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Evaluation of Physical and Chemical Properties of Coffee Pulp for its Potentiality as Soil Fertilizer

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Abstract—*The main objective of this paper was to study the physical and chemical properties of coffee pulp as it contains a high concentrations of biodegradable organic compounds and minerals of plant origin that can be better utilized by composting with other organic materials and can be used as a growth media substitute. It differs in chemical composition according to the production site, the coffee variety, the treatment type and the stage of the maturity of the fruit. These properties include water holding capacity, porosity, bulk density, moisture content, pH, total organic carbon, total nitrogen, total phosphorus, total potassium and C/N ratio and evaluation of these properties indicate the potential ability of coffee pulp to be used as soil fertilizer and conditioner.*

Keywords*: Coffee pulp, moisture content, bulk density, porosity, C/N ratio.*

1. INTRODUCTION.

Coffee is one of the major plantation worldwide and it is most popular beverages is consumed by millions of people all over the world (Patricia E and Víctor M.J, 2012). coffee need considerable amount of water during processing for receiving the cherries. the pulp, and sorting and re-passing any cherries with residual pulp adhering to them. The Coffee pulp is one of the principal byproducts of wet processed coffee which comprises about 40% of the wet weight of the coffee berry. The improper disposal of waste is a major concern as it acts as a pollutant along with the huge amount of water used in the coffee pulp production. Even though the coffee wastewater originated from the traditional coffee processing is a valuable resource. (Dejen et al., 2015). The coffee husks, peel and pulp, which comprises nearly 45% of the cherry, are one of the main by-products of coffee agro-industry and might be a valuable material for several purposes (Patricia E and Víctor M.J, 2012) because the coffee pulp rich in organic matter. one must analyze its physical and chemical properties which help to know the proportions to be added to other organic residues to get a growth media substitute for adequate plant growth. in order to exploit its agricultural potential and to reduce the pollutant load in the environment.

Fig. 1. Coffee pulping machine in the pulping process.

Fig. 2. Waste pulp is coming out of the unit after the pulping process.

2. MATERIALS AND METHODS

2.1. Sample Collection

Coffee pulp was collected from the coffee plantations from Sakleshpur, Hassan, Karnataka.

2.2. Sample Preparation

To prepare the homogenous sample, the dried pulp residues were ground through three types of sieves, a coarse sieve (12.7 mm) and a 20-mesh sieve (0.85 mm) on a medium size. The coarse ground samples were then reground through a 40-mesh sieve (0.425 mm) in order to narrow the range of particle.

2.3.. Physical properties

2.31. Moisture Content

To determine the moisture content, the popular method is oven-drying method. A large aluminum dish was weighed using a digital balance. Then the ground sample was placed in the dish and both the dish and sample were weighed. The dish and sample were then placed in an air-forced drying oven and kept at 105°C until a constant weight was achieved. The dish containing the dried sample was cooled to the room temperature in a desiccator and then weighed. The moisture content was calculated on a wet basis as follows:

$$MC=\frac{(WW-DW)}{WW}x100$$

Where,

MC= Percentage of moisture content

WW=Wet weight of the sample and dish(g)

DW=The dry weight of the sample and dish(g)

Initial and final moisture content of the coffee pulp after 15 days of drying time was found as follows as in the **Table 1.**

2.32. Bulk Density

The bulk density was determined by filling a sample into a 1000 ml measuring cylinder. By dividing weight of filled sample with the cylinder volume, bulk density was obtained. The bulk density of the sample was calculated from the following equation:

$$\text{Bulk density}=\frac{(W_2-W_1)}{V}, \quad [1]$$

Where,

W_2= Weight of the measuring cylinder and sample

W_1= Weight of the measuring cylinder

V= The volume of the measuring cylinder

The average bulk density of coffee pulp was found to be 0.25g/cm^3.

2.33. Porosity

It is the value used to describe how much void space is present in a given sample of coffee pulp. Porosity of coffee pulp can be determined by the following simple method:

First about half of 100ml graduated cylinder was filled with the coffee pulp sample and tap the cylinder to settle the sample. Now record the volume. Now take out the sample from the cylinder and set it aside. Fill the graduated cylinder to the 70ml level with water. Now add the sample that was kept aside to the cylinder slowly. Stir and then let stand for 5-10 minutes to allow bubbles to escape. Record the final volume of this mixture. The porosity was calculated from the following equation [1]:

$$\text{Porosity (\%)} = \frac{Vi-Vf}{Vs} x100$$

where,

P = Porosity of the sample (%)

V_i= (volume of sample + volume of added water)(ml)

V_f= The final volume of the sample and added water(ml)

V_s = The volume of the sample(ml)

The average porosity of sun dried and grounded coffee pulp was found to be 65%.

2.34. Particle size

The particle size was determined by conventional sieving. The particles collected in each sieve were weighed(1).

The average particle size of sun dried and grounded coffee pulp was found to be 0.67mm.

The physical properties of coffee pulp is summarized in the **Table 1.**

2.4 Chemical properties

Total nitrogen (TN) was determined by Kjeldahl digestion (Bremmer and Mulvaney, 1982)).

Total organic carbon (TOC) by the dry combustion method at 540 ◦C for 4 h according to Abad et al. (2002).

The Electrical conductivity and pH were analyzed in a 1:5 (v/v) water extract using a glass electrode according to Rayment and Higginson (1992).

Potassium (K) was determined by atomic absorption.

Phosphorus (P) was determined calorimetrically following the Murphy and Riley (1962) method.[1,7]

3. RESULTS AND DISCUSSION

The physical parameters of coffee pulp were determined and presented in table 1. The result showed that the moisture content of coffee pulp was found to be 8.9%. The bulk density

, average porosity and particle size was not changed during storage period but the bulk density decreases drastically during storage period that is very beneficial for composting.

Table 1: Physical analysis of coffee pulp

Parameters	Values
Moisture content (%)	8.9 %
Bulk density (gm/cm^3)	0.25
Average porosity (%)	65
Average particle size (in mm)	0.6

As a mulch and organic substitute, the coffee pulp exhibit a good water holding capacity to sustain plant life during dry periods. As it has less bulk density and porosity and rich organic matter it retains a good amount of water. As per research conducted by Gloria Sanchez, Eugenia J. Olguin and Gabriel Marcado, (Global Environmental technology) pp 199-209, when it is composted with other organic agricultural residues it creates a better environment for the roots of the plants by improving soil texture, porosity and water holding capacity.

Table 2: The chemical analysis of samples of fresh pulp:

Parameters	Values
Nitrogen (%)	1.2
Organic carbon (%)	53.6
Phosphorus (%)	1.2
C/N ratio	26.8
Potassium (%)	58
pH	4.6

Table 3: The chemical composition of samples of dry coffee pulp (sun dried)

Parameters	Values
Nitrogen (%)	1.9
Organic carbon (%)	48.4
Phosphorus	1.3
C/N ratio	24.4
Potassium (%)	53
pH	5.2

This experimental study was carried out to determine physical and chemical properties of coffee pulp to be used as organic matter in preparing composting. The obtained results indicate that the bulk density of 0.25gm/cm^3, C/N ratio of 24:1, and average porosity of 65% makes it a very ideal organic matter for a speedy decomposition. At this C/N ratio the decomposition of pulp along with other additives such as cow dung, saw dust and such organic matters does not produce stinky pile and the microbes never find deficiency of nitrogen. With acidic pH in the range of 4.7 to 4.9, coffee pulp could be used for substrate production, bearing in the mind that the acidity of the final substrate must be adjusted as ideal pH range for seedling production would be between 5.4-6.5. The chemical parameters listed above also indicate that contains the major nutrients required for the plant growth.

The wet processing of coffee pulp production generates huge amounts of organic and nutrient rich coffee pulp and waste water that can be recycled wisely.[5,6].

Amendment of topsoil with 20 % of coffee pulp compost by volume has resulted in the improvement of physicochemical and biological properties of soil that enhanced the plant growth and yield attributes, indicating the potential use of composted coffee pulp on the field as an alternative source of bio-fertilizer to improve the organic carbon content of poor soils in Ethiopia [2,5].

Coffee pulp composted with grass while making compost enhanced the yield of tomato and reduced the dependence on chemical fertilizers[3].

4. CONCLUSION

Coffee pulp is slightly toxic for the environment if not disposed of or composted properly. As it is a nutrient-rich material which is relatively high in nitrogen and potassium among other beneficial organic qualities required for the plant growth and it can replace chemical fertilizers if it is composted with other agricultural organic wastes. However, we need to investigate the effects of substituting commercial growth media with different rates of coffee pulp on other commercially important crops.

REFERENCES

[1] El-Sayed G. Khater, Chemical and physical properties of compost, International journal of waste resources, 2015,

[2] Kassa H., Workayehu T. Evaluation of some additives on coffee residue (coffee husk and pulp) quality as compost, Southern Ethiopia. International Invention Journal of Agricultural and Soil Science. 2014; 2(2):. 14-21

[3] Gezahegn B, Kikre Lemessa and Mulatu Wakjira, Exploring the suitability of coffee pulp compost as growth media substitute in green house production, International journal for agricultural research, 2011; 6(3): 255-267

[4] Mihret Dananto Ulsido, Meng Li, Effect of organic matter from coffee pulp compost on yield response of chickpeas (Cicer arietinum L.) Engineering for rural development, 2016; 1339-1347

[5] Patricia E and Víctor M.J, Functional properties of coffee and coffee by-products, Food Research International, 2012; 46(2): 488-495.

[6] Dejen Yemane Tekle1, Abebe Beyene Hailu, , Taffere Addis Waste and , Azeb Gebresilassie Tesema, Effect of coffee processing plant effluent on the physicochemical properties of receiving water bodies, Jimma zone Ethiopia American Journal of Environmental Protection, 2015; 4(2): 83-90.

[7] AACC American Association of Cereal Chemists., Approved methods of the American Association of Cereal Chemists, 10th (ed), St. Paul, 2000.