

**COMPARING THE MICRO AND MACRO NUTRIENTS OF TWO
DIFFERENT BIO COMPOST, PRODUCED USING BLACK SOLDIER
FLY LARVAE (*hermetia illucens*)**

Submitted in partial fulfilment of the requirements for the award of
Bachelor of Technology degree in Biotechnology

By

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**DEPARTMENT OF BIOTECHNOLOGY
SCHOOL OF BIO AND CHEMICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

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JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI – 600 119

APRIL-2021

DECLARATION

We Saran.B (37230078) and Purushothaman.A (37230063) hereby declare that the Project Report entitled) “**COMPARING THE MICRO AND MACRO NUTRIENTS OF TWO DIFFERENT BIO COMPOST, PRODUCED USING BLACK SOLDIER FLY LARVAE (*hermetia illucens*)**” done by us under the guidance of **Dr.Thyagarajan**, is submitted in partial fulfilment of the requirements for the award of Bachelor of Technology degree in Biotechnology.

DATE

PLACE: Chennai

signature of candidate

- 1.
- 2.

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of Saran.B (37230078) and Purushothaman.A (37230063) who carried out the project entitled "Comparing the Micro and Macro Nutrients of two different Bio compost, produced using black soldier fly larvae (*hermetia illucens*)" under our supervision from January 2021 to March 2021.

Internal Guide

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Submitted for Viva voce Examination held on _____

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ABSTRACT

Composting is the best way to convert organic waste into a useful resource, the process of composting can be accelerated by various techniques, one of which is, vermicompost which usually uses redworms (*Eisenia fetida*) which helps in decomposing, this is where black soldier plays its role. Utilization of Black soldier fly (*Hermetia illucens*) larvae can be one of the methods for treatment of biodegradable waste, they like warm, moist conditions, and when the larvae hatch they feed voraciously on organic waste, they eat twice their body weight, compost produced is mostly used as fertilizer for soil, Here we use two different types for feed for biocompost, one which contains food waste from kitchen and, other with animal manure (cow and chicken manure), and compost from these are feeds are compared based on the concentration of essential nutrients required by the plant for its growth and development

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S.no	List of abbreviation	
1	C1	Container 1
2	C2	Container 2
3	Bsfl	Black soldier fly larvae
4	HCL	Hydro chloric acid
5	HNO ₃	Nitric acid
6	H ₂ SO ₄	Sulphuric acid
7	Compost FD	Compost made from kitchen waste
8	Compost MN	Compost made from animal manure

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CHAPTER 1

1.INTRODUCTION

Large quantities of organic waste is generated every day all around the world, about 20-60% of total waste is organic (wang and zeng.,2017),the best way to utilize organic waste is by decomposing them, the can be decomposed in both aerobic and aerobic, vermicomposting is aerobic composting technique that uses worms to convert food waste to organic fertilizer, there's sub category of composting where larvae of black soldier flies were used, black soldier fly larvae's use in composting is still increasing after it introduction in 1990s ,(Mertenat et al., 2019).BSF larvae (*hermetia illucens*)has a life cycle of 41-43 days, their eggs take about four days to hatch, after which it enters larval stage during this stage, Bsfl consume a lot of food,duration of larval and prepupal stage can vary based on the availability of food and temperature(sheppard.,2002).Bio composting using, bsfl is been growing rapidly, because of the better composting time and quality, when compared to other composting methods where red or white worms are used

The commercial value of compost is been increasing greatly, compost help in retaining or replenishing the fertility of the soil ,since people have started knowing about the harmful effects of mineral fertilizer like leaching and salt burn due to excessive use, in other hand organic fertilizer contains all the essential nutrients for plant growth, they have a upper hand when it comes to maintain the soil and plants health

1.1 Origin, Taxonomy and morphological features of Bsfl

Black soldier fly is classified order Diptera family stratiomyidae genus hermetia species illucens, these originate from southern part of America, its black wasp like fly which ranges about 15-20mm in lengths, there are dull white in colour and larvae can go up to 26mm in length and 6mm in breath, It doesn't have well differentiated head but its distinct with a compound eye, rapid moving jaws which is common trait in Brachycera (sub order under Diptera).those jaws help them in rapid digestion of organic matter(Vasilios F et al.,2017)



Fig1.1 3rd day and 10th day Bsfl

1.2 Black soldier fly larvae life cycle

Adult Bsfl has an average life span of 5 to 8, which greatly varies based on the food availability and fat storage. Female fly lay about 300-600 eggs, it takes about four Days for the eggs to hatch, it's in larval stage for 14-18 day and, moult 6 times in the between this duration, they feed a lot in larval stage ,the adult fly's life time is totally dependent on the amount of food it consumes during the larval stage, the fly rarely tend to eat, so they mostly survive with fat stored during the larval stage, they consume about 25-500mg fresh organic matter each day

1.3 Plant growth and compost importance

Like every living organism plants also need nutrients to show good growth and development, plant lack essential nutrients may under develop root shoot leaves and flower, deficiency often kills the plant. Essential nutrients required for the plants are,carbon(C),oxygen(O),hydrogen(H),nitrogen(N),phosphorus(P),potassium(K),calcium(Ca),magnesium(Mg),sulfur(S),these are macro nutrients and it they also require micronutrients like zinc(Zn),iron(Fe),copper(cu),chlorine(cl),boron(B).the macro nutrients are required in high quantities ,compared to the micro nutrients,

Plants get their carbon oxygen and hydrogen from air and water their supplied with, all other nutrient are obtained from the soil, if it doesn't have those nutrients then it affects the growth, this where compost plays its role of replenishing nutrients present in the soil, compost is made from organic matter mostly organic waste (animal manure, dead plants, food waste etc) which has those nutrients in a complex form ,which needs to be broke down to its simpler form, so that plants can use them

CHAPTER 2

2.LITRATURE SURVEY

The larvae of the *Hermetia illucens*, also known as the black soldier fly (BSF) are the most studied insect type and are reared on large scale worldwide. (Lise Soetemans et al.,2020) Black soldier fly larvae go by the scientific name (*Hermetia illucens*) are used as feed. The pupae and preppie are consumed by poultry, lizards, turtles, pigs, even cats and dogs. They are known to be one of the most beneficial flies that still in existences. This is one of the most valuable species whose larvae have higher potentials for the converting organic waste into compost, and the larvae itself could be harvested for its protein and fatty acids contents. (E.A. Ewusie, September 2019)

The larvae biomass is known for its abundant fat and protein that can feed to animals as protein source, the compost could also be utilised in the field as biofertilizer. (Katon- gole et al., 2011; Lalander et al., 2015).

(Diner et al. (2011)) has been reported that BSFL consumed and degraded 70% of large of organic waste. BSFL processing is a new way of biowaste recycle technology and can convert into marketable valuable products that can conduce towards financially and sustainable.

Especially, the quick biodegradation of readily available organic matter can intensively acidify the substrate, resulting in low pH values in the initial phase of FW treatment and eventually inhibiting the larval growth and microbial activity (Chan et al., 2016; Ma et al., 2018)

The straightforward application of livestock manure to farmland is a common method that can increase the richness of nitrogen, phosphorous, and potassium in soils to improve plant survival and growth (Yang et al., 2017; Hageman et al., 2018).

However, levels of toxic metals (e.g., Cu and Zn) are high in livestock manure due to the excessive use of feed additives, which can lead to metal pollution (Li et al., 2010; Fegade et al., 2013)

The moisture content of the substrate was adjusted to 75–85 % by adding distilled water to obtain the maximum growth of the BSFL into pre-pupae (Kumar et al., 2018).

The black soldier fly is not recognized as a pest because the adult is not attracted to human habitation or foods (Furman et al. 1959). BSFL utilization contributes to natural recycling of nutrients and these insects are food for many larger animals. Insects obtain protein and other nutrients from the residual manure and increase their biomass, which is high quality animals' protein feedstuff. (Larry newton et al. 6 June 2005)

This species is highly versatile and can feed on a wide variety of organic matter, from vegetable residues to decaying animal tissues (Lardé, 1989; St-Hilaire et al., 2007; Hem et al., 2008; Martínez-Sánchez et al., 2011).

CHAPTER 3

3.1 AIM

- i. The compare and contrast the composts made from two different feeds using black soldier fly larvae (*hermetia illucens*)

3.2 Objective

- i. Making a compost out of two different feeds, One with vegetable waste from household and another with animal manure (cow and poultry manure)
- ii. To find a Better feed among the two used, based on the results of macro and micro nutritional analysis
- iii. Parameter consider are - micro and macro nutrients, pH, electrical conductivity, moisture, particle size and bulk density

CHAPTER 4

4. MATERIALS AND METHODOLOGY

4.1 MATERIALS USED FOR COMPOSTING

A basic small-scale backyard setup is used for composting the feed's

- I. Composting containers with a dimension of 50cmx35cmx7cm
- II. Feeds for composting
Feed1, consist of kitchen waste cocopeat and soil
Feed2, consist of animal manure (mixture of cow and chicken manure), cocopeat and soil
- III. Black soldier fly larvae (*hermetia illucens*)

4.2 MATERIALS USED IN EACH EXPERIMENT, CONDUCTED FOR QUANTITATIVE ANALYSIS OF NUTRIENTS AND OTHER PARAMETERS COMPOST

4.2.1 Apparatus used:

- I. 100ml,500ml Standard measuring flask
- II. Digestion flask (round bottom flask) 500-800ml
- III. Flat bottom flask 250ml
- IV. 100ml,200ml beaker
- V. Distillation unit
- VI. 100ml burette
- VII. Test tubes and test tube rack
- VIII. Silica crucible
- IX. Erlenmeyer flask
- X. Buchner funnel
- XI. sintered glass Gooch crucible Grade 4
- XII. Whatman filter paper No. 1
- XIII. Whatman No. 42 filter paper
- XIV. Petri dish

4.2.2 Reagents and chemicals:

- I. Distilled water
- II. Sulphuric acid-93-98 percent, N-free

- III. Potassium Chloride
- IV. salicylic acid
- V. Sodium thiosulphate ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$), reagent grade
- VI. Digestion mixture (CuSO_4 and K_2SO_4 in the ratio of 1:10)
- VII. Sodium hydroxide pellets or solution, N-free
- VIII. Zinc granules-reagent grade.
- IX. (a) Methyl red indicator (b) Mixed indicator (methyl blue and red in the ratio of 1:4 in ethanol)
- X. sulphuric acid (H_2SO_4)
- XI. Hydrochloric acid (HCL)
- XII. Quinoline solution
- XIII. Quimociac reagent
- XIV. sodium molybdate dehydrate
- XV. citric acid
- XVI. Nitric acid (HNO_3)
- XVII. synthetic quinoline
- XVIII. AR grade potassium chloride
- XIX. Sodium hydroxide standard solution – 0.1 N

4.2.3 INSTRUMENTS:

- I. Muffle furnace
- II. Desiccator
- III. Weighing balance
- IV. Hot air oven
- V. Hot plate
- VI. Conductivity meter [With temperature compensation system]
- VII. Flame photometer
- VIII. Atomic absorption spectrometer

4.3 METHODOLOGY

4.3.1 COMPOSTING

A basic composting setup consisting of two containers, both where filled with one of the feeds C1, with feed containing kitchen waste and C2 with animal manure, cocopeat was added increase aeration and mobility of the Bsfl. the weight of the feed used is based on the amount of Bsfl, because they can consume about 50-250mg per day (Diener, S et al,2011), so each container was filled with 1.5 kg of feed,300g of coco peat and 200g of soil which total up to 2kg in each container.

black soldier fly larvae used for composting was borrowed form a senior peer which were sourced from Ananth Aadya Agrovat Private Limited,5th day larvae were used,200g of Bsfl was add to C1 and C2



Fig 4.3.1 composting containers

number of Bsfl

5th day larvae weigh about 70-100mg, for calculation let it be 100mg

200g Bsfl = 200000 mg Bsfl

$200000\text{mg}/100\text{mg} = 2000$

200g of Bsfl contains 2000 Bsfl approx.

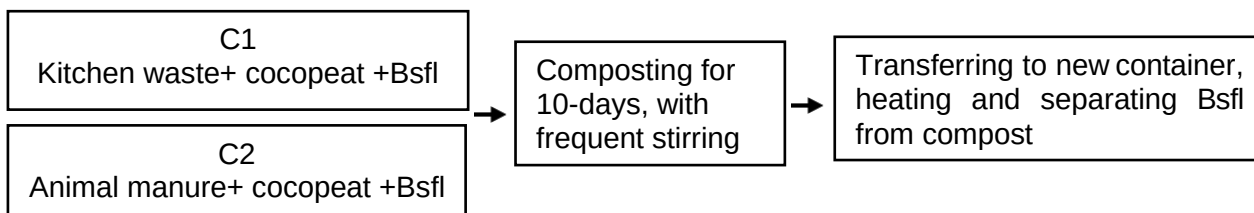
The composting was done for 10 days and containers were stirred gently with a wooden stick for better air flow and to move the Bsfl to different parts of the compost
10-day Composting time period was based on calculation, (considering one Bsfl consumes 100mg per day approx.)

2000 Bsfl can consume $700 \times 2000 = 1400000$ mg or 1.4kg

It takes about 7 days to compost 1.4 kg, with the assumed condition

Extra three days were added to compensate for the parameters, like Bsfl can consume more or less than estimated, composition feed, Bsfl mortality. which can affect the composting efficiency

After 10 days of composting the compost is transferred into a stain less steel bowl, and heated to kill the Bsfl, it should be Heated until the Bsfl stops wriggling, then it is sieved to separate Bsfl from compost



Composting work flow Fig 4.3.2

4.3.2 Quantitative analysis of nutrients and other parameters

Different test was done, for determination of different macro and micro nutrients

4.3.2.1 estimation of total organic carbon

sample is weighed and dried in oven at 105°C for 6 hours, a pre weighed crucible is used to burn the dried sample in muffled furnace at 650-700°C for 6 to 8 hours, cool them to room and keep the burnt sample in desiccator for 12 hours.

Weigh the sample with crucible after its time desiccator

Calculation:

Total organic matter % = $\frac{\text{initial wt.} - (\text{final wt.} / \text{wt. of the sample taken})}{1} \times 100$

Total Carbon % = Total organic matter % / 1.724

For, compost FD

Total organic matter % = $(4.11/10) \times 100 = 41.1$

Total Carbon % = $(41.1/1.724) = 23.8$

compost MN

Total organic matter % = $(4.47/10) \times 100 = 44.7$

Total Carbon % = $(44.7/1.724) = 25.9$

4.3.2.2 Estimation of Potassium

Potassium is estimated using flame photometry method

5g of sample is taken in porcelain crucible and burnt to ash at 650-700⁰ Celsius in a muffled furnace After burning it to ash allow it cool down and, add 5ml of concentrated hydrochloric acid, transfer it 250ml beaker and washed with some distilled water and heated (cleaning step to get rid of other impurities), then again transfer them to a 100ml volumetric flask to make up 100ml solution, then it is filtered and diluted with distilled water

necessary calibration for flame photometer is done, the K is value is determined using flame photo meter, K is the intensity of light produced when burning the metal similarly the k for different concentration of stock solution (5,10,15, 20 ppm stock solution are made by taking 0.5,10,15,20 ml of 100ppm making them up 100ml solution using a volumetric flask) is measured

a standard graph is plot for, standard potassium chloride solution and ppm of sample is found by extrapolating with respect to k in the graph

% of potassium = $P \times 20 \times \text{Dilution factor}$

Where P is the found out form the standard graph

Percentage of total potassium for

Compost FD = 0.85 %

Compost MN = 1.96 %

4.3.2.3 ESTIMATION OF TOTAL NITROGEN BY KJEDAHN METHOD

modified kjedahl method used for determining total nitrogen in soil and plant samples

2g of sample is taken in digestion flask, then add 40ml H₂SO₄ and 2g of salicylic acid, mix it thoroughly and let it be for 30 minutes or more with some occasional stirring, after that 5g of sodium thiosulphate and 2g of zinc dust is added, it is mixed gently by moving the flask in a circular motion and heated over low flame until frothing ceases, then 0.7g CuSO₄ and 15g K₂SO₄ (1:20) is added heated at high flame for at least 2 hours, because copper and potassium sulphate increases the boiling point of the solution.

After heating at high temperature for 2 hours turn off the burner and allow it to cool, then add some distilled water to dissolve everything then transfer it to 500ml volumetric flask to make up 500ml solution.25ml is taken from the made-up solution,

transferred to distillation flask and diluted with 300ml of water, a pinch of zinc dust is added, after all this 30ml of 45% NaOH is added slowly into the flask and attached to the distillation unit, a Receiving flask is attached to the condenser end of distillation unit which has a standard H_2SO_4 with methylene red indicator, ammonia will be produced from flask attached to the distillation unit, will be condensed and poured into the flask with standard. After distillation the standard solution is titrated against std NaOH solution

$$\% \text{ of total Nitrogen} = \frac{1.401(V_1N_1 - V_2N_2) - (V_3N_1 - V_4N_2) \times df}{W}$$

Where,

V1 = Volume in ml of standard acid taken in receiver flask for sample

V2 = Volume in ml of standard NaOH used in titrating standard acid in receive flask after distillation of test sample

V3 = Volume in ml of standard acid taken in receiver flask for blank

V4 = Volume in ml of standard NaOH used in titrating standard acid in receiver flask after distillation in blank

N1 = Normality of standard acid

N2 = Normality of standard NaOH

W = weight of the sample taken in grams

df = Dilution factor of sample

% of total Nitrogen in:

Compost MN = 1.96%

Compost FD = 1.52%

4.3.2.4 Estimation of phosphate by Gravimetric quinoline molybdate method

Sample preparation

10g of sample dried sample is taken in a silica crucible and burnt in a muzzle furnace at 650° to 700° to get ash, crucible is stored in a desiccator. After some time, ash is transferred to a 100 ml and mixed with 25% HCL the crucible is washed with 25% HCL to get all the particles out of it, heat the mixture for 10-15 minutes and keep it aside for 4 hours. After that the undisturbed mixture is filtered using a Whatman No.1 filter paper. Washed with distilled water, and poured into 250ml volumetric flask to make up solution

Quinoline solution – Is made by Dissolving 50 ml synthetic quinoline in mixture of 60 ml HCl and 300 ml water, while continuously stirring. Cool dilute to 1 lit and filter. Store in polyethylene bottle.

Quimociac reagent – is made by Dissolving 70 gm of sodium molybdate dehydrate in 150 ml water and Dissolving 60 gm citric acid in mixture of 85 ml HNO_3 and 150 ml water and cool. Gradually mix molybdate solution to citric acid-nitric acid mixture while stirring. Dissolve 5 ml synthetic quinoline in mixture of 35 ml HNO_3 and 100 ml water. Gradually start add this solution to molybdate –citric-nitric acid solution mix and let it stand for 24 hr, then Filter, add 280 ml acetone, dilute to 1 litre with water and mix well. Store in polyethylene bottle.

- I. Prepared sample is pipetted into 500ml Erlenmeyer flask and diluted to approximately 100ml with water then 50 ml quimociac reagent is added, and heated on a hot plate with well-ventilated hood and boiled for 1 minute
The flask is allowed to cool, while swirling carefully, then the solution is filtered using a sintered glass Gooch crucible Grade 4, which is dried and weighed, the crucible is dried and weighed again. The difference between before after weight Of the crucible multiplied by 0.03207 gives the percentage of total phosphate

Total phosphate percentage for:

Compost MN = 0.99%

Compost FD = 0.85%

4.3.2.5 ESTIMATION OF, COPPER, ZINC, IRON, MANGANESE AND MAGNESIUM

Cu, Zn, Fe, Mn, Mg where determined using atomic absorption spectroscopy

Triacid mixture: is obtained by Mixing 10 parts of HNO_3 (Nitric acid), 1 part of H_2SO_4 (Sulphuric Acid) and 4 parts of HClO_3 (Perchloric Acid)

Sample preparation:

suitable quantity of sample is oven dried at 105°C and then sieved through 0.2 mm sieve in a conical flask and mixed with 30 ml triacid mixture and, covered with a small glass funnel for refluxing. Then the whole is kept at 200°C on a hot plate till the volume is significantly reduced with a whitish residue. After cooling, filter the sample with Whatman No. 42 filter paper and make up to 100 ml in a volumetric flask.

Standard solution wasn't made, because standard graph used in previously were available

Samples were analysed using atomic absorption for wavelength produced while burning, values obtained is extrapolated using their respective standard graphs

4.3.2.6 Estimation of pH

Make a suspension 25g of compost in 50 ml of distilled water and shake on a rotary shaker for 2 hours. Then Filter through Whatman No. filter paper under vacuum using a Buchner funnel. Then pH of the filtrate is measured using a pH meter

4.3.2.7 Estimation of moisture

about 5 gm of compost is taken in a weighed clean, dry Petri Dish, then Heated in an oven for about 5 hours at 65°C to constant weight. After that it is Cooled in a desiccator and weighed. percentage lost in weight is moisture content.

Calculation:

$$\text{Moisture percent by weight} = \frac{100(B-C)}{(B-A)}$$

A = Weight of the Petri Dish

B = Weight of the Petri dish plus material before drying

C = Weight of the Petri Dish plus material after drying

4.3.2.8 Estimation of Electrical conductivity

fresh sample of compost is sieved using a 2-4mm sieve, 20 gm of the sieved sample compost is added to 100 ml of distilled water to it to give a ratio of 1:5, the suspension is Stirred for about an hour at regular intervals. conductivity meter calibrated using 0.01 M potassium chloride solution is used to Measure the conductivity of the compost suspension.

CHAPTER: 5

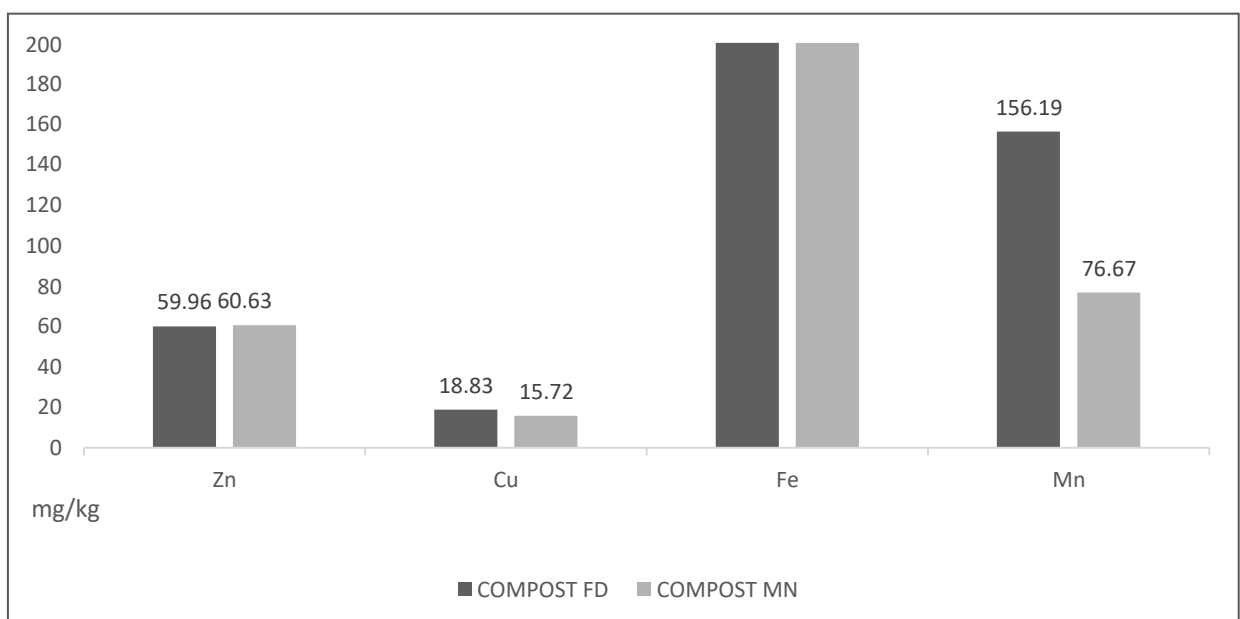
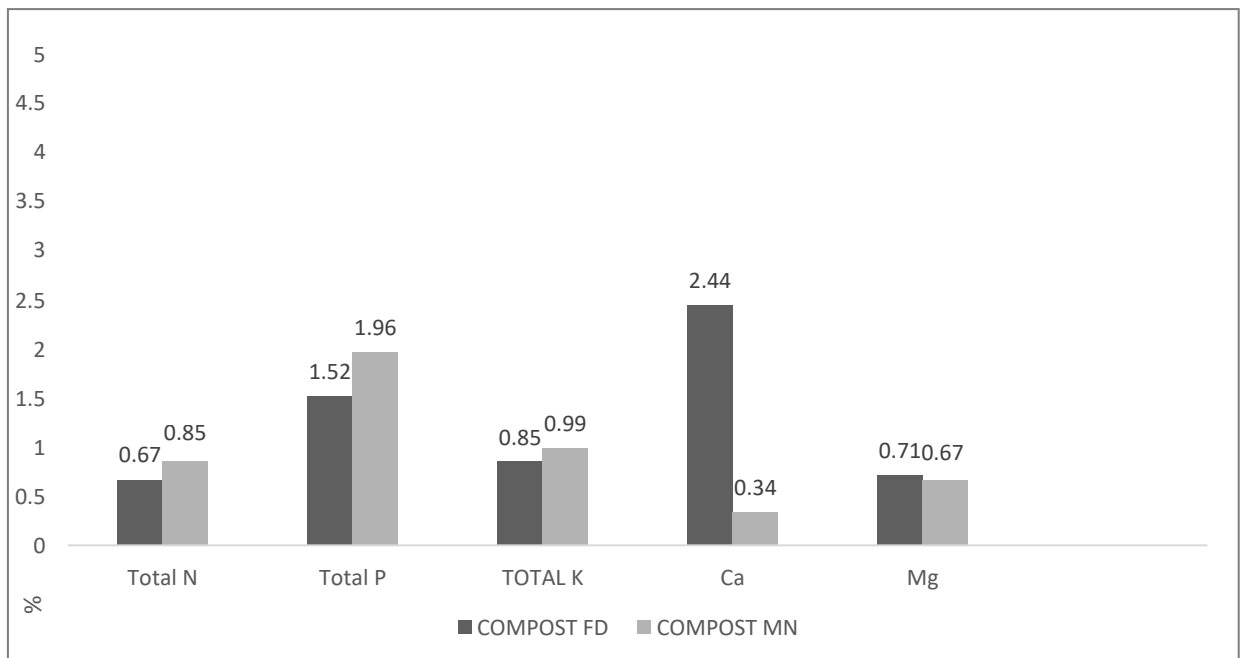
5.Results and Discussion:

	unit	COMPOST MN	COMPOST FD	Acceptable limit for compost
pH	-	5.50	7.30	6.5-7.5
Electrical conductivity	-	4300	3500	Less than 4000
moisture	%	47.03	45.49	-
Organic carbon	%	25.98	23.85	Minimum 12
Total nitrogen	%	0.85	0.67	Minimum. 0.8
Total phosphate	%	1.96	1.52	Minimum 0.4
Total potassium	%	0.99	0.85	Minimum 0.4
Zinc (Zn)	mg/kg	60.63	59.96	Less than 1000
Copper (Cu)	mg/kg	15.27	18.83	Less than 300
Iron (Fe)	mg/kg	2588.53	7191.70	-
Manganese (Mn)	mg/kg	76.67	156.19	-
Magnesium (Mg)	%	0.67	0.71	-
Calcium (Ca)	%	0.34	2.44	-
C:N ratio	-	31:1	37:1	-
Particle size	%	100	100	At least 90%
Bulk density	g/cc	0.48	0.40	Less than 1

Each compost meets the requirements to be characterized as good compost, based on the requirements limits stated by Biofertilizers and Organic Fertilizers in Fertilizer (Control) Order, 1985,

5.1 Graphical representation:

Graphs representing the difference in the concentration of macro and micro nutrients, in Compost FD and Compost MN



The quantity of macro and micro nutrients in a compost is main indicator reflecting, the quality of the compost.

The difference in the concentration macro and micro nutrients isn't significant, Ca is the only micro nutrient showing a considerable amount of difference, it is obvious

because Compost FD has kitchen waste, other primary macro nutrients like N, P, K doesn't show a significant difference

Other parameters like pH, Electrical conductivity and moisture didn't show that much of a difference as well, compost FD is more alkali than compost MN, that should be due to presence of more calcium (Ca),

Phosphorus is the considerably more than the other two macro nutrients, hence these can help plants grow strong roots, improve flowering and seed growth, phosphorus (P) also play a major role in energy transfer (carbohydrate and fat metabolism). the availability of phosphorus is said to be increased (Amlinger, F, 2003) over time, since we are considering total concentration for N, P and Amount readily useable form of nutrients like NO_3^- , NH_4^+ , HPO_4^{2-} , H_2PO_4^- , K^+ , is quite low.

Carbon nitrogen ratio is good and close to optimal ratio 30:1, because High nitrogen concentration starts to produce ammonia gas, and gives a bad odour to the compost. Concentration of mg pretty low in both the compost, because Mg is a secondary macro nutrient and a major component of chlorophyll, low concentration of Mg can affect the growth of plants

Overall, the concentration of macro and micro nutrient isn't too high or too low, moderate amount of nutrients are present, in the compost produced by Bsfl

CHAPTER 6

6.Summary and conclusion

The main objective of stating the better feed based the concentration of nutrients and other parameters is irrational since there isn't any significant difference in the concentration of the of the nutrients. A considerable amount of increase is only seen with Mn and calcium, calcium concentration in Compost FD is probably due to the leafy vegetable waste or egg shell in the kitchen waste. manganese and calcium do Have a vital role in plant growth like calcium deficiency in plants causes, if this had showed significant difference in concentration of nutrients, different feed can produce nutrient specific compost. For example, if manure compost shows high conc. of nitrogen then they can be used to make nitrogen rich compost. this can be highly useful different plants require different amounts macro and micro nutrients. Compost with low concentration of nitrogen can be given to plants which has a lot

of leaves but aren't flowering, compost with high concentration phosphorus can be given to plant for better root growth.

But it turns all organic feed produce similar macro nutrient concentration especially (N, P, K), some secondary macro nutrient and micro nutrients showed a significant difference in in concentration like Ca which shows a difference of 2.04% and Mn which shows 76.52 mg/kg difference but quality cannot be defined only by two nutrients

Compost also shows a high concentrating of iron which can be toxic to some plant, mixing the compost with soil can compensate for the high concentration iron

Overall, the concentration of macro and micro nutrient isn't too high or too low, moderate amount of nutrients are present, in the compost produced by Bsfl

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