

**Hormesis Phenomena of Some Parameter Aspect in Usage of Water Lettuce  
(*Pistia stratiotes* L.) for Phytoremediation Process of Petroleum Liquid Waste.**

Hanifa Marisa<sup>1\*</sup> and Sri Pertiwi Estuningsih<sup>2</sup>  
<sup>1,2</sup> Lecturer at Biology Department of Faculty of Science  
The University of Sriwijaya, Indonesia 30662

\*Corresponding authors: gmdiqhan2002@yahoo.com

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**ABSTRACT**

The research about potential test of water lettuce (*Pistia stratiotes*) in order of phytoremediation of petroleum liquid waste had been done during June until December 2012 at Microbiology Laboratory, Department of Biology, Faculty of Science, The University of Sriwijaya, Indonesia. Completely Randomized Design was used in the experiment while the concentration of liquid waste as treatment were: 0, 15, 30, 45, 60 and 75 %. Each treatment were replicated 4 times. Three parameter was measured; Total Petroleum Hydrocarbons (TPH) reduction percentage, efficiency of phytoremediation and number of tillers. Regression analysis were used for the data and two of parameters show the hormesis phenomena, were; efficiency of phytoremediation and number of tillers. The highest peak effect of treatment for efficiency of phytoremediation and number of tillers was on 45 %. TPH reduction percentage was the only one parameter that shows linear regression

Keywords: hormesis, *Pistia stratiotes*, TPH, phytoremediation, tiller

**ABSTRAK**

Penelitian ini mengenai uji potensi pada selada air (*Pistia stratiotes*) sebagai fitoremediasi limbah cair minyak bumi. Penelitian ini telah dilakukan pada bulan Juni sampai Desember 2012 di Laboratorium Mikrobiologi, Fakultas Biologi, Universitas Sriwijaya, Indonesia. Rancangan Acak Lengkap digunakan dalam percobaan sedangkan konsentrasi limbah cair sebagai perlakuan adalah: 0, 15, 30, 45, 60 dan 75%. Setiap perlakuan direplikasi 4 kali. Tiga parameter diukur; Persentase reduksi Total Petroleum Hydrocarbons (TPH), efisiensi fitoremediasi dan jumlah anakan. Analisis regresi digunakan untuk data dan dua parameter menunjukkan fenomena hormon; Manfaat fitoremediasi dan jumlah anakan. Efek puncak tertinggi perlakuan untuk efisiensi fitoremediasi dan jumlah anakan adalah pada 45%. Persentase penurunan TPH adalah satu-satunya parameter yang menunjukkan regresi linier

Kata kunci: Hormon, *Pistia stratiotes*, TPH, fitoremediasi, anakan

## INTRODUCTION

Hormesis is a natural phenomena. These concept explain about graphic trend of xenobion to biological object. At low concentration, xenobion or pollutant could be help the growth of individual object, but not at high concentration. At high concentration, xenobion could effect the physiological stress or even death (Stebbing, 1981). De la Rosa et al. (2004) cit. Lian Jia et al. (2013) explained hormesis as the chemicals toxic at high doses but can stimulatory at low doses. They call these phenomena as ‘biphasic dose response’ and always characterized by J or inverted-U shaped curve. Marisa (1990), found that ethanol extract of pine needle (*Pinus merkusii*) at 250 ppm concentration was stimulate the growth of radicle length of soybean seed germination, but begin to inhibit the growth of radicle at 750 ppm.

*Pistia* is a genus of aquatic plant included in family Araceae. *Pistia stratiotes* is the one species and usually called water lettuce or water cabbage, or in Indonesia/Malay; kiapu or kiambang. It is floats on water surface. The roots hanging submersed beneath floating leaves, and ecologically consider as weed species. *Pistia stratiotes* could be used as phytoremediation as reported by Rahman and Hasegawa (2011). According to Mkandawire and Dudel (2007), aquatic plants which characterized as fast growth, small in size, floating in nature and low sedimentation are good potential for phytoremediation agent.

So, the aim of the reseach is to show relationship between concentration of petroleum liquid waste to phytoremediation efficiency, number of tillers and TPH reduction during one month. It should perform the ability of *Pistia stratiotes* as phytoremediation agent.

## EXPERIMENT.

Completely Randomized Design was used in the experiment while the concentration of liquid waste as treatment were: 0, 15, 30, 45, 60 and 75 %. Each treatment were replicated 4 times. Plastic bioreactor were used for *Pistia* growth. Three parameter was measured; Total Petroleum Hydrocarbons (TPH) reduction percentage(after 30 days), efficiency of phytoremediation and number of tillers.

The formula for TPH (%): 
$$\frac{\text{Oil residue (g)} \times 100}{\text{Sample volume (50 ml)}}$$

Percentage of decrease of TPH (%): 
$$\frac{\text{TPH before treatment} - \text{TPH end}}{\text{TPH before treatment}} \times 100 \%$$

Efficiency of phytoremediation measured according to Lin et al. (2009) :

$$EP = \frac{[(M_o - M) - (M_{co} - M_{c0})]}{M_o} \times 100 \%$$

Regression analisys were used for the data. Statistica 6.0 version was used as software analysis data. Software should shows wherethere data trend is parabole (quadratic regression) or line (linier regression). Graphic of regression were pictured through red line and two black line for deviation limit.

### RESULT AND DISCUSSION

Table 1 below is the measurement of Phyto remediation Efficiency, Number of Tiller and decrease of Total Petroleum Hydrocarbon after 30 days. The table is followed by picture of graphical trend on relationship between concentration and those three parameters.

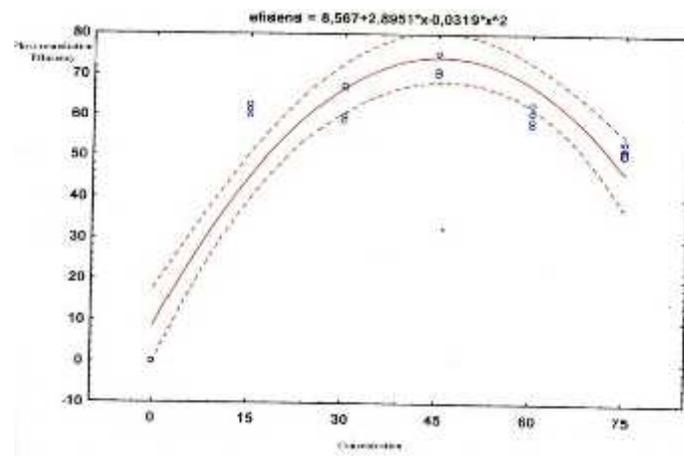
Table 1. Measurement of three parameter aspects of phytoremediation experiment of Petroleum Liquid Waste by *Pistia stratiotes*

No	Concentration Treatment	Measurement of Parameter Aspect		
		1. Phyto remediation Efficiency	2. Number of Tiller	3. TPH Decrease
1.	0	0 <sup>a</sup>	65.75 <sup>bc</sup>	0 <sup>a</sup>
2.	15	61.300 <sup>c</sup>	69.25 <sup>bc</sup>	71.625 <sup>b</sup>
3.	30	63.125 <sup>c</sup>	73.75 <sup>c</sup>	72.650 <sup>b</sup>
4.	45	71.750 <sup>d</sup>	89.50 <sup>d</sup>	75.175 <sup>b</sup>
5.	60	60.050 <sup>c</sup>	61.25 <sup>ab</sup>	83.825 <sup>d</sup>
6.	75	51.775 <sup>b</sup>	50.75 <sup>a</sup>	80.150 <sup>c</sup>

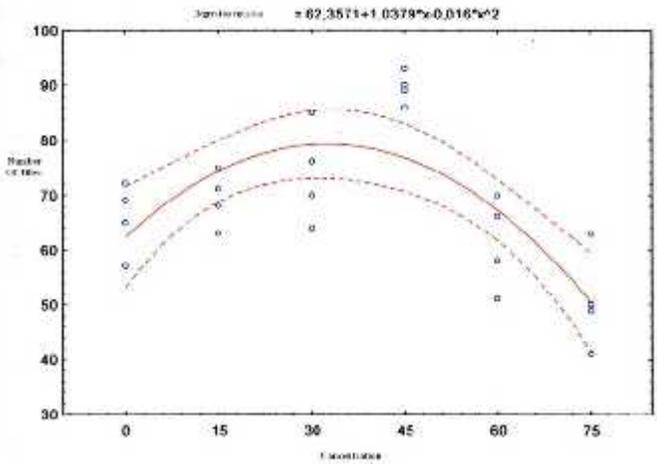
Note: letter indexed after values are Duncan Multiple Range Test category.

From above table seems that two of three parameter show hormesis curve phenomena; the efficiency of phyto remediation and number of tillers. TPH decrease shows linier regression trend.

Picture 1. Phyto remediation efficiency as affected by increase of petroleum liquid. Waste concentration

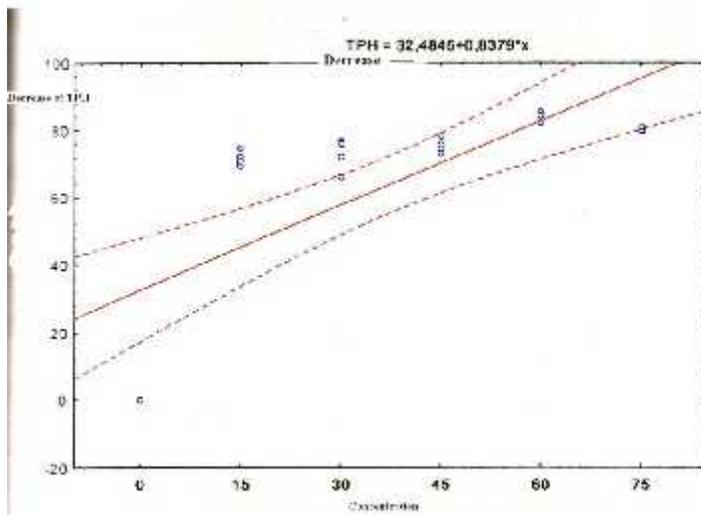


Picture 2. Number of tillers as affected by increase of petroleum liquid waste concentration



The same result had been found by Ye Tao Tang et al. (2009) where concentration of Pb, Zn and Cd impact the dry weight and chlorophyll concentration of *Arabis paniculata* Franch as inverted-U shape graphic. Fonkou et al. (2002) reported *Pistia stratiotes* has some characters as rapid growth and associated with microorganism. Those reasons supports this species in domestic sewage treatment as observed in macrophytic lagoon systems in Cameroon.

Picture 3. Decrease of TPH as affected by increase of petroleum liquid waste concentration



Look, TPH reduction is the only one aspect that shows linier curve. It means that addition of liquid waste concentration would increase the TPH during 30 days, in the *Pistia stratiotes* plant body.

According to Rahman and Hasegawa (2011), *P stratiotes* mats degrade water quality by blocking air-water interface, reduce oxygen level in the water and threaten aquatic life; but its could be role as bioaccumulator, because of strongly adsorb of toxic contaminant of water, like arsenic and others. Prajapati et al., (2012) improved the role of *P stratiotes* in phytoremediation of Chromium and cobalt in India. The same result also found by Chakraborty and Mukherjee (2013) for Chromium phytoremediation.

### CONCLUSION

Two of parameters show the hormesis phenomena, were; efficiency of phytoremediation and number of tillers. The highest peak effect of treatment for efficiency of phytoremediation and number of tillers was on 45 %. TPH reduction percentage was the only one parameter that shows linier regression

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