

THE EFFECT OF WATER HYACINTH (*Eichornia crassipes*) FROM POLLUTED WATER IN THE RATION AND ITS IMPACT ON THE PERFORMANCE OF LANDRACE PIGS

by

I W. Sudiastra.¹⁾, I G. Mahardika.¹⁾, I N.S. Dharmawan.²⁾, K. Budaarsa¹⁾

1). Faculty of Animal Sciences, Udayana University, Denpasar, Bali

2). Faculty of Veterinary Sciences, Udayana University, Denpasar, Bali

ABSTRACT

The use of waste as component material ration provides benefits that do not compete with humans, is relatively inexpensive and can reduce environmental pollution. The purpose of this study were to determine the benefits and the impact of the provision of water hyacinth (*Eichornia crassipes*) from polluted waters as feed supplement on the performance of Landrace pigs. This research used completely randomized design (CRD) with 4 treatments and 4 replications. A total of 16 Landrace pigs with an average live weight of 20 kg were used in this study. The four treatments are: (A) pigs received rations without water hyacinth, (B) pigs received rations plus 2.5% water hyacinth, (C) pigs received rations 5% plus water hyacinth and (D) pigs received rations 7.5% water hyacinth plus. Growth of pigs, feed intake, feed efficiency, feed digestibility and nutrient digestibility, carcass composition and quality, fat content, and the content of heavy metals (Pb and Cd) in the meat, intestines, kidneys and liver were evaluated in this study. The results showed that the use of water hyacinth from polluted waters up 7.5% in the feed had no effect on the growth of pigs ($P > 0.05$). They tends to improve feed intake and consumption of organic matter, as well as increasing their feed conversion but the difference significant ($P > 0.05$). Digestibility of dry matter, organic matter and nutrient but were not significantly different by tend to decrease with the increasing the use of water hyacinth originated from polluted waters in the ration ($P > 0.05$). Digestibility of dry matter, organic matter digestibility and nutrient digestibility were also tend to decrease by increasing the use of water hyacinth originated from polluted waters in the ration but not significantly different ($P > 0.05$). The use of water hyacinth up to 7.5% in the ration did not affect to the percentage and pieces of carcass weight ($P > 0.05$). The content of heavy metals (Pb and Cd) in meat, kidney, liver and small intestine of pigs received rations containing water hyacinth originated from polluted water, still below the limit of safe consumption. It was concended tha the use of water hyacinth from polluted waters as pig feed material to the level of 7.5% did not significantly affect the performance of Landrace pig in tern of growth carcass weight, carcass percentage and meat quality

Keywords: *water hyacinth, water polluted, rations, landrace pig*

INTRODUCTION

One of the problems in the development of farm animals included pigs is the availability of feed. In addition the price was continuously rising, the difficulty in gaining some materials of feed besides it also consumed by people, therefore the usage of feed competed the human needs. One effort to overcome this problem is to utilize agricultural or horticultural waste as feed ingredients. The use of waste as a constituent of ration will provide benefits which are not compete human food, relatively cheap and can reduce environmental pollution. One of agricultural waste that has prospects to develop is water hyacinth.

Water hyacinth (*Eichornia crassipes*) is an aquatic weed which is often damaged the environment and has not been used optimally for animal feed. Water hyacinth may can be used for reducing pollution levels of heavy metals such as in polluted water Pb, Cd, Cu, Fe, Zn, and Hg (Armand and Nisma 2010). The proper treatment of water hyacinth can produced biogas as fuel for power generat on gas engine (Alvi et al., 2014; Wibisono et al., 2014); and also can be used as crop fertilizer (Mashavira et al., 2015).

Tosepu (2012) states that water hyacinth can grow and multiply very quickly, so the productivity is very high. This condition requires an effort to utilize the water hyacinth plants as feed, especially for pigs. The availability of water hyacinth is very abundant and can be used as the component of pig rations. In some areas the water hyacinth has been used as food ingredient for pigs. The scientific studies on the use of water hyacinth plants originating from polluted water as one component of pig ration has not been done. Therefore, research on its use as pig feed is very important. The aim of their study were determine whether water hyacinth which were collected from polluted water might affect pig performance and their meat quality. Lack of informations were formd about water hyacinth which grew polluted water and its unsafe for animal feed pig.

MATERIALS AND METHODS

This research used 16 castrated male Landrace pigs weaned at 2 months of age with an average body weight of 20 kg. The pigs were vaccinated with SE and cholera vaccine and given worm medicine before being used for this study.

Sixteen individual cage were used in this study each of them, equipped with food place and one bucket for drinking water. Cage roof is made of tiles, while the floor of the cage is made of concrete. Commercial feed was used in this study which was provided *ad-libitum* as will as their drinking water.

The studyh was conducted at the Research station of the Faculty of Animal Science, University of Udayana and proximate analysis of the feed carried out in the Laboratory of Animal Nutrition Faculty of Animal Science, Udayana University.

Design of the study was completely randomized design with 4 treatments and 4 replicates in each treatment. The four treatment were:

A: Commercial feed rations without hyacinth as control

B: Commercial feed supplemented with 2.5% water hyacinth,

C: Commercial feed supplemented with 5% water hyacinth,

D: Commercial feed supplemented with 7.5% water hyacinth

The variables observed were: growth of pigs, feed intake, feed efficiency, feed digestibility and nutrient digestibility, as well as the composition and quality of the carcass

Feed consumption was determined by reducing the amount of feed given to the rest of the food day by growth of the pig calculated by weighting this pigs every week, then weight gain is calculated by subtracted final body weight with the initial weight divided by study period. Ration digestibility coefficient dry matter was determined by one week collection method (Tillman, *et al.* 1998). Dry matter digestibility was calculated by the following formula:

$$\text{Dry matter digestibility} = \frac{A - B}{A} \times 100\%$$

Note:

A: is consumption dry matter (kg),

B: is the production of dry matter feces (kg).

Feed Conversion Ratio (FCR) was obtained by divided the amount of feed consumed with weight gain. Carcass weight was measured by reducing the pig weight with blood, hair, head, feet, gastrointestinal and internal organs except the lungs and kidneys (USDA, 1977). Carcass percentage was measured by divided carcass weight with slaughtered weight multiplied by 100%.

Data were analyzed using analysis of variance, if the analysis was significantly analysis to be continued with Duncan Murtiple range test to find one the differences between the treatment means. Determination of the optimal amount of water hyacinth might be supplemented to the ration was analysed using orthogonal polynomials method (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Pig Performance

Daily weight gain of pigs on control feed (A) was: 0,57 kg /d, while in treatment B, C and D were 0.59 kg /d, 0.55 kg /d, and 0.56 kg /d (Table 1). There were no significant differenced in daily weight gain between the all treatment and the control group ($P > 0.05$).

Table 1. Performances of Pigs Fed Commercial with Water Hyacinth From Polluted Water.

Variables	Treatment			
	A	B	C	D
Daily weight gain (kg/d)	0,57a	0,59a	0,55a	0,56a
DW consumption (kg/d)	1,53a	1,58a	1,58a	1,76a
OM consumption (kg/d)	1,46a	1,53a	1,49a	1,66a
FCR	2,70a	2,71a	2,89a	3,15a

Note:

A: Commercial feed rations without hyacinth as control

B: Commercial feed supplemented with 2.5% water hyacinth,

C: Commercial feed supplemented with 5% water hyacinth,

D: Commercial feed supplemented with 7.5% water hyacinth

Values followed by the same letter, on the same line are not significantly different (P > 0.05)

Feed consumption of pigs in the control group was: 1.53 kg /d, while feed intake in treatment B, C and D showed an increasing trend but their differences were not statistically from the control on treatment A ($P > 0.05$). By increasing the level water hyacinth supplemented nutrient.

The average protein consumption in treatment A was: 301.53 g /d, while the consumption of pigs receiving water hyacinth is supplementation were not different with pig feed the control (without water hyacinth), While the energy and crude fiber consumption in pigs that received rations contained water hyacinth tended to be higher than pigs that received ration without water hyacinth (Table 2). It might because tendency of the increase in consumption of dry matter and organic matter, getting supplementation of water hyacinth in their feed pig rations contained water hyacinth (Table 2). The results were similar to those reported by Manh, *et al.* (2002) which used water hyacinth 0 (control), 2, 4 and 6% (DM) in the rations. Consumption of dry matter, organic matter, crude protein, ether extract, NDF and ADF did not show significant differences between the treatments. GE (gross energy) consumption tended to decrease in pigs that were given water hyacinth supplement ration but statistically was not significantly different. According to Suharsono (1979), mixing of water hyacinth up to 15% into the rations did not significantly affect pig growth and it could reducing the prices of the ration because reducing the amount of cosentrate was needed.

Table 2. Nutrients Consumption of Pigs

Variables	Treatment			
	A	B	C	D
Protein consumption (g/d)	301,53a	331,19a	302,60a	335,22a
Energy consumption (k.kal/d)	6934a	7664b	7054a	7852b
Fat consumption (g/d)	68,41a	74,61a	67,59a	74,47a
CF consumption (g/d)	118,00a	139,71ab	138,63ab	161,51b

Note:

A: Commercial feed rations without hyacinth as control

B: Commercial feed supplemented with 2.5% water hyacinth,

C: Commercial feed supplemented with 5% water hyacinth,

D: Commercial feed supplemented with 7.5% water hyacinth

Values followed by the same letter, on the same line are not significantly different (P > 0.05)

Feed Digestibility.

Nutrient digestibility in the study found that mostly tended to be decreasing by increasing level water hyacinth . However the differences between treatments were not significant except the protein digestibility. Increasing the supplementation of water hyacinth in the ration particularly by 7,5% caused decreasing nutrient digestibilities because of increasing crude fiber content in the feed (Table 3). Dung, *et al.* (2002) also found that the provision of water hyacinth silage with molasis to 7% did not significantly affect the performance and feed digestibility in growing pigs. Daily weight gain of control pig was 660 g / day, while silage water hyacinth given 5 and 7% measured daily gain 650 and 700 g / day respectivity. So the provision of fermented water hyacinth as silage not capable in improving the performance of pigs.

Table 3. Digestibility of Nutrients for The Control and Treated Pigs

Variables	Treatment			
	A	B	C	D
Dry matter digestibility (%)	63,14a	62,24a	61,02a	58,53a
Organic matter digestibility (%)	66,84a	66,38a	65,20a	61,24a
Protein digestibility (g/d)	68,55a	66,53a	66,61a	62,90b
Crude fiber digestibility (g/d)	27,94a	26,64a	27,64a	25,65a

Note:

A: Commercial feed rations without hyacinth as control

B: Commercial feed supplemented with 2.5% water hyacinth,

*C: Commercial feed supplemented with 5% water hyacinth,
D: Commercial feed supplemented with 7.5% water hyacinth
Values followed by the same letter, on the same line are not significantly different
($P > 0.05$)*

Carcass

Water hyacinth supplementation in the commercial feed had no effect on carcass percentage, ham, loin and picnic weight in this study (Table 4).

Table 4. Carcass Percentage and Cut Weights Fed Water Hyacinth Supplementation in Their Feed.

Variables	Treatment			
	A	B	C	D
Carcass percentage (%)	71,11a	73,43a	71,69a	70,98a
Ham (Kg)	8,05a	8,55a	8,20a	8,00a
Loin (Kg)	5,15a	4,40a	4,65a	5,13a
Picnic (g/d)	4,55a	4,95a	4,30a	4,55a

Note:

*A: Commercial feed rations without hyacinth as control
B: Commercial feed supplemented with 2.5% water hyacinth,
C: Commercial feed supplemented with 5% water hyacinth,
D: Commercial feed supplemented with 7.5% water hyacinth
Values followed by the same letter, on the same line are not significantly different
($P > 0.05$)*

This results might one to the similar carcass weights for all treatments including the control group.

CONCLUSION AND RECOMMENDATION

It concluded that supplementation of water hyacinth from polluted water up to 7.5% in the commercial feed did not affect the growth of Landrace pigs. Although this supplementation tended to increase feed and nutrient intakes but differences were not significant. Digestibility of dry mater, organic mater and their nutrients tended to decrease by increasing the supplementation of water hyacinth in pigs diet, while carcass percentage and cut weight of pigs did not affected by supplementation of water hyacinth from polluted in their feed.

It might be recommended that water hyacinth from polluted water could be used as feed supplement up to 7.5% without affected the performances of Landrace pigs

REFERENCES

- Alvi, S.S.M., M.N. Ali, M. Mohiudin, M.M. Khan and M.M. Khan. 2014. *Eichornia crassipes* – a Potential Substrate for Biofuel Production. *International Journal of Current Microbiology and Applied Sciences*. 3 (10): 618-627.
- Arman, B. dan F. Nisman. 2010. Pengaruh Umur Eceng Gondok (*Eichornia crassipes*) dan Genjer (*Limnocharis flava*) terhadap Penyerapan Logam Pb, Cd dan Cu Dalam Ember Perlakuan dengan Metode Spektrofotometri Serapan Atom. *Farmasains* (1) 2
- Dung N.N.X.D., Luu.H.M., Yamasaki S. 2002. Water hyacinth (*Eichornia crassipes*) ensiling techniques, its composition and intake of pigs. *Development of New Technologies and Their Practice for Sustainable Farming System in the Mekong Delta*. Proc. of The 2002 annual workshop of JIRCAS Mekong Delta Project, Can Tho University.
- Mashavira, M., T. Chitata, R.L. Mhindu, S. Muzemu, A. Kapenzi and P. Manjeru. 2015. The Effect of Water Hyacinth (*Eichornia crassipes*) Compost Tomato (*Lycopersicon esculentum*) Growth Attributes, Yield Potential and Heavy Metal Levels. *American Journal of Plant Sciences*. 6: 545-553.
- Manh, L.T., Yamasaki. S, John S. Caldwell, Tran Kim Thuan, Ryuichi Yamada, Do Vo Anh Khoa and R. Takada. 2003. Effect of Rice Base Balanced Resources and the Water Hyacinth (*Eichornia crassipes*) in Diet Pig Production in Tan Phu Than Village, Cantho Province. *Proceeding of the final final workshop of JIRCAS Mekong Delta Project*. <http://www.etu.edu.vn/institutes/mdi/jircas/JIRCAS/research/workshop/Pro03/C4--livestock.4> (Mhs.Men).pdf.
- Steel, R.G.D dan J.H.Torrie. 1989. *Prinsip dan Prosedur Statistika. Suatu Pendekatan Biometrik*. Edisi Kedua. Penerbit PT Gramedia, Jakarta.
- Suharsono. 1979. Pemanfaatan Eceng Gondok sebagai Makanan Ternak Non Ruminansia. *Prosiding Seminar Penelitian dan Penunjang Pengembangan Peternakan II*, LPP. Bogor. P. 3-8.
- Tillman, A.D., H. Hartadi., S. Reksohadiprojo., P. Soeharto dan L. Soekamto. 1998. *Ilmu Makanan Ternak Dasar*. Gajah Mada University Press.
- Tosepu, R. 2012. Laju Penurunan Logam Berat Plumbum (Pb) dan Cadmium (Cd) Oleh *Eichornia Crassipes* dan *Cyperus Papyrus*. *Journal Manusia dan Lingkungan*. (19) 1: 37 – 45.

USDA. 1997. Poultry Grading Manual. U.S. Government Printing Office Washington, D.C. 20402.

Wibisono, R., B.H. Armadi, dan B. Feriyanto. 2014. Eceng Gondok, Masalah Menjadi Manfaat. Proceedings Seminar Nasional Teknik Mesin Universitas Tri Sakti. Teknik Mesin – FTI Usakti, 20 Februari 2014.

**THE EFFECT OF WATER HYACINTH (*Eichornia crassipes*) FROM
POLLUTED WATERS IN THE RATION AND ITS IMPACT ON THE
PERFORMANCE OF LANDRACE PIGS**

by

I W. Sudiastra., I G. Mahardika., I N.S. Dharmawan., K. Budaarsa
Udayana University Graduate Program
Denpasar Bali

ABSTRACT

The use of waste as component material ration provides benefits that do not compete with humans, is relatively inexpensive and can reduce environmental pollution. The purpose of this study was to determine the benefits and the impact of the provision of water hyacinth (*Eichornia crassipes*) from polluted waters as feed supplements to the performance of Landrace pigs. This research used completely randomized design (CRD) with 4 treatments and 4 replications. A total of 16 Landrace pigs with an average live weight of 20 kg were used in this study. The four treatments are: (A) pigs received rations without water hyacinth, (B) pigs received rations plus 2.5% water hyacinth, (C) pigs received rations plus hyacinth 5% and (D) pigs received rations hyacinth plus 7.5%. The examination was made on growth, feed intake, feed efficiency, feed digestibility and nutrient digestibility, carcass composition and quality, fat content, and the content of heavy metals (Pb and Cd) in the meat, intestines, kidneys and liver. The results showed that the use of water hyacinth from polluted waters to the level of 7.5% in Landrace pigs feed had no effect on the growth of pigs ($P > 0.05$), They tends to improve feed intake and consumption of organic matter, as well as an increase in feed conversion ($P > 0.05$). Digestibility of dry matter, organic matter digestibility and nutrient digestibility tend to decrease with the increasing use of water hyacinth originating from polluted waters in the ration Landrace pigs ($P > 0.05$). Digestibility of dry matter, organic matter digestibility and nutrient digestibility tend to decrease with the increasing use of water hyacinth originating from polluted waters in the ration Landrace pigs ($P > 0.05$). The use of water hyacinth to the level of 7.5% in Landrace pig rations did not affect to the percentage and pieces of carcass weight ($P > 0.05$). The content of heavy metals (Pb and Cd) in meat, kidney, liver and small intestine of pigs received rations containing water hyacinth originating from polluted waters, still below the threshold limit of safe consumption. The use of water hyacinth from polluted waters as pig feed material to the level of 7.5% gives the appearance results pigs, carcass weight, carcass percentage and quality of the meat (below the limit of safe consumption threshold) the same for all treatments.

Keywords: *water hyacinth, water polluted, rations, landrace pig*

I. INTRODUCTION

One of the problems in the development of farms animals, included pigs is the availability of fodder. In addition to the price continues to rise, the difficulty in gaining and many materials of fodder that also consumed by humans, thereby the usage of fodder still competing with humans. One effort to overcome this problem is to utilize agricultural or horticultural waste as fodder ingredients. The use of waste as a constituent material ration will provide benefits that do not compete with humans, is relatively inexpensive and can reduce environmental pollution. One of agricultural waste that has prospects to develop is water hyacinth.

Hyacinth (*Eichornia crassipes*) is an aquatic weed that is often damaged to the environment and has not been used optimally. Water hyacinth plant can be used to reduce the pollution levels of heavy metals in polluted water element of Pb, Cd, Cu, Fe, Zn, and Hg (Armand and Nisma 2010). The proper treatment of water hyacinth can produced biogas as fuel for power generation gas engine (Alvi et al., 2014; Wibisono et al., 2014); and also can be used as fertilizer for crop fertilizer (Mashavira et al., 2015).

Tosepu (2012) states that water hyacinth can grow and multiply very quickly, so the productivity is very high. This condition requires an effort to utilize the water hyacinth plants as fodder, especially pigs. The availability of water hyacinth is very abundant and can be used as the component of pig rations. In some areas the water hyacinth has been used as food ingredient for pigs. The scientific studies on the use of water hyacinth plants originating from polluted waters as the component of pig rations has not been done. Therefore, research on its use as a pig feed is very important. It is intended to determine whether the plants are suspected to be contaminated by pollutants will affect the quality of pig produced.

The previous studies have been lacked on the emphasis of water pollution aspects as a habitat for the growth of water hyacinth. Referring to some of the results of these studies and the lack of information about the use of water hyacinth from polluted waters, it is necessary to do research on its use as feed material and the effect on the performance and quality of pig.

II. MATERIALS AND METHODS

This research used 16 male Landrace pigs that have been castrated weaned age of 2 months with an average body weight of 20 kg. Before being used for research, the pigs vaccinated with the vaccine SE, cholera and given worm medicine.

Cages used are individual cage as much as 16 plots, each plot is equipped with a food place and a bucket for drinking water. Cage roof is made of tiles, while the floor of the cage is made of concrete. Rations provided are a commercial ration. Rations and drinking water were given *ad-libitum*.

The research was conducted at the research station of the Faculty of Animal Husbandry, University of Udayana, proximate analysis carried out in the Laboratory of Food Udayana University Faculty of Animal Husbandry.

Research used completely randomized design with 4 treatments and 4 replicates and each experimental unit consisted of one pig tail. The four treatment are:

A: Pigs who received rations without hyacinth

B: Pigs who received rations supplemented with 2.5% water hyacinth,

C: Pigs who received rations supplemented with 5% water hyacinth,

D: Pigs who received rations supplemented with 7.5% water hyacinth

The variables observed were: feed intake, growth, feed efficiency, feed digestibility and nutrient digestibility, as well as the composition and quality of the carcass

Feed consumption is determined by reducing the amount of feed given to the rest of the food is calculated every day. Livestock growth is calculated by weight pigs every week, then weight gain is calculated by subtracted final body weight with the initial weight divided by the period study. Ration dry matter digestibility coefficients is determined by the method collection for 1 week, with 1 week adaptation period (Tillman, *et al.* 1998). Dry matter digestibility is calculated by:

$$\text{KCBK} = \frac{\text{A} - \text{B}}{\text{A}} \times 100\%$$

Note:

A: is consumption dry matter (kg),

B: is the production of dry matter feces (kg).

Feed efficiency ratio (FCR) is obtained by divided the amount of feed consumed with weight gain. Carcass weight gained by reducing the weight pieces with blood, feathers, heads, feet, gastrointestinal and internal organs except the lungs and kidneys (USDA, 1977). Measured carcass percentage of carcass weight divided by the live weight multiplied by 100%.

Data were analyzed by analysis of variance, if there are differentiation among significant treatments then continued with Duncan test. Determination of the optimal amount of water hyacinth is with analysis of orthogonal polynomials (Steel and Torrie, 1980).

III. RESULTS AND DISCUSSION

3.1 Pig Performance

Weight gain of pigs on treatment A is: 0,57 kg / h, while in treatment B. 0.59 kg / h of treatment C 0.55 kg / h, and on the treatment D was 0.56 kg / h (Table 3.1). Statistically there was no different in weight gain for pigs receiving supplemental water hyacinth and the pigs that did not get additional water hyacinth.

Table 3.1. Pigs Performance Received Feed Contained Water Hyacinth.

Variable	Treatment ¹⁾			
	A	B	C	D
Weight gain (kg/h)	0,57a	0,59a	0,55a	0,56a
DW consumption (kg/h)	1,53a	1,58a	1,58a	1,76a
OM consumption (kg/h)	1,46a	1,53a	1,49a	1,66a
FCR	2,70a	2,71a	2,89a	3,15a

Note:

- 1). A: Pigs received rations without water hyacinth
 B: Pigs received rations contained 2.5% water hyacinth
 C: Pigs received rations contained 5% water hyacinth
 D: Pigs received rations contained 7.5% water hyacinth
- 2). Values followed by the same letters, on the same line are not significantly different (P> 0.05)

Feed consumption of pigs who received treatment A is: 1.53 kg / h, while the feed intake in treatment B, C and D showed an increasing trend but were not statistically different from the treatment of A (P> 0.05). With increased of feed consumption caused the pig to get nutrients in higher amounts.

Protein consumption in treatment A: 301.53 g / h, while the consumption of protein from pigs that get water hyacinth is not different with pig rations that do not contain water hyacinth, similarly with the consumption of fat, and crude fiber consumption. While the energy consumption in pigs that received rations contained hyacinth tend to be higher than pigs that received rations without water hyacinth. It happened because there is a tendency of increased consumption of dry matter and organic matter from getting pig rations contained water hyacinth (Table 3.2). The results are consistent with research in replaced the influence of water hyacinth concentrate on pigs reported by Manh, *et al.* (2002) which uses water hyacinth level 0 (control), 2, 4 and 6% (DM) in the rations. Consumption of dry matter, organic matter, crude protein, ether extract, NDF and ADF did not show significant different between treatments. GE consumption (gross energy) tends to decrease in pigs that were given water hyacinth, although not statistically significantly different. In the control pigs and water hyacinth 2% reported a dry matter digestibility and organic matter is higher than the other treatments. According Suharsono (1979), the mixing of water hyacinth to 15% into the rations did not significantly affect pig growth, and it would be very depressed prices ration because it will reduce the use of cosentrat.

Table 3.2. Consumption Nutrients of Pigs Feed Contained Water Hyacinth.

Variable	Treatment ¹⁾			
	A	B	C	D
Protein consumption (g/h)	301,53a	331,19a	302,60a	335,22a
Energy consumption (k.kal/h)	6934a	7664b	7054a	7852b
Fat consumption (g/h)	68,41a	74,61a	67,59a	74,47a
CF consumption (g/h)	118,00a	139,71ab	138,63ab	161,51b

Note:

- 1). A: Pigs received rations without water hyacinth
 B: Pigs received rations contained 2.5% water hyacinth
 C: Pigs received rations contained 5% water hyacinth
 D: Pigs received rations contained 7.5% water hyacinth
- 2). Values followed by the same letters, on the same line are not significantly different (P> 0.05)

3.2 Feed Digestibility.

Digestibility measurements found that the digestibility of the ration dry matter decreased with the increased use of water hyacinth in the ration. This is due to the increased water hyacinth causes an increase in crude fiber content of the ration resulting in decreased digestibility (Table 3.3). The same thing happened to the organic matter digestibility and protein digestibility of crude fiber digestibility except there is not different. Dung, *et al.* (2002) found that the provision of water hyacinth is used as silage by adding molasis to 7% did not significantly affect the performance and feed digestibility in pigs that are growing. In the control pigs (without water hyacinth) daily weight gain was 660 g / day, while the silage water hyacinth given 5 and 7% respectively 650 and 700 g / day. So the provision of water hyacinth were process of fermentation in silage form capable of improving the performance of pigs.

Table 3.3. Nutrient Digestibility Pigs Rations Contained Water Hyacinth.

Variable	Treatment ¹⁾			
	A	B	C	D
Dry matter digestibility (%)	63,14a	62,24a	61,02a	58,53a
Organic matter digestibility (%)	66,84a	66,38a	65,20a	61,24a
Protein digestibility (g/h)	68,55a	66,53a	66,61a	62,90b
Crude fiber digestibility (g/h)	27,94a	26,64a	27,64a	25,65a

Note:

- 1). A: Pigs received rations without water hyacinth

- B: Pigs received rations contained 2.5% water hyacinth
 C: Pigs received rations contained 5% water hyacinth
 D: Pigs received rations contained 7.5% water hyacinth
 2). Values followed by the same letters, on the same line are not significantly different (P> 0.05)

3.3 Carcass

The percentage of pig carcasses treatment A is: 71.11%, while the percentage of carcasses of pigs who received treatment B, C and D respectively are : 73.43%, 71.69% and 70.98%. Water hyacinth has no effect on the percentage different of pig carcass. This is because heavy pieces of pig on all treatments are relatively the same. The percentage of carcass weight is affected by the cut weight.

Table 3.4. The Percentage and Cuts of Pig Carcasses Received Feed Contained Water Hyacinth.

Variable	Treatment ¹⁾			
	A	B	C	D
Carcass percentage (%)	71,11a	73,43a	71,69a	70,98a
Ham (Kg)	8,05a	8,55a	8,20a	8,00a
Loin (Kg)	5,15a	4,40a	4,65a	5,13a
Picnic (g/h)	4,55a	4,95a	4,30a	4,55a

Note:

- 1). A: Pigs received rations without water hyacinth
 B: Pigs received rations contained 2.5% water hyacinth
 C: Pigs received rations contained 5% water hyacinth
 D: Pigs received rations contained 7.5% water hyacinth
 2). Values followed by the same letters, on the same line are not significantly different (P> 0.05)

Pieces of carcass weight as Ham, Loin and Picnic on all treatments also showed no significant different (P> 0.05). It is also due to carcass weight of all treatments were not significantly different.

IV. CONCLUSION AND RECOMMENDATION

4.1. Conclusion

These results of study can be concluded that:

1. Use of water hyacinth to the level of 7.5% in Landrace pig rations did not affect the growth of pigs.

2. Use of water hyacinth in pig rations tends to improve feed intake and consumption of organic matter, as well as an increase in feed conversion.
3. digestibility of dry matter, organic matter digestibility and nutrient digestibility tends to decrease with the increased use of water hyacinth in the diet of pigs Landrace
4. Use of water hyacinth in swine rations Landrace do not affect the percentage and pieces of carcass weight

4.2. Recommendation

1. Water hyacinth from polluted waters can be used as pig feed material to the level of 7.5%
2. The meat from pigs given feed contained hyacinth from polluted waters to the level of 7.5% in the diet is safe for consumption.
3. Need to do more research on the effect of water hyacinth from polluted waters against tissue damage in the liver and kidneys of pigs.

REFERENCES

- Alvi, S.S.M., M.N. Ali, M. Mohiudin, M.M. Khan and M.M. Khan. 2014. *Eichornia crassipes* – a Potential Substrate for Biofuel Production. International Journal of Current Microbiology and Applied Sciences. 3 (10): 618-627.
- Arman, B. dan F. Nisman. 2010. Pengaruh Umur Eceng Gondok (*Eichornia crassipes*) dan Genjer (*Limnocharis flava*) terhadap Penyerapan Logam Pb, Cd dan Cu Dalam Ember Perlakuan dengan Metode Spektrofotometri Serapan Atom. Farmasains (1) 2
- Dung N.N..X.D., Luu.H.M., Yamasaki S. 2002. Water hyacinth (*Eichornia crassipes*) ensiling techniques, its composition and intake of pigs. Development of New Technologies and Their Practice for Sustainable Farming System in the Mekong Delta. Proc. of The 2002 annual workshop of JIRCAS Mekong Delta Project, Can Tho University.
- Mashavira, M., T. Chitata, R.L. Mhinda, S. Muzemu, A. Kapenzi and P. Manjeru. 2015. The Effect of Water Hyacinth (*Eichornia crassipes*) Compost Tomato (*Lycopersicon esculentum*) Growth Attributes, Yield Potential and Heavy Metal Levels. American Journal of Plant Sciences. 6: 545-553.
- Manh, L.T., Yamasaki. S, John S. Caldwell, Tran Kim Thuan, Ryuichi Yamada, Do Vo Anh Khoa and R. Takada. 2003. Effect of Rice Based Balanced Resources and the

- Water Hyacinth (*Eichornia crassipes*) in Diet Pig Production in Tan Phu Than Village, Cantho Province. Proceeding of the final final workshop of JIRCAS Mekong Delta Project. <http://www.etu.edu.vn/institutes/mdi/jircas/JIRCAS/reseach/workshop/Pro03/C4--livestock.4> (Mhs.Men).pdf.
- Steel, R.G.D dan J.H.Torrie. 1989. Prinsip dan Prosedur Statistika. Suatu Pendekatan Biometrik. Edisi Kedua. Penerbit PT Gramedia, Jakarta.
- Suharsono. 1979. Pemanfaatan Eceng Gondok sebagai Makanan Ternak Non Ruminansia. Prosiding Seminar Penelitian dan Penunjang Pengembangan Peternakan II, LPP. Bogor. P. 3-8.
- Tillman, A.D., H. Hartadi., S. Reksohadiprojo., P. Soeharto dan L. Soekamto. 1998. Ilmu Makanan Ternak Dasar. Gajah Mada University Press.
- Tosepu, R. 2012. Laju Penurunan Logam Berat Plumbum (Pb) dan Cadmium (Cd) Oleh *Eichornia Crassipes* dan *Cyperus Papyrus*. Journal Manusia dan Lingkungan. (19) 1: 37 – 45.
- USDA. 1997. Poultry Grading Manual. U.S. Government Printing Office Washington, D.C. 20402.
- Wibisono, R., B.H. Armadi, dan B. Feriyanto. 2014. Eceng Gondok, Masalah Menjadi Manfaat. Proceedings Seminar Nasional Teknik Mesin Universitas Tri Sakti. Teknik Mesin – FTI Usakti, 20 Februari 2014.

THE EFFECT OF WATER HYACINTH (*Eichornia crassipes*) FROM POLLUTED WATER IN THE RATION AND ITS IMPACT ON THE PERFORMANCE OF LANDRACE PIGS

by

I W. Sudiastra.¹, I G. Mahardika.¹, I N.S. Dharmawan.², K. Budaarsa¹

1). Faculty of Animal Sciences, Udayana University, Denpasar, Bali

2). Faculty of Veterinary Sciences, Udayana University, Denpasar, Bali

ABSTRACT

The use of waste as component material ration provides benefits that do not compete with humans, is relatively inexpensive and can reduce environmental pollution. The purpose of this study were to determine the benefits and the impact of the provision of water hyacinth (*Eichornia crassipes*) from polluted waters as feed supplement on the performance of Landrace pigs. This research used completely randomized design (CRD) with 4 treatments and 4 replications. A total of 16 Landrace pigs with an average live weight of 20 kg were used in this study. The four treatments are: (A) pigs received rations without water hyacinth, (B) pigs received rations plus 2.5% water hyacinth, (C) pigs received rations 5% plus water hyacinth and (D) pigs received rations 7.5% water hyacinth plus. Growth of pigs, feed intake, feed efficiency, feed digestibility and nutrient digestibility, carcass composition and quality, fat content, and the content of heavy metals (Pb and Cd) in the meat, intestines, kidneys and liver were evaluated in this study. The results showed that the use of water hyacinth from polluted waters up 7.5% in the feed had no effect on the growth of pigs ($P > 0.05$). They tends to improve feed intake and consumption of organic matter, as well as increasing their feed conversion but the difference significant ($P > 0.05$). Digestibility of dry matter, organic matter and nutrient but were not significantly different by tend to decrease with the increasing the use of water hyacinth originated from polluted waters in the ration ($P > 0.05$). Digestibility of dry matter, organic matter digestibility and nutrient digestibility were also tend to decrease by increasing the use of water hyacinth originated from polluted waters in the ration but not significantly different ($P > 0.05$). The use of water hyacinth up to 7.5% in the ration did not affect to the percentage and pieces of carcass weight ($P > 0.05$). The content of heavy metals (Pb and Cd) in meat, kidney, liver and small intestine of pigs received rations containing water hyacinth originated from polluted water, still below the limit of safe consumption. It was concended tha the use of water hyacinth from polluted waters as pig feed material to the level of 7.5% did not significantly affect the performance of Landrace pig in tern of growth carcass weight, carcass percentage and meat quality

Keywords: *water hyacinth, water polluted, rations, landrace pig*

INTRODUCTION

One of the problems in the development of farm animals included pigs is the availability of feed. In addition the price was continuously rising, the difficulty in gaining some materials of feed besides it also consumed by people, therefore the usage of feed competed the human needs. One effort to overcome this problem is to utilize agricultural or horticultural waste as feed ingredients. The use of waste as a constituent of ration will provide benefits which are not compete human food, relatively cheap and can reduce environmental pollution. One of agricultural waste that has prospects to develop is water hyacinth.

Water hyacinth (*Eichornia crassipes*) is an aquatic weed which is often damaged the environment and has not been used optimally for animal feed. Water hyacinth may can be used for reducing pollution levels of heavy metals such as in polluted water Pb, Cd, Cu, Fe, Zn, and Hg (Armand and Nisma 2010). The proper treatment of water hyacinth can produced biogas as fuel for power generat on gas engine (Alvi et al., 2014; Wibisono et al., 2014); and also can be used as crop fertilizer (Mashavira et al., 2015).

Tosepu (2012) states that water hyacinth can grow and multiply very quickly, so the productivity is very high. This condition requires an effort to utilize the water hyacinth plants as feed, especially for pigs. The availability of water hyacinth is very abundant and can be used as the component of pig rations. In some areas the water hyacinth has been used as food ingredient for pigs. The scientific studies on the use of water hyacinth plants originating from polluted water as one component of pig ration has not been done. Therefore, research on its use as pig feed is very important. The study were determine whether water hyacinth which were collected from polluted water might affect pig performance and their meat quality. Lock of informations were formd about water hyacinth which grew polluted water and its for animal feed pig.

MATERIALS AND METHODS

This research used 16 castrated male Landrace pigs weaned at 2 months of age with an average body weight of 20 kg. The pigs were vaccinated with SE and cholera vaccine and given worm medicine before being used for this study.

Sixteen individual cage were used in this study each of them, equipped with food place and one bucket for drinking water. Cage roof is made of tiles, while the floor of the cage is made of concrete. Commercial feed was used in this study which was provided *ad-libitum* as will as their drinking water.

The studyh was conducted at the Research station of the Faculty of Animal Science, University of Udayana and proximate analysis of the feed carried out in the Laboratory of Animal Nutrition Faculty of Animal Science, Udayana University.

Design of the study was completely randomized design with 4 treatments and 4 replicates in each treatment. The four treatment were:

A: Commercial feed rations without hyacinth as control

B: Commercial feed supplemented with 2.5% water hyacinth,

C: Commercial feed supplemented with 5% water hyacinth,

D: Commercial feed supplemented with 7.5% water hyacinth

The variables observed were: growth of pigs, feed intake, feed efficiency, feed digestibility and nutrient digestibility, as well as the composition and quality of the carcass

Feed consumption was determined by reducing the amount of feed given to the rest of the food day by growth of the pig calculated by weighting this pigs every week, then weight gain is calculated by subtracted final body weight with the initial weight divided by study period. Ration digestibility coefficient dry matter was determined by one week collection method (Tillman, *et al.* 1998). Dry matter digestibility was calculated by the following formula:

$$\text{Dry matter digestibility} = \frac{A - B}{A} \times 100\%$$

Note:

A: is consumption dry matter (kg),

B: is the production of dry matter feces (kg).

Feed Conversion Ratio (FCR) was obtained by divided the amount of feed consumed with weight gain. Carcass weight was measured by reducing the pig weight with blood, hair, head, feet, gastrointestinal and internal organs except the lungs and kidneys (USDA, 1977). Carcass percentage was measured by divided carcass weight with slaughtered weight multiplied by 100%.

Data were analyzed using analysis of variance, if the analysis was significantly analysis to be continued with Duncan Multiple range test to find one the differences between the treatment means. Determination of the optimal amount of water hyacinth might be supplemented to the ration was analysed using orthogonal polynomials method (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Pig Performance

Daily weight gain of pigs on control feed (A) was: 0,57 kg /d, while in treatment B, C and D were 0.59 kg /d, 0.55 kg /d, and 0.56 kg /d (Table 1). There were no significant differenced in daily weight gain between the all treatment and the control group ($P > 0.05$).

Table 1. Performances of Pigs Fed Commercial with Water Hyacinth From Polluted Water.

Variables	Treatment			
	A	B	C	D
Daily weight gain (kg/d)	0,57a	0,59a	0,55a	0,56a
DW consumption (kg/d)	1,53a	1,58a	1,58a	1,76a
OM consumption (kg/d)	1,46a	1,53a	1,49a	1,66a
FCR	2,70a	2,71a	2,89a	3,15a

Note:

A: Commercial feed rations without hyacinth as control

B: Commercial feed supplemented with 2.5% water hyacinth,

C: Commercial feed supplemented with 5% water hyacinth,

D: Commercial feed supplemented with 7.5% water hyacinth

Values followed by the same letter, on the same line are not significantly different (P> 0.05)

Feed consumption of pigs in the control group was: 1.53 kg /d, while feed intake in treatment B, C and D showed an increasing trend but their differences were not statistically from the control on treatment A ($P > 0.05$). By increasing the level water hyacinth supplemented nutrient.

The average protein consumption in treatment A was: 301.53 g /d, while the consumption of pigs receiving water hyacinth is supplementation were not different with pig feed the control (without water hyacinth), While the energy and crude fiber consumption in pigs that received rations contained water hyacinth tended to be higher than pigs that received ration without water hyacinth (Table 2). It might because tendency of the increase in consumption of dry matter and organic matter, getting supplementation of water hyacinth in their feed pig rations contained water hyacinth (Table 2). The results were similar to those reported by Manh, *et al.* (2002) which used water hyacinth 0 (control), 2, 4 and 6% (DM) in the rations. Consumption of dry matter, organic matter, crude protein, ether extract, NDF and ADF did not show significant differences between the treatments. GE (gross energy) consumption tended to decrease in pigs that were given water hyacinth supplement ration but statistically was not significantly different. According to Suharsono (1979), mixing of water hyacinth up to 15% into the rations did not significantly affect pig growth and it could reducing the prices of the ration because reducing the amount of cosentrate was needed.

Table 2. Nutrients Consumption of Pigs

Variables	Treatment			
	A	B	C	D
Protein consumption (g/d)	301,53a	331,19a	302,60a	335,22a
Energy consumption (k.kal/d)	6934a	7664b	7054a	7852b
Fat consumption (g/d)	68,41a	74,61a	67,59a	74,47a
CF consumption (g/d)	118,00a	139,71ab	138,63ab	161,51b

Note:

A: Commercial feed rations without hyacinth as control

B: Commercial feed supplemented with 2.5% water hyacinth,

C: Commercial feed supplemented with 5% water hyacinth,

D: Commercial feed supplemented with 7.5% water hyacinth

Values followed by the same letter, on the same line are not significantly different (P > 0.05)

Feed Digestibility.

Nutrient digestibility in the study found that mostly tended to be decreasing by increasing level water hyacinth . However the differences between treatments were not significant except the protein digestibility. Increasing the supplementation of water hyacinth in the ration particularly by 7,5% caused decreasing nutrient digestibilitys because of increasing crude fiber content in the feed (Table 3). Dung, *et al.* (2002) also found that the provision of water hyacinth silage with molasis to 7% did not significantly affect the performance and feed digestibility in growing pigs. Daily weight gain of control pig was 660 g / day, while silage water hyacinth given 5 and 7% measured daily gain 650 and 700 g / day respectivity. So the provision of fermented water hyacinth as silage not capable in improving the performance of pigs.

Table 3. Digestibility of Nutrients for The Control and Treated Pigs

Variables	Treatment			
	A	B	C	D
Dry matter digestibility (%)	63,14a	62,24a	61,02a	58,53a
Organic matter digestibility (%)	66,84a	66,38a	65,20a	61,24a
Protein digestibility (g/d)	68,55a	66,53a	66,61a	62,90b
Crude fiber digestibility (g/d)	27,94a	26,64a	27,64a	25,65a

Note:

A: Commercial feed rations without hyacinth as control

B: Commercial feed supplemented with 2.5% water hyacinth,

*C: Commercial feed supplemented with 5% water hyacinth,
D: Commercial feed supplemented with 7.5% water hyacinth
Values followed by the same letter, on the same line are not significantly different
($P > 0.05$)*

Carcass

Water hyacinth supplementation in the commercial feed had no effect on carcass percentage, ham, loin and picnic weight in this study (Table 4).

Table 4. Carcass Percentage and Cut Weights Fed Water Hyacinth Supplementation in Their Feed.

Variables	Treatment			
	A	B	C	D
Carcass percentage (%)	71,11a	73,43a	71,69a	70,98a
Ham (Kg)	8,05a	8,55a	8,20a	8,00a
Loin (Kg)	5,15a	4,40a	4,65a	5,13a
Picnic (g/d)	4,55a	4,95a	4,30a	4,55a

Note:

*A: Commercial feed rations without hyacinth as control
B: Commercial feed supplemented with 2.5% water hyacinth,
C: Commercial feed supplemented with 5% water hyacinth,
D: Commercial feed supplemented with 7.5% water hyacinth
Values followed by the same letter, on the same line are not significantly different
($P > 0.05$)*

This results might one to the similar carcass weights for all treatments including the control group.

CONCLUSION AND RECOMMENDATION

It concluded that supplementation of water hyacinth from polluted water up to 7.5% in the commercial feed did not affect the growth of Landrace pigs. Although this supplementation tended to increase feed and nutrient intakes but differences were not significant. Digestibility of dry mater, organic mater and their nutrients tended to decrease by increasing the supplementation of water hyacinth in pigs diet, while carcass percentage and cut weight of pigs did not affected by supplementation of water hyacinth from polluted in their feed.

It might be recommended that water hyacinth from polluted water could be used as feed supplement up to 7.5% without affected the performances of Landrace pigs

REFERENCES

- Alvi, S.S.M., M.N. Ali, M. Mohiudin, M.M. Khan and M.M. Khan. 2014. *Eichornia crassipes* – a Potential Substrate for Biofuel Production. *International Journal of Current Microbiology and Applied Sciences*. 3 (10): 618-627.
- Arman, B. dan F. Nisman. 2010. Pengaruh Umur Eceng Gondok (*Eichornia crassipes*) dan Genjer (*Limnocharis flava*) terhadap Penyerapan Logam Pb, Cd dan Cu Dalam Ember Perlakuan dengan Metode Spektrofotometri Serapan Atom. *Farmasains* (1) 2
- Dung N.N.X.D., Luu.H.M., Yamasaki S. 2002. Water hyacinth (*Eichornia crassipes*) ensiling techniques, its composition and intake of pigs. *Development of New Technologies and Their Practice for Sustainable Farming System in the Mekong Delta*. Proc. of The 2002 annual workshop of JIRCAS Mekong Delta Project, Can Tho University.
- Mashavira, M., T. Chitata, R.L. Mhindu, S. Muzemu, A. Kapenzi and P. Manjeru. 2015. The Effect of Water Hyacinth (*Eichornia crassipes*) Compost Tomato (*Lycopersicon esculentum*) Growth Attributes, Yield Potential and Heavy Metal Levels. *American Journal of Plant Sciences*. 6: 545-553.
- Manh, L.T., Yamasaki. S, John S. Caldwell, Tran Kim Thuan, Ryuichi Yamada, Do Vo Anh Khoa and R. Takada. 2003. Effect of Rice Base Balanced Resources and the Water Hyacinth (*Eichornia crassipes*) in Diet Pig Production in Tan Phu Than Village, Cantho Province. *Proceeding of the final final workshop of JIRCAS Mekong Delta Project*. <http://www.etu.edu.vn/institutes/mdi/jircas/JIRCAS/research/workshop/Pro03/C4--livestock.4> (Mhs.Men).pdf.
- Steel, R.G.D dan J.H.Torrie. 1989. *Prinsip dan Prosedur Statistika. Suatu Pendekatan Biometrik*. Edisi Kedua. Penerbit PT Gramedia, Jakarta.
- Suharsono. 1979. Pemanfaatan Eceng Gondok sebagai Makanan Ternak Non Ruminansia. *Prosiding Seminar Penelitian dan Penunjang Pengembangan Peternakan II*, LPP. Bogor. P. 3-8.
- Tillman, A.D., H. Hartadi., S. Reksohadiprojo., P. Soeharto dan L. Soekamto. 1998. *Ilmu Makanan Ternak Dasar*. Gajah Mada University Press.
- Tosepu, R. 2012. Laju Penurunan Logam Berat Plumbum (Pb) dan Cadmium (Cd) Oleh *Eichornia Crassipes* dan *Cyperus Papyrus*. *Journal Manusia dan Lingkungan*. (19) 1: 37 – 45.

USDA. 1997. Poultry Grading Manual. U.S. Government Printing Office Washington, D.C. 20402.

Wibisono, R., B.H. Armadi, dan B. Feriyanto. 2014. Eceng Gondok, Masalah Menjadi Manfaat. Proceedings Seminar Nasional Teknik Mesin Universitas Tri Sakti. Teknik Mesin – FTI Usakti, 20 Februari 2014.