Effect of Drying on Vermicompost Macronutrient Composition

M. M. Manyuchi., A. Phiri., P. Muredzi, N. Chirinda

Abstract*— Vermicomposting is widely being used for bio-conversion of organic wastes into bio-fertilizers. Vermicompost which was obtained from various food wastes was dried at 105◦C for 5 minutes in a moisture analyzer. The dried vermicompost macronutrient composition was analyzed and quantified over the raw vermicompost. The dried vermicompost total nitrogen content was 31.25% lower as compared to the raw vermicompost whereas , the phosphorous and potassium content were 63.75% and 72.86% higher in the dried vermicompost compared to the raw vermicompost respectively. Vermicompost can be dried for easier packaging, storage and transportation as the drying process in overall enhances nutritional value to the vermicompost.

Key words*— Drying, earthworms, food wastes, nutrient composition, vermicompost

I. INTRODUCTION

Vermicomposting technology is widely being used as solid waste management strategy [1]-[13]. Vermicomposting is the bioconversion of any organic waste into vermicompost and vermiwash by the use of earthworms [1]-[13]. Earthworms feed on the organic waste into their gut whereby the waste goes through a bio-conversion process by the action of enzymes within the earthworm gut [1]-[13]. The organic waste is then expelled as vermicompost which is also termed vermicasts [2], [10]-[11]. The vermicompost and vermiwash are rich in fertilizer macro and micronutrients such that they can be used as bio-fertilizers [4]. To date, vermicompost has been applied as a bio-fertilizer in its raw form [3], [5], [8]. This has challenges in terms of storage and packaging for sale especially when there is mass production of vermicompost. This study therefore focused on the possibility of drying vermicompost as a storage measure for use and application at medium to large scale ventures. Furthermore, the macronutrient composition of the raw and dried vermicompost was quantified.

II. MATERIALS AND METHODS

A. Materials

Vermicompost was obtained from vermicomposting various food wastes using Eisenia Fetida earthworms. Eisenia Fetida earthworm species are an epigeic earthworm species which is ideal for vermicomposting [1].

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The food wastes and earthworms were allowed to undergo through the vermicomposting process in a vermi-reactor described in detail by Manyuchi *et al.*, [1]. In addition, vermiwash, which is a leachate, was continually collected during this vermicomposting period. A trommel screen earthworm separator was used for efficiently separating the vermicompost from the earthworms before drying [10].

B. Methods

The various food wastes were vermicomposted over 30 days. 5g of vermicompost was then dried using an AND moisture analyzer from a moisture content of around 50% to moisture content of 25% for 2 minutes at 105◦C. When considering pelletizing and packaging of bio-fertilizers a 25% moisture content is recommended. The moisture content in the vermicompost sample was determined according to Equation 1:

$$\%\ Moisture\ content = \frac{Initial\ vermicompost\ mass - Final\ vermicompost\ mass}{Initial\ vermicompost\ mass} X\ 100\%$$

The ammonical, nitrogen, phosphorous and potassium nutrient composition of the raw and dried vermicompost was analysed and compared. The vermiwash from food wastes nutrient composition is given in [11]. The nitrogen content was measured by the Kjeldahl method (AOAC-920.87), whereas the phosphorus content was measured by the Gravimetric Quimociac method (AOAC-962.02) and the potassium content was measured using a Shimadzu 6800 atomic absorption spectrophotometer.

III. RESULTS AND DISCUSSION

The raw vermicompost obtained was dark brown in color and odorless (see Fig 1)

Fig 1: Raw vermicompost from food wastes

Fig 2: Dried vermicompost from food wastes

Fig 3: Vermiwash obtained from food wastes

A. *Variation in the ammonical and composition*

The ammonical composition decreased by 31.25% upon drying of the vermicompost as compared to the raw vermicompost (see Fig 4). Furthermore, the nitrogen composition decreased by 31.25% upon drying of the vermicompost as compared to the raw vermicompost (see Fig 4). The decrease in the moisture content from the raw to dried vermicompost lowers the microbial activities hence the food wastes can no longer be decomposed hence the reduced ammonical nitrogen content [14]. Furthermore, the absence of either earthworms or cocoons that have a potential of progressing with the vermicomposting process naturally stops the microbial process hence lowered ammonical and nitrogen compositions [15].

B. *Variation in the phosphorous composition*

The total phosphorous content increased by 63.75% upon drying of the vermicompost as compared to the raw vermicompost (see Fig 4). Abbey *et al.*, [ref] indicated a 39.8% increase in the total phosphorous content upon oven drying vermicompost and strongly indicated that dying does not affect the quality parameters of the vermicompost. Instead, drying of the vermicompost promoted mineralization and nutrient release from dead cells and micro-organisms hence the increased phosphorous content on drying [16].

C. *Variation in the potassium composition*

The total potassium content increased by 72.86% upon drying of the vermicompost as compared to the raw vermicompost (see Fig 4). Abbey *et al.*, [16] indicated a 45% increase in the total potassium content upon oven drying vermicompost and strongly indicated that dying does not affect the quality parameters of the vermicompost. Instead, drying of the vermicompost promoted mineralization and nutrient release from dead cells and micro-organisms hence the increased potassium content on drying [16].

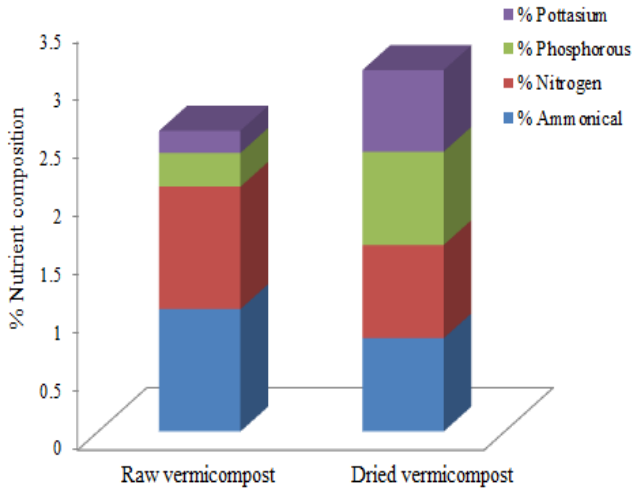

Fig 4: Raw and dried vermicompost nutrient composition

The decrease in the total nitrogen content due to the drying of the vermicompost is outweighed by the significant increase in the phosphorous and potassium content upon drying (see Fig 4). Henceforth, drying of the vermicompost is recommended especially for easier storage, package and packaging issues at large scale operations.

IV. CONCLUSION

Vermicompost can be dried and packaged for easier storage and transportation. Drying the vermicompost has a positive impact on the vermicompost phosphorus and potassium content due to mineralisation and nutrient release from the dead cells from the drying process. However, the absence of microbial activity in the vermicompost due to drying results in lowered nitrogen content.

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