potential to improve soil health characteristics such as soil organic matter and soil fertility. Crop N needs are met by soil N as well as fertilizer inputs. By building soil organic matter and mineralizable soil N, crop production is less dependent on N additions (Spargo et al., 2011), resulting in more sustainable agroecosystems. However, studies of manure application to cropland have not always resulted in improved soil health indicators, partially because of difficulties in assessing soil health in short-term studies due to the complex and dynamic nature of soil N and organic matter. Soil health characteristic measurements typically include bulk density, total soil carbon (C) and nitrogen (N), particulate organic matter (POM) content, POM C and N, and aggregate size distribution, but can also include soil biological activity and potentially mineralizable N. Early work by Aduku, A.O. (1993) reported improved active organic matter in an animal-based rotation which included poultry manure, and another study recently reported that poultry manure application prior to raspberry planting improved soil bulk density and aggregation relative to control and cover crop treatments.

Research design

Enugu is the study area. The *Experimental research* design and survey was adopted for the study. *Based on empirical analyses, dry tiger nut chaff and soil with poultry manure was subjected to experimental test to determine the constituent nutrients. The crushed dried Tiger nut chaff and the dry poultry manure was (hydrolyzed using 4% H₂SO) heated on the hotplate at 600degrees Celsius reaction temperature for 4hours with potassium methoxide catalyst. The soil with poultry manure was also tested in the laboratory. Data were also obtained from primary sources through*

questionnaire interview and focus group discussion to draw the opinion of the participants, for the impact of the tiger-nut chaff and poultry manure on the physical environment. A total sample size of 20 participants was used for the study. The research population was drawn from the farmers and traders who deal on poultry and tiger-nut in Enugu. The research was guided by three research questions; a) identify one of the major environmental impact of poultry manure and tiger-nut chaff waste management on the physical environment. The question was address through primary sources of data, which was generated from 2 focus group discussions (FGD) conducted among farmers and traders.

Results and Discussions



Fig. 1: Showing crushed tiger nut shaft used in the study.

Source: Researcher’s survey

Table 1-3: The chemical/ Nutrition constituent of Tiger nut.

Sample	Protein (%)	Crude fiber (%)	Fat and Oil (%)	Moisture (%)	Ash (%)	Carbohydrate (%)	Energy value (kcal kg ⁻¹)
Tiger Nut	7.23	44.27	13.34	5.65	1.99	27.52	259.06

Source: Researchers experiment/field work

This table shows that Tiger nut is very rich in crude fiber among other nutrients besides vitamins. It shows that a high rate of energy can also be derived from the consumption of tiger nut along with carbohydrate which is also a source of energy. Fat and oil, moisture as well as ash are also products of tiger nut.

Sample	Vitamin A (mg/kg)	Vitamin B1 (mg/g)	Vitamin B2 (mg/g)	Vitamin B3 (mg/kg)
Tiger Nut	0.294	60.00	0.00088	258.20

Source: Researchers experiment/field work

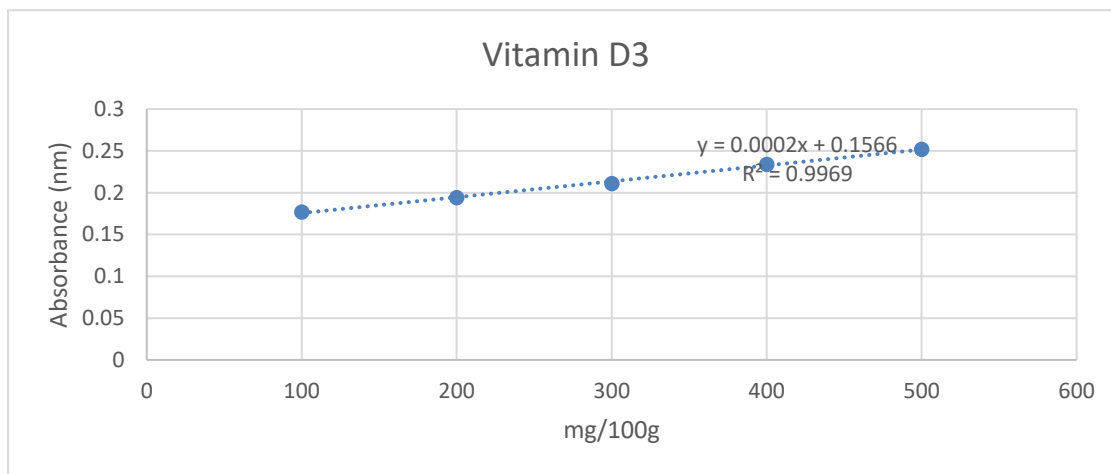
This table shows that tiger nut is very rich in vitamin B3 and contains very little percent of vitamin B2 which can be said to be negligible. Vitamin B1 and Vitamin A are also important products of tiger nut.

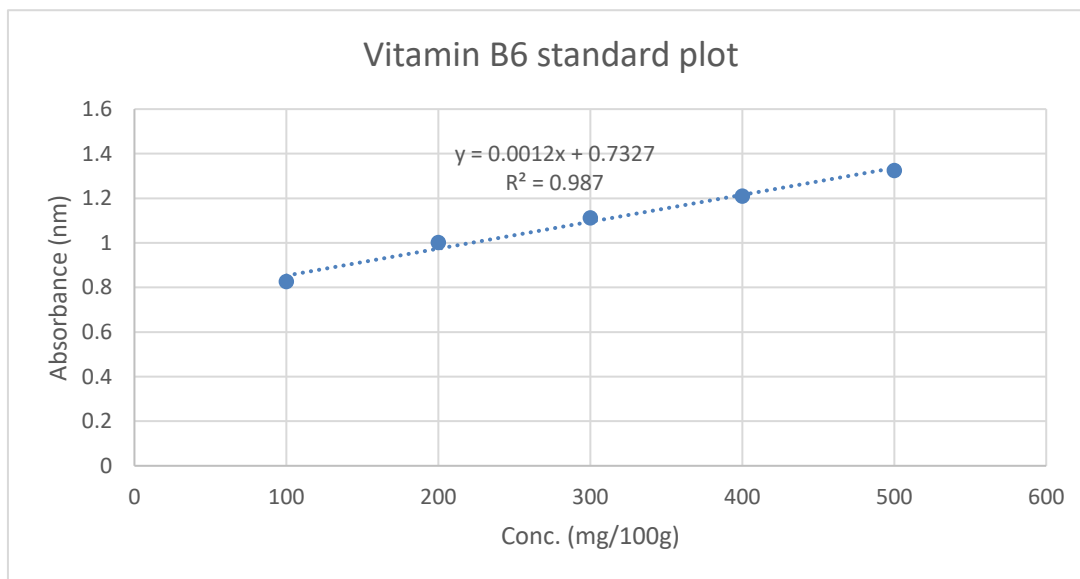
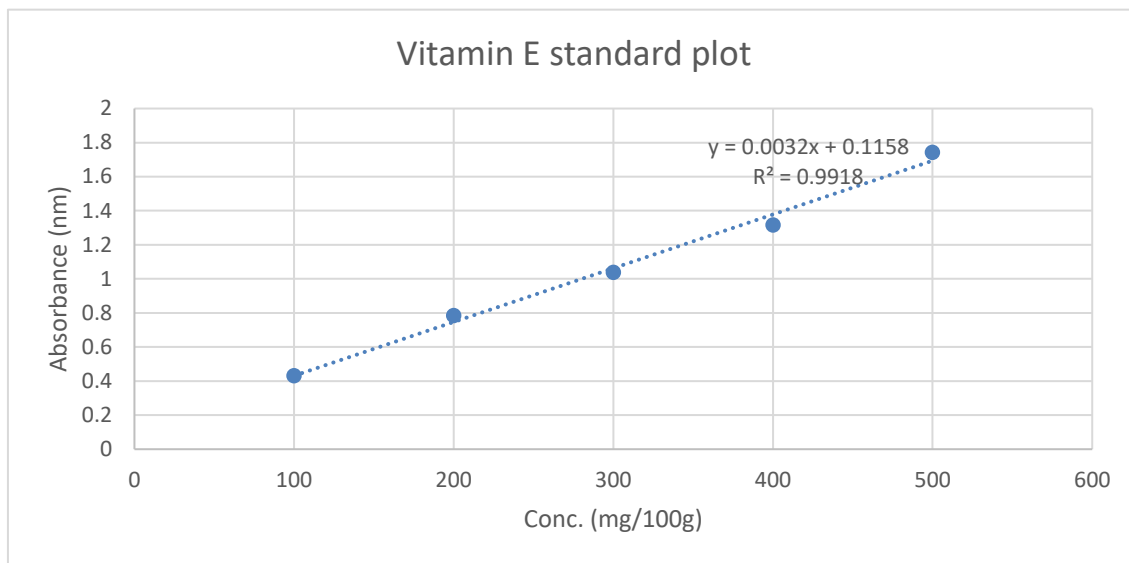
Sample	Vitamin B6 (mg/kg)	Vitamin C (mg/100g)	Vitamin D3 (mg/kg)	Vitamin E (mg/kg)
Tiger Nut	0.00	0.029	40.70	0.00

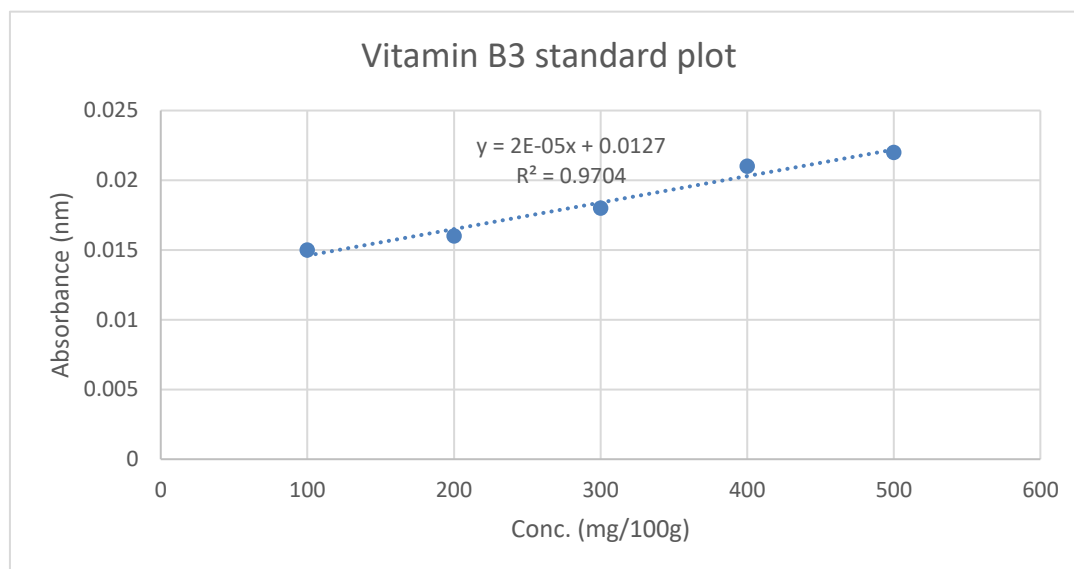
Source: Researchers experiment/field work

This table shows that tiger nut does not contain any form of vitamin B6 and vitamin E but it is comprised of vitamin D3 in a relatively large content and vitamin C in a relatively low content.

4.2 STANDARD GRAPHS/CONCENTRATION OF VITAMINS







Tiger nut (*Cyperus Esculentus Lativum*) contains about 7.23% protein which is relatively low. However, the presence of protein is very crucial as it helps the growth and regeneration of tissues. Proteins cannot be replaced or derived from any other element, which makes the content of protein in tiger nut very important in animals (Wikipedia, 2021). Crude fiber (44.27%) is very important for gut health in pigs and poultry due to the indigestion of portions of food derived from plants. Tiger nut also contains 13.34% of fats and oil. Fat is very important in animals as it provides high level of energy and fat-soluble vitamins. Moisture is also present in tiger nut at 5.65%. Moisture is very vital for the functioning of animals like pigs and poultry in terms of temperature regulation, nutrient uptake, removing wastes, body weight and so on (Wikipedia, 2021). Tiger nut also contains 1.99% ash which is at a very low level. This makes tiger nut a useful diet because it contains a very little content of ash. Diets with high level of ash are not recommended for consumption because it may lead to urinary tract problems. However, this ash is derived from the minerals existing and not the common ash known to people. Tiger nut contains carbohydrate at 27.52% which also provides pigs and poultry with energy and fibres. Tiger nut also contains 259.06% energy

Table 4-5: Nutrients in soil with manure and soil without manure

Sample	Nitrogen (%)	Phosphorus (mg/kg)	Potassium (mg/kg)	Moisture (%)	Volatile matter (%)	Organic carbon (%)
Soil with manure	0.38	0.006	0.019	31.03	41.71	0.413
Soil without manure	0.09	0.002	0.06	9.97	14.75	0.142

Source: Researchers experiment/field work

This table shows that soil with manure contain a very large content of volatile matter (evaporating) than soil without poultry litter. Water which is also very important is found in large quantity in soil with poultry litter as compared to soil without poultry litter. Other nutrients like nitrogen, phosphorus, potassium and organic carbon are found in larger quantities in soil with poultry litter than in soil without poultry litter.

Table 5.: Soil with and without manure

Sample	Organic matter (%)	Fixed carbon (%)	Ash (%)	pH	Conductivity ($\mu\text{s}/\text{cm}$)
Soil with manure	1.22	9.66	17.60	8.24	1795.00
Soil without manure	0.421	54.14	21.14	6.87	169.10

Source: Researchers experiment/field work

This table shows that soil without poultry litter contains a very high percent of fixed carbon as compared to soil with poultry litter. Also, the percentage of ash in soil without poultry litter is relatively higher than that in the soil with poultry litter. However, the level of organic matter, potential of hydrogen (PH) and conductivity found in soil with manure is higher than the one found in soil without poultry litter.

Soil with poultry litter in this case contains a lower percentage of fixed carbon (9.66) than soil without poultry litter (54.14). Conductivity is a measure of the number of salts in the soil. It indicates soil health. However, excess salts hinder plant growth by affecting the soil water balance. Soil with poultry litter contains a higher value of concentration (1795) than soil without poultry litter (169.1).

However, based on the overall discussion or analysis carried out above, it is obvious that tiger nut has a great positive impact on animals (pig and poultry) when consumed and soil with poultry litter from animals has a great positive impact on plants than soil without poultry litter. Hence the null hypothesis is rejected because there is significant positive effect of wastes on agricultural production.

Conclusion

Wastes do not always mean or pose harm to the environment. This notion of wastes as harmful substances to human, animals and entire environment is the cause for the rising hazards in various locations. This is because it leads to the unregulated disposal of wastes, instead of converting those wastes to wealth. Waste should however be transformed into wealth as much as possible in order

to improve agricultural development in nations and finally ensure a sustainable, functional and aesthetic environment. Waste to wealth goes beyond the above stated and involves the improvement of the Gross National Product of Nations. The recycled and used of these waste produced also aid in clean and healthy environment. Therefore, the proper management of waste such as waste recycling should be promoted to promote aesthetic and health environment. Further study on the economic usefulness of waste is recommended for further study.

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