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Comparative Study of Zooplankton Production Using Vermicompost And Vermiwash

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ABSTRACT
The present peculiar research is an attempt put forward to study the physico-chemical parameters of water and to study the zooplankton diversity and to evaluate the difference between the presence of zooplanktons diversity in vermicompost and vermiwash. Different parameters of water such as temperature, pH, nitrates, phosphates, sulphates, Dissolved oxygen, BOD, COD is calculated. Then, the qualitative and quantitative analysis of zooplankton diversity was evaluated. The data formed between morphology of zooplankton versus physico-chemical characteristics of the plankton community were subjected to statistical analysis through linear regression and one-way ANOVA. The research revealed thattemperature, pH, Electrical conductivity (EC), DO, BOD and COD of water with addition of vermicompost and vermiwash resulted in different numbers. The comparative significance after addition of different manures showed vermicompost non-significant with vermiwash and significant with control. Then, estimation of zooplankton numbers in vermicompost and vermiwash gives an output of a significant increase in the population, which is then correlated with linear regression and one-way ANOVA test. In conclusion, the results indicate that the use of vermicompost and vermiwash showed good results of zooplanktons species. Among the different manures, the highest number of zooplankton was recorded with addition of vermiwash followed by vermicompost, which shows that vermiwash not only provides nutrients to phytoplankton, it also provides optimum physical factors for zooplankton growth.
Key words: *Zooplankton, Physico chemical parameters, vermicompost, vermiwash*

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INTRODUCTION

Zooplankton are heterogeneous assemblage of free floating microscopic animals, it consist of various invertebrate groups, such as protozoa, rotifera, cladocera and copepoda. They play crucial role in the food chain and energy flow in the aquatic ecosystem through interlinking the autotrophs and heterotrophs. An ecosystem has a biological community that happens with physical and chemical factors that make up the whole nonliving or abiotic environment (1). There are many examples of ecosystems such as pond, lake, forest, estuary and grassland. The word plankton is the common term for a large and heterogeneous group of organisms (from Greek, drifter, wanderer). This category includes bacteria, virus, single celled animals (microzooplankton), single celled algae (phytoplankton) and multicellular animals (mesozooplankton) such as copepods, small medusa, krill and fish larvae. Conventionally, competition, nutrient limitation, predation and abiotic factors were assumed to shape phytoplankton community structure in marine and freshwater ecosystems (2).

Zooplankton abundance clustering and biomass thus water quality influences. Water quality generally involves analysis of physic chemical, biological and microbiological parameters and reflects on abiotic and biotic status of the ecosystem. Most of the species are cosmopolitan in distribution (3). The supply of zooplankton communities depends on several factors such as change of climatic conditions physico-chemical parameters and vegetation (4). Aquatic ecosystem is an extremely diverse ecosystem in the world. The primary life originated and evolved in the water forms and first organisms were also aquatic where the principal most external as well as internal medium for organisms. Aquatic system provides the food, water, shelter and space for the continued existence of aquatic animals and plants (5).

Earthworms possess the ability to condition the substrate to encourage microbial activity and decomposition. Substrates get broken down and surface area gets increased, this therefore hastens the process of waste processing."Vermiwash" has been tested for the production of live fish food organisms. Vermiwash is an essential part of vermicompost, which is a watery extract of earthworms. It is primarily a combination of mixture secretion and wash of earthworms, present in the medium, honey brown in colour. It is a nutrient rich liquid which is produced by earthworms, feeding on organic waste material and plants residues. It is also nontoxic and ecofriendly, which arrests bacterial growth and forms as a protective layer for their survival and growth. Vermiwash contains N, P, K, Ca and hormones such as auxin, cytokinins, some other secretions and many useful microbes like heterotrophic bacteria, fungi etc. (6).

MATERIALS AND METHODS

The physicochemical characteristics such as temperature, pH, electrical conductivity, nitrates, phosphates, sulphates, dissolved oxygen, biological oxygen demand, chemical oxygen demand of vermicompost and vermin wash were characterised using standard procedure.

Zooplanktons study

Qualitative Analysis of the Zooplankton

For qualitative analysis of zooplankton, water samples were collected by using plankton net with the help of an inverted microscope zooplanktons were studied

Quantitative Analysis of the Zooplankton

For the quantitative analysis of zooplankton 5 litre capacity plastic container. Immediately after filtering out the water, the plankton biomasses were transferred to polyethylene specimen bottles (100 mL) filled with 5% of formalin (10 mL), the aqueous solution of formaldehyde (7). The sample (1 ml) was taken with a wide mouthed pipette and poured into the counting chamber of the Sedgwick Rafter. After allowing it to settle for some time, they were counted. At least 5 such counting was made for each group.

Number of zooplankton was measured according to the formula reported by Boyd and Lichktoppler [8].

Number of zooplankton / ml = T x 1000 A x N x Vol. of concentrate in ml/ Vol. of sample

where,

T = total number of zooplankton counted

A = area of grid in mm^2

N = number of grids counted

1000 = area of counting chambers in mm^2

Data collected were analysed, using one-way analysis of variance (ANOVA). The data were subjected to statistical analysis through one-way ANOVA and correlation-regression which was represented in respective tables.

RESULTS

Temperature, pH and Electrical conductivity (Ec) of water with addition of vermicompost and vermiwash ranged from 25.33°C, 6.60 and 248.33,with addition of vermicompost to 26.17°C, 7.12 and 709.00 in control water samples (Figure 1), with significant p value 0.0115, 0.0172 and <0.0001 and f value 10.293, 8.615 and 1030.1 (Table 1).

Table 1: Temperature, pH and electrical conductivity of water after addition of different manures (S -Significant; ES – Extremely significant)

Experiments	Vermicompost	Vermiwash	Control	P value	F value
Temperature of water	25.33±0.29	25.17±0.29	26.17±0.29	0.0115[S]	10.293
pH	6.60±0.14	6.76±0.23	7.12±0.04	0.0172[S]	8.615
Electrical Conductivity (μm cm-1)	710.00±20.03	640.67±24.57	258.33± 5.51	< 0.0001[ES]	1040.1

Nitrates, sulphates, phosphates and silicates of water with addition of different manures ranged from 0.06 mg/ml, 0.57mg/ml, 6.28mg/ml and 1.17mg/ml with control to 1.38 mg/ml, 1.18mg/ml, 12.77mg/ml and 1.79mg/ml in addition of vermiwash, with extremely significant p value <0.0001(Table 2).

Table 2: Nutrients of water after addition of different manures (S -Significant; ES – Extremely significant)

Experiments	Vermicompost	Vermiwash	Control	P value	F value
Nitrates mg/ml	0.73±0.03	1.38±0.08	0.06±0.015	< 0.0001[ES]	521.02
Sulfate mg/ml	1.09±0.04	1.18±0.04	0.57±0.066	< 0.0001[ES]	129.16
Phosphate mg/l	10.87±0.34	12.77±0.35	6.28±0.207	< 0.0001[ES]	356.64
Silicate mg/l	1.65±0.07	1.79±0.03	1.17±0.031	< 0.0001[ES]	140.75

Dissolved oxygen of water with addition of different manures ranged from 4.21 in vermicompost addition to 5.26 in control (Figure 8), with extremely significant p value <0.0001 and f value 126.20. BOD of water with addition of different manures ranged from 4.39 in control to 7.56 in addition of vermiwash, with extremely significant p value <0.0001 and f value 565.56.COD of water with addition of different manures ranged from 11.03 in control to 21.75 in vermiwash, with extremely significant p value <0.0001 and f value 958.60 (Table 3).

Table 3. Dissolved oxygen, BOD and COD of water after addition of different manures (S -Significant; ES – Extremely significant).

Experiments	Vermicompost	Vermiwash	Control	P value	F value
Dissolved oxygen	4.21±0.10	4.36±0.07	5.26±0.09	< 0.0001[ES]	126.20
BOD	7.22±0.12	7.56±0.07	4.39±0.17	< 0.0001[ES]	565.56
COD	19.78±0.34	21.75±0.35	11.03±0.26	< 0.0001[ES]	958.60

Fifth day zooplankton count with addition of different manures ranged from 11.33 with control to 50.33 in vermiwash, with extremely significant p value <0.0001 and f value 282.44.Tenth day zooplankton count with addition of different manures ranged from 18.67 in control to 64.00 in vermiwash, with extremely significant p value <0.0001 and f value 387.89.Fifteenth day zooplankton count with addition of different manures ranged from 24.00 in control to 76.33 in vermiwash), with extremely significant p value <0.0001 and f value 370.25.Twentieth day zooplankton count with addition of different manures ranged from 33.00 with control to 95.00 in vermiwash, with extremely significant p value <0.0001 and f value 791.98.Twenty-fifth day zooplankton with addition of different manures ranged from 39.667 in control to 114.667 in vermiwash, with extremely significant p value <0.0001 and f value 446.31 (Table 4).

Table 4: Zooplankton dynamics in water after addition of different manures (S -Significant; ES – Extremely significant)

Types of Experiments	Days				
	5	10	15	20	25
Vermicompost	43.00±2.65	55.00±2.00	61.67±1.53	69.00±1.00	84.000±3.606
Vermiwash	50.33±2.08	64.00±2.65	76.33±1.53	95.00±1.73	114.667±3.055
Control	11.33±1.53	18.67±1.53	24.00±3.61	33.00±2.65	39.667±2.517
P value	**< 0.0001ES**	**< 0.0001ES**	**< 0.0001ES**	**< 0.0001ES**	**< 0.0001ES**
F value	**282.44**	**387.89**	**370.25**	**791.98**	**446.31**

DISCUSSION

The present research attempted to understand the zooplankton growth in the water in laboratory experiment when substituted nutrients through vermicompost and vermiwash which would substitute nutrients to the primary production of the systems which in turn influence the zooplankton growth through availability of food.Temperature plays a vital role in an aquatic system where it increases the metabolic rates of both phytoplanktons and zooplanktons. However, increase or decrease of temperature after certain levels decreases and increases the primary production which leads to reduced zooplankton growth (9). What so ever the temperature in the present study ranged between 25.17°C in vermiwash to 26.17°C in control other manures which are within the optimum temperature range of the aquatic systems. pH determines the availability of nutrients in the system where pH between 6.5 to 7.5 most of the nutrients are in the available forms which supports the primary production. In the present study the pH ranged from 6.6 in vermicompost to 7.12 with control addition which again within the optimum range however, addition of manures decreased the pH significantly compared to control samples which is without any addition. In general pH was expected to reduce in poultry manure addition since in the present context poultry sector uses maximum chemical medicine to the chicks the result of the present research with regard to pH was mainly due to humic acid formation. Electrical conductivity is one another important physical factor which determines the dissolved salts and solids which in turn an important parameter in fresh water ecosystems which also determines the growth of microbes which is an important mediator of nutrient conversion and mineralization. In the present research the electrical conductivity ranged from 248.33 in control to 709.00 in vermicompost treated which was more or less similar with addition of other manures however, this salinity within the optimum range of fresh water ecosystems.

Among the nutrients nitrates are an important macro nutrient which determine the growth of phytoplankton which in turn the zooplankton this ranged from 0.06mg/ml in control to 0.73mg/ml with addition of vermicompost. This shows that manures contribute extremely significantly higher nitrates cow manure in particularly extremely higher nitrates than the other goat and poultry manures. However, at some cases nitrates lead to blooming of phytoplanktons and eutropication which is not the situation in the present study since the quantity of nitrate is within the optimum range. Phosphates are important for aquatic production especially the zooplanktons which grow well at higher phosphate levels (10). In the present study the phosphate ranged from 6.28mg/ml in control to 12.77mg/ml with addition of vermiwash. Sulfate is one another important nutrient in the aquatic ecosystems which enhances the plankton's tissue growth at optimum conditions. The present research was able to estimate sulfate range from 0.57mg/ml in control to 1.18mg/ml with addition of vermiwash. Sulfate values were not very higher than the control significantly low with addition of poultry manure which is may be due to chemical used in the poultry units. Silicates are one another important element apart from phosphate which increases the zooplanktons in the freshwater ecosystems. Silicates in the present research increases with vermiwash ranged from 1.17mg/l to 1.79mg/l which is within the optimum concentration.

Dissolved oxygen (DO) is important factors that determine the zooplankton growth it also indicate the phytoplankton health [11]. Surface area exposed to the atmosphere, temperature and zooplankton vertical movement influence the concentration of DO. Temperature increase decreases the DO where as active zooplankton increases the DO. DO measurement showed decreased tread with addition of manures. This is due to increased chemical oxygen demand in the initial phase that is oxygen required to chemical reactions for oxidation reduction. The DO ranged from 4.21 with addition of vermicompost to 5.26 in control samples. Biological oxygen demand (BOD) significantly increased with addition of manures except the poultry manure which ranged from 4.39 to 7.56 in vermiwash. Addition of manure increases the nutrient concentration which enhances the biological activity hence increases in the BOD is seen. With addition of poultry manure due to their chemical nature it reduces the biological activity which leads to reduce BOD compared to control samples. COD also showed similar trend like BOD where the organic compounds under oxidation and reduction.

Estimation of zooplankton numbers periodically for 25 days showed significant increase in numbers after addition of manures and positively correlated with time. Among the different manures highest number of zooplankton was recorded with addition of vermiwash followed by vermicompost, this shows that vermiwash not only provides nutrients to phytoplankton it also provides optimum physical factors for zooplankton growth.

CONCLUSION

In conclusion, the results indicated that the use of vermicompost and vermiwash showed good results of zooplanktons species. Temperature of water, pH of water, Electrical conductivity showed high in vermicompost added treatment. The other nutrients such as Nitrates, Phosphates, Sulphates, Silicates was high in vermiwash treated. Dissolved oxygen, BOD, COD of water was also high in vermiwash treated water. Estimation of zooplankton numbers periodically for 25 days showed significant increase in numbers after addition of manures and positively correlated with time. Among the different manures highest number of zooplankton was recorded with addition of vermiwash followed by vermicompost, this shows that vermiwash not only provides nutrients to phytoplankton it also provides optimum physical factors for zooplankton growth.

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