A PROJECT REPORT ON:

TO STUDY THE NUTRIENTS CONTENT IN TWO DIFFERENT KINDS OF ORGANIC MANURES

Carried out at

Department of Analytical Service
TOCKLAI TEA RESEARCH INSTITUTE
Jorhat, Assam

Submitted to

Department of Chemistry

Bahona College, Jorhat, Assam

Submitted by
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It is my radiant sentiment to place on record my best regards, deepest sense of gratitude to Dr. Parinita Borah, Head of the Department, Chemistry, Bahona College, Jorhat and also the faculty of the Department for recommending me for this winter research training at Tocklai Tea Research Institute, Jorhat.

I perceive as this opportunity as a big milestone in my career development.

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TO WHOM IT MAY CONCERN

This is to certify that Ms. Shyamolima Bairagi, a 6th semester student of B.Sc., Chemistry from Bahona College, Jorhat has successfully completed her Training on the topic of ***"To study the nutrients content in two different kinds of organic manures"*** *in our Analytical Service Department, as a partial fulfillment of her attaining the award of degree of Bachelor of Science.*

During the period of her four weeks training in the month of December, 2018, Ms. Bairagi was found to be sincere, hardworking, technically sound and result oriented. Her conduct and behavior was also satisfactory.

We wish her success in her future endeavour.

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Abstract

A study was undertaken to determine the major nutrient contents (N, P, K & S) in two different types of organic manures viz. Vermicompost and Cow dung manure samples collected from different sources. The samples were analysed by standard methods and test results were compared for their nutrient contents. Between the two organic manures analysed Vermicompost was found to be rich in terms of nutrient contents.

Introduction

Manures may be defined as materials which are organic in origin, bulky and concentrated in nature and capable of supplying plant nutrients and improving soil physical environment having no definite chemical composition produced from animal, plant and other organic wastes and by products.

Organic manures are included well rotten farm yard manure (FYM), compost, vermicompost, green manures etc. Generally farm yard manures and composts are the decomposed products of agricultural by-products (animals and crops). Whereas green manures may be defined as materials which are un-decomposed green plant tissues susceptible to decomposition in the soil after incorporation.

The objective of organic cultivation is to have an ecologically sustainable plantation, aimed at the conservation of ecology and natural habit without polluting soil, air and water. So, Organic farming is a method of crop and livestock production that involves much more than choosing not to use pesticides, fertilizers, genetically modified organisms, antibiotics and growth hormones.

Organic manures are of different types i.e. mainly ***bulky*** and **concentrated** in nature

Bulky organic manures generally contain fewer amounts of plant nutrients as compared to concentrated organic manures. The concentrated organic manures are mainly derived from raw materials of animal or plant origin.

The amount of nutrients content varies with the nature and kind of manures. No definite composition of NPK and other micro-nutrients can be given. However, all oil cakes either edible or non-edible contains differential amount of N, P and K etc.

Concentrated organic manure may be defined as a material of organic origin derived from raw materials of animal or plant, without bulky in nature having no definite composition of plant nutrients.

Some most common such organic manures are oil cakes edible to cattle (e.g. mustard oil cake, groundnut oil cake, till oil cake etc.) and non-edible to cattle (e.g. neem oil cake, mahua oil cakes etc.); blood-meal, fish manure, bone meal etc.

Materials and Methods

DETERMINATION OF MOISTURE CONTENT IN ORGANIC MANNURE

(a) Equipments and Apparatus:

1. Precision Balance
2. Hot air oven
3. Porcelain crucible

(b) Procedure:

About 5g of the fresh organic manure sample (in replicate) was accurately weighed in previously weighed clean, dry porcelain crucibles. The crucibles were placed in a hot air oven at 105°C for overnight, and then transferred to a desiccator for cooling. The dry weight of the sample was taken to a constant mass. The loss in mass is the moisture content.

(c) Calculations:

The moisture content was calculated by using the following formulae:

$$\% \text{ Moisture content (on fresh weight basis)} = \frac{W2-W3}{W2-W1} \times 100$$

Where, W1 is the weight of the empty basin
W2 is the weight of the fresh sample with basin
W3 is the weight of the sample with basin after drying

DETERMINATION ORGANIC MATTER IN ORGANIC MANURE

(a) Equipments and apparatus:

(1) Precision Balance
(2) Muffle furnace
(3) Silica crucible

(b) Procedure:

About 5g of fresh well mixed organic manure sample (in replicate) was weighed in a previously weighed clean, dry silica crucible. The crucible was placed in a muffle furnace at 550°C for four hours. The crucible was removed from the furnace when temperature goes down below 200°C and allowed to cool in a desiccator and weighed to a constant mass. The residue represents the ash and loss in mass represents the moisture and organic matter.

(c) Calculations:

The organic matter content was calculated by using the following formulae:

$$\% \text{ Organic matter content} = 100 - M - Z$$

Where, M is the moisture content in the sample and
Z is the ash content

DETERMINATION OF pH OF ORGANIC MANURE

(a) Principle:

pH is a measure of hydrogen ion concentration in a solution. Mathematically it is a negative logarithm of hydrogen ion concentration,

$$pH = -\log [H^+]$$

A pH meter (Fig-1) is used to measure the hydrogen ion activity in aqueous solutions, indicating the acidity or alkalinity expressed as pH. The pH meter measure the difference in electrical potential developed between a glass electrode and a reference electrode (calomel electrode). The difference in electrical potential relates to the pH of the solution.

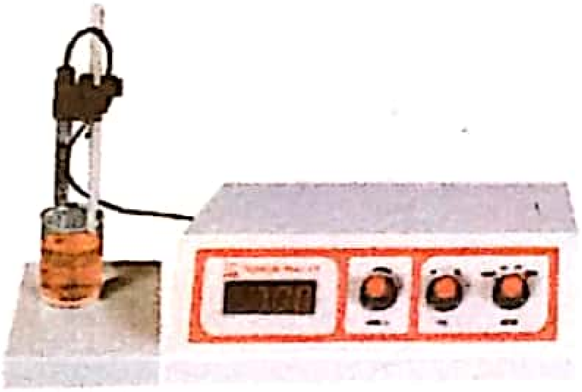


Fig-1: pH meter

(b) Equipments and Apparatus:

1) Weighing balance
2) pH meter
3) Horizontal rotary shaker
4) Conical flask (capacity – 100ml)
5) Beaker (capacity – 100ml)
6) Measuring cylinder (capacity – 50ml)

(c) Procedure:

20.00 g of test sample (air dried and sieved) is taken into a 100ml conical flask and added 50ml of distilled water of pH 7.00 with a measuring cylinder. The content was shaken on a horizontal shaker for 30 minutes. The suspension was transferred into a beaker and immersed the combined electrode into the suspension. The pH of the sample was measured in a digital pH meter after calibrating the same with standard buffer solution of pH 7.00, 4.00 and 9.00.

DETERMINATION OF ORGANIC CARBON IN TEST SAMPLE

Principle:

The sample is treated with a known excess volume of standard $K_2Cr_2O_7$ solution in presence of concentrated H_2SO_4. The $K_2Cr_2O_7$ reacts with H_2SO_4 to produce nascent oxygen which oxidizes carbon to carbon dioxide. The heat of dilution of the acid facilitates the reaction. The excess unused $K_2Cr_2O_7$ is titrated back against a standard solution of ferrous ammonium sulphate in presence of orthophosphoric acid and sodium fluoride using diphenylamine indicator. At the end point of titration the colour changes through blue to green. Sodium fluoride flocculates the sample particles in suspension and orthophosphoric acid sharpens the colour change at end point.

Reactions:

(i) During oxidation of carbon

$$K_2Cr_2O_7 + 4H_2SO_4 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + 4H_2O + 3[O] \qquad \times 2$$

$$C + 2[O] \longrightarrow CO_2 \qquad \times 3$$

$$2K_2Cr_2O_7 + 8H_2SO_4 + 3C \longrightarrow 2K_2SO_4 + 2Cr_2(SO_4)_3 + 2H_2O + 3CO_2$$

(ii) During titration with ferrous ammonium sulphate:

$$2FeSO_4(NH_4)_2SO_4.6H_2O \longrightarrow 2FeSO_4 + 2(NH_4)_2SO_4 + 12H_2O$$

$$2FeSO_4 + H_2SO_4 + O \longrightarrow Fe_2(SO_4)_3 + H_2O$$

$$2FeSO_4(NH_4)_2SO_4.6H_2O + H_2SO_4 + O \longrightarrow 2(NH_4)_2SO_4 + Fe_2(SO_4)_3 + 13H_2O$$

(a) Apparatus and chemical requirements:

1. Weighing balance
2. Conical flask (500ml capacity)
3. Volumetric flask (capacity – 1000ml)
4. Burette (capacity – 50ml)
5. Pipette (capacity – 10ml)
6. 1N potassium dichromate solution
7. 0.5N ferrous ammonium sulphate solution
8. Concentrated sulphuric acid (98%)
9. Solid sodium fluoride
10. Orthophosphoric acid
11. Diphenylamine
12. Distilled water

(b) Procedure :

0.10 - 0.50 g of the test sample was taken into a 500ml conical flask and added 10ml of 1N potassium dichromate solution. Then 20ml of sulphuric acid is added to the above mixture and mixed the content gently for one minute. The content is allowed to stand for 30 minutes for complete the reaction and then cooled down to the room temperature. Then 170ml of distilled water is added to the mixture.Then 0.2g of sodium fluoride and 10ml of orthophosphoric acid is added to the content and shaked gently. Finally 30 drops of diphenylamine indicator is added to the content and titrated against 0.5N ferrous ammonium sulphate solution taken into a burette. At the end point of titration the colour changes through blue to green.

(c) Calculations :

$$\% \text{ carbon} = \frac{(B-S)\times 3.869}{S \times W}$$

Where,

B is the volume (in ml) of ferrous ammonium sulphate solution consumed in titration with blank determination.

S is the volume (in ml) of ferrous ammonium sulphate solution consumed in titration with sample determination.

W is the sample taken for test in gram.

DETERMINATION OF PHOSPHORUS IN ORGANIC MANURE

(a) Principle:

The determination of phosphorous is based on Lambert and Beer's law using a colorimeter (Fig-2a & b) or a spectrometer.

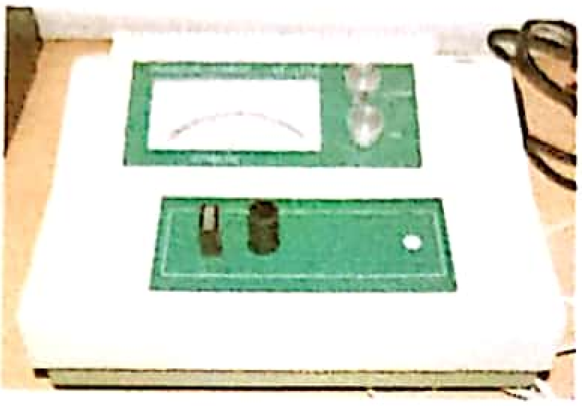


Fig-2(a): ERBA colorimeter

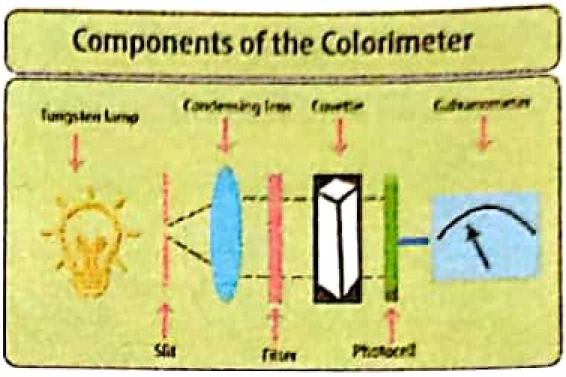


Fig-2(b): Component of a colorimeter

(b) Absorptiometry or colorimetry:

When a beam of light is passed through a medium, a portion of the radiant light (intensity) of the beam get absorbed. The extent of absorption depends upon the wavelength of the radiation and thickness (also concentration if solution is used) of the medium.

Lambert law:

This law gives the relationship between the amount of absorption of light and the thickness of the absorbing medium. It can be stated as each layer of equal thickness of a homogeneous absorbing medium absorbs an equal fraction of the radiant energy passing through it, i.e., rate of decrease of intensity (I) of light with the distance on passing through a medium is proportional to the initial intensity of the radiation. Thus

$$-\frac{dI}{dx} = K'I$$

or

$$-\frac{dI}{I} = K'dx \qquad -(1)$$

if the intensity of incident radiation is I_0, when x=0, integration of equation (1) gives

$$I = I_0 10^{\left(\frac{-K'}{2.303}\right)x}$$

$$= I_0 10^{-Kx} \qquad - (2)$$

In case of solution, the intensity of light decreases in the similar manner with the concentration of the light absorbing solute. This is Beer's law. Now replacing the constant K of Lambert law by its equivalent 'ϵc' for solution, we can sum up the two laws in a single equation as

$$I = I_0 10^{-\epsilon cx} \qquad - (3)$$

Where c is the concentration of the solute in mol/litre and ϵ is a constant characteristic of the solute but independent of the concentration of the solution. This constant is called molar absorbance index or **molar extinction coefficient** or **absorptivity** .Equation (2) may be written in the form

$$\log\frac{I}{I_0} = \epsilon\ cx$$

The quantity $\log\frac{I}{I_0}$ is called **optical density (D)** or **absorbance (A)** or **extinction (E)**. Thus

$$D\ (E \text{ or } A) = \log\frac{I}{I_0} = \epsilon\ cx$$

Or $$I = I_0 10^{-D}$$

The ratio of radiant power transmitted by a sample to the radiant power incident on the sample, i.e., the fraction of light transmitted, I/I_0 is called **transmittance** of the solution. It is denoted by T. Thus

$$\log\frac{1}{T} = \log\frac{I_0}{I} = \epsilon\ cx = A \text{ or } D$$

(c) Apparatus and chemical requirements:

1. Precision Balance
2. Colorimeter
3. Conical flask (Cap-100ml)
4. Pipette
5. Volumetric flask (Cap-50,100,250 & 1000ml)
6. Reference standard of phosphorous
7. Concentrated nitric acid
8. Perchloric acid (70-72%)
9. Ammonium molybdate
10. Concentrated hydrochloric acid
11. Stannous chloride

(d) Procedure:

(i) Digestion:

0.50g of air dried and sieved test sample is taken in a 250 ml conical flask and added 30 ml of conc. Nitric acid and boiled on a hot plate. Repeat with another 20ml of acid if much organic matter remains. Cooled and added 5ml of 70-72% Perchloric acid, boiled gently until the solution is colourless or nearly so and white dense fumes ceases to appear in the flask. Cooled slightly, added 50ml distilled water and boiled for a few minutes. Cooled and transferred the digested material quantitatively to a 250ml volumetric flask, made the volume up to the mark, mixed well and filtered using Whatman no. 42 filter paper. The filtrate is used for estimation of total phosphorous.

(ii) Determination of total phosphorous:

Total phosphorous in the extract is determined by Chlorostannous-reduced molybdophosphoric blue colour method in HCl system.

For this 1ml of the extract (in replicate) is taken into a 50ml volumetric flask using a pipette and added 10ml of ammonium molybdate solution to it followed by addition of distilled water upto two third of the flask. Then 1ml of working stannous chloride solution (obtained by diluting the stock solution) is added and made the volume upto the mark by adding distilled water and shaked well, when a blue colour is developed. Total phosphorous is determined by measuring the absorbance reading of the blue coloured solution in the colorimeter by using a 660nm filter.

(e) Calculations:

The concentration of phosphorous (%) in the sample extract is determined by comparing its absorbance reading with the standard curve. The results are expressed as %P_2O_5 (by mass) using the following formulae:

Total phosphate in the test sample (as %P_2O_5)

$$= \frac{SR \times V1 \times V3}{W \times V2 \times 10000} \times 2.29$$

Where,

SR is the sample reading from the standard curve

V1 is the original volume of the extract

V2 is the volume of aliquot of the extract taken for analysis

V3 is the final volume of the aliquot after dilution

2.29 is the factor used for converting P to P_2O_5

DETERMINATION OF POTASSIUM IN ORGANIC MANURE

(a) Principle :

The determination of Potassium is based on flame emission spectroscopy by using a flame photometer (Fig-3a & b).

Fig-3(a)

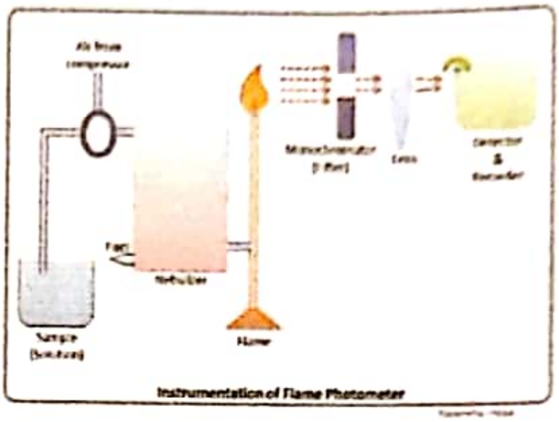
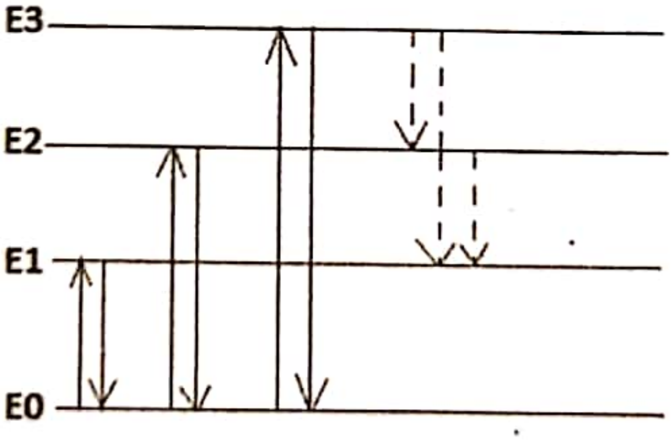


Fig-3(b)

Flame photometry:

If a solution containing metallic salt (or some other metallic compound) is aspirated into a flame, a vapour which contains atoms of the metal is formed. Some of these gaseous metal atoms is raised to an energy level which is sufficiently high to permit the emission of radiation characteristic of that metal, e.g. the characteristic golden yellow colour imparted to flame by compounds of sodium.



Let us consider the simplified energy level diagram as shown in the above figure, where E_o represents the ground state in which the electrons of a given atom are at their lowest energy level and E_1, E_2, E_3, etc.., represent higher or excited energy levels.

Transition between two quantized energy levels say from E_o to E_1, corresponds to absorption of radiant energy , and the amount of energy absorbed (ΔE) is determined by Bohr's equation

$$\Delta E = E_1 - E_o = hv = \frac{hc}{\lambda}$$

Where,

c = Velocity of light

h = Plank's constant

v = frequency

λ = wavelength of the radiation absorbed

Clearly, the transition from E_1 to E_o corresponds to the emission of radiation of frequency v.

Since an atom of a given element give rise to a definite, characteristic line spectrum, it follows that there are different excited states associated with different elements. The consequent emission spectra involve not only transition from excited states to ground states, e.g., E_3 to E_o, E_2 to E_o (indicated by full lines in the figure), but also transitions such as E_3 to E_2, E_3 to E_1, etc., (indicated by dotted lines in the figure). Thus it follows that the emission spectrum of a given element may be quite complex.

In theory it is also possible for absorption of radiation by already excited states to occur, e.g., E_1 to E_2, E_2 to E_3, etc., but in practice the ratio of excited to ground state atom is extremely small, and thus the absorption spectrum of a given element is usually only associated with transitions from the ground state to higher energy states and is consequently much simpler in character than the emission spectrum.

The relationship between the ground state and excited state populations is given by the Boltzmann equation

(b) Apparatus and requirements :

1) Precision Balance
2) Flame photometer
3) Standard potassium solution

(c) Procedure:

i. Preparation of sample extract:

The extract as prepared in the determination of phosphorous is used for determination of total potassium in the organic manure.

ii. Determination of total potassium:

Total potassium in the sample extract is determined by aspirating the extract to the flame photometer (which is calibrated by using a standard potassium solution) and then noting down the reading.

(d) Calculations:

The concentration of potassium (%) in the sample extract is obtained by comparing the flame photometer reading with the standard curve. The results are expressed as %K_2O (by mass)

Total potash in the sample (as %K_2O) $= \frac{SR \times V1 \times V3}{W \times V2 \times 10000} \times 1.2$

Where,

SR is the sample reading from the standard curve

V1 is the original volume of the extract

V2 is the volume of aliquot of the extract taken for analysis

V3 is the final volume of the aliquot after dilution

1.2 is the factor used for converting K to K_2O

DETERMINATION OF SULPHUR IN ORGANIC MANJURE

(a) Principle:

The estimation of total sulphur is done by using a colorimeter based on the principle as describe in the determination of phosphorous. Here sulphur is converted into sulphate by adding barium chloride in acidic medium and the absorbance or transmittance of the suspension is determined. The The concentration of sulphur (%) in the sample extract is determined by comparing its absorbance reading with the standard curve.

(b) Apparatus and chemicals required:

1. Precision Balance
2. Colorimeter
3. Standard sulphate solution
4. Barium chloride
5. Hydrochloric acid

(c) Procedure:

(i) Digestion:

Taken 0.5g of air dried and sieved test sample in a flask and added 30 ml of conc. Nitric acid and boiled on a hot plate. Repeat with another 20ml of acid if much organic matter remains. Cooled and added 5-10ml of & 70-72% Perchloric acid, boiled gently until the solution is colourless or nearly so and white dense fumes appear in the flask. Cooled slightly, added 50ml water and boiled for a few minutes. Cooled and transferred the digested material to a 250ml volumetric flask, diluted to mark, mixed well and filtered using Whatman no. 42 filter paper.

(ii) Determination of total sulphur:

1) Taken 10ml of the sample extract and added 0.2ml 6N HCl.
2) Added 0.4g $BaCl_2$ and shake for 15 seconds. Allowed the contents to stand for 2-3 minutes.
3) Similarly repeat the above two procedures using a 10ml of di-acid blank.
4) Insert the 420nm filter into the colorimeter and adjust zero using the blank.
5) Take absorbance of the sample and determine the amount of sulphur from the standard curve.

(d) Calculations :

The concentration of sulphur (%) in the sample extract is obtained by comparing the sample absorbance or transmittance with the standard curve. The results are expressed as %S (by mass) using the following formulae:

$$\text{Total sulphur in the sample (as \%S)} = \frac{SR \times V1 \times V3}{W \times V2 \times 10000}$$

Where,

SR is the sample reading from the standard curve

V1 is the original volume of the extract

V2 is the volume of aliquot of the extract taken for analysis

V3 is the final volume of the aliquot

RESULT AND DISCUSSION

Tests parameters were analysed in replicate, the mean of which are reported below: The tests results are given in table-1(a) & (b):

Table-1(a)

Sample mark	Replicate	Moisture content* %	Organic matter* %
Cow dung	I	14.97	51.67
	II	15.49	56.06
	Mean	**15.23**	**53.87**
Vermi compost	I	10.80	27.78
	II	11.00	28.40
	Mean	**10.90**	**28.09**

*On fresh weight basis

Table-1(a)

Sample mark	Replicate	pH (1:2.5 ratio)	Total nutrient content %(w/w)*					C:N ratio	Total of NPK
			Organic carbon	Nitrogen as N	Phosphorous as P_2O_5	Potassium as K_2O	Sulphur as S		
Cow dung	I	7.6	28.83	1.01	0.35	0.71	0.14	28.60	
	II		28.63	1.04	0.35	0.68	0.25	27.64	
	Mean		**28.73**	**1.02**	**0.35**	**0.70**	**0.19**	**28.11**	**2.07**
Vermi compost	I	7.5	14.03	1.09	0.57	1.14	0.46	12.84	
	II		14.12	1.15	0.57	1.18	0.46	12.30	
	Mean		**14.07**	**1.12**	**0.57**	**1.16**	**0.46**	**12.57**	**2.85**

** On air dry weight basis

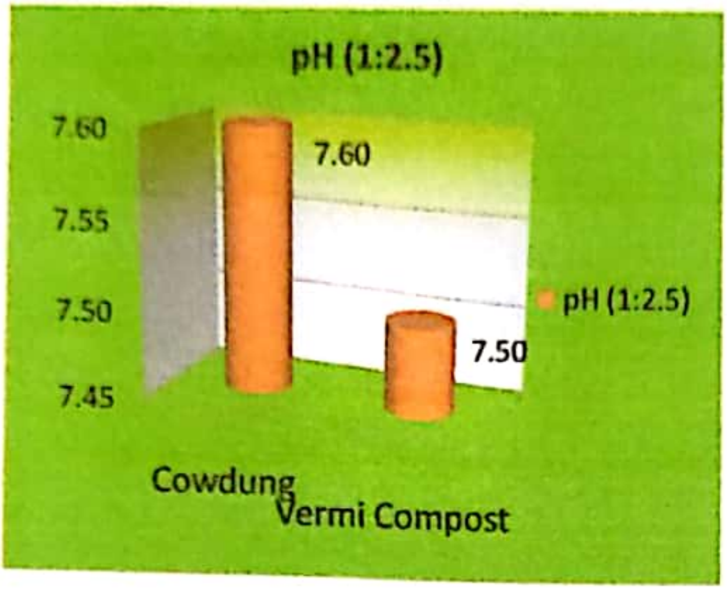


Fig-4

The pH of the samples, *Cow dung* and Vermi*compost* manure are found alkaline in nature. (Fig-4).

The organic carbon level is found high in *Cow dung (28.73%)*, while it is comparatively low (14.07%) in Vermi*compost* sample under analysis (Fig-5).

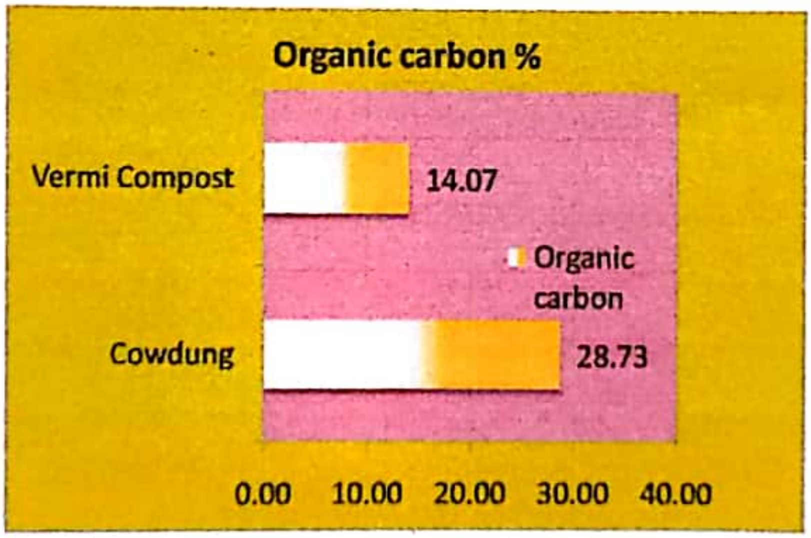


Fig-5

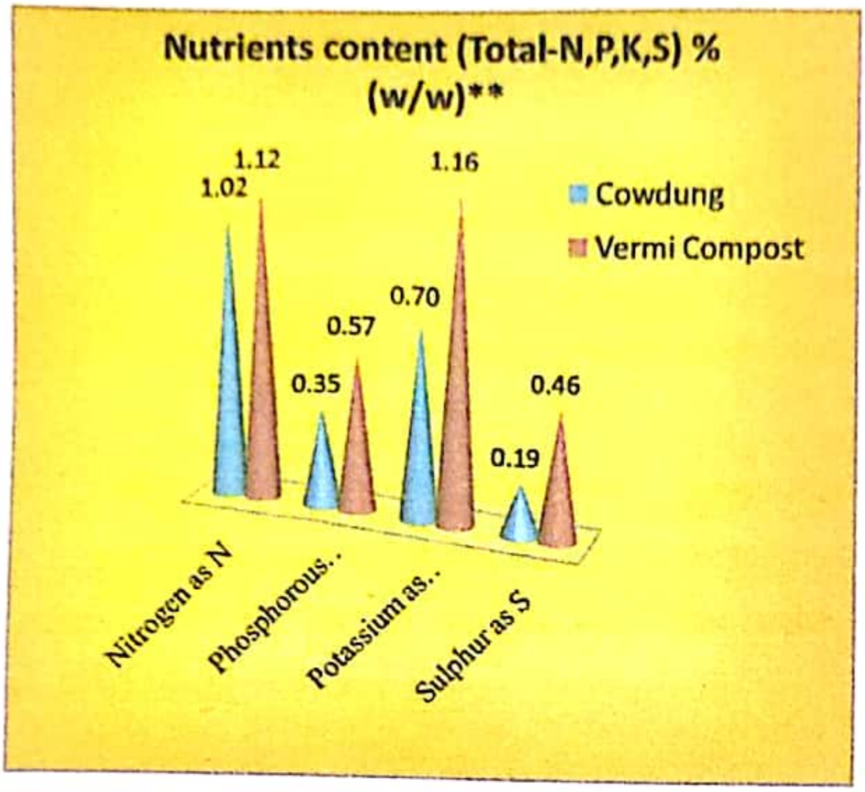


Fig-6

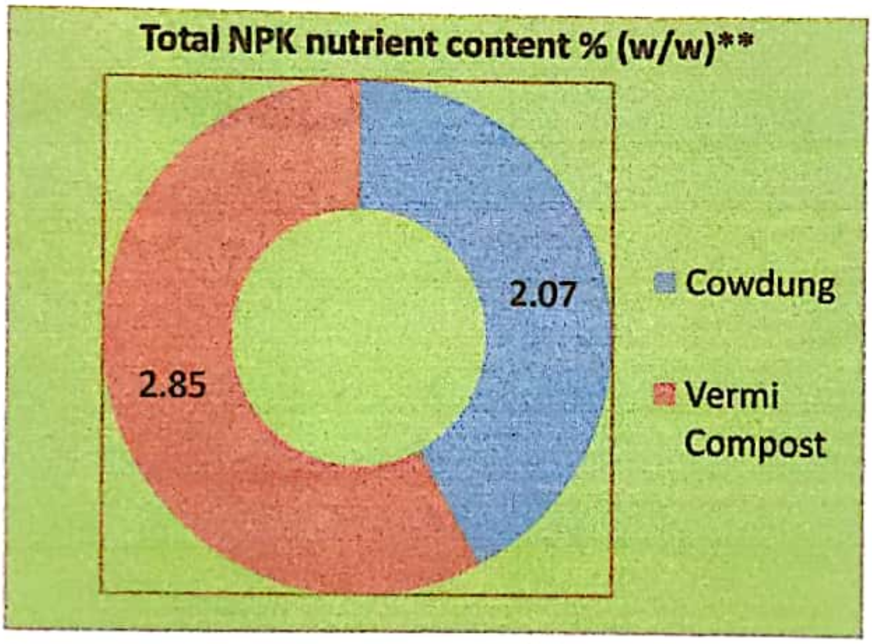


Fig-7

The sum total of NPK content is found high in Vermicompost sample (2.85%), as compared to *Cow dung* sample (2.07%) under analysis (Fig-7).

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