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STUDY ON THE CHARACTERISTICS AND UTILIZATION OF NASIPADANG, GENERAL RESTAURANT AND HOUSING WASTE AT PEKANBARU, INDONESIA

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ABSTRACT

This study was conducted to investigate suitability of restaurant and housing wastewater to be reused as fertilizer for food crops. High concentration of wastewater applied to soil resulted into decreasing plant growth, however in low concentration (suitable) could increase the biomass of plants. Wastewater of restaurants in Pekanbaru contained the macro and micro essential nutrient (N, P,K, Ca, Mg and Ca). It is proven that there was only small significant difference in the performance of plant growth between restaurant, housing wastewater and commercial control (pure water). It can be seen that general restaurants and housing wastewater were able to perform as well as organic fertilizer. This result could be used as an alternative for substitution of organic fertilizer.

KEY WORD *:* General-restaurant, Nasi-padang restaurant, Fertilizer, Wastewater.

INTRODUCTION

GULLY wastewater became one of the major environmental problems mainly in developing countries. Domestic industries like livestock industries, food manufacturing or other food industrial inevitably contribute to waste-water. In Indonesia about 25,000,000 m tons of waste produced annually and it has been approximated increase to 650.000.000 m tons in 2020 (Jumin, 2018). Waste-water taken from restaurants is becoming appear to pollutants material and accumulated to ground water or water bodies (lake, river and swamp water). The poor environment management in developing counties could cost 1.0 % of GDP (Jumin, 2018).

In Malaysia, the total lose of money for managing waste-water is approximated US$ 0.33 billion per year (Roslan *et al*., 2013). However, the treated-waste-water is usually thrown away either at landfills or being burned in incinerators (Bradly *et al*., 2018). Preliminary experiment has shown that restaurant wastewater consists of essential nutrition's for plant growth (Jumin, 2018).

Suitable concentration of wastewater applied to *Cucuma sxanthorrhiza* and *Carica papaya* has shown adequate nitrogen. Naturally, nasipadang restaurant has contained small number of essential nutrient level as compared to the commercial fertilizers where, it was 163 mg/L nitrogen, 3.4 mg/l phosphorus, <0,0194 mg/L potassium, <0,0194 mg/L magnesium and 60 mg/L calcium and low content of heavy metals (Jumin *et al*., 2017). Meanwhile, a commercial fertilizer might contain 45% nitrogen for urea fertilizer, 36% phosphorus for SP 36 fertilizer and 36% potassium for KCl fertilizer.

Beside that macro-nutrients and micro-nutrients, nasipadang restaurant waste-water also contains essential micro nutrient and others as amino acids, vitamins, enzymes, and growth regulators (Metcalf and Eddy, 2004).

The objective of this study is (1) to identify the Characteristic and utilization of nasipadang, general restaurant restaurants, housing wastewater and the feasibility of waste to be used as fertilizer.(2) to evaluate the potential of nasipadang, general restaurant and housing waste-water to be used as a alternative organic fertilizer.

MATERIALS AND METHODS

Site Description

This research has been conducted in green house Fakultas Pertanian Universitas Islam Riau, Indonesia. The study materials were obtained from water cutter of two nasipadang restaurants located in Pekanbaru.

Material used for this experiment was red yellow podzol soil and the experiment was arranged with randomly block design. The experiment were designed to two split plots and conducted under green house. First split was designed with 2 factors and contains 16 unit treatments and 3 replications for *Carica papaya*, with first factor is nasipadang restaurant water waste, 0.0 mg/L, 500 mg/L, 750 mg/L and 1000 mg/L, and second factor is urea fertilizer 0.0 g/plant, 0.5 g/plant, 1.0 g/plant, 1.5 g/plant. A single seed was planted to a polybag (35 x 40 cm). Plants were maintained under natural temperature and light intensity with 12 hours photoperiod average for 42 days.

Second split plot was designed also with two factors and contain 16 unit experiment and 3 replication for *Carica papaya* and *Curcuma xanthorrhiza*, with the first factor is general restaurant water waste 0.0 mg/L, 250 mg/L, 500 mg/L, 750 mg/L, and second factor is housing water waste 0.0 mg/L, 250 mg/L. 500 mg/L, 750 mg/L. A single 5 cm bulb with 9 month age were planted to a polybag (35 x 40 cm). Plants were maintained under natural temperature and light intensity with 12 hours photoperiods average during 120 days.

Parameters

Utilization Possibility in Agriculture

Growth Performance Parameters

Mean relative growth rate (MRGR)

Mean relative growth rate is the hoard of dry weight of *Curcuma xanthorriza* and *Carrica papaya* during their photosynthesis under light condition. The accumulation of dry weight estimated the increasing of organ and tissue in *Curcuma xanthorriza* and *Carica papaya*. Mean relative growth rate (MRGR) can be calculated by sampling plant size at first time (t1) and second time (t2) in different age of plants. The equation for calculating the MRGR (South, (1995), is as follows;

$$MRGR = \frac{\ln W2 - \ln W1}{t2 - t1} \quad .. (1)$$

W1 is the dry weight of *Curcuma xanthorriza* and *Carrica papaya* on first calculated whereas W2 is the dry weight of *Curcuma xanthorriza* and *Carica papaya* on second calculated. T1 is first period of dry weight calculated and T2 I second period of dry weight dry weight.

Net assimilation rates (NAR)

The net assimilation rate is the weight of total dry weight per unit area and certain time (t), of*Carica papaya* and *Curcuma xanthorrhiza.* The NAR calculating four time during experiment. T1 is first period of dry weight calculated and T2 second period of dry weight dry weight. Dry weight will be used to calculate of the cells activities, so which affected to increased the dry weight of of *Carica papaya* and *Curcuma xanthorrhiza*. The NAR is draw rate photosynthesis an *Curcuma xanthorrhiza* and *Carica papaya* increase of biomass weight and also based on leaf area at a certain fixed time (t) of of *Carica papaya* and *Curcuma xanthorrhiza* all treatments and it is positively correlated with mean MRGR.

Net assimilation rate of the photosynthetic efficiency of plants was measured by South, 1995 method. Net assimilation rate of plants and E) is defined as the rate of increase of dry weight of plants (W) per unit leaf area of *Carica papaya* and *Curcuma xanthorrhiza* (South, 1995) as presented in equation 2 thus;

$$MRGR = \frac{1\ dW}{L\ dt} \quad .. (2)$$

In measuring W the plant is destroyed to calculate dry weight thus changes in W is calculated by random sampling from all plants of *Carica papaya* and *Curcuma xanthorrhiza.* In this experiment samples are examined at intervals 7 days form calculating W and L during vegetative growth. The *dW* and L means may then be used to accumulate E_M, an estimate of the mean E for each time- interval (t2–t1), usually as proposed by Alison and Vernon (1963) and shown in equation 3 thus;

$$\text{MRGR} = \frac{(W2-W1)\ (\text{Logel2}-\text{Logel1})}{(T_2 - T_1\ (L2-L1)} \quad ..\ (3)$$

Leaf area

Leaf area was measured on sub-sample using leaf area meter and image analysis software. Leaf area were measured four times since 21, 28, 35 and 42 days after planting for *Curcuma xanthorrhiza*, and 7. 14, 21 and 35 days after planting for *Carica papaya.*

Dry weight

Dry weight of pants were measured 4 times during plant life cycles. Dry weight was used to evaluate the component of mean relative growth rate and net assimilation rate. The dry weight was calculated at beginning since 21, 28, 35 and 42 days after planting for *Curcuma xanthorrhiza*, and dry weight of *Carica papaya* calculated since 7, 14, 21 and 28 days after planting.

Biomass

Biomass is biological material derived from plant and is measured at the end of the experiment. Chemical contents of wastewater were analyzed with appropriate procedures at the Laboratory of Agro-technology, Faculty of Agriculture, and Islamic University of Riau Indonesia. Nitrogen, phosphorus, calcium, pH and heavy metals (Pb, Cu, Ar, Cd and Zn) contents were analyzed at the Kimpraswil Riau. Province Pekanbaru, PT. Central Alam Resources Lestari (Central Plantation Services) and PT. Scupindo Pekanbaru Laboratories.

Characteristic of Wastewater

Chemical content

Physical characteristic (color, temperature and smelling) of the wastewater were analyzed with appropriate procedure at T Kesehatandan Lingkungan Laboratory Riau Province and Riau University laboratory. Chemical characteristic as nitrogen were analyzed with USEPA procedure, Lead, Copper, and Potassium with SNI 06-6989.11-2004 procedure pH level with SNI 06-6989.11-2014, Sodium (Specto-photometric), Calcium with SNI 06-6989-12-200 procedure), Phosphorus with SNI 06-6989.31-2005 procedure, Chemical oxygen demand with APHA 5220 C 2012 procedure, Biochemical oxygen demand SNI 06-2503-1991 procedure.

RESULT AND DISCUSSION

Increasingly the restaurants waste-water concentration treated to *Curcuma xanthorihiza* showed significant increase in the vegetative and generative growth. The concentration of 750 mg/L restaurant wastewater could increase plant height, net assimilation rate, mean relative growth rate and dray weight of bulb. However different case with *Carica papaya*, increasing the restaurant wastewater concentration that a negative effect to the vegetative growth. The concentration of 1000 mg/L restaurant wastewater could decrease the vegetative growth significantly from 9.8 number of leaf and 4.7 number of leaf (Figure 1). The differences effect to vegetative growth of two horticulture plants not only caused to different level nutrient content between nasipadang restaurants and general restaurants wastewater, but it also caused by the response of different plants.

The reasons behind the wastewater treatment are the scarce in natural land and water resources and the higher demand of clean water supply and possibility to use for agriculture purpose. Moreover the higher volume of wastewater back to natural soil deteriorates quality of soil water in receiving land bodies. These matters have emphasized technological development in plant forest industry to provide innovative yet proven technical solution. The efficacy of heavy metals biological leaching (acid generous and alkali generous)taking from some place of gutter in Pekanbaru and there have indicator containing heavy metals and parasite micro organism.

The main purpose of any waste-water treatment to plant is to reduce or remove heavy metals, organic matters, solids, nutrients, disease-causing organisms and their pollutants from wastewater. Nasipadang, general restaurants and housing wastewater treatment plants go through several steps in a treatment process in order to safely treat large quantities of heavy metals and other dangerous waste buried. Each nasipadang restaurant, general restaurants and housing wastewater to plant must hold a permit listing the allowable macro or micro nutrient to reserve plants and heavy metal to accumulate by plants so its not became pollutants matters. Currently the systems like septic tank, burial tank, oxidation ponds and aerated lagoon are used to treat the polluted wastewater and heavy metals in sewage.

The heavy metals leaching was accompanied by organic and others compound suspension destabilization in the soil by plants. The most rapid restaurants wastewater response was observed in plant high growth, mean relative growth rate, net assimilation rate process of *C. xanthorrhiza* and C. *papaya* plants (Table 1 and 2).

Level of pH in wastewater and in soil are more informants to control and maintenance its benefit to plant growth. Some of metals is also needed to plants growth and production, however high level of metal matters is damaged to plants. In nasipadang, general restaurants and housing wastewater have shown positive effect to plants growth and its drawing to dry weight of *Cucumis xanthorrhiza* and *C. papaya* plants. Pathogens and other micro organisms in soil and wastewater of nasipadang, general restaurants and housing it could hindered of the plants (Chow and Wei, 2010).

This indicated wastewater of nasipadang restaurants and housing it could be decreased value of soil pH, because waste content of some organic compound with low (3.0) pH value (Table 4). Nikovskaya *et al.* (2006) mentioned that, fertilizers with moderate between 5.6–7.0 pH is suitable for plants growth and nutrient availability of fertilizers and soil fertility indicator. The unfavorable condition of wastewater it was response to decreasing of the *C. papaya* growth if the wastewater of nasipadang restaurant treatments increasingly. Four functions of growth root medium are a root medium; continuous supply of water, provide nutrients, allow the exchange of gases to land from the roots, and offer support for the plants (Nelson, 1991). The optimum yield of plant can be pacemaker by the application of suitability soi condition, which have a conspicuous effect on the plant growth (Vernon Allison, 1963).

Use of wastewater of nasipadang, general restaurantsand housing to land may be utility to plants, because it can repair the physical, chemical and biological properties of land which may enhance crop growth (Beck *et al.*, 21996). In addition the use of sludge as a fertilizer would decrease the amounts of chemical fertilizers needed in agriculture use (Jumin *et al.*, 2014; Jumin, 2014; Jumin *et al*,. 2016; Jumin *et al*,. 2017).

Table 1. Net assimilation rate of *C. papaya* plants after pouring with nasipadang restaurant - and urea fertilizer (mg/ cm^2/day).

Planting (day)	Water waste (mL/L)	Urea fertilizer (g/plant) 0.0	0.5	01.0	1.5	Average
7-14	0	0.012	0.016	0.018	0.019	0.016a
	500	0.011	0.013	0.014	0.015	0.013b
	750	0.004	0.006	0.009	0.010	0.007c
	1000	0.003	0.005	0.007	0.008	0.006c
	Average	0.008d	0.010c	0.012b	0.013a	
14-21	0	0.014def	0.022ab	0.023a	0.025a	0.021a
	500	0.013efg	0.015de	0.017cd	0.019bc	0.016b
	750	0.006k	0.008ijk	0.011fghi	0.012efgh	0.009c
	1000	0.005k	0.007jk	0.009hijk	0.010ghij	0.008c
	Average	0.010d	0.013c	0.015b	0.017a	
21-28	0	0.024def	0.029ab	0.030ab	0.031a	0.029a
	500	0.023ef	0.025cde	0.027bcd	0.028abc	0.026b
	750	0.011i	0.016hi	0.021fg	0.022efg	0.018c
	1000	0.010j	0.015i	0.017hi	0.019gh	0.015d
	Average	0.017c	0.021b	0.024a	0.025a	

Mean value followed by different alphabet/s within a column do not differ significantly over one other at Pd"0.05 lead by Duncan's Multiple Range Test

Table 2. Mean relative growth rate of *C. papaya* after pouring with waste and urea fertilizer (mg/day).

General restaurant waste-water (ml/L)	0	Housing waste-water (ml/L) 250	500	750	Average
0	80.27	0.0	95.67	120.00	96.98
250	81.00	98.67	105.00	122.00	101.67
500	84.00	100.67	114.33	156.67	113.92
750	87.00	250.00	118.00	123.00	108.75
Average	83.07	92.00	108.25	130.42	

Comparisons were made between the different plant and waste-water treatments in order to determine which waste-water concentration could produce the highest *C. xanthorrhiza* growth and production of bulb if compared to the commercial fertilizer. The growth of *C. xanthorrhiza* was being monitored by measuring its stem high, number of leaf and other vegetative process it was being monitored by measuring its dry weight of bulb (Table 3).

By observing the graph presented in Figure 1, it is noted that the increasing value of waste-water application on the plant had affected the growth of *C. xanthorrhiza* from 750 mg/L general restaurant waste-water treatment, followed by 500 mg/L and 250 mg/L in *C. xanthorihaza* (101.7 g). Whereas very high of dray weight of bulb (113.9 g) was obtained from 500 mg/L housing waste-water concentration. This is assuming the red yellow podzol soil using for this experiments may be contained the essential nutrients and combined to the wastewater taking from gutter of the restaurants and there promoting the plant growth.Waste-water contained a height amount of nitrogen (Table 4) that can contribute to the plant growth. It can be proven from Table 3, where the highest applications of waste-water soil, which was 750 mg/L waste-water treatment gives the rapid growth as compared to the other wastewater treatment that contained less amount of waste-water especially for *C. xanthorrihaza* (Figure 3). The plants growth increased by the sufficiently of macro and micro nutrient in the soil its beneficial to promote the plant reproductive to produce high quality of yield. The growth of plant in all waste-water of general restaurant and housing wastewater was increasing greatly. The difference between *C. xanthorrihaza* and *C. papaya*, there *C. papaya* shown upside down effect of nasipadang restaurant waste-water, where if the concentration increasing the vegetative plant growth was decreased significantly

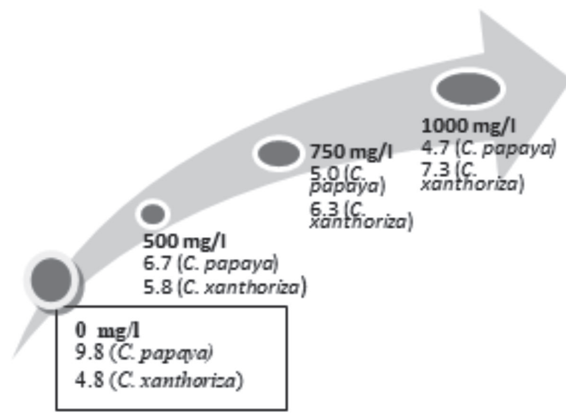

Fig. 1. Growth of Curcuma xanthoriza and *Carica papaya* nasipadang after poring with waste-water of , general restaurant and housing.

Table 3. Weight (g) of *C. xanthorrihaza* bulb after pouring with general restaurant waste-water on 120 days after planting.

Day After Planting	Water waste (ml/L)	Urea fertilizer (g/plant) 0.0	0.5	1.0	1.5	Average
21-28	0	0.146e	0.167bc	0.175ab	0.184a	0.168a
	500	0.143e	0.149de	0.157cd	0.163c	0.153b
	750	0.070k	0.093i	0.121fg	0.136f	0.105c
	1000	0.060k	0.082j	0.108h	0.131g	0.095c
	Average	0.105 d	0.123 c	0.140 b	0.154 a	
28-35	0	0.162e	0.211b	0.215ab	0.222a	0.203a
	500	0.158ef	0.182d	0.197c	0.208b	0.186b
	750	0.084j	0.113h	0.149fg	0.157ef	0.126c
	1000	0.078j	0.100i	0.120h	0.145g	0.111d
	Average	0.121d	0.152c	0.170b	0.183a	
35-42	0	0.184d	0.231ab	0.234ab	0.240a	0.222a
	500	0.179de	0.205c	0.218bc	0.227ab	0.207b
	750	0.102h	0.129fg	0.167de	0.171de	0.142c
	1000	0.094h	0.114gh	0.135f	0.160e	0.126d
	Average	0.140d	0.170c	0.189b	0.200a	

Mean value followed by different alphabet/s within a column do not differ significantly over one other at Pd”0.05 lead by Duncan’s Multiple Range Test

(Figure 4). This is may cause by differences in the plant response to wastewater and it also differences in nutrient contents of sources of water waste.

Phosphorus is one macro nutrient to plant growth. Micro nutrient functioning to promote coenzymes activities in plant metabolisms. In wastewater of nasipadang, general restaurant and housing are consisting almost that macro and micro nutrients. Coenzymes benefit to photosynthesis to arrange carbohydrate and some of them to amino acid in protein synthesis (Jacob and Mc-Creary, 2001). Bulb weight production and quality are the significantly important elements in *C. xanthorrihaza*, because their amino acid and glucoses contents are useful to food materials. Balanced potting soil plays an important role in the production of bulb. A high dry weight of bulb will indicate suitable conditions for growing plants.

Fig. 2. *Curcuma xanthorrhiza* growth with 750 mg/L waste-water on 120 days after planting (left) and tuber formation (right).

Based on the result from Table 3, phosphorus in the wastewater could be increased the dry weight of bulb has a close relation with red yellow podzol soil. and 500 mg/L waste-water treatment produced more bulb weight per plant.

Macro nutrient compound in soil and water like potassium, magnesium and sulfur are promoting the plant growth and reproduction. In the wastewater of nasipadang, general restaurant and housing significantly showed biological oxygen demands and chemical oxygen demands beneficially exist in the suitable condition to support the plant growth for *C. xanthorrihaza* (Table 4). The concentration of potassium in the plants increased the growth rate of plants.

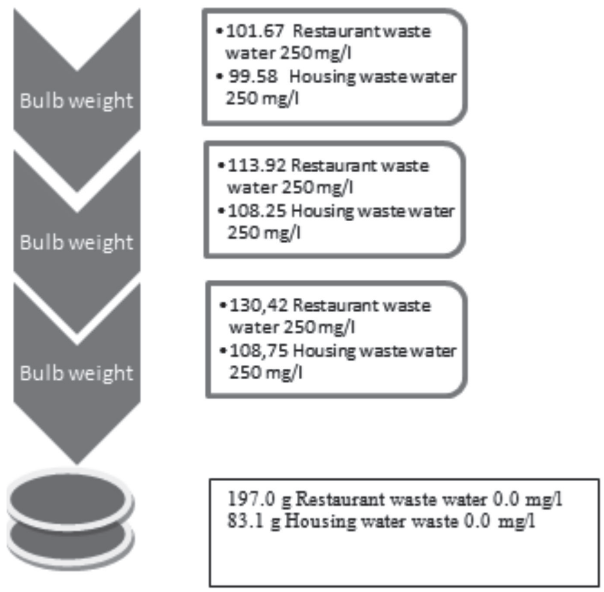

Fig. 3. Bulb weight of *C. xanthorrhiza* after pouring with restaurant water waste and housing wastewater 12 days after planting.

Contents of lead, sodium inwaste-water are lower than the threshold of human health tolerance (Bapedal, 1995).

At similar efficiency, the processes of excess sodium removal with organic compound in soil due

Table 4. Chemical analyzes of waste-water of nasipadang, general restaurants and housing wastewater.

No	Parameters	Unit	Water waste		
			Nasi-padang Restaurants	Housing	General restaurant
1	pH	-	4,76	3.6	3.0
2	BOD	Mg/L	1049	870	980
3	COD	Mg/L	5765	4980	5693
4	Lead	Mg/L	<0,0017	<0.0017	<0.001
5	Sodium	Mg/L	1265	3.634	3.632
6	Copper	Mg/L	<0,0172	<0,0172	<0,0172
7	Calcium	Mg/L	60	29	30
8	Magnesium	Mg/L	4681	109.37	4.681
9	Phosphorus	Mg/L	3,4	0.368	0.762.
10	Potassium	Mg/L	<0,0194	<0,0194	<0,0194
11	Nitrogen Total	Mg/L	163	336	163

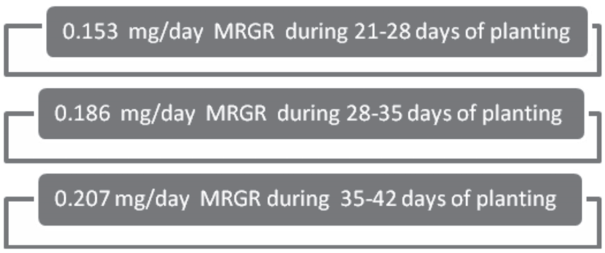

Fig. 4. Mean relative growth rate (mg/days) of *Curcuma xanthorriza* under condition of 500 mg/L restaurant waste-water.

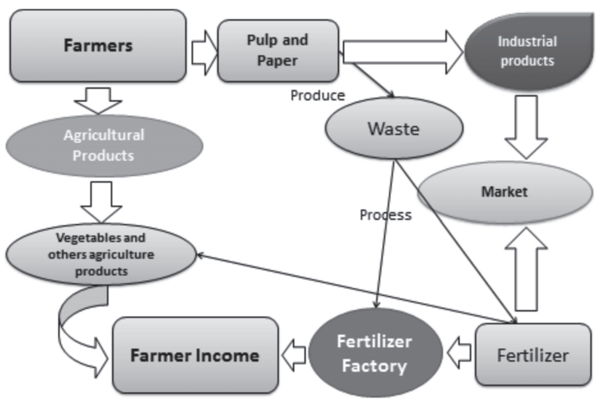

Fig. 5. Circulation system of industrial products will be used as a fertilizer for agriculture use

to their high speed and exclusion of secondary chemical pollution (Table 4). The results showed that the process of bioconvention produced waste-water with sutable concentration and under threshold of dangerous natrium and it is possible to use as subtitution fertilizer.. This process includes then chancing of vital ability of wastewater by adding the easily metabolized nutrients, synthesis of metabolites by growing plant. These metabolites with the properties of sodium extraction and wastewater provided in the soil. Some of the wastewater is the mineral fertilizer of prolonged action with immobilized bio-elements.

CONCLUSION

General restaurant and housing wastewater could increased vegetative and generative growth of *Curcuma xanthorrhiza*, and it has possibility as substitution to commercial fertilizer. Increasingly concentration of nasipadang restaurant wastewater decreased the vegetative growth of *Carica papaya*. Nasipadang wastewater contained a high of sodium content and it not possible to use as fertilizer for agriculture purpose.

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