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Production, Nutritional Analysis, Properties and uses of Vermiwash: A Review

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Abstract: The use of agrochemicals is increasing continuously despite their potential environmental and toxicological risks. To save the environment and human health from the harmful effects of agrochemicals, vermitechnology can be used as a useful tool. Vermitechnology employs epigeic earthworms to convert organic waste into nutrient-rich vermicompost, vermicast, vermiwash, etc. Vermiwash is a collection of wash of earthworms and extract of vermicomposting culture media densely populated by earthworms. It is an extract of vermicompost and coelomic fluid of earthworms. Despite being rich in primary plant nutrients it has antimicrobial properties and suppresses insect pest infestation. It contains heterotrophic, nitrogen-fixer bacteria, mucus, vitamins, and plant hormones. It is a non-hazardous, less expensive, eco-friendly liquid bio-fertilizer that can be used as a foliar spray. The present article reviews the production techniques, nutritive values, properties, and uses of vermiwash.

Keywords: Agrochemicals, Vermitechnology, Vermicompost, Vermiwash, Earthworms

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Introduction

Excessive use of synthetic fertilizers and pesticides to increase food production for growing populations adversely affected agricultural ecosystems. Continuous use of fertilizers and chemicals for the protection of crops from pests, diseases, and weeds has weakened soil health. In recent decades vermitechnology has emerged as a tool to solve the problem of waste management, the use of chemicals in agriculture, loss of productivity of agricultural land, and environmental pollution. Vermitechnology is a technique that exploits earthworms to produce valuable vermicompost and vermiwash. It is a liquid fertilizer, collected by passing the water through the column of live earthworms being cultured in a media containing cow dung and organic waste. It is a drainage collection of vermiculture columns. Vermiwash comprises

earthworm's excretory products, coelomic fluid oozing through dorsal pores, enzymes, and mucus. Vermiwash is a liquid leachate produced by passing water through a vermicomposting substrate which is densely populated by earthworms. It contains washable nutrients of vermicast and biomolecules present on the surface of earthworms. It is a vermicast extract containing plant growth hormones, and plant nutrients particularly soluble potassium, calcium, and magnesium. Besides being rich in plant nutrients, it also contains nitrogen-fixing bacteria, phosphorus-solubilizing bacteria, and plant hormones auxin, and cytokinins. Vermiwash increases resistance against viral, bacterial, and fungal infections in plants (Kale *et al*., 1986). It also significantly increases plant growth and crop yield (Meenatchi *et al*., 2010).

Principle of Vermiwash preparation: Earthworms form burrows in the soil. These burrows are known as drilospheres which have high microbial activities. The term drilosphere was coined by Bouche (1975) for a zone up to 2 mm around the burrow wall of earthworms. Lavelle (1988) included in drilosphere earthworm populations, microbes, and invertebrates of the soil volume under the influence of earthworms. Drilospheres also contain the secretory and excretory products of earthworms. Earthworms also produce vermicast which is rich in bioavailable nutrients. When water passes through the earthworm-influenced column, nutrients, microbes, hormones, and enzymes are washed away with water. This clear transparent nutrient-rich bio-fertilizer is collected at the bottom of the barrel or column and is known as vermiwash.

Materials for Vermiwash Unit:

(1) *Materials*: For the establishment of a vermiwash unit at a domestic level a barrel of 50 - 200 liter capacity (Fig. 1) with a tap at the bottom can be used. For a barrel of 50-litre capacity, Bricks pieces (15 mm-20 mm), Pebbles (15 mm-20 mm), Coarse sand, Garden soil, 15 kg of 20-25 days old cow dung, 2-3 kg of dry leaves or straw are required.

(2) *Earthworm*: Earthworms (Fig. 2) are terrestrial detrivorus annelid invertebrates found in diverse habitats and bring physical and chemical changes in soil. Earthworms increase the fertility of soil through their activities (Lalitha *et al*., 2000). Earthworms decompose organic matter by feeding, fragmenting, and aeration (Shuster *et al*., 2000). Aristotle referred to earthworms as - The intestines of earth (Shefali and Gupta, 2020). Epigeic earthworm species, *Eisenia foetida* (Red wiggler), *Eudrilus eugeniae* (African night crawler), *Perionyx excavates* (Indian blue worm), and *Lumbricus rubillus* (Red worm) are commonly used for the preparation of vermiwash. Food for these species comprises 90% organic waste and 10% soil. Among the epigeic earthworm species, *Eisenia fetida* is commonly used to prepare vermiwash and vermicompost. It is due to its rapid reproduction potential and capacity to withstand a wide temperature range of 0 to 36°C.

(3) *Culture medium*: A mixture of cow dung and organic waste can be used as a culture medium for earthworms. For the value addition of the vermiwash, leaves of *Azadirachta indica* (Neem), *Aegle marmelos* (Bel patra), *Murraya koenigii* (Curry tree), and leaves of other useful plants are used. Culture medium (Cow dung and organic waste) should be 20- 30 days old.

Procedure for Vermiwash preparation: According to Kale (2006), real vermiwash is prepared by washing earthworms in lukewarm water. Half a liter of lukewarm water is needed to wash half a kilogram of earthworms. Earthworms are washed for about 35 sec in lukewarm water so that coelomic fluid oozes out through dorsal pores. Then earthworms are immersed in water at room temperature. Then water in both containers is mixed to get vermiwash. According to Gopal *et al.* (2010), Vermiwash can be produced by two methods. In the first method to collect vermiwash, earthworm substrate, cow dung, and soil are soaked in water. In the second method, earthworms are agitated in lukewarm water so that they release body fluid and mucus which is said true vermiwash. For domestic and

Fig. 1: Materials for vermiwash unit.

Fig. 2: Earthworms.

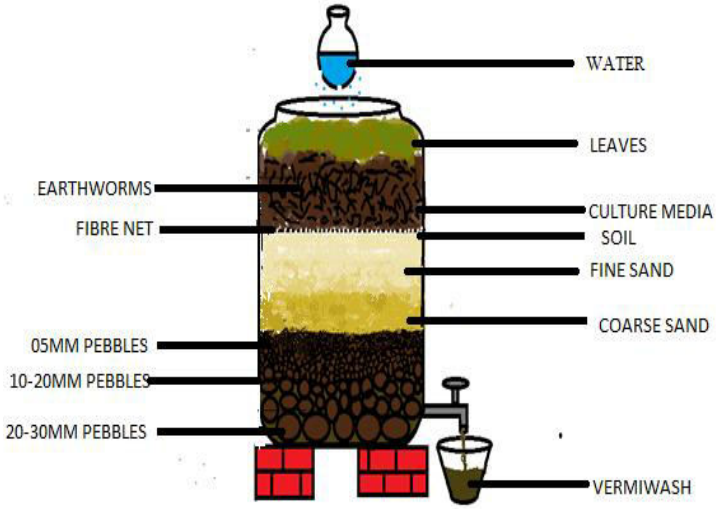

Fig. 3: Vermiwash unit.

commercial use vermiwash is prepared by setting up of vermiwash unit. A vermiwash unit consists of a column containing active living earthworms, micro-organisms, organic wastes, cattle's dung, soil, fiber net sheet, sand, gravel, or brick pieces. The lower 60% portion of the column contains a natural filtration system, while the upper 40% portion contains culture media which is a mixture of cattle's dung, organic waste, and leaves. The upper portion contains culture medium and earthworms almost in equal ratio by weight. The following steps are followed for the preparation of vermiwash from a vermiwash unit made of a barrel (Fig. 3) of 25-inch height:

(1) The basement layer of the vermiwash column is made from a 3-inch thick layer of gravel or pieces of bricks of size 20 mm-30 mm.

(2) A layer of 3-inch thickness made up of pebbles of 10 mm-20 mm is spread over the basement layer.

(3) The third layer of 3-inch thickness is made up

Table 1: Nutrients and microbial content of vermiwash

S. No.	Parameters	Content
1	pH	7.39-7.50
2	Electrical conductivity (EC)	0.008±0.001
3	Organic carbon (%)	0.025±0.03
4	Phosphorus (%)	1.70
5	Nitrogen (%)	0.01-0.001
6	Magensium (ppm)	160
7	Potassium (ppm)	26
8	Calcium (ppm)	03
9	Manganese (ppm)	0.60
10	Zinc (ppm)	0.02
11	Iron (ppm)	0.06
12	Copper (ppm)	0.01
13	Total fungi (cfu/ml)	1.46×10^3
14	Total heterotrophs (cfu/ml)	1.79×10^3
15	Nitrobacter (cfu/ml)	1.12×10^3
16	Nitrosomonas (cfu/ml)	1.01×10^3

Source: Nayak *et al*. (2019); Meena *et al*. (2021)

of pebbles of 4 mm-6 mm size.

(4) The fourth layer of 2-inch thickness is made up of coarse sand.

(5) The fifth layer of 2-inch thickness is made up of fine sand.

(6) A fiber mesh net is spread over the fine sand to prevent the movement of earthworms into the filtration system.

(7) A layer of garden soil of 2 cm thickness is spread over the net.

(8) The remaining half part of the column is filled with culture medium.

(9) Add two litres of water daily in the unit for 10 days keeping the tap open.

(10) After 10 days put earthworms in the unit almost equal to the weight of culture media.

(11) Cover the unit with a layer of straws or leaves.

(12) Sprinkle water drop by drop in the unit with the help of a hanging pot.

(13) A radish-brown liquid is collected at the bottom of the unit, which is known as vermiwash.

Properties of vermiwash: Vermiwash (Table 1) had low pH and electrical conductivity compared to vermicompost. Vermiwash also had a low content of nitrogen and potassium in comparison to vermicompost but the content of magnesium and calcium was found higher. Vermiwash was found rich in plant growth hormones like gibberellins, cytokines, and vitamins along with micro and macronutrients (Buckerfield *et al*., 1999). Vermiwash shows bio-pesticide properties and toxicity against insect pests. Vermiwash possesses plant growth promoters and biopesticides properties. (Sundararasu and Jeyasankar, 2014). Vermiwash is rich in manganese, zinc, copper, iron, and other elements (Zarei *et al*., 2018). Many useful micro-organisms such as heterotrophic bacteria, and fungi are present in vermiwash (Deepti *et al*., 2021). Vermiwash showed potentiality in seed germination and seedling vigor (Chattopadhyay, 2015). Organic formulations with neem oil could reduce pest and disease infestation (Verma *et al*., 2016). Chatterjee *et al*. (2020) reported that the microbes found in the vermiwash provide the soil with more potassium ions.

(1) Antifungal properties: The peptides present in mucus inhibit the growth of pathogenic fungi in soil (Liu *et al*., 2004; Li *et al*.,, 2011).

(2) Disease suppression: The rich microbial content of vermiwash hinders the development of

plant diseases (Mehta *et al*., 2014). Microbes of vermiwash compete with pathogens for food, and space and inhibit the growth of pathogens by parasitizing and producing antimicrobial compounds (Naseri, 2019).

(3) Pest suppression: Vermiwash contains peptides lysenin, lumbricin-I, and fetidin which help in the suppression of pests and pathogens (Vaillier *et al*., 1985; Gupta and Yadav, 2016).

(4) Rhizobial nodulation in the roots of legumes: Vermiwash promotes nodulation in the roots of leguminous plants (Kasahun Gudeta *et al*., 2021).

Uses: Farmers are not getting proper yield by using organic manure. Liquid manures are getting more and more relevant, because foliar application of liquid manures provides twenty times faster nutrients to plants. Foliar application of liquid manure is beneficial when soil is deficient in nutrients and when quick response is desired. 10% solution of vermiwash in water is usually used as foliar spray. Foliar feeding supplies plant nutrients timely and compensates soil nutrient deficiencies. Plants can absorb nutrients through leaves. Foliar spray supplies nutrients to plants through leaves. Applying vermiwash through the soil drenching technique supplies plants with useful microbes that help in nitrogen fixation, mycorrhizal association, phosphate, and potassium solubilization. Vermiwash can also be used as a pest control agent by mixing vermiwash with 10% cow's urine.

Conclusion

Vermiwash is a collection of watery extract of compost and wash of earthworms. Vermiwash is a plant tonic containing several microorganisms, actinomycetes, hormones, enzymes, and plant nutrients. Soluble nitrogen, phosphorus, and potassium are the main nutrients of vermiwash. Useful microbes such as heterotrophic bacteria, fungi, and actinomycetes including nitrogen fixers, and phosphate solubilizers are present in vermiwash. The chemical composition of vermiwash varies with the types of substrate used in culture media. It is a bio-fertilizer that is completely organic and free from harmful chemicals. It acts as a plant tonic due to its plant growth promoter properties. it is used as foliar spray which saves plants from diseases and pests.

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