DJAS., Vol. (4) (I): (117-12) (2025)

Damietta Journal of Agricultural Sciences

http://publication.du.edu.eg/journal/ojs302design/index.php/agr/index

ISSN: 2812-5347(Print)- 2812-5355 (Online)

Impact of Fertilization with Aquaculture Sludge-Derived Vermicompost on Growth Performance, Feed Utilization and Biochemical Parameters of *Oreochromis niloticus* Reared in Cement Ponds

Eslam A. M. Abd El-Wahab[1], Yasser T. A. Moustafa[2] and Ahmed F. Fath El-Bab[1]

1- Animal, Poultry and Fish Production Department, Faculty of Agriculture, Damietta University, Egypt.

2- Limnology Department, Central Laboratory for Aquaculture Research, Agricultural Research Center, Egypt.

Email address: ahfarouk74@gmail.com Mobile No: +20 1155302017

Email address: ymoustafaonline@yahoo.com Mobile No: +20 1061818993

Corresponding author*: rofidaeslam@gmail.com Mobile No: +20 1090890830

ARTICLE INFO

Key words: *Aquaculture Sludge, Vermicompost, Growth Performance, Feed Utilization, Biochemical Parameters, Oreochromis niloticus*

Abstract

The present study was carried out in cement ponds with surface area of $4m^2$ and working volume of $4m^3$ to investigate the potentiality of using new bio-organic fertilizer (vermicompost) produced though recycling aquaculture solid wastes using earthworm. The efficiency of three types of the vermicompost were tested in the present study. Three species of vermicomposting-earthworm were recruited in the vermicomposting of aquaculture sludge without or with sawdust or sugar-bee. Mono sex Nile tilapia with initial weight 22.88 ± 0.14 g the fish were stocked at the density of 80 fish per pond ($4m^3$). Fish in all treatments were fed (25% protein commercial diet) at a feeding rate of (3% of BW daily), 6 days a week for14weeks. Twelve cement ponds were assigned for four treatments as following: control treatment using cow dung as conventional organic manure (T1); vermicompost of only aquaculture sludge (T2); vermicompost of a mixture of aquaculture sludge and sawdust (T3) and vermicompost of a mixture of aquaculture sludge and sugar beet bagasse (T4). All ponds received 3 g urea and 10 g single super phosphate/pond/fortnights as they were provided with continuous aeration. Compared with the control group (T1), fish fed in ponds T4, T3 and T2, respectively, showed the best values of feed conversion ratio, highest values of final weight, weight gain, specific growth rate and protein efficiency ratio. The same trend was observed in total protein, albumin and globulin. The levels of alanine aminotransferase (ALT) and aspartate aminotransferase (AST) of fish reared in ponds enriched with T1 were significantly higher. From the above, it is clear that vermicompost made from a mixture of aquaculture wastes was better than cow manure as organic fertilizer in fish ponds, especially when there were water quality improving materials such as sugar beet pulp or sawdust. this study can be concluded that use of vermicompost from the mixture of water sludge with sugar beet pulp had a better effect on performance, survival and chemical composition without changing the biochemical parameters.

INTRODUCTION

In an effort to make up for the lack of animal proteins, the public and private sectors have been very interested in increasing fish production in recent decades. This is because fish are important aquatic organisms that can provide humans with high-quality proteins **(Ismael *et al*., 2021; Mahmoud *et al*., 2021)**. To enhance freshwater culture and produce highly profitable fish products from a small space, organic fertilizers must be used **(Abdelghany *et al*., 2020)**. Because cow manure contains organic matter that can promote the establishment and development of large bacterial populations through decomposition, it can be used as a complete fertilizer in fish ponds **(Javed *et al*., 1992; Ghosh *et al*., 1994)**. Fertilizer-treated ponds showed the highest zooplankton and plankton biomass and the highest fish output, indicating the importance of organic fertilizers in fish culture **(Balasubramanian and Bai, 1996; Garg and Bhatnagar, 1999)**.

Fish sludge is another kind of organic fertilizer that has been used in various crops. Fish sludge is a mixture of solid waste and undigested food that persists as precipitated and suspended solids **(Arif *et al*., 2020; Zhanga *et al*., 2021)**.

According to **Strauch *et al*. (2018)**, sedimentation would eventually account for 7.1% to 9.9% of the fish diet ingested. According to **Cerozi and Fitzsimmons (2017)**, between 25 and 35 percent of the feed that is consumed may end up as suspended solids in the water. Fish sludge has been collected by a mechanical filtering mechanism and removed from the system as unwanted waste, whereas only nutrients in liquid effluent have been recovered in aquaponic systems thus far **(Khiari *et al*., 2019)**. However, toxins including pesticides, insecticides, heavy metals, and other organic compounds may be present in the sludge from conventional aquacultures, endangering aquatic life, human health, and ecological balance **(Dŕȯzdz *et al*., 2020)**. These factors prompted studies to look for more affordable and efficient sorbents made from industrial waste or biological sources **(Witek-Krowiak and Harikishore, 2013; Naiel *et al*., 2020)**.

It has been demonstrated that a variety of materials made from waste products from plants exhibit an efficient adsorptive capacity. The issue of disposing of waste and cleaning wastewater of several contaminants may be resolved by this activity **(Naiel *et al*., 2022)**.

Sawdust has been used to absorb a variety of contaminants, including heavy metal ions **(Rahman and Islam, 2009; Ofomaja, 2010)**, phenolic compounds **(Ofomaja, 2011; Ofomaja and Unuabonah, 2011)**, organic dyes **(Ofomaja and Ho, 2008)**, humic acids **(Kamari *et al*., 2009)**, and herbicides **(Nanseu-Njiki *et al*., 2010)**. Additionally, **Adonadaga *et al*. (2020)** demonstrated that sawdust appeared to be the most effective filter for improving the quality of grey water by reducing the content of total nitrate-nitrogen (NO_3-N) by 39.21%.

Another waste product of the sugar industry that is produced in large amounts each year is sugar beet pulp (SBP) (*Beta vulgaris* L.). SBP is primarily composed of polysaccharides, which make up 65–80% of its dry weight (30% pectin, 30% hemicelluloses, and 40% cellulose); galacturonic acid and pectic substances also exhibit carboxyl functions that allow them to bind firmly with cations in various solutions (**Sun and Hughes, 1998**). According to reports, SBP works well as an adsorbent to remove metal ions like lead and cadmium **(Pehlivan *et al*., 2008)**, cationic dyes like safranin and methylene blue **(Malekbala *et al*., 2012)**, and anionic dyes like Gemazol turquoise blue-G **(Aksu and Isoglu, 2007)**.

The scopes of the present study can be summarized following steps: The first step is to minimize the negative environmental impact of aquaculture by recycling aquaculture sludge (AS) into bio-organic fertilizer referred to as vermicompost. This is achieved through using vermicomposting technology to treat aquaculture sludge combined with agricultural waste, generating valuable vermicompost by-products. This step not only solves the aquaculture sludge disposal problem, but also provides an additional source of income.

The next step is to explore the potential of using vermicompost, derived from aquaculture sludge, as an eco-friendly bio-organic fertilizer in fish ponds. Vermicompost's impact on water quality and fish growth performance has been also studied in the present study, aiming to offer a sustainable solution for recycling freshwater aquaculture solid waste through vermicomposting technology.

Materials and Methods:

Experimental Procedures:

The, present experiment was conducted in 12 concrete ponds of working volume of 4 m^3 at (Fish Research Unit, Agriculture Faculty, Al-Azhar University) for 14 weeks from 17th July 2020 to-24th Oct 2020 in collaboration with Central Laboratory of Aquaculture Research (CLAR), Abbassa, Abou-Hammad, Sharkia, Egypt and Animal, Poultry, and Fish Production Department, Faculty of Agriculture, Damietta University, Damietta Governorate, Egypt. There were four treatments each in triplicate: control, in which cow dung was used as traditional organic fertilizer in first treatment (T1= CD control), vermicompost made of Aquaculture sludge in the second treatment (T2= AS), vermicompost made of AS mixed with sawdust (SD) in the third treatment (T3= AS+SD) and vermicompost made of AS mixed with sugar beet bagasse (SB) in the fourth treatment (T4= AS+SB) .

All ponds received also chemical fertilizers (urea and single super phosphate (SSP, 16%), at concentrations of 0.345 mg N / L fortnight and 0.4 mg P/L single superphosphate fortnightly. The overall N:P ratio of combined organic and inorganic fertilizers, of 2:1 by molar weigh **(Diana *et al*., 1994)**. The fertilizing process carried out in weekly alternation manner between organic and inorganic fertilizers, to avoid abrupt changes in water quality parameters.

Vermicompost types and cow dung manure were applied fortnightly at a rate of 75 g / pond.

In the control treatment ponds, a weekly one-third of the water volume was replaced in conjunction with the experiment, while in the vermicompost treatments the pond's bottom was cleaned by siphoning the one-third amount of water every two weeks just before adding organic fertilizers doses. Pond water level was maintained at 1 m high by weekly topping up to replace losses due to evaporation if necessary.

Fish rearing:

Monosex Nile tilapia (*Oreochromis niloticus*) were purchased from a private Nile tilapia hatchery, Kafer El-Sheikh governorate. Fish had an average weight 22.88 ± 0.14 g and appeared healthy have been randomly assigned to 12 ponds after subjecting for acclimation procedures for two weeks to provide a relief from transportation stress and injury. During acclimation period, fish were feed 25% protein feed at 3% of their biomass daily.

At the experiment initiation, the fish were stocked at the density of 80 fish per pond ($4m^3$) with with the initial biomass of 1830 gm/pond 4m3(457gm/m^3). Commercial meals in pellet form with 25% crude protein were applied **Table** 1. At the beginning, each pond received the same amount of feed, and the formulated rations, which were divided into two equal instalments based on a live weight percentage, given out every day at 9:00 AM and 3:00 PM, at a rate at 3% of the total live body weight 6 days/week.

Table 1: Proximate chemical analysis of the basal diet (air-dry basis, %).

Analyzed composition (g kg^{-1}) as fed basis	
Crude protein (N × 6.25)	24.16
Crude lipids	9.47
Ash	8.24
Crude fiber	7.09
Nitrogen free extract (NFE)[3]	51.04
Gross energy, MJ/kg	435.77

[1] Composition of mineral premix kg^{-1}: manganese,53 g; zinc,40 g; iron, 20 g; copper, 2.7 g; iodine, 0.34 g; selenium, 70 mg; cobalt, 70 mg and calcium carbonate as carrier up to 1 kg.
[2] Composition of vitamin premix kg^{-1}: vitamin A,8000000 IU; vitamin D_3, 2,000,000 IU; vitamin E, 7000 mg; vitamin K_3,1500 mg; vitamin B_1, 700 mg; vitamin B_2, 3500 mg; vitamin B_6, 1000 mg; vitamin B_{12}, 7 mg; biotin, 50 mg; folic acid, 700 mg; nicotinic, 20,000 mg; pantothenic acid,7000 mg.
[3] NFE = 100 – (crude protein + crude lipids+ ash + crude fiber).

Vermicompost production:

In an effort to recycle freshwater aquaculture sludge (AS) from intensive aquaculture systems into vermicompost, this study followed the method described by **Moustafa *et al*. (2020).** The AS was collected from the intensive Nile tilapia ponds, with a moisture content of 97.5% and dry matter content of 2.5%, in plastic barrels and spread on a cement floor in a thin layer for 10 days to de-water in a ventilated, shaded area. The dried AS was then gathered and can be stored safely until being used in a clean and ventilated space until it was used in the vermicomposting process. Vermicompost production was carried out at the Central Laboratory for Aquaculture Research (CLAR), Abbassa, Abou-Hammad, Sharkia.

The sugar beet bagasse was got from the sugar mill private sector. Sugar beet of specific weight was moistened for two hours using tap water then mixed with aquaculture sludge and left for 24 hours before inoculating with earthworm. The used fine sawdust was collected from at Abou-Hammad, Sharkia, Egypt-based private wood industry and sieved with 3-mm pores sieve. The Aquaculture sludge was mixed in a constant ratio (3:1 weight/weight) with either sawdust or sugar beet and left for 48 hours before earthworm inoculation. These agricultural wastes were added to arrest the leachate and also to maintain the aerobic condition as well as to increase C/N ratio in the earthworm growing media to accelerate vermicomposting process (**Shrimal and Khwairakpam 2010**). This combination was vermicomposting over 3months.

Inoculation of earthworms:

Vermicomposting process was conducted in wooden trays measuring 50 x 70 x 10 cm and area of 0.35 m^2. The trays were covered with plastic sheet to retain moisture during vermicomposting process and to prevent spoilage or mold growth. The AS was weighed and either mixed with agricultural wastes, such as sawdust (SD) or sugar beet bagasse (SB), or spread alone in the trays. The AS with or without Agricultural wastes was moistened and lift for 48 hours before introducing earthworms into the prepared media.

combination of three vermicomposting earthworms (*Eisenia fetida*; *Perionyx excavatus*; *Lumbricus rubellus*) was introduced at a density of 65 worms /1000 g of media. The media was covered with cardboard and checked biweekly with remoistening as needed. The vermicomposting process took 90 days (April-July 2020) to reach maturity, according to the texture of vermicompost. The required amount of each type of vermicompost (vermicompost of AS, Vermicompost of AS + SD, vermicompost of AS + SB), was collected and stored in tightly-sealed plastic bag until being used.

The used methods in this experiment:

The chemical compositions of the applied different organic and inorganic fertilizers are show in **Table** (2).

Water quality measurements:

Throughout the trial period (14 weeks), the water total alkalinity was determined monthly. water temperature; Water Dissolved oxygen, water pH, nitrogenous dissolved forms (total ammonia, nitrite and nitrate) and orthophosphate were measured biweekly.

Total alkalinity has been measured once monthly by titration methods **(APHA, 2000)**. The water samples were filtered and then the dissolved inorganic nitrogenous compounds were determined including, Total ammonia, nitrite and nitrate were measured spectrophotometrically by using an instrument (model WPA Linton Cambridge, UK) according to **(APHA, 2000)**. Ortho-Phosphate was determined using the vanadomolybdate method **(APHA, 2000)**.

Table (2): The chemical composition of the chemical and organic / bio-organic fertilizers applied in the different treatments in the present study.

Characteristics	**Organic Fertilizer**			
	T1	**T2**	**T3**	**T4**
Urea (g/pond/fortnights)	3	3	3	3
Single supper-phosphate (g/pond/fortnights)	10	10	10	10
Cow dung (g/pond/fortnights)	75	0	0	0
AS vermicompost (g/pond/fortnights)	0	75	0	0
AS+SD vermicompost (g/pond/fortnights)	0	0	75	0
AS+SBB vermicompost (g/pond/fortnights)	0	0	0	75
Nutrients (%) in organic fertilizers				
OM[1] (%)	46.6	21.7	28	25.48
Ash	20.4	58.3	60	62.03
N% [add ADG, RGR, SR, FER.2]	1.33	1.09	1.6	1.34
P%[3]	0.35	0.71	0.48	0.32
K%[4]	1.08	2.31	1.53	2.13
Total C/N [5] **ratio in organic fertilizer**	8.4	3.4	7.38	9.3
Total N/P ratio in the treatment	2.83	2.28	2.9	2.87

CD, cow dung; AS, Aquaculture sludge; SD, sawdust; SBB, sugar beet bagasse.

[1] OM, organic matter. [2] N, nitrogen. [3] P, phosphorus. [4] K, potassium. [5] C/N, carbon/nitrogen.

Growth performance criteria:

Ten Fish were weighted and recorded every two weeks in order to estimate the growth performance characteristics, and daily feed intake (FI) was recorded at the initiation of the experiment. The growth performance parameters, weight gain (WG), specific growth rate (SGR), Relative Growth Ratio (RGR), feed conversion ratio (FCR), and protein efficiency ratio (PER), were calculated using the following computerized formulas:

WG (g) = (final body weight — initial body weight);

SGR; % day^{-1} = 100 x (Ln final body weight - Ln initial body weight)/days of the experiment;

FCR = total dry weight of feed intake / total fish wet biomass gain;

PER = total weight gain/total protein intake.

ADG= total weight gain/No. of days

RGR=final weight - initial weight / initial weight x 100

SR=No. of fish at the end / No. of fish at the beginning x 100

FER= total weight gain / total feed intake

Blood and fish sampling:

The fish were starved for 24 hours prior to sampling. The fish were subsequently anesthetized with at a concentration of 30 mg of clove oil L^{-1}, within for about 5 minutes **(Javahery and Nekoubin, 2012); Cunha, 2015)**. After the ponds had been drained of their contents. Nonheparinized tuberculin syringes were used to draw blood from the caudal vein of six fish each pond. After the blood samples had coagulate, they were centrifuged for 15 minutes at 3000 rpm (4 ◦C) to extract serum. Serum samples were kept in storage at 20 ◦C in order to perform immunological, antioxidant, and biochemical tests.

Biochemical parameters:

Colorimetric measurements were made of total protein (TP), albumin, globulin, creatinine, urea, and serum levels of AST, ALT, and alanine aminotransferase using commercial kits that were acquired from Diamond Diagnostics Company, Egypt, in accordance with the instruments.

Antioxidants variables:

Commercial kits were used to catalase activity (CAT). TAC was assessed in accordance with the manufacturer's instructions using the kit from Biodiagnostic Co., Egypt (Catalog No. TA2513). The malondialdehyde (MDA) was measured calorimetrically using the protocol described by **Ohkawa *et al*. (1979)**.

Statistical analysis:

Statistical analysis was performed using one way Analysis of Variance (ANOVA) and Duncan's multiple range test to determine differences between groups, means at significance level of 0.05. Standard deviation of treatment means was also estimated. All statistics were carried out using Statistical Analysis Systems (SAS) program (**SAS On Demand, 2021**) ®.

Results and Discussion

Every physicochemical characteristic evaluated in the water was judged appropriate for the development of Nile tilapia **(Boyd, 1990; Boyd and Craig, 1998 and Boyd *et al*., 2016)**. The ranges of rearing water temperatures were (24.2 ± 0.44 to 25.45 ± 0.45 °C), pH ranges (6.54±.16 to 7.07±.22), and dissolved oxygen ranges (4.98±0.75 to 6.33±0.18 mg/L) are all in the meantime. Other estimated water quality requirements had mean ranges of 0.09 ± 0.03 to 0.16 ± 0.01 mg/L for nitrite (NO_2), 0.83 ± 0.05 to 1.00 ± 0.06 mg/L for nitrate (NO_3), 0.30 ± 0.13 to 0.50 ± 0.11 mg/L for ammonia (NH_4), and 0.31± 0.05 to 0.37±.0.04 mg/L for organic phosphorus (OP).

Table (3) displays the growth performance and survival rate of pond-cultured Nile tilapia after fertilization with cow dung or various types of vermicompost. As shown in this table, the initial body weight of the fish subjected to different treatments ranged from 22.10 to 23.50 g across all treatments. The random distribution of fish around the various experimental treatments suggests that there are negligible differences in beginning body weight among the treatments. At the end of this trial, the T4 treatment released the highest body weight (227.90±1.36 g), while the T1 (control group) treatment released the lowest BW (157.80±2.84 g) (**Table,** 3). The differences between the treatments were significant (P > 0.001).

The average body weight gain during this study (14 weeks) was shown to be 135.10, 161.00, 203.28, and 204.40 g, respectively, according to the results in **Table** (3). According to WG statistics, T4 had the highest WG value (204.40 g) across all experimental groups, while T1, the fish group in the control group, had the lowest WG value (135.10 ±3.29 g). **Table** 3 presents the ADG results, which indicate that all experimental groups had ADG values that were significantly higher than those of the control group. Specifically, T4 had the highest ADG value (2.43±0.12 g), while the fish group in the control group (T1) had the lowest ADG (1.61±0.21 g). There were notable variations across the treatment groups (P>0.001).

The SGR results were shown in the same table. It shows that, while the SGR of the Nile tilapia was 2.31±0.13%in control group, the other groups (T2, T3, and T4) released significant (P<0.01) values of SGR, which were 2.52±0.07, 2.71±0.11, and 2.72±0.09%, respectively, compared to the control group .

The average RGR values are displayed in **Table** 3. The averages for T1, T2, T3, and T4 were, respectively, 5.99±0.18, 7.33±0.12, 8.75±0.36, and 8.81±0.42 %. The RGR values were significantly (P<0.001) higher in the experimental groups than in the control group (T1) .

The average survival rate (SR %) for all four experimental groups was 100% after 14 weeks of the experiment's start, according to **Table** 3 results. This rate was unaffected by fertilization with cow dung or various kinds of vermicompost.

Table 3: Growth performance and survival rate of Nile tilapia cultured in ponds fertilized with several types of aquaculture sludge-derived vermicompost:

Measured parameters	Treatments				Overall mean	P-Value
	T1	T2	T3	T4		
Initial weight (g)	22.70 ±0.65	22.10 ±0.53	23.22 ±0.78	23.50 ±0.69	22.88 ±1.14	0.44
Final weight (g)	157.80 ±2.84^{c}	183.10 ±2.79^{b}	226.50 ±2.04^{a}	227.90 ±1.36^{a}	198.83 ±2.38	0.0001
Initial length (cm)	13.80 ±0.59	13.00 ±0.45	13.60 ±0.38	13.60 ±0.32	13.33 ±0.29	0.2290
Final length (cm)	20.90 ±0.62^{b}	21.10 ±0.54^{b}	23.10 ±0.59^{a}	22.40 ±0.66a^{ab}	21.88 ±0.28	0.0131
Weight Gain (g)	135.10 ±3.29^{c}	161.00 ±2.06^{b}	203.28 ±1.63^{a}	204.40 ±1.49^{a}	175.95 ±2.35	0.0001
ADG g/d	1.61 ±0.21^{c}	1.92 ±0.17^{b}	2.42 ±0.14^{a}	2.43 ±0.12^{a}	2.09 ±0.13	0.0001
SGR	2.31 ±0.13c	2.52 ±0.07^{b}	2.71 ±0.11^{a}	2.72 ±0.09^{a}	2.56 ±0.12	0.0001
RGR	5.99 ±0.18c	7.33 ±0.12^{b}	8.75 ±0.36^{a}	8.81 ±0.42^{a}	7.72 ±0.39	0.0001
SR%	100	100	100	100	100	0.23

±Means±SD with the same letter in each row are not significantly differences (P < 0.05).

The feed intake data are shown in **Table** 4. The feed consumption during the course of the 14-week trial is detailed in this table. According to the data, fish in T3 had the highest recorded value of FI (206.21±1.62 g), while fish in T1 had the lowest value (171.09±1.33 g). There were substantial differences (P<0.05) between the various treatments.

The average feed conversion ratios (FCR) were displayed in **Table** (4) results. showed substantial differences in FCR due to treatment effects. When compared to the other experimental groups, the control group's FCR values across the course of the 14-week trial were the highest (worst).

The feed efficiency ratio (FER) averages for fish ponds fertilized with various sludge-derived vermicompost are displayed in **Table** 4. the (FER)values in the control group were the lowest (79.62±0.0.5%), and T4 recorded the highest value (103.02±0.06%). Analysis of variance revealed significant variations in FER due to the treatments' effects when compared to the control.

As shown in the same table, when compared to the control group, the PER of every pond fertilized with various kinds of vermicompost greatly increased. The results demonstrated that the control group and the different treatments differed significantly from one another.

Table 4: Feed utilization of Nile tilapia cultured in ponds fertilized with several types of aquaculture sludge-derived vermicompost:

Measured parameters	Treatments				Overall mean	P-Value
	T1	T2	T3	T4		
FI	171.09 ±1.33 d	177.05 ±1.55 c	206.21 ±1.62 a	198.42 ±1.43 b	186.94 ±1.87	.0001
FCR	1.27 ±0.11 a	1.07 ±0.09 b	1.01 ±0.12 bc	0.97 ±0.06 c	1.08 ±0.01	.0001
PER	2.63 ±0.19 c	3.12 ±0.14 b	3.29 ±0.09 ab	3.44 ±0.12 a	3.12 ±0.43	.0001
FER	79.62 ±0.0. 5c	94.29 ±0.07 b	99.11 ±0.04 a	103.02 ±0.06 a	0.94 ±0.14	0.23

±Means±SD with the same letter in each row are not significantly differences (P < 0.05).

The chemical analysis of the whole fish at the end of this investigation is displayed in **Table** 5. According to this data, the dry matter content of entire fish fluctuated during the current investigation between 35.57 and 37.33% depending on whether they were fertilized with cow dung or various forms of vermicompost. **Table** 5 shows that T1 had the lowest percentage of crude protein (55.08±0.32%), while T3 had the highest proportion (58.33±0.17%), followed by T4 (56.68±0.11%) and T2 (55.44±0.18%). A comparable trend was also seen for crude fat, with T3 recording the highest proportion (27.69±0.18%) and T1 recording the lowest percentage (25.84±0.34%). In comparison, T1 had the highest percentage of ash (14.81±0.120%), while T4 had the lowest percentage of ash contents (13.79±0.13%).

Table 5: Proximate chemical analyses (%; on dry weight basis) of whole fish of Nile tilapia reared in fertilized ponds with several aquaculture sludge-derived vermicompost:

Measured parameters	Treatments				Overall mean	P-Value
	T1	T2	T3	T4		
Dry matter	35.57 ±0.18[c]	36.73 ±0.35[ab]	37.33 ±0.17[a]	36.13 ±0.19[b]	36.44 ±0.22	.004
Moisture	64.43 ±0.18[a]	63.27 ±0.35[b]	62.67 ±0.17[c]	63.87 ±0.19[ab]	63.56 ±0.22	.004
Crude Protein	55.08 ±0.32[b]	55.44 ±0.18[b]	58.33 ±0.17[a]	56.68 ±0.11[b]	56.38 ±0.39	0.001
Crude Fat	25.84 ±0.34[c]	26.73 ±0.18[b]	27.69 ±0.18[a]	27.51 ±0.11[a]	26.94 ±0.24	0.001
Ash	14.81 ±0.12[a]	14.37 ±0.17[b]	13.91 ±0.11[c]	13.79 ±0.13[c]	14.22 ±0.12	0.001

Means±SD with the same letter in each row are not significantly differences (P < 0.05).

The data in **Table** 6 show that adding cow dung or other kinds of vermicompost to fish ponds significantly increased the amount of total protein (TP). The levels of globulin (GLO) and albumin (ALB) also fluctuated significantly (P<0.01); fish given diet T1 had the lowest amounts of these variables, whereas fish in T4 showed the highest levels of TP, ALB, and GLO .

Table 6 showed the effect of treatments on liver functions. Fish in T1 (cow dung) had the highest (P<0.01) AST and ALT values (50.78±2.20 and 82.93±1.34 IU/L), respectively, according to data in **Table** (6), whereas fish from T4 had the lowest (P<0.01) AST and ALT values (43.67±0.97 and 60.61±0.92 IU/L), respectively .

Creatinine and urea levels of Nile tilapia are displayed in **Table** 6. In comparison to the control, the usage of the various fertilizers had no discernible (P > 0.05) impact on the creatinine level. Conversely, the T4 group showed the only discernible significant change in urea level, which was higher than that of the control and all other groups.

According to the results of the current experiment, fish treated with aquaculture vermicompost with sugar beet (FS + SB) had the highest FW, BWG, SGR, and PER while having the lowest feed conversion ratio (FCR) when compared to the control group. The presence of humic acid and other nutrients in vermicompost, along with its capacity for fertilization, could be the reason for the improvement in growth performance. Moreover, fish pond sludge can be composted, utilized as an energy source for biogas generation (**Eymontt *et al.* , 2017**), utilized as animal feed, or utilized as an algal growth medium **(Zhang and Sun, 2017; Kouba *et al.*, 2018; Dŕòzdz *et al.*, 2020)**.

Table 6: Serum biochemical parameters of Nile tilapia reared in fertilized ponds with several aquaculture sludge-derived vermicompost:

Measured parameters	Treatments				Overall mean	P-Value
	T1	T2	T3	T4		
TP	5.87 ±0.15^{c}	6.00 ±0.06^{b}	6.86 ±0.22^{a}	7.70 ±0.20^{a}	6.61 ±0.23	0.098
ALB	3.86 ±0.16^{c}	4.50 ±0.32^{b}	4.82 ±0.11^{ab}	5.29 ±0.24^{a}	4.62 ±0.18	0.011
GLO	2.33 ±0.30^{a}	1.42 ±0.26^{b}	1.95 ±0.33^{ab}	2.32 ±0.15^{a}	2.00 ±0.16	0.116
AST	50.78 ±2.20^{a}	47.38 ±1.22^{ab}	44.51 ±1.13^{b}	43.67 ±0.97^{b}	46.59 ±1.04	00.033
ALT	82.93 ±1.34^{a}	75.54 ±1.34^{b}	68.92 ±0.82^{c}	60.61 ±0.92^{d}	71.99 ±2.53	0.009
Cr	0.32 ±0.02	0.27 ±0.03	0.27 ±0.04	0.27 ±0.03	0.28 ±0.01	0.12
Urea	1.68 ±0.03^{ab}	1.64 ±0.001^{b}	1.52 ±0.01^{c}	1.71 ±0.03^{a}	1.63 ±0.02	0.002

Means±SD with the same letter in each row are not significantly differences ($P < 0.05$).

The present study showed that the compost used to make aquaculture vermicompost and Sugar Beet had lower percentages of organic matter than composts prepared from cow dung. Because the released nutrients are relatively easily and quickly released, the harvested vermicompost has elevated nutrient levels that are in a form that can readily absorb, unlike compost that must be cured before use. This improves the growth performance of fish and plankton **(Sulochana *et al.*, 2009; Chakrabarty *et al.*, 2008, 2009, 2010, Bansal *et al.*, 2014)**. This is because, as opposed to the ammonia form found in conventional compost, the earthworms' large intake of nitrogen-rich organic matter, mineralization in their guts, and excretion of it results in the storage of nitrate that is more bioavailable to plants in vermicompost **(Hand *et al.*, 1988, Thakur *et al.*, 2021)**.

The vermiliquid, the organic waste's leachate, and vermicompost are the other products of the vermicomposting process. Similar to vermicompost, vermiliquid (also called vermiwash or worm tea) is an equally nutritious fertilizer because it contains soluble plant nutrients along with organic materials, microorganisms, enzymes, mucus, secretions from earthworms, and excreted feces **(Shivsubramanian and Ganeshkumar, 2004)**. The vermiliquid has demonstrated greater potential for enhancing aquaculture nutrition due to its inclusion of cocoons, worm body parts, small and dead earthworms—all of which are edible to fish—as well as some zoo-planktons, which add extra nitrogen to the vermicompost **(Hand *et al*., 1988; Ronald and Donald, 1977)**. Additionally, vermiwash is known to contain bacterial biomass, hormones, antibiotics, free amino acids, vitamins (pro-vitamin B and D complex), metabolites appropriate for fish growth, feed digestion, disease resistance, and immune boosters **(Chakrabarty *et al.*, 2008)**. Moreover, vermiliquid has recommended protein contents and has the potential to replace basal ingredients in fish feed formulation **(Zhenjun *et al*., 1997)**. The combination of the three vermicomposting products earthworms, vermicompost, and vermiliquid also referred to as earthworm bedding, as shown by **Musyoka *et al*. (2020)** has superior nutrition and can replace fishmeal in Nile tilapia (*Oreochromis niloticus*) diets economically without sacrificing growth performance. In organic farming, where the use of fertilizers, growth regulators, hormones, feed additives, and pesticides is discouraged, vermicompost and vermiwastes are both strongly advised.

Research has indicated that vermicompost, as opposed to traditional composting, has up to seven times higher nutritional and growth-promoting potential for plants because of the humus's quicker activation **(Suhane, 2007; Pajon, 2007)**. When ingested by animals, humic acid from vermicomposting not only supplies nutrition but also inhibits the growth of harmful bacteria and fungi, especially those that produce mycotoxin. This means that the acid helps regulate intestinal diseases and improves gut health by increasing nutrient utilization, stress management, and immune system function **(Bahadori *et al*., 2017)**. Vermicompost has a rich microbial community that doesn't change even after drying, in contrast to compost, which denatures nutrients like nitrogen and kills microbes due to high temperatures. This microbial community has been shown to be directly feeding fish and zooplanktons and to be helpful in lowering pathogenic bacteria **(Godara *et al*., 2015)**. In order to use vermicompost as a biocontrol agent, **Kaur and Ansal (2010)** suggested developing biotechniques for separating and collecting the advantageous microbial biomass that is present. Furthermore, vermicompost is pathogen-free and significantly reduces fish disease due to the earthworms' production of coelom fluid (which they release when disturbed) **(Godara *et al*., 2015)**.

Additionally, adding vermicompost fertilizers to concrete ponds on a weekly basis promoted the growth of phytoplankton and zooplankton, which the fish raised in those ponds consumed. Pond fertilization, according to **Knud-Hansen (1998)**, boosts algal productivity, which in turn enhances natural food production. As a result, there is an increase in fish growth-promoting natural food (phytoplankton and zooplankton) that is readily available.

In the present study, the FCR is significantly decreased by the aquaculture vermicompost with sugar beet group. In Atlantic cod fingerlings, lactic acid decreased the FCR **(Gildberg *et al*., 1997)**. **Hansen (1997)** claims that applying organic fertilizer to ponds boosts the output of natural food by encouraging algal productivity. As a result of the increasing availability of natural food (phytoplankton and zooplankton), fish grow more rapidly. Additionally, he mentioned that the enhanced productivity of phytoplankton and zooplankton as a result of fertilization is directly linked to fish development. Research has demonstrated a strong correlation between fish development and the enhanced productivity of phytoplankton and zooplankton resulting from fertilization **(Elnady *et al*., 2010).**

Furthermore, **Habibnia and Bahram (2020)** noted that higher plankton abundance following vermicomposting contributed to the enhanced growth and survival of Rutiles kutum (*Kospiensis kutum*) fry. Similarly, after vermicomposting, **Godara *et al*. (2015)** found increased phytoplankton and zooplankton concentrations. In a similar vein, Vermicomposting *Labeo rohita* Pond enhanced net productivity, according to **Deolalikar and Mitra (2004)**. Vermicomposting application rates have been suggested by the majority of research for optimal fish and plankton performance as well as water quality indicators. Additionally, fish and zooplankton can directly eat vermicompost **(Kumar *et al*., 2012)**. The bacteria in vermicompost enhance its nutrition to levels appropriate for most aquatic creatures, even if the material itself may not have enough protein for fish to eat directly.

CONCLUSION

Based on this study findings, it can be concluded that, when compared to the other treatments, the use of vermicompost of an aquaculture sludge mixture with sugar beet pulp had a better impact on performance, survival, and chemical composition without changing the biochemical parameters. Vermicompost of an aquaculture sludge mixture with sawdust came in second. This demonstrated the vermicompost of an aquaculture sludge mixture's prospective quality that allow it to be used as an organic fertilizer in fish ponds. It is advised to use an efficient adsorbent, like sugar beet pulp or sawdust, to remove contaminants from water; sawdust was not as effective as sugar beet pulp.

FUNDING:

This research did not receive any funding

CONFLICTS OF INTEREST:

This research did not receive any funding.

AUTHORS CONTRIBUTION

All authors developed the concept of the manuscript, achieved the experiments ,and wrote and revised the final manuscript.

References

Abdelghany, M. F., El-Sawy, H. B., Abd El-Hameed, S. A., Khames, M. K., Abdel-Latif, H. M. and Naiel, M. A. (2020). Effects of dietary *Nannochloropsis oculata* on growth performance, serum biochemical parameters, immune responses, and resistance against *Aeromonas veronii* challenge in Nile tilapia (*Oreochromis niloticus*). Fish & Shellfish Immunol. 107, 277–288.

Adonadaga, M. G., Alimoh, S. C. and Ampadu, B. (2020). Effectiveness of some selected natural filter media for on-sitesmall-scale treatment of medium strength greywater. J. Appl. Sci. Environ. Manag. 24 (5), 887–893.

Aksu, Z. and Isoglu, I. A. (2007). Use of dried sugar beet pulp for binary biosorption of Gemazol turquoise blue-G reactive dye and copper (II) ions: equilibrium modeling. Chem. Eng. J. 127, 177–188.

APHA (American Public Health Association), (2000). Standard methods for the examination of water and waste water. 16th ed., Washington, D.C., USA.

Arif, M., Iram, A., Bhutta, M. A., Naiel, M. A., El-Hack, A., Mohamed, E. and Taha, A.

E. (2020). The biodegradation role of Saccharomyces cerevisiae against harmful effects of mycotoxin contaminated diets on broiler performance, immunity status, and carcass characteristics. Animals. 10, 238.

Bahadori, Z., Esmaielzadeha, L., Karimi-Torshizib, M. A., Seidavic, A. and Olivarese, J. (2017). The effect of earthworm (*Eisenia foetida*) meal with vermi-humus on growth performance, hematology, immunity, intestinal microbiota, carcass characteristics, and meat quality of broiler chickens. Livestock Science. 2017;202:74-81.

Balasubramanian, P., Bai, R. K. (1996). Biogas plant-effluent as an organic fertilizer in monosex, monoculture of fish (*Oreochromis mossambicus*). Bioresour. Technol. 55, 119–124.

Bansal N, Gupta, R., Garg,S., Singh,G., Sharma K. (2014). Effect of vermicompost as pond fertilizer on growth performance of common carp (*Cyprinus carpio* L.) [M.Sc. thesis]. Dept. of Zoology CCSHAU; 2014.

Boyd, C. E. (1990). Water quality in ponds for aquaculture. Alabama Agriculture Experiment Station Auburn University, Alabama, pp. 482.

Boyd, C. E., and Craig, S. T. (1998). Pond aquaculture water quality management. Kluwer Academic Publishers; Springer Science Business Media New York. USA.

Boyd, C. E., Tucker, C. S, and Somridhivej, B. (2016). Alkalinity and hardness: Critical but elusive concepts in aquaculture. Journal World Aquaculture Soc. 1(47), 6 – 41.

Cerozi, B. D. S. and Fitzsimmons, K. (2017). Phosphorus dynamics modeling and mass balance in an aquaponics system. Agric. Syst. 153, 94–100.

Chakrabarty, D., Das, M. K. and Das, S. K. (2008). Growth performance of *Cyprinus carpio* L. in intensively different organic manures. International Journal of Environmental Research.2:419-424

Chakrabarty, D., Das, M.K. and Das, S. K. (2009). Relative efficiency of vermicompost as direct application manure in pisciculture. Paddy and Water Environment.7: 27-32.

Chakrabarty, D., Das, S. K., Das, M. K. and Bag, M. P. (2010). Assessment of vermicompost as direct application manure in fish farming ponds. Turkish Journal of Fisheries and Aquatic Sciences.10:47-52

Cunha, L. D., Geraldo, A. M. R., da Silva, V. C., Cardoso, M. d. S., Tamajusuku, A. S. K. and Hoshiba, M. A. (2015). Clove oil as anesthetic for Guppy. Bol. Inst. Pesca, São Paulo, 41(esp.): 729 – 735.

Deolalikar, A.V. and Mitra, A. (2004). Effect of vermicompost on growth of fish *Labeo rohita* Hamilton. Journal of Aquaculture in the Tropics. 19:63-79.

Diana, J. S., Lin, C. K. and Jaiyen, K. (1994). Supplemental feeding of tilapia in fertilized ponds. J. World Aquac. Soci. 25, 497–506.

Dŕòzdz, D., Malinska, K., Kacprzak, M., Mrowiec, M., Szczypior, A., Postawa, P. and Stachowiak, T. (2020). Potential of fish pond sediments composts as organic fertilizers. Waste Biomass Valori. 11, 5151–5163.

Elnady, M. A., Alkobaby, A. I., Salem, M. A., Abdel-Salam, M. and Asran, B. M. (2010). Effect of fertilization and low quality feed on water quality dynamics and growth performance of Nile tilapia, *Oreochromis niloticus*. J.American Science,6(10):10441054

Eymontt, A., Wierzbicki, K., Brogowski, Z., Burzyn´ska, I. and Rossa, L. (2017). New technology of extracting bottom sediments from ditches in fish ponds and their application in agriculture. Fishing Messages 2, 7–13.

Garg, S. and Bhatnagar, A. (1999). Effect of different doses of organic fertilizer (cow dung) on pond productivity and fish biomass in Stillwater ponds. J. Appl. Ichthyol. 15, 10–18.

Ghosh, B., Ghosh, R., Mittra, B., Mitra, A. and Jana, M. (1994). Influence of organic and inorganic fertilization on the growth and nutrition of rice and fish in a dual culture system. J. Agric. Sci. 122, 41–45.

Gildberg, A., Mikkelsen, H., Sandaker, E. and Ringø, E. (1997). Probiotic effect of lactic acid bacteria in the feed on growth and survival of fry of Atlantic cod (*Gadus morhua*). Hydrobiol. 352, 279–285.

Godara, S., Sihag, C. and Gupta, R. (2015). Effect of pond fertilization with vermicompost and some other manures on the growth performance of Indian major carps. Journal of Fisheries and Aquatic Science. 2015;10(3):199-211. DOI: 10.3923/ jfas. 199.211.

Habibnia, M. and Bahram, S. (2020). Effect of vermicomposting fertilizer and other organic fertilizers on plankton abundance growth indices and survival of Caspian kutum (*Rutilis kutum*) fry. Iranian Scientific Fisheries Journal.29:4.

Hand, P., Hayes, W. A., Frankland, J. C. and Satchell, J. E. (1988). The Vermicomposting of cow slurry. Pedobiologia; 31,199-209.

Hansen, P. J., P. K. and Bjømsen, B. W. (1997) Zooplankton grazing and growth: Scaling within the 2-2,000 µm body size range. Limnol Oceanogr 42:687-704.

Haque, M. M., Belton, B., Alam, M. M., Ahmed, A. G. and Alam, M. R. (2016). Reuse of fish pond sediments as fertilizer for fodder grass production in Bangladesh: potential for sustainable intensification and improved nutrition. Agric. Ecosyst. Environ. 216, 226–236.

Ismael, N. E., Abd El-hameed, S. A., Salama, A. M., Naiel, M. A. and Abdel-Latif, H. M. (2021). The effects of dietary clinoptilolite and chitosan nanoparticles on growth, body composition, haemato-biochemical parameters, immune responses, and antioxidative status of Nile tilapia exposed to imidacloprid. Environ. Sci. Pollut. Res. 1–16.

Javahery, S. and Nekoubin, H. (2012). Effect of anesthesia with clove oil in fish (review). Fish Physiol Biochem (2012) 38:1545–1552.

Javed, M., Hassan, M. and Sial, M. (1992). Fish pond fertilization. Iv. Effect of cow-dung on the growth performance of major carps. Pak. J. Agric. Sci. 29, 111–115.

Kamari, A., Wan Ngah, W. S. and Wong, L. W. (2009). *Shorea dasyphylla* sawdust for humic acid sorption. Europ. J. Wood & Wood Prod. 67, 417–426.

Kaur, V. and Ansal, M. (2010). Efficacy of vermicompost as fish pond manure – Effect on water quality and growth of *Cyprinus carpio* (Linn). Bioresource Technology. 101:6215-6218.

Khiari, Z., Kaluthota, S. and Savidov, N. (2019). Aerobic bioconversion of aquaculture solid waste into liquid fertilizer: effects of bioprocess parameters on kinetics of nitrogen mineralization. Aquaculture. 500, 492–499.

Knud-Hansen, C. F. (1998). Pond fertilization: Ecological approach and practical applications. Aquaculture Collaborative Research Support Program, Oregon State University, Corvallis, Oregon, USA. 125p.

Kouba, A., Lunda, R., Hlaváč, D., Kuklina, I., Hamáčková, J., Randák, T., Kozák, P., Koubová, A., and Buřič, M. (2018). Vermicomposting of sludge from recirculating aquaculture system using *Eisenia andrei*: Technological feasibility and quality assessment of end-products. J. Cleaner Production, 177, 665-673. https://doi.org/10.1016/j.jclepro.2017.12.216

Kumar, V., Saud, B.J. and Kumar, D. (2012). Vermicompost: Quality organic manure for zooplankton production in aquaculture. International Journal of Applied Biology and Pharmaceutical Technology. 3:89-93.

Mahmoud, H. K., Reda, F. M., Alagawany, M. and Farag, M. R. (2021). Ameliorating deleterious effects of high stocking density on *Oreochromis niloticus* using natural and biological feed additives. Aquaculture. 531, 735900.

Malekbala, M. R., Hosseini, S., Kazemi Yazdi, S. and Masoudi Soltani, S. (2012). The study of the potential capability of sugar beet pulp on the removal efficiency of two cationic dyes. Chem. Eng. Res. Design. 90, 704–712.

Naiel, M., Gewida, A., Merwad, A., Abdel-Hamid, E., Negm, S., Alagawany, M. and Farag, M. (2022). The effects of various organic fertilizers with or without adsorbents on the productivity, antioxidant status and immune responses of Nile tilapia raised in cement ponds. Aquaculture 548 (2022) 737593.

Moustafa, Y. T. A., Ali, A. A. A., Gomha, S. A. A. and Glal, E. M. (2020). Nitrogen and Phosphorus budget for Nile tilapia hatchery. Egyptian J. for Aqua., 10 (1) :1-22.

Musyoka, S. N., Liti, D. M., Ogello, E., Meulbroek, P. and Waidbacher, H. (2020). Earthworm, Eisenia fetida bedding as potential cheap fishmeal replacement ingredient for semi-intensive farming of Nile Tilapia *Oreochromis niloticus*. **Aquaculture Research. 51:2359-2368**

Naiel, M. A., Alagawany, M., Patra, A. K., El-Kholy, A. I., Amer, M. S. and Abd El-Hack, M. E. (2020). Beneficial impacts and health benefits of macroalgae phenolic molecules on fish production. Aquaculture 736186.

Nanseu-Njiki, C. P., Dedzo, G. K. and Ngameni, E. (2010). Study of the removal of paraquat from aqueous solution by biosorption onto Ayous (*Triplochiton schleroxylon)* sawdust. J. Hazard. Mater. 179, 63–71.

Ofomaja, A. E. and Ho, Y. -S. (2008). Effect of temperatures and pH on methyl violet biosorption by Mansonia wood sawdust. Bioresour. Technol. 99, 5411–5417.

Ofomaja, A.E., (2010). Intraparticle diffusion process for lead (II) biosorption onto mansonia wood sawdust. Bioresour. Technol. 101, 5868–5876.

Ofomaja, A. E. (2011). Kinetics and pseudo-isotherm studies of 4-nitrophenol adsorption onto mansonia wood sawdust. Ind. Crop. Prod. 33, 418–428.

Ohkawa, H., Ohishi, N. and Yagi, K. (1979). Assay for lipid peroxides in animal tissues by thiobarbituric acid reaction. Anal. Biochem. 95, 351–358.

Pajon, S. (2007) The Worms Turn Argentina Intermediate Technology Development Group. Case Study Series 4; Quoted in Munroe. http://www.tve.org./ho/doc.cfm?aid= 1450&lang=English.

Pehlivan, E., Yanık, B.H., Ahmetli, G. and Pehlivan, M. (2008). Equilibrium isotherm studies for the uptake of cadmium and lead ions onto sugar beet pulp. Bioresour. Technol. 99, 3520–3527.

Rahman, M. S., Islam, M. R. (2009). Effects of pH on isotherms modeling for cu (II) ions adsorption using maple wood sawdust. Chem. Eng. J. 149, 273–280.

Ronald, E. G. and Donald, E. D. (1977). Earthworms for Ecology and Profit. Earthworm and the Ecology. Ontario, CA: Bookworm Publishing Company.

Shivsubramanian, K. and Ganeshkumar, M. (2004). Influence of vermiwash on biological productivity of Marigold. The Madras Agricultural Journal. 91:221-225.

Shrimal, S. and KhwairaKpam, M. (2010). Effect of C/N ratio on vermicomposting of vegetable wastes. Dynamic soil, **Dynamci plant 4(1):123-126.**

Statistical Analyses Systems (SAS) (2021). SAS Program on Demand, SAS institute incorporation, Cary, NC 27513 USA.

Strauch, S., Wenzel, L., Bischoff, A., Dellwig, O., Klein, J., Schüch, A. and Palm, H. (2018). Commercial African catfish (Clarias gariepinus) recirculating aquaculture systems: assessment of element and energy pathways with special focus on the phosphorus cycle. Sustainability. 10, 1805.

Suhane, R. K. (2007). Vermicompost. Pusa, Bihar, India: Publication of Rajendra Agriculture University. p. 88.

Sulochana, M. S., Saxena, R. R. and Gaur, S. R. (2009). Fish ponds fertilized with different organic manures-hydrobiological characteristics. Fishing Chimes. 28:36-39.

Sun, R. and Hughes, S. (1998). Fractional extraction and physico-chemical characterization of hemicelluloses and cellulose from sugar beet pulp. Carbohydr. Polym. 36, 293–299.

Thakur, A., Kumar, A., Kumar, C., Kiran, B., Kumar S, Athokpam VA. (2021). Review on vermicomposting: By-products and its importance. Plant Cell Biotechnology and Molecular Biology.22:156-164.

Witek-Krowiak, A. and Harikishore Kumar Reddy, D. (2013). Removal of microelemental Cr (III) and cu (II) by using soybean meal waste – unusual isotherms and insights of binding mechanism. Bioresour.Technol.127, 350–357.

Zhang, L. and Sun, X. (2017). Addition of fish pond sediment and rock phosphate enhances the composting of green waste. Bioresour. Technol. 233, 116–126.

Zhanga, H., Gaoa, Y., Liua, J., Lina, Z., Leeb,C. T., Hashimb, H. and Lia, C. (2021). Recovery of nutrients from fish sludge as liquid fertilizer to enhance sustainability of aquaponics: a review. Chem. Eng. J. 83, 55–60.

Zhenjun, S., Xianchun, L., Lihui, S. and Chunyang, S. (1997). Earthworm as a potential protein resource. Ecology of Food and Nutrition. 36(2-4):221-236.

الملخص العربى

تأثير التسميد بالسماد الدودى الناتج من مخلفات الإستزراع السمكى على أداء النمو وكفاءة الأعلاف والمعايير البيوكيميائية لأسماك البلطي النيلي المرباة في أحواض أسمنتية

إسلام أكرم محمد عبدالوهاب، ياسر ثابت عبدالمجيد مصطفى، أحمد فاروق فتح الباب

1- قسم الإنتاج الحيواني والداجني والسمكي، كلية الزراعة، جامعة دمياط، مصر.

2- قسم الليمنولوجى، المعمل المركزي لبحوث الثروة السمكية، مركز البحوث الزراعية، مصر.

أجريت الدراسة الحالية في أحواض أسمنتية بمساحة سطح 4م^2 وحجم 4م^3، للتحقيق في إمكانية استخدام سماد حيوي عضوي جديد (سماد الديدان) يتم إنتاجه من خلال إعادة تدوير المخلفات الصلبة من تربية الأحياء المائية باستخدام ديدان الأرض في محاولة للتغلب على التحديات التي تواجه تربية الأحياء المائية في المياه العذبة فيما يتعلق بموارد المياه العذبة وارتفاع أسعار الأعلاف. وتم اختبار كفاءة ثلاثة أنواع من السماد الدودي كأسمدة حيوية عضوية جديدة لأحواض تربية الأحياء المائية في الدراسة الحالية. تم تجنيد ثلاثة أنواع من ديدان الأرض تم تجنيد ثلاثة أنواع من ديدان الأرض المستخدمة في التسميد الدودي لمخلفات تربية الأحياء المائية بدون أو مع نشارة الخشب أو بقايا قصب السكر. تم تخزين اسماك البلطى النيلى بمعدل 80 سمكة فى الحوض بمتوسط وزن ابتدائى 22.88 ± 0.14 g تم تخصيص اثني عشر حوض أسمنتي لأربع معاملات على النحو التالي: المعاملة القياسية باستخدام روث البقر كسماد عضوي تقليدي (T1)؛ سماد دودي من مخلفات تربية الأحياء المائية فقط (T2)؛ سماد دودي من خليط من مخلفات تربية الأحياء المائية ونشارة الخشب (T3)؛ وسماد دودي من خليط من مخلفات تربية الأحياء المائية وبقايا قصب السكر (T4). تلقت جميع الأحواض 3 جرام من اليوريا و 10 جرام من السوبر فوسفات الاحادى / بركة / أسبوعين حيث تم تزويدها بالتهوية المستمرة. تم تغذية الأسماك في جميع المعاملات (25٪ بروتين غذائي تجاري) بمعدل تغذية (3٪ من وزن الجسم يوميًا)، 6 أيام في الأسبوع لمدة 14 أسبوعًا.

بالمقارنة بالمجموعة الكنترول (T1)، أظهرت الأسماك التي تغذت في أحواض مخصبة بـ T4 و T3 و T2 على التوالي أفضل قيم لنسبة تحويل العلف و أعلى قيم للوزن النهائي وزيادة الوزن ومعدل النمو النوعي ونسبة كفاءة البروتين. وكان نفس الاتجاه في البروتين الكلى والألبومين والجلوبيولين. وكانت مستويات انزيمات ناقلة أمين الألانين (ALT) وناقلة أمين الأسبارتات (AST) للأسماك التي تم تربيتها في أحواض مخصبة بـ T1 أعلى بشكل ملحوظ. مما سبق يتبين أن تأثير السماد الدودي المصنوع من مزيج نفايات تربية الأحياء المائية أفضل من روث الأبقار كسماد عضوي في أحواض الأسماك، خاصةً وجود مواد تحسن جودة المياه مثل لب البنجر السكري أو نشارة الخشب.