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Assessment of Water Quality in Some Biodegradable and Non- Biodegradable Substrates Added Periphyton Systems

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Abstracts: ***The water is universal solvent. The physico-chemical properties of water has vital role in the aquatic ecosystem. The physico-chemical characters are fundamental for the development of aquatic organisms. The physico-chemical parameters determine the presence and absence of biota in an ecosystem. Substrates added water was found with more fluctuation in the parameters as compare to standard values of aquaculture. The biodegradable substrates have nutrient diffusing properties since these substrates uptake of phosphate, nitrates and sulphate from the substrates added water. Therefore the use of combination of substrates is suggested to improve quality of water as well as primary production of fresh water ecosystem.***

Keywords: Physico-chemical, Biodegradable, Non- biodegradable, water, periphyton

1. Introduction

The physico-chemical characteristics of water perform vital role in aquaculture; they have sympathetic effect on the diversity of living organisms present in an aquaculture system. The water controls the structural and functional processes in an ecosystem. The chemistry of water proves the presence, absence and types of biota. The biological composition of an ecosystem varies with difference in type of substrates added. Due to difference in the type of differentiation in their physico-chemical properties of substrate inoculated periphyton system necessary to understand the periphyton formation in the system [4]. Periphyton improves the water quality through oxygen production, organic matter break down, ammonium and nitrate uptake, and nitrification [1]. The freshwater ecosystem has self-purification ability through biological processes [2], which depends largely on the physiographic features of the pond and climatic conditions as wastes received and discharged are within the carrying capacity of the system [3].

2. Materials and Methods

2.1 Experimental set up for Biodegradable and Non-biodegradable substrates added systems in the laboratory conditions

The plastic trough size 38x23 cm and 40x25.5 cm on base side and top side respectively were selected, depth of the trough was 15 cm. Soil layer of 1 cm thick was put on the base of all troughs for providing nutrient in the periphyton system and then 125 gm Garden wastes- fish manure in all troughs was mixed with soil for proper growth of periphyton. The Biodegradable dried substrates like Cotton stem (N1), Sugarcane baggasse (N2), *Ipomoea sp*. stem (N3) and Non-biodegradable substrates like Stones (A1), Tyre rubber strips (A2) and Plastic bottle strips (A3) were submerged at the base of trough with one lit pond water as a culture water sample (cws). In to the cws nine lit bore well water was added to increase the water level in the trough. The tungston light bulb was provided to facilitate photosynthesis of growing periphyton. The experimental substrates were kept in the trough for 30 days standard protocol for experimental periphyton study was used [7].

2.2 Collection of water samples:

The initial water sample was collected after the addition of one lit pond water and nine lit bore well water at 0 day. After 30 days water samples were collected from substrates added experimental troughs with different substrates selected and mentioned as earlier and physico-chemical analysis of water was carried within 2-3 days after collection.

2.3 Physico-chemical analysis of water samples:

The physico-chemical parameter of water from substrate added periphyton system viz. temperature, pH, DO, Free Co2, TS, TDS, TSS, PA, TA, Total hardness, Ca hardness, Mg hardness, Sulphate, Phosphate and Nitrate were analyzed in the laboratory by following standards methods [5][8].

3. Results

The values of physico-chemical parameters of water samples collected from the experimental and control set of periphyton system is given in the Table No. 1.

4. Discussion

The periphyton is the primary productivity of an aquatic ecosystem and is an indicator of water pollution and it has direct impact on the health of cultured organisms in it. Hence physico-chemical parameters of the water samples were analyzed as initial and final reading for 0 days and 30 days for laboratory condition.

4.1 Temperature

The water temperatures in the experimental set was not having more fluctuation because same environmental temperature applied for all substrates for periphyton growth, temperature within the standard value [6] and this temperature was found accelerated the growth of periphyton.

4.2 pH

The pH of water samples from initial and biodegradable substrates added systems was in the acceptable standard limits but Non-biodegradable substrates were not in standard range of aquaculture limits for pH values. The pH was performing great role in the growth of crustacean and aquatic insect larvae [11].

4.3 Dissolved Oxygen (DO)

The DO content of initial water sample, Biodegradable substrates and Non-biodegradable substrates added water has permissible standard limit except WA2 that was not in range as compare to standard [6]. The DO content of water directly effect on the cultured organisms in the periphyton based aquaculture [10].

4.4 Free Co_2

The free Co_2 content of initial water was in the tolerable limit with standards; although both type of substrates added water with free Co_2 was absent. The Co_2 was utilized by the autotrophs in the system is reported by many authors [1].

4.5 Chloride:

The chloride content of initial water and all type of substrates added water was within the standard limit except from WN1 [6].

4.6 TS, TDS and TSS:

TS, TDS and TSS of initial water, biodegradable and Non-biodegradable substrates added water was not in the adequate range of standard excluding WN1 [6].

4.7 Phenolphthalein and Total alkalinity (PA and TA):

The PA of substrates added water from WN1, WN3 and WA2 was not in the range of aquaculture standards except these all other has permissible limit. TA of water samples from WN1, WN3, WA1 and WA2 substrate added system was found not in the range of aquaculture standards whereas the TA of water system was within the permissible limit from initial, WN2 and WA3 systems [6]. The water with more TA has high rate of photosynthesis and periphyton production.

4.8 Total, Ca and Mg Hardness

The total hardness of initial water has supportable value with standard but these values in all other substrates added water was not in the suitable range with standards. The Ca Hardness of initial water and biodegradable substrates added water was in the standard range but non-biodegradable substrates supplemented water the Ca hardness was not in the standard range. Magnesium hardness of initial water and all type of substrates inoculated water was within the range of standard except WN1.

4.9 Sulphate

The sulphate concentration of initial water and non-biodegradable substrates inoculated water was not in the range of aquaculture standards but biodegradable substrates having in the range [6].

4.10 Phosphate

The phosphate concentration of initial water and substrates inoculated water was not in given range of standard values except from WN2, WN3 and WA2 added water samples. The nutrients like phosphates promote the periphytic growth [9].

4.11 Nitrate

The nitrate concentration of water from all experimental sets was in the range of standard values [6]. The nutrients like nitrate concentration was higher in the sugarcane baggasse added water that played great role in the growth of bacteria [9].

5. Conclusion

In the present study it was concluded that the biodegradable and non-biodegradable substrates has mixed effects on the water quality for periphyton based experimental water system. Some parameters have improved the water quality for aquaculture but several parameters were highly affected owing to substrate inoculation in the water and due to addition of garden wastes-fish manure in it. Therefore it is essential to inoculate both types as biodegradable and non-biodegradable substrates in the same aquaculture system. The Biodegradable substrates have nutrient diffusing abilities since this substrate has uptake of phosphate, nitrates and sulphate from the substrates added water. Therefore it is suggested to use both the biodegradable and Non-biodegradable substrates in the combination to improve quality of water as well as primary production of fresh water ecosystem especially periphyton based aquaculture.

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Table 1: Physico- chemical analysis of Initial and biodegradable, non-biodegradable substrates added water in the periphyton systems maintained at laboratory conditions

Parameters	Initial water	Biodegradable Substrate growing Water			Non-Biodegradable growing water Substrate			*Standards
		WN1	WN2	WN3	WA1	WA2	WA3	
Temperature°C	27	25	25	25	25	25	25	25- 32
pH	7.37 ± 0.05	8.86 ± 0.04	7.87 ± 0.05	9.05 ± 0.01	9.11 ± 0.01	9.22 ± 0.01	9.34 ± 0.04	7-9
DO mg/lit	5.16 ± 0.47	6.66 ± 2.03	5.5 ± 1.14	7.83 ± 2.40	10.91 ± 0.57	2 ± 0.86	8 ± 1.14	5-15
Free Co_2mg/lit	5.99± 0.23	Nil	Nil	Nil	Nil	Nil	Nil	1-10
Chloride mg/lit	65.32 ± 2.84	103.22 ± 9.09	91.82 ± 5.91	76.68 ± 0	71 ± 2.84	59.64 ± 8.19	59.64 ± 2.84	1-100
TS mg/lit	1166.67± 1040.8	500 ± 500	1000 ± 500	3000 ± 500	1833.33 ± 577.35	2333.33 ± 866.03	2833.33 ± 1154.7	
TDS mg/lit	1166.67± 288.68	333.33 ± 288.68	500 ± 500	1166.67 ± 288.68	1000 ± 500	1500 ± 577.35	1333.33 ± 577.35	500
TSS mg/lit	Nil	166.67 ± 211.32	500 ± 0	1833.33 ± 211.32	833.33 ± 77.35	833.33 ± 288.68	1500 ± 577.35	500
PA mg/lit	Nil	491.67 ± 52.04	Nil	500 ± 25	258.33 ± 28.86	316.67 ± 125.83	250 ± 50	50-300
TA mg/lit	400 ± 25	275 ± 50	1058.33 ± 14.43	283.33 ± 123.32	325 ± 50	291.66 ± 38.18	358.33 ± 38.18	50-300
Total Hardness mg/lit	130.66 ± 2.30	544 ± 10.58	617.33 ± 14.04	352 ± 10.58	224 ± 4	268 ± 10.58	268 ± 10.58	50-200
Calcium Hardness mg/lit	48.62 ± 2.44	105.53 ± 7.27	237.88 ± 20.18	128.78 ± 10.91	74.28 ± 3.33	83.89 ± 4.03	82.29 ± 7.90	5-100
Magnesium Hardness mg/lit	20.18 ± 0.68	106.98 ± 3.99	92.58 ± 1.71	54.46 ± 3.49	36.53 ± 1.11	44.92 ± 3.54	53.12 ± 4.63	5-100
Sulphate mg/lit	5.91 ±0.14	0.13 ±0.01	0.11 ±0.01	0.18 ±0.01	11 ±0.25	10.33 ±0.28	10.58 ±0.28	.005-0.2
Phosphate mg/lit	0.23 ±0.02	0.71 ±0.01	0.07 ± 0.01	0.04 ±0.01	0.32 ±0.01	0.21 ±0.01	0.3 ±0.01	.005-0.2
Nitrate mg/lit	0.12 ±0.01	0.23 ±0.03	0.83 ±0.02	0.29 ±0.01	0.13 ±0.02	0.14 ±0.01	0.22 ±0.02	0.2-10

Mean ± SD of 3 samples
*** Standard values of aquaculture water as per reference [6]**
Green colour values indicates within range of standard
Red colour values indicates not in the range of standard
WN1: N1 substrate growing Water sample**; WN2:** N2 substrate growing Water sample**;**
WN3: N3 substrate growing Water sample; **WA1:** A1 substrate growing Water sample**;**
WA2: A2 substrate growing Water sample**; WA3:** A3 substrate growing water sample.