SOIL NUTRIENTS POTENTIALITY OF PIG DEEP LITTER INOCULATED WITH EFFECTIVE MICROORGANISM (EM) IN FERMENTED BED TECHNOLOGY PIG PRODUCTION

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ABSTRACT
A total number of thirty six (36) weaner pigs were randomly allotted to two (2) treatments of eighteen (18) weaner each, with each treatment having three (3) replicates of six (6) weaners. The study was designed for the assessment of soil nutrients potentials of pig deep litter inoculated with Effective Microorganism (EM) obtained from pig production using Fermented Bed Technology (FBT). Bedding materials were inoculated with the solution of EM-*Bacillus subtilis* (STL002), *Lactobacillus plantarum* (MKL430), *Saccharomyces cerevisiae* (RSU512) and *Actinomycetes* (OLT231). Samples were collected from each replicates of bedding without EM ($T_{1,}$ control) and with EM (T_2) and individuals sample from each replicate for T_1 and T_2 were mixed thoroughly in order to obtain homogeneous samples for nutrients analysis. Kjeldhal apparatus, flame photometer, molybdovanadate method and model 55B Atomic Absorption Spectrophotometer (AAS) were used for the analysis. Data obtained from triplicate determination for individuals sample were subjected to t-test analysis and results indicated significant different ($p<0.05$) between T_1 and T_2. Pig deep litter macronutrients analysis revealed that Mg=8.42ppm, K=7.25ppm, N=1.62%, P=52.01mg/l, S=9.55% while micronutrients depicted Fe=9.45ppm, Mn=6.60ppm, Zn=5.34ppm, Cu=8.11ppm, Cl=4.81ppm. This study therefore, showed that Fermented Bed Technology which make use of EM actively breakdown pig waste thus, significantly decreased offensive odour and flies populations. Pig deep litter nutrients content obtained further suggest future use of this biotechnology in a farming system that are economically, environmentally, and socially sustainable.

Keywords: Effective microorganisms, Soil nutrients, Pig deep litter, Inoculation, Pig.

INTRODUCTION
The issue of insufficient protein intake and malnutrition generally in developing countries can be attributed to the high cost of conventional sources of meat such as cattle, goat, sheep, pigs, poultry etc. and the demand-supply gaps which has not yet been bridged. FAO (2014) reported high per caput (more than 10 kg) consumption of meat in some industrialized countries while less than10 kg per caput consumption for developing countries was considered insufficient and often leads to under-nourishment and malnutrition. Deficiencies occur when people have limited access to micronutrient-rich foods such as meat, fish, fruit and vegetables. Therefore, bridging this gap can only be achieved by the increasing and consistent encouragement of production of short-cycled and highly prolific animals such as pigs.

Pigs have been described as one of the most prolific and fast growing livestock that can convert food waste to valuable products and being pure white meat, can excel above other red meat animals. Despite all these attributes, farmers are been discouraged to go into pig production because of challenges associated with pig production. These include offensive odour and large population of flies usually seen around pig farms.

Enforcing Federal Environmental Protection Agency Act No 59 of 1992, which regulates pig farms to be located not less than 500 meters away from residential areas has made many farmers to lose their land to residential owners and this has also continued to discourage farmers from investing in production of such animals. The Act argued that waste (feacal and urine) from pig farms have the potential of carrying pathogens, bacteria (often antibiotic resistant), and heavy metals that can be toxic when ingested (Nicole, 2017). These waste products causes mucosal irritation, respiratory ailments, decreased quality of life, pollution of water bodies, release of greenhouse gases (ammonia, nitrogen oxide and methane). The foul odours, flies and mosquitoes breed in manure pit are grassed continually to the neighboring communities and these are capable of transmitting diseases such as cholera, dysentery, typhoid, and malaria. Annette *et al*. (2006) reported that pig farms are capable of spreading diseases like- Salmonella, Toxoplasma, and Campylobacter.

Studies by AfrII (2016) and Laishram *et al*. (2018), showed that Fermented Bed Technology (FBT) might be an effective technology in reducing occurrences of diseases and also increasing the immunity of the pigs. FBT with the help of EM's offers many benefits but the core benefit is the efficient way of turning both manure and urine into finished compost/litter. There is dearth of information about soil nutrient contents of pig deep litter in available literature. This study was therefore undertaken to assess soil nutrients potentiality of pig deep litter inoculated with EM's in FBT pig production.

MATERIALS AND METHODS

Study Location and Sources of Experimental Materials

This experiment was conducted at the Teaching and Research Farm of Ikwo Local Government, Ndufu Echara, Ikwo Ebonyi State. This location lies in latitudes $60^{0}4'$N and Longitude $08^{0}65'$E in the Derived Savanna Zone of Southern Nigeria (AE-FUNAI, 2012).Thirty six (36) weaner pigs, selected from existing population in the farm were used as experimental animals. They were randomly allotted to two (2) treatments of eighteen (18) weaners each, with each treatment having three (3) replicates of six (6) weaners each. Required quantity of rice straw was gathered as a left over waste after rice paddy harvest from selected farms within Ikwo Local Government Area (LGA). Rice husk and dried palm fronds used as bedding material were freely obtained from Nwakpu rice mill cluster and Obuegu Ndufu Echara palm tree plantation, respectively. Maize bran, used as substrate for culturing the Effective Microorganisms (EM's) was also obtained free from milling clusters within Abakaliki, metropolis. Pure cultures of EM's: *Bacillus subtilis* (STL002), *Lactobacillus plantarum* (MKL430), *Saccharomyces cerevisiae* (RSU512) and *Actinomycetes* (OLT231) were procured from Federal Institute for Industrial Research, Oshodi Lagos State. Other materials (loam soil, distilled water, table salt and glucose) were sourced locally. .

Experimental Procedures

The inoculum development was carried out at biotechnology laboratory, Alex Ekwueme Federal University Ndufu-Alike in line with the method of Balogun *et al.* (2016) with little modification.The solution (containing EM's) obtained were used to inoculate and ferment the bedding materials.

Rice straws and dried palm fronds were laid firmly on non-cemented floor to a height of 30cm in a 12m x 12m size pen. Immediately after this, bedding materials was added to the height of 40cm. The bedding materials consists of rice husk (30 bags), 100kg or 3 wheelbarrows of loam soil, ash (10kg) and table salt (10kg). Solution of EM's were continually sprinkled on the bedding materials as they were mixed thoroughly using combination of shovel and garden forks. Turning of the bed was carried out daily and allowed to ferment for eight days before stocking. In order to maintain a healthy bed and also to encourage rooting, turning and mixing of the bed with sprinkle of EM's solution was carried out weekly within the period of the experiment. All animals were kept under the same management and climatic conditions.

Samples Collection and Nutrients Analysis

At the end of the experiment (6 months), samples were collected from each replicates of deep litter without EM's ($T_{1,}$ control) and with EM's (T_2) for nutrients analysis. These were carried out at Home-water Research Laboratory. Abakaliki, Ebonyi State. Nitrogen content was determined using Kjeldhal apparatus in a processes described by Pearson (1976) while Potassium and Magnesium were determined by the use of flame photometer. The molybdovanadate method (AOAC, 2010) was used to determine the total Phosphorous. Sulphur and micronutrients (Fe, Mn, Zn, Cu and Cl) content of the samples were obtained through variant 55B Atomic Absorption Spectrophotometer (AAS).

Data Analysis

Data obtained were subjected to pair t-test analysis using the procedure of Ogbeibu (2005). Significant difference ($p<0.05$) was observed between T_1 and T_2.

RESULTS AND DISCUSSION

Macronutrients and micronutrients content of pig litter from T_2 shows significant ($p<0.05$) better results than control, T_1. This may be attributed to the ability of the EM to ferment organic matter, decompose and convert fiber and lignin components of bed materials to release nutrients and nutrient-rich organic acids (Higa, 2012).

Table1: Macronutrient composition of Fermented Bed Product (FBP) for T_1 and T_2.

Macronutrient	**T_1 (bedding without EM)**	**T_2 (bedding with EM)**
Mg (ppm)	2.25	8.42
K (ppm)	1.21	7.25
N (%)	0.90	1.62
P (mg/l)	28.62	52.01
S (%)	7.15	9.55

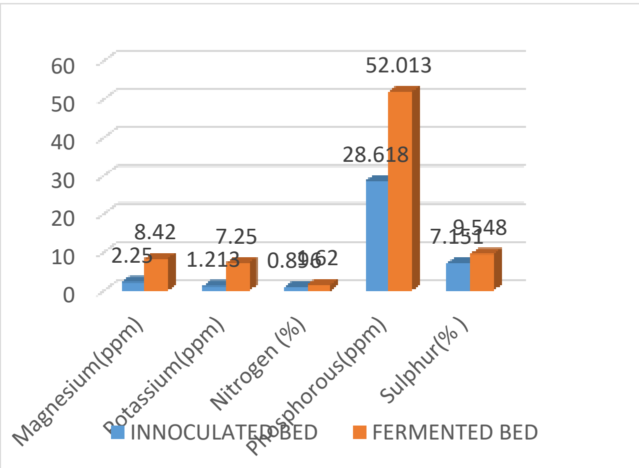
Mg= Magnesium; K=Potassium; N=Nitrogen; Phosphorous=P; S=Sulphur

There are inadequate information on soil nutrient contents of FBP in available literature. However, Ncube *et al*. (2011) and Javaid (2010) noted the efficacy of organic manure formulated with EM's in seed germination and vigour in carrot, cucumber, pea, beet, tomatoe and cowpea plants. Kim *et al*. (2012) reported that treatments with EM and EM-fermented compost in a greenhouse increased the yields of Spinach and Costmary by 10.4 to 24.8% and by 19.4 – 32.9%, respectively.

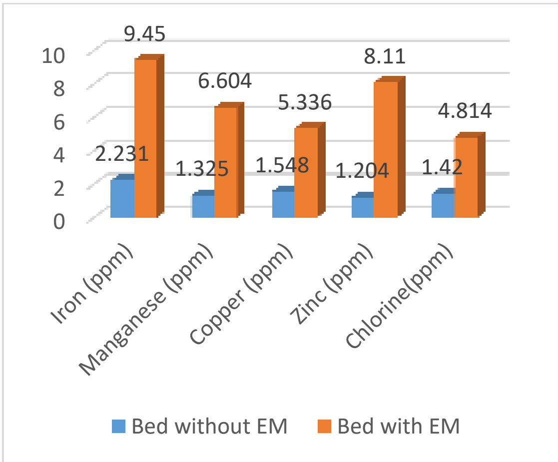
Table 2: Micronutrient composition of Fermented Bed Product (FBP) for T_1 and T_2.

Micronutrient (ppm)	**T_1 (bedding without EM)**	**T_2 (bedding with EM)**
Fe	2.23	9.45
Mn	1.33	6.60
Zn	1.55	5.34
Cu	1.20	8.11
Cl	1.42	4.81

Fe= Iron; Mn=Manganese; Zn= Zinc; Cu=Copper; Cl=Chlorine



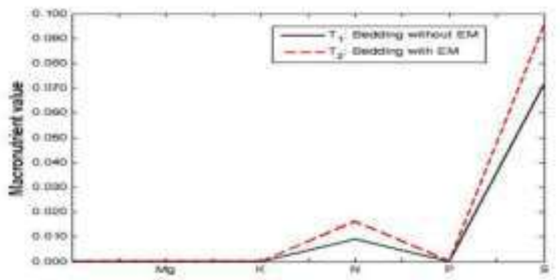
Macronutrients



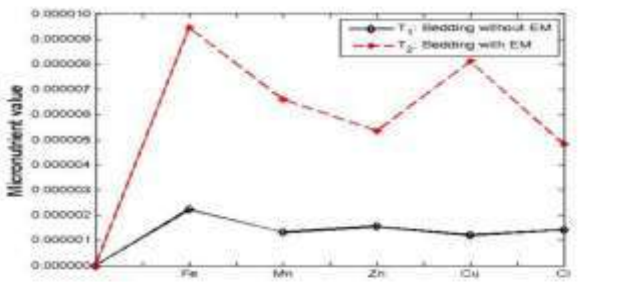
Micronutrients

Figure 1: *Graphical representation of soil nutrients composition of Fermented Bed Product (FBP)*

A cursory look at the Figure 3 reveals a great trends similarity between bedding with EM and bedding without EM. However, the proportionality trend of soil nutrients in bedding with EM confirmed the superiority of such technology over the control (bedding without EM).



Mg= Magnesium; K=Potassium; N=Nitrogen; Phosphorous=P; S=Sulphur
%Macronutrient data using 1%=10000ppm, 1mg/l=1ppm, 1ppm=0.000001



Fe= Iron; Mn=Manganese; Zn= Zinc; Cu=Copper; Cl=Chlorine
% Micronutrients data using 1ppm=0.000001

Figure 2: *Nutrients proportionality trend of bedding without and with EM's*

CONCLUSION

The present study presented the efficacy of FBT in breaking down pigs' effluent and urine into a compost/litter. It was also observed that this biotechnology allows pig natural behavior of rooting and minimizes frequent cleaning and the need for disinfection. Therefore, effective microorganisms (EM's) based technology as a part of Fermented Bed Technology (FBT) is one such great technology that has the potential of minerals extraction, enhancement of agriculture and waste management for environmental protection and food security as it allows rearing of pigs in a clean environment without flies and offensive odour.

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