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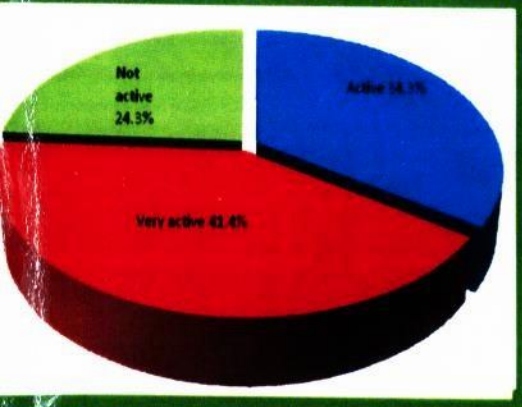

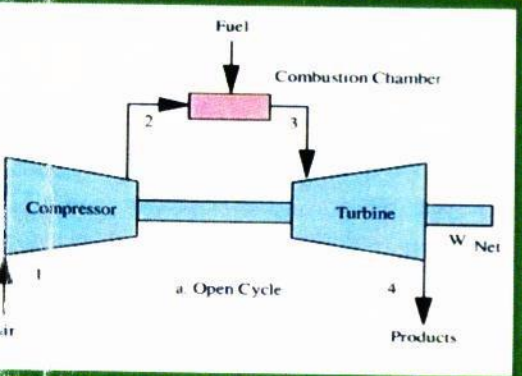

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Nutrient Compositions of Digesta of Three Ruminants as A Source of Manure for Soils of A Humid Tropics

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Abstract:
The relative comparism of nutrient compositions of different domestic ruminants as a source of manure for sustainable organic farming was carried out in the 2014 farming season at Soil Science Laboratory of the Federal University of Technology, Owerri, Nigeria. Rumen Digesta from Cattle, Sheep and Goat was collected from the state operated abattoir located within Owerri zone comprising of Mbaitoli, Owerri West, Owerri North, Owerri Municipal, Ikeduru, Aboh Mbaise, Ahiazu Mbaise Imo state Nigeria. The characterization involved the analysis of the nutrient content of these species of the ruminant. Each sample of rumen digesta collected was divided into three replicate and the experiment was laid out in completely randomized design. Analysis of Variance and Fishers Least Significant test was used to dictate significant differences among the nutrient composition of the three ruminant animals studied. The results revealed that all the nutrient content of the rumen digesta showed significant difference ($p = 0.05$) when they were compared with one another except crude fibre. The quantity of rumen digesta produced in Owerri zone in Imo State is high. If this organic substance is effectively incorporated into farming, the environment will be better, cleaner and healthier while at the same time increasing crop yield and providing employment opportunities to many youths.

1.0 Introduction

Low soil fertility has been recognized as one of the major constraints affecting agriculture in sub-Sahara Africa. Soil fertility depletion in small holder farms is the fundamental cause of decline per capital food production. This depletion is mainly due to intensity and continuous cropping with low application of fertilizer, causing a negative balance between nutrition supply and extraction from soil (Sanchez *et al.*, 1996). It is known that continuous cropping on a piece of land without adequate use of chemical fertilizer or manure lower soil fertility and crop yield (Agboola & Odeyeni, 1972).

Modern farming is emphasizing on organic farming and de-emphasizing the use of chemical fertilizer because waste can supply virtually all the nutrients required by plant and improves soil physical and biological condition for sustainable crop production and environment (FAO, 1976). These wastes can also add to the pool of organic matter content of tropical soil which has been reported to be a major problem militating against the yield of crop (Mbah *et al.*, 2007; Onweremmadu *et al.*, 2008).

The need to take appropriate measure to check this decline in soil productivity is urgent as the rate of deterioration is on the increase and if not check will have serious implication for future food security. In the past, soil fertility is maintained in south-east Nigeria via prolonged bush fallow (5-10years) (Umumma *et al.*, 1985). However, increase in population has resulted to reduced fallow period leading to poor crop yield. The

shortage and high cost of inorganic fertilizer have limited their use for production among the small holders in Nigeria (Tanimu *et al.*, 2007; Ekpe *et al.*, 2011). There is therefore the tendency for increase dependence on organic waste such farm yard manure, crop residue and rumen digesta.

The rumen is an open fermentation chamber, inhabited by microorganism that anaerobically digest complex compound of foodstuffs and generate fermentation products (mainly acids) microbial cell mass for utilization by the host. Managing rumen digesta from abattoirs is a common problem in developing countries like Nigeria. Putting these wastes into effective agrarian use is also often a problem because they are bulky, low grade fertilizer of variable composition and frequently have high water content thus not easy to transport far from point source. This waste could however be used to alleviate soil nutrient depletion problem, which is one of the most important constraint to crop productivity in sub-Saharan Africa (Schobery *et al.*, 2000). It is already documented that the current use of fertilizer in Africa is well below the recommended rate, partly due to prohibitive cost, limited availability and lack of knowledge on appropriate and efficient application methods. Worldwide, interest in the use of organic materials as a source of nutrient in cultivation has increased.

Rumen digesta are waste from abattoir obtained from cattle, sheep, goats that are presently a menace in most urban cities of developing countries. The digesta is made up of undigested fibrous materials example grasses that are still in their early stage of digestion. The digesta in the rumen is not uniform, but rather is stratified into gas, liquid and particles of different sizes, densities and other physical charactistics. The rumen digesta is acted upon by good number of microbes which include: Bacterial, Protozoa, Fungi, archaic and viruses and by mass account for 40-60 % of total microbial matter in rumen (Awoden, 2008).

Soil treated with cow dung or rumen digesta releases nutrient into the soil (Chinkuyu *et al.*, 2002). Rumen digesta supply nitrogen and has higher phosphorus content. Its limitation unlike other organic matter is the slow rate of decomposition. The aim of this study was to determine the chemical composition of three selected common ruminant animals and to statistically compare their nutrient composition levels.

2.0 Materials And Method

2.1 Study Area

The rumen samples were collected from abattoir within Owerri zone comprising Mbaitoli, Owerri West, Owerri North, Owerri Municipal, Ikeduru, Aboi Mbaise, Ahiazu Mbaise Imo state Nigeria, located between the latitudes 4° 45'N and 7° 15'N, and longitude 6° 50' E and 7° 25' E and altitude 125 meters above sea level. The samples were analysed at the soil Science Laboratory of the Federal university of Technology, Owerri. The study area lies within the humid tropics with aqua moisture regime in which soils undergo continuous or periodic saturation and reduction (Soil Survey Staff, 2003). There are two distinct weather conditions of rainy and dry Seasons in the area. The total annual rainfall ranges from 1,500-2,200 mm and spread from April and last until October. The average minimum and maximum temperature is above 20 °C (68.0 °f). The relative humidity is 75 % with humidity reaching 90 % in the rainy season.

2.2 Data Collection and Analysis

In each of the eleven locations, rumen digesta from the three different ruminant animals were collected and each sample was divided into three to make replication. The data was arranged in a completely randomize design. The results were subjected to analysis of variance and the least significant difference was dictated using Fishers Least Significant Test at P = 0.005 according to Gomez and Gomez (1994).

3.0 Results And Discussion

Nutritional and heavy metal Composition of the Different Rumen Digesta Sources are presented in the Tables 1 and 2 respectively.

Table 1: The nutrient content of the rumen digesta of cow, sheep and goat

Ruminant	%TN	%OC	C:N	P Mg.k g^{-1}	K Mg.k g^{-1}	Na Mg.k g^{-1}	Ca Mg.k g^{-1}	% Total Ash	%Crude Fibre
Cattle	0.68	37.1	59.89	14.2	110	96	75.83	7.3	51.6
Sheep	5.1	37.5	7.4	19.2	320	63	160.2	6.3	63.0
Goat	4.3	38.7	9.0	15.3	90	130	235.9	9.0	5.7
F-LSD p=0.005	1.08	NS	13.34	0.02	0.39	0.40	27.23	0.003	5.72

NS= Not Significant
Note: Figures with the same superscript along the same column are not statistically significant

The % total nitrogen of different sources rumen digesta sources are shown in table 1.when the % total nitrogen of the difference rumen digesta sources were compared with one another the result revealed significant differences. Sheep and goat rumen digesta % nitrogen did not show any significant difference. Cow recorded the lowest % nitrogen while sheep recorded the highest. There was 4.405 % more % nitrogen in sheep when compared with the value recorded for cow. Also the goat digesta recorded 3.608 % more nitrogen than the cow digesta. Although there was no significant difference but the sheep produced 0.797 % more total nitrogen than the goat digesta. Sheep rumen digesta proves to provide more nitrogen to soil when used as a source organic matter for organic farming.

Organic Carbon
The organic carbon of the different rumen digesta sources when compared with one another did not show any significant difference. Comparism of cow and sheep rumen digesta sources shown that there was no significant difference between cow and sheep digesta. Sheep recorded a higher value of organic carbon and cow recorded a lower value but sheep produced 0.399 % organic carbon more than cow. Also goat recorded 1.596 % more organic carbon when compared with that produced by cow

Carbon - Nitrogen Ratio (C : N)
The C: N of different rumen digesta sources when compared with one another showed significant difference. When the C: N of the rumen digesta of the cow was compared with that of sheep, the result revealed that C: N in the cow relative to the sheep. The cow recorded 52.51 of C: N higher than that of sheep. Also cow recorded 50.90 more C: N than that of goat digesta. Also goat produced 1.70 C: N than that of sheep digesta. A low C: N is a proof of easy of availability of nitrogen content of the digesta when applied to the soil for crop production.

Phosphorus
When the phosphorus of the rumen digesta of the cow was compared with that of sheep, the result revealed higher amount of phosphorus relative to that contained in cattle digesta. The sheep recorded 5 $mg.kg^{-1}$ of total phosphorus more than that recorded by cattle digesta and 3.9 $mg.kg^{-1}$ more than that recorded from the Goat digesta. Although there were recorded significant differences in the potassium content of the domestic ruminant animals, this element is lower than the other macro nutrients in the digesta.

Potassium (K)
There were significant differences in the potassium content of the different rumen digesta from the cattle, sheep and goat when compared with one another. The sheep recorded 210 $mg.kg^{-1}$ of potassium more than the value recorded for Cattle and 230 $mg.kg^{-1}$ more than that of the Goat. The Cattle digesta contains 20 $mg.kg^{-1}$ more potassium than that from the Goat. The goat produced the least quantity of potassium and therefore the least source of the element for crop production. The best here is the digesta from the Sheep.

Sodium (Na)
There was statistically significant difference in rumen digesta sodium content of the ruminants when compared with one another .There was 33.0 $mg.kg^{-1}$ more Na in cattle rumen digesta than in sheep but 34 $mg.kg^{-1}$ more in goat than in the cattle. The goat rumen digesta contained 67 $mg.kg^{-1}$ more Na than the sheep. Soils treated with goat rumen digesta are expected to release more sodium for plant nutrition and soil acidity management.

Calcium (Ca)
Goat rumen digesta also contained significantly

more Calcium than those of cattle and sheep. The goat recorded 60.1 and 75.7 mg.kg^{-1} of calcium more than cattle and the sheep respectively, while the sheep revealed 84.4 mg.kg^{-1} more calcium than the cattle. Again the goat has proved superior in calcium content than the other domestic ruminants under study.

%Ash Content

The percent ash content of different rumen digesta source when compared with one another showed significant difference. When the % ash of the rumen digesta of the cow was compared with that of sheep, the result revealed that the cattle had 1.0 of % ash higher relative to the sheep but 2.7 less than concentration in the goat digesta.

Crude Fibre (%)

The % crude fibre content of different rumen digesta sources when compared with one another showed that there were statistically significant differences. The highest crude fibre difference was recorded when the % crude fibre of the rumen digesta of the cow was compared with that of sheep, the results further revealed that crude fibre in the sheep digesta was 57.3 % higher relative to the goat. The sheep recorded 11.4 % more crude fibre when compared with the value recorded for cow. Also, cow digesta recorded 16.6 % less percent crude fibre than that of goat digesta. Goat digesta recorded 28 % more percent crude fibre than that of sheep digesta.

Table 2: Heavy Metal Composition of Rumen Digesta of Cow, Sheep and Goat in mg.100g^{-1}.

Ruminant	B	Fe	Pb	Zn	Mo	Cd	Mn	Hg
Cattle	0.70^{a}	3.71^{a}	0.60^{a}	1.95^{a}	0.27^{a}	0.14^{a}	37.91^{a}	0.03^{a}
Sheep	2.03^{b}	14.49^{b}	1.11^{b}	3.27^{b}	0.99^{b}	0.37^{b}	108.8^{b}	0.06^{b}
Goat	1.60^{c}	15.98^{c}	1.98^{c}	5.18^{c}	1.07^{c}	0.61^{c}	159.8^{c}	0.08^{c}
F-LSD p=0.005	0.009	0.009	0.006	0.001	0.004	0.006	0.092	0.006

NS= Not Significant

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Boron (B)

Boron concentrations of rumen digesta of the domestic ruminants when compared with one another showed statistically significant difference. Sheep and cow digesta did not show any significant different in their boron concentration. Cow recoded a lower value while sheep recoded a higher value when compare to one another. There were 1.33 mg.100g^{-1} more boron in sheep rumen digesta than that recorded for cow digesta. Also goat digesta recorded 0.894 mg.100g^{-1} less boron than that of cattle digesta. Although there was no significant difference between sheep and goat digesta in their boron concentration, but sheep produced 0.436 mg.100g^{-1} more boron than that of goat.

Iron (Fe)

The iron content of the rumen digesta of the different domestic ruminants showed significant difference when compared with one another. The cattle digesta was 0, 79 and 12.28 mg.100g^{-1} less than the iron contents in the sheep and goat respectively. Further the goat digesta recorded 1.49 mg.100g^{-1} more iron than the sheep digesta. The cattle digesta has proved to contain very little iron relative to sheep and goat rumen digesta. The sheep digesta recorded more iron concentration than even the goat.

Lead (Pb)

Lead concentration is highest in goat than in sheep and cattle rumen digesta. The goat recorded 0.87 and 1.38 more lead than sheep and cattle respectively. The cattle digesta had very low concentration of lead.

Zinc (Zn)

Zinc concentrations of rumen digesta of different the domestic ruminants when compared with one another showed significant difference. When the zinc of the rumen digesta of the cow was compared with that of sheep, the result revealed that zinc concentration in the sheep was higher relative to the concentration in cow digesta. The sheep recorded 1.32 mg.100 g^{-1} more zinc concentration than the concentration in the cattle digesta. Also, goat recorded 3.23 mg.100 g^{-1} more than that of cattle digesta. The goat recorded 1.91 mg.100 g^{-1} less zinc than that of sheep digesta.

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Molybdenum (Mo)
Molybdenum content of rumen digesta of the different ruminants when compared with one another showed statistically significant difference. The molybdenum concentration of the rumen digesta of the sheep revealed 1.32 mg.100g^{-1} more than that found in the cattle digesta. The sheep also recorded 0.8 g/100g of Molybdenum concentration than that of the cattle. The goat digesta recorded 0.079g/100g more Molybdenum content than that of sheep digesta.

Cadmium (Cd)
When the cadmium concentration in the rumen digesta of the cattle was compared with that of sheep, the result revealed that cadmium in the cattle digesta was 0.23 mg.100g^{-1} and 0.47 mg.100g^{-1} less than the content in the sheep and goat digesta respectively. The sheep digesta also recorded 0.24 mg.100g^{-1} more Cd than that of sheep digesta.

Manganese (Mn)
Manganese concentration was high in all rumen digesta of the three domestic ruminant animals studied. The goat digesta recorded the highest concentration followed by the sheep. The cattle digesta recorded the lowest value in this respect. Manganese content in the rumen digesta of the goat was 121.89 and 51.0 mg.100g^{-1} higher than the concentration in cattle and sheep rumen digesta respectively. The sheep recorded 70.89 mg.100g^{-1} more Manganese than the quantity found in the cattle digesta.

Mercury (Hg)
There was statistically significant difference when the mercury content of the rumen digesta was compared with one another. The result revealed that goat digesta mercury concentration revealed significantly higher values of 0.05 and 0.02 mg.100g^{-1} when compared with cattle and sheep respectively. Again sheep rumen digesta recorded 0.03 mg.100g^{-1} more mercury when compared with concentration in the sheep digesta

4.0 Conclusion and Recommendations

The nutritional qualities of the rumen digesta generally from the domestic ruminant animals are adequate under proper organic matter management. The sheep rumen digesta has consistently proved to contain higher value of the three most important plant nutrient (NPK) followed by goat digesta which recorded higher values of N and P but less K than cattle. The heavy metals are adequate and none recorded values outside the permissible limit.
The best and the richest organic rumen digesta can be gotten from the sheep. All the other sources are ideal also as organic matter functions in other ways to improve soil productivity than nutrient enrichment. This waste from abattoirs polluting the environment can be put into effective agrarian use by supplementing it with other organic sources like human urine and humanure. This will make for complete organic fertilization for sustainable crop production.

Acknowledgment
My family and the entire Soil Science Team of Federal University of Technology Owerri are fondly appreciated. May their support for our collective **quest** to advance soil health in this **year of soil** be amply rewarded by the Almighty God! Amen.

References

Agboola A.A & Odeyemi O (1972). The effect of land use on the soil organic matter, exchangeable K, available phosphorus and soil pH in the rainforest zone of western Nigeria. *Nigeria Agricultural Journal* 2, 161-168.

Awodun M.A (2008).Effect of nitrogen related from rumen digesta and cow dung on soil and leaf nutrient content of Gboma (solanum macrocarpon.L) Journal on *Applied Bioscience* 7, 202-206.

Awodun M.A. (2002). Effect of sawdust ash on nutrient status, growth and yield of cowpea evigina unjuiculate (l) ualp). *African Journal of Agricultural Research* 1 (2), 92

Chinkuyu A.J (2002). Effect of laying hen manure application rates on water quality .*Trans AJAE45*(21), 299-308

Ekpe I.I (2011). Assessment of rumen digesta as a source of organic manure and income in Abakaliki south-East Nigeria. *Global research journal of science* 2276-8300.

FAO (1976). Organic materials as fertilizers, Soils *Bulletin* 27 FAO Rome.

Gomez L.A & Gomez G.O. (1984) statistic for biology and agriculture research Oxford University press UK, 84-102

Mbah, C.N Anikwe, Onweremmadu, E.U & Mgbagwu, JSC (2007). Soil organic matter and carbohydrate content of a District Leptosol under organic waste management

and their role in structural stability of soil aggregates. *International Journal of Soil Science*, 268-277

Onweremmadu E.U, Onyia V.N. & Anikwe, M.A.N. (2008). Geospatial distribution of organic matter in soils of Imo and Abia areas, South-eastern Nigeria. *Journal of Environmental Science and Pollution Research* 46-53, ER (1966).

Sanchez P.A., (1996). Soil fertility replenishment in Africa. A concept note in: Breth (Eds), proceedings of workshop on achieving greater impact from research investment in Africa, 26 30 September, 1996, Addis Ababa Ethiopia.

Schobery J. (2002). Nitrogen stress effect on growth and nitrogen accumulation by field grown tomatoes. Agorn .j.92,152 167.

Tanimu J, Iwuafor, E N, Odunze, A.C, & Tian, G. (2007). Effect of incorporation of leguminous cover crops yield and composts of maize. World journal of Agric. Sciences 3(2), 243-249.

Unamma R.P.A, Odurukwe SO, Okereke HE, ENE LSO & Okoli OO (1985). Farming Systems in Nigeria. Report of benchmark Survey of Farming systems of Eastern Agricultural zone of Nigeria AERLS, NRCRI Umudike.