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Preliminary evaluating the possible use of water-decanted sludge from seafood processing wastewater treatment to raise *Peryonyx excavatus*

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***Abstract*— *The study was conducted to evaluate the possibility of using sludge from processing seafood after dehydration to grow earthworm (Peryonyx excavatus). The worms (purchased from the Xuan Nong worm farm) were raised with a density of 5,000 individuals in three plastic drums with dimensions of LxWxH of 60x42x18 cm. Plastic drums contain a layer of coconut fiber in the bottom and sludge layer above. At the bottom of the plastic drums there are several drainage holes with a diameter of 5mm which could let the water out but not the worms. Soil samples were collected before and after the experiment to analyze the parameters of temperature, pH, humidity, total nitrogen (Nt), total potassium (Kt), total phosphorus (Pt). The results showed that the sludge after raising earthworms has the nutrient components increased significantly. Nt increased from 0.7% to 3.32%, Pt from 0.675% to 3.381%, and Kt from 0.046% to 0.245% compared to input sludge. E. coli was not detected and coliform was reduced to a level that is safe for human health. The use of sludge from the wastewater treatment system of the seafood processing company for raising Peryonyx excavatusbrings benefits since it both brings an additional income, and converts sludge into organic fertilizer, contributing to solving environmental problem.*

***Keywords*— Sludge, seafood processing, worm, environment, coliform, nutrients, Peryonyx excavates.**

I. INTRODUCTION

Seafood exploitation and processing is one of the key economic sectors and has great potential of Ca Mau province. Up to now, the province's export turnover has reached over 1.3 billion USD. In particular, the shrimp alone is over 1.2 billion USD, up 34% over the same period, total shrimp production is over 155,000 tons, the industry has always affirmed as the leading industry in the country in terms of output, solving employment, increasing budget revenue for the province. Along with the growth of shrimp production and other aquatic products over the past time are the establishment and development of a system of seafood export processing companies and enterprises. The province currently has 32 companies and nearly 38 affiliated enterprises with a total design capacity of over 190,000 tons/year. With this number of powerful companies and enterprises, Ca Mau shrimp has been contributed to over 40 countries and territories with fastidious markets such as the US, EU, Japan, and some Western countries. With the growth and development of the seafood industry, the treatment of wastewater from existing seafood processing companies, the wastewater treatment capacity of 10,000 m^3/day, the amount of sludge after each day up to 20 tons. This amount of sludge is not treated and discharged directly into the environment, which will be favorable for the development of pathogens and environmental pollution. This type of sludge contains many nutrients and does not contain heavy metals, can be used as a source of raw materials to produce vermicompost fertilizer effectively. This study aims to assess the possibility of using the sludge after decanting water to raise earthworm (**Peryonyx excavatus)**. The results of the study provide important information in the direction of the sludge management.

II. MATERIALS AND METHODS

2.1 Experimental design

Preparation of three plastic drums with dimensions of 60x4LxWxH of 60x42x18 cm with drainage holes with a diameter of 5mm and lined with plastic to prevent worms from moving out of the drums (Figure 1a) . Placed a thin layer of coconut fiber lining the bottom of the drums, and then placed sludge into the drums accounting for about 3/4 of the height of the drums. The worms (Peryonyx excavatus) were purchased from the production facility at the Xuan Nong worm farm in Can Tho city, stocked with a density of 5000 individuals with a total weight of 1500 g, evenly distributed into the three drums (1,500 gram of living worms for each drum). The worms were released into the drums by scattering it in a straight line in the middle of the drums. About 5 to 7 minutes after scattered the worms in the drums, worms should move down into the sludge. The drums were covered with the black plastic sheets (Figure 1b) to prevent the sunlight that could reach and kill worms. The moisture, pH, and temperature were measured daily. Plastic tool was used to dig and mix the sludge in the drums to take care of the worms and harvest them. Worms were harvested after 60 days of raising.

Fig.1: Preparation of plastic drums for worm raising

Fig.2: Harvesting worms in the drum 1, 2 and 3

2.2 Sample collection and analysis

Sludge samples were collected before and after the experiment to assess changes in physical, chemical and biological conditions. About 200g of sludge samples were collected on the plastic drums, then dried, pulverized and mixed to obtain the representative sample. The parameters of temperature, humidity, pH, total nitrogen (Nt), total phosphorus (Pt), total potassium (Kt), E. coli and Coliforms were analyzed for the sludge samples. Methods of collecting and analyzing the criteria were presented in Table 1.

Table 1. Parameters and methods for analysis

Parameter	Unit	Methods
pH	-	TCVN 5979:2007 (ISO 10390:2005) - pH
Moisture	%	TCVN 4048:2011 –Method for determining moisture
Temperature	^oC	TCVN 5508:2009 – Requirements on climatic conditions and measurement

		methods
Total nitrogen (N_t)	%	TCVN 8557:2010 – Fertilizers - Determination method for Nt
Total phosphorus (P_t)	%	AOAC 990.08
Total potassium (K_t)	%	AOAC 990.08
Coliforms	MPN/g	TCVN 4882:2007 (ISO 4831:2006) – Methods to detect and quantify Coliforms
E.Coli	MPN/g	TCVN 6846:2007 (ISO 7251:2005) – Method to detect and quantify E. coli

III. RESULTS AND DISCUSSION

3.1 Characteristics of sludge before the experiment

Some physical, chemical and biological properties of sludge were presented in Table 2. The neutral pH (pH = 7.3) was suitable for raising worms, with the best threshold for the worms to grow in the range of 7.0-7.5. The amount of Nt in the sludge reached a high level of 0.7%. The total potassium concentration in the sludge was low level of 0.046% which was below the nutrient level for plants. The total Pt concentration in the sludge was of 0.675%. Fishery processing sludge with E. coli and coliforms densities were within the permissible levels regulated in the Circular 41/2014 / BNNPTNT(<1000 MPN/g for E. coli; and <3000 MPN/g for coliforms.

Table 2.The characteristics of the sludge sample before the experiment

Parameters	Unit	Value
pH	-	7.3
Moisture	%	85
K_t	%	0,046
P_t	%	0,675
N_t	%	0,7
Coliforms	MNP/g	43
E. coli	MNP/g	0,74

3.2 Characteristics of sludge after the experiment

3.2.1 pH

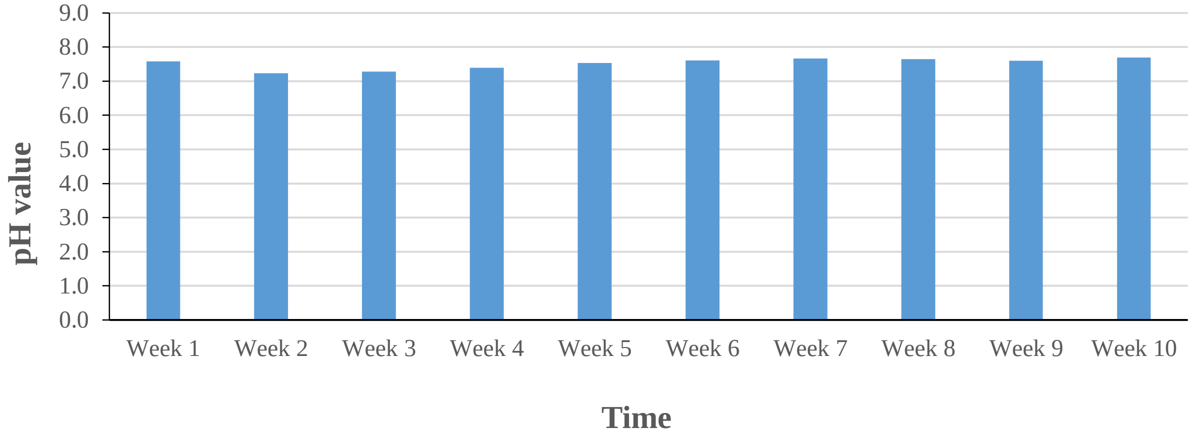

Fig.3: pH during the experiment

Figure 3 showed that the pH maintained neutral level ranged from 7.6 to 7.7. Peryonyx excavatus favors to live in a wet and stable environment, the most suitable pH is about 7.0 - 7.5, but they can withstand a fairly wide pH range of 4 - 9, if the pH is too low they will move away. Thus, the pH in the experiment meets the growth and development requirements of Peryonyx excavatus.

3.2.2 Moisture

Figure 4presented that the humidity did not change much and ranged from 76.0% to 76.7%. The appropriate humidity for Peryonyx excavatus is between 75-80%. Thus, the moisture in the experiment was kept stable during raising worms.

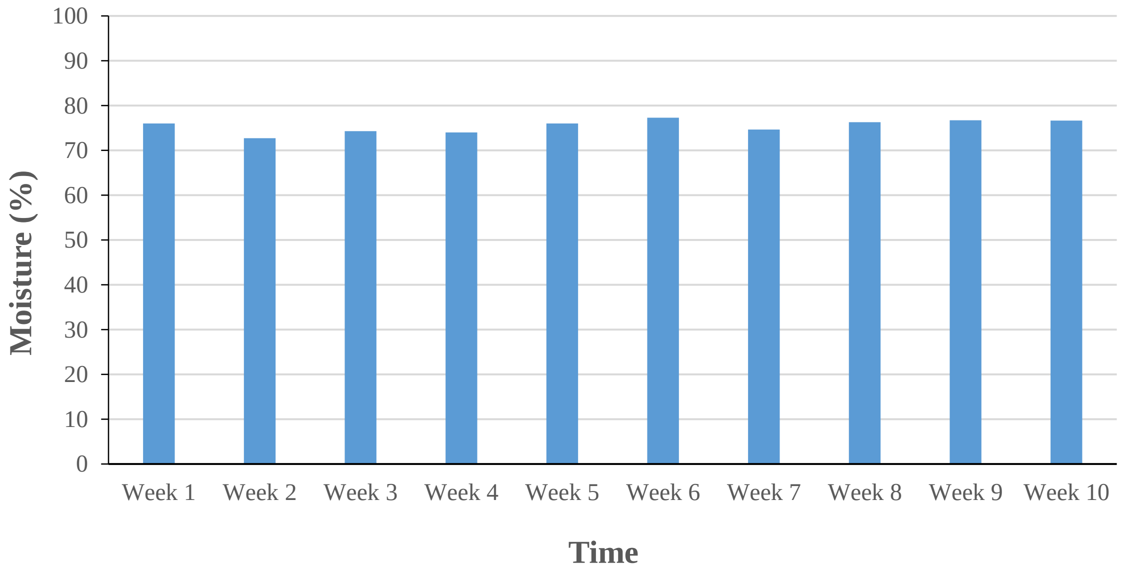

Fig.4: Moisture during the experiment

3.2.3 Temperature

The results in Figure 5indicated that the temperature varied with the weather outside, because the temperature range of raising the worms is relatively wide from 22ºC to 38ºC, the best for worms to live and grow well from 28ºC to 33ºC. The temperature results during the study were kept consistent for Peryonyx excavatus to grow well.

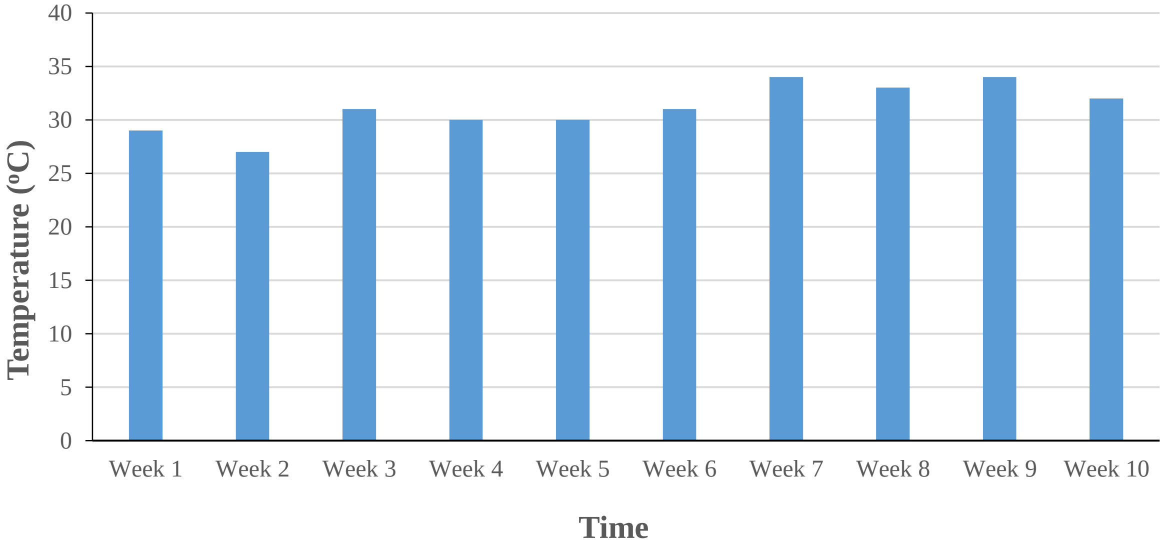

Fig.5: Temperature during the experiment

3.2.4 Properties of sludge after the experiment

The results from table 3 indicated that the potassium content in the sludge after used for raising the worm was high increasing from 0.046%to 0.245% estimated 5.32 times higher than that in the sludge before raising worm. The sludge after the experiment containedrich potassium which will be very beneficial for the use as fertilizer. Potassium is one of the macronutrient elements, plays an important role in agricultural production, contributing to increasing productivity and quality of agricultural products.Total phosphorus Pt increased sharply from 0.675% to 3.381%, 5 times higher than the input sludge. Further studies need to clarify this metabolic mechanism. The total phosphorus content increased by five times, indicating that the worms play an important role. Phosphate content in sludge after the worm is suitable for plants. Total nitrogen increased sharply from 0.70% to 3.23%, 4.6 times compared to the input sludge samples. Similar to phosphorus, nitrogen is present in the sludge after raising the worms suitable for use as fertilizer. The results of the analysis of the finished product samples showed that Coliform and E. coli decreased sharply, in which E. coli was no longer presented in the samples (Table 3).Thereby, it was found that the amount of input sludge providing feed as well as a living environment for the worms. The metabolism of the worms will release feces (Vermicas) out of the surface which is very nutritious. With the intial amounts of worms of 1.5 kg after sixty days the amounts of worms increased to 5 kg.

Table 3. Properties of sludge after the experiment

Parameters	Unit	Before the experiment	After the experiment
K_t	%	0,046	0.245
P_t	%	0,675	3.381
N_t	%	0,70	3.32
Coliforms	MNP/g	43	2.3
E. coli	MNP/g	0,74	0

3.3 Benefit of using sludge for raising Peryonyx excavatus

The intial estimate of economic benefit of growing *Peryonyx excavatus* using the sludge from the seafood processing wastewater treatment plants was described below.

In the experiment, 30 kg of water-decanted sludge was used, 1.5 kg seed worms was placed in the three drums. After 2 months of experiment from February 22, 2019 to April 22, 2019, the amount of the worms in each plastic drim increased from 1.5 kg to 5 kg.

Table 4.Simple cost-benefit analysis

Materials	**Unit**	**Cost**	**Amount**	**Money (VND)**
Input				**315,000**
Seed worm	Kg	30.000	4.5	135.000
Sludge	Kg	0	0	0
Plastic drum	piece	55.000	3	165.000
Plastic folk	piece	15.000	1	15.000
Output				**572,000**
Feeding worms	kg	35,000	15	512,000
Soil after raising worms	kg	2,000	30	60,000
Benefit				**315,000**

In addition to economic benefit, the use of sludge to feed the worms could contribute to solve the environmental problem and reduce the cost for sludge treatment. The sludge after the experiment could be used as organic fertilizers for improving soil fertile.

IV. CONCLUSION

The results showed that the sludge after raising the worms (*Peryonyx excavatus*) has the nutrient components increased significantly. Total nitrogen increased from 0.7% to 3.32%, total phosphorus from 0.675% to 3.381%, total potassium from 0.046% to 0.245% compared to input sludge. E. coli is not detected and coliform is reduced to a level that is safe for human health. The use of sludge from the wastewater treatment system for raising *Peryonyx excavatus* has many benefits because it both brings an additional income, and converts sludge into organic fertilizer, contributing to solving the environmental problem. This study should be continued to elaborate all the social-econimic and environmental aspects of raising worms using the water-decanted sludge from the seafood wastewater treatment process.

REFERENCES

[1] Vo Phu Duc (2013). Establish a process for producing compost from the sludge generated during pangasius processing. Dong Thap Science and Technology project.
[2] Tran Ngoc Hung (2009). Study on making soluble protein products from earthworm.
[3] Nguyen Lan Phuong (2011). Studying the process of producing compost from waste with the participation of earthworm.