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EFFECTS OF WATER HYACINTH SILAGE IN DIETS ON FEED INTAKE, DIGESTIBILITY AND RUMEN PARAMETERS OF SHEEP (*Ovis aries*) IN THE MEKONG DELTA OF VIETNAM

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ABSTRACT

Water hyacinth silage (EWH) was used in this experiment. Four growing sheep (19.8±0.43kg) were allocated in a 4x4 Latin square design with 4 treatments including Para grass (EWH0), replacement of 15% Para grass by ensilaged water hyacinth (EWH15), replacement of 30% Para grass by ensilaged water hyacinth (EWH30), replacement of 45% Para grass by ensilaged water hyacinth (EWH45). The study aimed to evaluate effects of replacement of ensilaged water hyacinth (Eichhornia crassipes) to Para grass (Brachiaria mutica) in the diets (DM basis) on feed intake, rumen parameters, nutrient digestibility and nitrogen retention of growing sheep. There was a supplementation of coconut meal, soybean cake and urea to adjust the CP content of diets being 17%. Each experimental period was 14 days including 7 days for adaptation and 7 days for sample collecting. The results showed that DM, OM, CP and NDF of EWH were 19.0, 84.2, 11.2 and 54.2 %, respectively. The DM and CP intake were similar (P>0.05) among the treatments, however, the NDF intake was significantly higher for the EWH0 and EWH15 as compared to EWH30 and EWH45. The nutrient digestibility (DM, OM, CP, NDF) were not significantly different (P>0.05) among treatments and ranged from 66.4 to 67.3%. The results indicated that EWH could be used to replace Para grass at a level of 30% in growing sheep diet

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1 INTRODUCTION

Water hyacinth *(Eichhornia crassipes)* is more important in humid and tropical region where feed for ruminants is scarce in rainy season (Kibria *et al*., 1989). In some countries, the water hyacinth is used as fodder for cows, goats, sheep, pig and chickens (Gunanarsson and Petersen, 2006), however, it is as low economical forage because it contents high moisture, rapid deterioration and spoilage (Byron, 1975). Addition, fresh water hyacinth is unpalatable because it contents prickly crystals (Gohl, 1994). These limitations of using fresh water hyacinth for feeding ruminant may be solutions by ensiled methods (Linn *et al*., 1975). The ensiled water hyacinth was used and accepted palatable on sheep and goat feeding (Kibria *et al*., 1989). The ensiled water hyacinth could rather improve on growing performance of local cattle in Mekong Delta in Vietnam when it was used to replace rice straw in diets (Thanh, 2008). In recent years in

Vietnam, the sheep meat demand for food has been increased because it contents high nutrition, good smell and delicious with 74-75% DM, 21.7-22.3% CP, 1.86-1.88% EE (Han, 2007). Thus, sheep has been more concerned to development in many provinces of Mekong Delta in Vietnam, where water hyacinth is available with enormous biomass. This study aimed to evaluate effects of replacement of ensilaged water hyacinth (*Eichhornia crassipes*) to Para grass (*Brachiaria mutica*) in the diets (DM basis) on feed intake, rumen parameters, nutrient digestibility and nitrogen retention of growing sheep. Then the applicable recommendations could be given for farmers' practices.

2 MATERIALS AND METHODS

2.1 Study location

The experiment was conducted in the experimental farm and laboratory of Agricultural and Applied Biology Faculty, Can Tho University from February, 2009 to June, 2010.

2.2 Experimental design

Four growing sheep (19.8±0.43kg) were allocated in a 4x4 Latin square design with 4 treatments including Para grass (EWH0), replacement of 15% Para grass by ensilaged water hyacinth (EWH15), replacement of 30% Para grass by ensilaged water hyacinth (EWH30), replacement of 45% Para grass by ensilaged water hyacinth (EWH45).

2.3 Feeding and management

Para grass was fed ad-lib and supplemented with coconut meal, soybean cake and urea to adjust the CP content of diets of 17%. Each experimental period was 14 days including 7 days for adaptation and 7 days for sampling. Dry matter intake was 3.2% body live weight. The feed was fed at 6:30 h and 13:30 h. Feed offered and refused, feces and urine were collected daily during sample collecting periods. Rumen fluid was taken by oesophagus gutter in order to measure N-NH_3 and volatile fatty acid at before and 3 hours after feeding.

2.4 Making water hyacinth silage and chemical composition analysis

Water hyacinth was collected and eliminated the roots and then wilted under sunshine. When the DM of water hyacinth reached around 12%, it was used for making silage with molasses (3.5 kg molasses for 100 kg of fresh water hyacinth) in a plastic bag of 50kg. The silage was used for feeding sheep from day 7 to day 14.

Dry matter (DM), organic matter (OM), crude protein (CP) and total ash (Ash) of samples were determined according to AOAC (1990). Neutral detergent fiber (NDF) was analyzed following methods described by Van Soest *et al*. (1991). Metabolized energy of diets was calculated described by Bruinenberg *et al*. (2002). Apparent nutrient digestibility of DM, OM, CP and NDF was determined following methods described by Mc.Donald *et al*. (1995) and VFAs was analyzed following method described by Barnet and Reid (1957).

2.5 Statistical analysis

The data were analyzed preliminary by Microsoft Excel (2007) and analyzed of variance (ANOVA) using the General Linear Model (GLM) procedure of Minitab 16.1.0.0 software (Minitab, 2010). To compare difference between mean values of treatments, Tukey's test was used (Minitab, 2010).

3 RESULTS AND DISCUSSION

3.1 Chemical composition of feed ingredients

The chemical composition of feed used in the experiment was showed in Table 1. The DM, OM, CP and NDF of EWH were 19.0, 84.2, 11.2 and 54.2 %, respectively. The CP content of EWH was higher than that of Para grass, while its NDF content was lower than that of the Para grass. The replacement of Para grass by EWH was suitable due to the DM content was similar for both roughages. The soybean cake, coconut meal and urea were used to supply crude protein in the diets and to adjust the CP intake of sheep as plan proposed.

Table 1: Chemical composition of feed ingredients used in experiment (%DM)

Ingredients	DM	OM	CP	NDF	Ash
Ensilaged water hyacinth (EWH)	19.0	84.2	11.2	54.2	15.8
Para grass (PG)	19.4	87.0	9.40	68.1	12.3
Soybean cake (SC)	87.3	83.9	42.1	23.4	16.1
Coconut meal (CM)	87.5	94.2	16.2	56.6	5.80
Urea	-	-	288	-	-

DM: dry matter, OM: organic matter, CP: crude protein, NDF: neutral detergent fiber

3.2 Feed and nutrient intake

The DM and CP intake were not significantly different (P>0.05) among the treatments, however, the NDF intake was significantly higher for the EWH0 and EWH15 as compared to EWH30 and EWH45. It seemed that the replacement of EWH at level 15% had stimulated appetite of sheep in diet. It led to DM and OM intakes of EWH15 diet were slightly higher than the others (690 and 588g/sheep/day), respectively). In study of Thanh (2008) using EWH replacing Para grass at 0, 15, 30, 45% levels (DM basis) for growing cattle, it was indicated that cattle could consume at maximum EWH level of 800 g/day, while with the similar experiment this value was of 1270 g/day for the buffalo reported by Khanh (2008).

Table 2: Feed and nutrients intakes of sheep in the experiment

Items, g/day	Treatments				P	± SE
	EWH0	EWH15	EWH30	EWH45		
EWH	0[a]	80.5[b]	164[c]	243[d]	0.001	11.8
Para grass	566[a]	500[b]	385[c]	310[d]	0.001	11.8
DM	675	690	658	662	0.328	16.9
OM	576	588	560	558	0.307	16.4
CP	120	118	115	111	0.132	3.29
NDF	426[a]	425[a]	393[b]	390[b]	0.010	8.796
ME* (MJ/day)	6.05	6.10	5.83	5.89	0.854	0.370

EWH0, EWH15, EWH30, EWH45: EWH replacing Para grass at levels of 0, 15, 30 and 45 % (DM basis) respectively. [a, b, c] *Means with different letters within the same rows are significantly different at the 5% level*

3.3 Rumen parameters

The pH values of rumen fluid at before and after 3-hours feeding among treatments were not significantly different (P>0.05). However, pH value at before feeding was higher than this value at 3 hours after feeding in general. It could be explained that EWH was acidic feed. The pH values in this study were higher than the results of Lubis *et al.* (2002) being from 6.30 to 6.43. Thanh (2008) reported that the N-NH_3 and VFAs of rumen fluid at before feeding of cattle fed EWH were 11.6-11.9 mg/100ml and 71.7-75.2 mmole/liter, respectively. Then 3-hours after feeding, those values changed to 17.5-18.0 mg/100ml and 80.6-81.4 mmole/liter, respectively. With buffalo fed EWH replaced rice straw at 0, 15, 30, 45% levels (DM basis). Khanh (2008) reported that N-NH_3 ranged 14.0-14.4 mg/100ml and VFAs ranged 78.2-86.4 mmole/liter.

Table 3: N-NH_3 and total VFAs concentration and pH values of rumen of sheep

	EWH0	EWH15	EWH30	EWH45	P	± SE
N-NH_3, mg/100ml						
- Before feeding	27.1	26.1	25.0	26.6	0.198	1.21
- 3 hours after feeding	38.5	37.8	35.5	34.6	0.302	2.09
- Difference	10.3	11.7	13.3	10.5	0.774	3.17
VFAs, mmol/liter						
- Before feeding	85.9	87.9	87.7	89.3	0.964	6.40
- 3 hours after feeding	115	113	108	109	0.473	4.49
- Difference	29.9	25.8	21.2	20.3	0.831	11.7
pH						
- Before feeding	6.87	6.97	6.98	7.08	0.455	0.119
- 3 hours after feeding	6.63	6.59	6.77	6.63	0.775	0.185

EWH0, EWH15, EWH30, EWH45: EWH replacing Para grass at levels of 0, 15, 30 and 45 % (DM basis) respectively. VFAs: volatile fatty acids

3.4 Apparent digestibility, nitrogen balance and daily weight gain

The apparent nutrient digestibility, nitrogen retention and daily weight gain were showed in Table 4. The nutrient digestibility (DM, OM, CP, NDF) were not significantly different (P>0.05) among treatments and ranged from 66.4 to 67.3%. The DM and CP digestibility values reported

by Baldwin *et al.* (1975) in study on water hyacinth silage for sheep feeding were also lower than those of the present study. Nitrogen retention was not significantly different (P>0.05) among the treatment, however the highest value was numerically for the EWH30 treatment (0.809 g/kgW$^{0.75}$). In study of Hue (2007), nitrogen retention results ranged from 0.987 to 1.13 g/kgW$^{0.75}$. The daily weight gain was not significantly different (P>0.05) among the treatments and it was 52.5, 48.1, 57.3 and 38.1 g for the EWH0, EWH15, EWH30 and EWH45, respectively. The results in the present study indicated that EWH could be used for feeding sheep with the replacement level of 30% for the grass.

Table 4: Nutrient digestibility (%), nitrogen intakes, nitrogen retention and daily weight gain of sheep

Items	Treatments				P	±SE
	EWH0	EWH15	EWH30	EWH45		
Digestibility, %						
DM	67.3	66.9	66.4	66.8	0.989	2.51
OM	68.4	68.8	68.1	67.3	0.941	2.47
CP	79.0	78.4	78.8	78.3	0.978	1.94
NDF	66.7	66.1	65.6	66.1	0.969	2.26
Nitrogen balance, g/kgW^{0,75}						
Nitrogen intakes	1.94	1.91	1.86	1.81	0.302	0.048
Nitrogen in feces	0.363	0.415	0.393	0.391	0.490	0.031
Nitrogen in urine	0.852	0.793	0.654	0.777	0.098	0.065
Nitrogen retention	0.720	0.703	0.809	0.639	0.236	0.073
Initial weight, kg	20.9	21.2	20.8	20.9	0.520	0.114
Daily weight gain, g	52.5	48.1	57.3	38.1	0.561	13.4

DM: dry matter, OM: organic matter, CP: crude protein, NDF: neutral detergent fiber. EWH0, EWH15, EWH30, EWH45: EWH replacing para grass at levels of 0, 15, 30 and 45 % (DM basis) respectively

4 CONCLUSIONS

Ensilaged water hyacinth could be used to feed growing sheep without adverse effects on rumen parameters and the replacement level of 30% to Para grass in diet gave good results in term of growth performance and utilization of water hyacinth as a feed resource.

REFERENCES

AOAC, 1990. Official Methods of Analysis. 13th edition. Association of Official Analytical Chemists. Washington, DC.

Balwin, J.A., 1975. Comparison of Pangolagrass and water hyacinth silage as diets for sheep. Journal of animal science 1975. 40: 968-971.

Barnett, A.J.G., Reid, R.L., 1957. Study on the production of volatile fatty acids from grass by rumen liquor in an artificial rumen. The volatile fatty acid production from grass. Journal of Agricultural Science, 48: 315–321.

Bruinenberg, M.H., Valk, H., Korevaar, H. Struik, P.C., 2002. Factors affecting digestibility of temperate forages from seminatural grasslands. ID TNO Animal Nutrition, Lelystad, Wageningen University, Department of Plant Sciences, Crop and Weed Ecology Group, Wageningen, and Plant Research International, Wageningen, The Netherlands

Byron, H.T., 1975. Organic acid preservation of water hyacinth silage. Hyacinth control, 13: 64-66

Gohl, B., 1994. Tropical Feed. FAO Animal Production and Health Series.

Gunnarsson, C.C., Petersen, C.M., 2006. Water hyacinth as a resource in agriculture and energy production: a literature review.

Han, T.Q., 2007. Meat quality and productivity, economic efficiency of Phan Rang sheep feeding in Central highlands Vietnam. Journal of Animal science No. 3: 23-36.

Hue, K.T., 2007. Urea treated rice straw as a basal diet for growing ruminants: supplementation with protein rich forages. MSc Thesis, Swedish University of Agricultural Sciences

Kibria, S.S., Roxas, B.D., Ranjhan, K.S., 1989. A ruminant feed based on water hyacinth: its voluntary intake and in vitro and in vivo digestibility Pak. J. Agri. Sci. 26 (1): 24

Khanh, P.T., 2008. Effects of rice straw replacement by ensilage water hyacinth on rumen parameters, nutrient digestibility and nitrogen retention of local buffalo. Bachelor thesis on Animal Science, Can Tho University.

Linn, J.G., Staba, E.J., Goodrich, R.D., Meiske, J.C. Otterby, D.E., 1975. Nutritive value of dried or ensiled aquatic plants. I. Chemical composition. II. Di-

gestibility by sheep. Journal of Animal Science. 41(2): 601-609.

Lubis, W.E., Haryanto, B., Suhargiyantatmo, T., 2002. Feeding *Aspergillus oryzae legume seeds as protein supplements"*. Fermentation Culture (AOFC) to Growing Sheep: 1. Effect of AOFC on Rumen Fermentation. *JITV* 7(3): 155-161

McDonald, P., Edwards, R.A., Greenhagh, J.F.D., Morgan, C.A., 1998. Digestibility. Evaluation of food. In Animal Nutrition. Fifth edition Addison Wesley Longman, UK, pp. 221-237

Minitab, 2000. Minitab reference manual release 13.20. Minitab Inc.

Thanh, V.D., 2008. Effects of rice straw replacement by ensilage water hyacinth on rumen parameters, nutrient digestibility and nitrogen retention of local growing cattle. Bachelor thesis on Animal Science, Can Tho University

Van Soest, P.J., Robertson, J.B. Lewis, B.A., 1991 Method for dietary fiber, neutral detergent fiber and non-starch polysaccharide in relation to animal nutrition. Journal of Dairy Science 74: 3583-3597.