INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 5, No. 7, p. 144-150, 2014

RESEARCH PAPER OPEN ACCESS

Characteristics and nutrition silage duckweed (family lemnacea) addition with different additives

A. Jaelani, S. Djaya, T. Rostini*

Study Program of Animal Science, Faculty of Agriculture, Islamic University of Muhammad Arsyad Albanjary Kalimantan, Jl. Adyaksa no 2 Kayu Tangi Banjarmasin 70123, South Kalimantan, Indonesia

Key words: Duckweed, fungus, nutrition, Silage, texture.

http://dx.doi.org/10.12692/ijb/5.7.144-150 Article published on October 06, 2014

Abstract

Duckweed plant silage is forage that is produced through the fermentation process in anaerobic conditions. This study aims to determine the effect of several types of additives on silage characteristics and nutritional content of duckweed. This study used a completely randomized design (RAL). with four treatment and four times repetitions. variables that measured characteristics (color, odor and texture) as well as the nutrient content of silage. The results showed the addition tricoderm significantly affect the characteristics and nutrient content of silage. Tricoderma concluded that the use of nutritional quality silage can produce good duckweed.

* **Corresponding Author:** Tintin Rostini ✉ tintin_rostini@yahoo.com

Introduction

Problems common breeding business in Indonesia today is that the higher feed prices and low availability of animal feed ingredients, both from a quality and supply of feed. This is due to the transition function of agricultural land into residential areas, roads and industries that can reduce the chances of planting grass as the main food for ruminants. So it is necessary to find non-conventional feed ingredients such as "Weeds water" that had dominated the waters of Indonesia and has not been used optimally. One of the aquatic weeds that grow in swamps and ponds of the duckweed family lemnaceae. (Hatta *et al.*, 2009).

Duckweed is one of many types of aquatic plants that grow in rivers, paddy fields, reservoirs or swamps. The existence of this plant is more often regarded as a weed which is very detrimental to humans because these plants can cause silting of rivers or reservoirs and cause a reduction / evaporation of water and nutrient elements are large.

The use of duckweed as a feed source is the availability and development of the plant is quite a lot throughout the year in addition to nutrient content is also not good enough to compete with humans. Dried duckweed protein content is 25.2 - 36.5% and protein concentrates ranged from 44.7% 37.5-, essential amino acid content of protein concentrates better than FAO standard amino acids except methionin (Rusoff *et al*, 1990). Production of dry matter harvested duckweed with the system 2-3 times a week produces 44 tons / ha / yr (leng *et al.*,1994). Thus the potential of duckweed as a protein source of feed for ruminant livestock, especially goats.

Fungus *Trichoderma harzianum* is able to specifically produce cellulase enzymes with the potential to degrade the material lignoselulotik into glucose and increase the protein content in the biomass. The enzymes are produced from molds groups produced through fermentation of solid media (Schroeder, 2004).

Duckweed has a fairly high nitrogen content is 6-7% lower ash content and high protein content making it suitable as animal feed, with state of the potassium 1.5 - 3.0% (Josep *et al.,* 2005). According to Saun and Heinrichs (2008) have conducted experiments for 52 days by replacing 52% of the concentrate with duckweed, then the sheep who received the basal ration and duckweed mempunai receiving different levels of higher digestibility were using duckweed is 73.26% and 2:29 kg feed intake / 100 kg.

The purpose of this study was to determine the effect of the characteristics and tricoderma nutrition.

Materials and methods

This research was carried out for 4 months, the manufacture of fermentation is done in the laboratory Faperta UNISKA Banjarmasin, Laboratory Technology Laboratory feed and post harvest IPB Bogor. Duckweed is used is 14 days old crop. Trichoderma harzianum as an inoculum derived from biotechnology and bioprocess microbial biotechnology research units plantations Bogor.

Materials

The materials used in the manufacture of silage covers ducweed, rice bran, *trichoderma harzianum* inoculum (isolates from the Laboratory of Biotechnology LIPI), while the tool used is a plastic silo size 5 kg of a total of 18 pieces, plastic, wood, bamboo, plastic tape, and label name .

Methods

Duckweed is cut into a size of 3-5 cm, withered for 12 hours until the moisture content reaches 60%, then add molasess and rice bran. Duckweed which has been mixed rice bran *Trichoderma harzianum* was then given 3% of the material. Mixture is then fed into the silo, compacted and covered to get an anaerobic atmosphere, and brooded for 21 days. Product silage harvested after 21 days of curing. Silage harvested before quality is evaluated first aerated to remove harmful gases, after which the sample was taken from each treatment for analysis in the laboratory.

This research used Complete Random Design (RAL) with four treatment and four times repetitions. As the treatment is the different innoculant in duckweed fermentation. The research treatment included:

K1 = Duckweed with the molasess

K2 = Duckweed with the molasess and trichoderm

K3 = Duckweed with the rice bran

K4 = Duckweed with the rice bran and trichoderm.

Analysis of data

Data were analyzed by analysis of variance according to a completely randomized design (steel and Torrie, 1999). If there are differences between treatments were tested using orthogonal contrasts test.

Results and discussion

Assessment based on the characteristics of silage dukcweed physical observations which include: color, odor, and texture presented in Table 1.

Table 1. characteristics physical of silage duckweed.

	K1	K2	K3	K4	SEM
Color	2.5	3.0	2.5	2.75	0.10
Odor	3.0	3.0	2.5	3.0	0.21
Texture	2.67	3.0	2.67	3.0	0.17

Description = K1 = Duckweed mith the molases , K2 = Duckweed with the molasess and tricoderm

K3 = Duckweed with the rice bran, K4 = Duckweed with the rice bran and tricoderm.

Color silage duckweed obtained average scores ranged from 2.5 - 3.0, indicating that silage hijaua natural colored and slightly yellowish, the highest score in the treatment of fermentation with the addition of molasses and tricoderma as much as 100 g. although not statistically significant (P> 0.05) on silage color, it indicates that the addition of additives such as molasses, bran and tricoderma to levels that are applied not significantly affect the color of silage. This is in line with Rostini *et al.,* (2013) that the color change that occurs in plants that experienced ensilase process caused by the process of aerobic respiration, which lasted for the supply of oxygen is still there, until the sugar in plants depleted, the sugar will be oxidized to CO_2, water, and heat which dihasilkan.sehingga temperature rise that can cause discoloration. While Wieinberg *et al.,* (2004) suggested that good silage will be green and yellow. This again by Rostini (2004) that the color of silage is influenced by the type and dosage of additives used.

Table 2. Chemical composition (%) of silage duckweed with different additives.

	Silase				
	K1	K2	K3	K4	SEM
Dry Matter	20.2	22.4	21.2	23.9	1.59
Organik Matter	82.2	84.4	82.4	84.9	1.37
Crude protein	9.5	10.6	9.2	10.8	0.79
NDF	70.2	72.6	70.7	72.5	1.23
ADF	45.3	44.7	46.4	45.1	3.09
Hemiselulosa	16.7	17.2	16.1	16.9	0.46
Lignin	3.2	2.1	3	2.4	0.51

Description = K1 = Duckweed mith the molases , K2 = Duckweed with the molasess and tricoderm

K3 = Duckweed with the rice bran, K4 = Duckweed with the rice bran and tricoderm.

Observation of the odor of duckweed silage range between 2.5 -3, which is flavored lactic acid. This is presumably dominated by the fermentation of lactic acid which is characterized by pungent odors. Good silage lactic acid, not pungent odor (Saun & Heinrichs 2008). However, according to Widyastuti (2008) do not necessarily reflect the fragrant smell of silage quality, because the scent can be derived from the high ethanol produced acetic acid mixed yeast. Homofermentatif good silage is characterized by pungent odors, because lactic acid is almost odorless. Further explained if the high acetic acid production will smell of vinegar, while the propionic acid fermentation will cause the stinging aroma and Clostridia fermentation will produce a foul odor.

Observation of the texture of duckweed silage showed good texture ranged 2.67 - 3.0 this shows that intact silage, compact and no visible mucus. In general treatment of K1, K2, K3 and K4 showed good quality, because there are no signs of damage such as crushed or dry texture for silage. This is due to all silage treatments had a water content corresponding to a fermentation process about 60% and 30%. Texture silage is influenced by moisture content of the material at the beginning ensilase. Silage with high moisture content (> 80%) will show a slimy texture, soft and moldy, while silage low water content (<30%) had a dry texture and overgrown with fungus (Lopez . 2000).

Table 3. Silage fermentation characteristics ensilase duckweed after 21 days.

	K1	K2	K3	K4	SEM
pH	4.18	3.84	3.85	3.91	0.11
N-NH3(g/kg DM)	3.2	3.4	3	3.1	0.17
Lactic acid (g/kg DM)	29.3	33.5	30.8	33.3	2.68
Acetic acid (g/kg DM)	14.6	9.6	10.6[b]	7.8[a]	2.88
Propionic acid (g/kg DM)	5.3	5	6.4	5.4	0.61
Butyric acid (g/kg DM)	6.3	4.4	4.2	3.8	1.28
VFA total (g/kg DM)	26.2	19a	19.2	19	3.57
Value Fleigh	26.7	30.7	32.2	34.6	3.32

Description = K1 = Duckweed mith the molases , K2 = Duckweed with the molasess and tricoderm
K3 = Duckweed with the rice bran, K4 = Duckweed with the rice bran and tricoderm.

Quality fermentation silage

Content DM Silage of duckweed were added tricoderm relatively higher than silage without tricoderm, especially with the addition of rice bran (Table 2), It is thought to relate to an additive is added to the silage material can lower the pH so that it can inhibit the growth of bacteria clostridia and further suppress the degradation of nutrients.

Content of organic matters (OM) on silage K2 and K4 are relatively higher than the K1 and K3 due to the degradation of carbohydrates into organic acids such as acetate, propionate and butyrate both silage was lower than K1 and K3. Powered total VFA concentration at both the silage (Table 3). Crude protein content of relatively higher in both treatments (K2 and K4) because of the degradation of proteins into amino acids and ammonia in silage K1 and K3 greater than K2 and K4 treatments. This is consistent with the N-NH_3 content of these four treatments.

The content of NDF and ADF fiber fractions in silage K2 and K4 are relatively lower than other treatments, this suggests that the addition tricoderma on K2 and K4 treatments can reduce the content of fiber fractions duckweed plants, so it is more easily digested cattle. Ensilase process causes a decrease in carbohydrate content instead of fiber, occurs extensively during ensilase due to the fermentation process and resulted in an increase in the content of NDF and ADF (Okine *et al.*, 2007). Fungus *Trichoderm harzianum* is able to specifically produce cellulase enzymes with the potential to degrade the material lignoselulotik into glucose and increase the protein content in the biomass. The enzymes are produced from molds groups produced through fermentation of solid media (Yahaya *et al.*, 2004).

Silage acidity level is very important to note because it is a major assessment of the success of the silage. The pH values obtained meet criteria of good silage is equal to 3.8 until 4.18 which can suppress the growth of fungi and cause rot. The low pH of the silage was supported by sufficient availability of WSC content (3.83% DM) which serves as a substrate for lactic acid bacteria growth driver .. This is in accordance with the opinion of Chemey *et al*, (2004) that there is a positive relationship anata soluble carbohydrate and pH. Soluble carbohydrates needed by lactic acid bacteria to cause a decrease in pH to 3.5 (Muck, 1990). Antaribaba *et al.* (2009) that in order to get a good silage WSC minimum required amount contained in the material by 3-5% ensilase BK. While Bolsen *et al.*, (2001) stated that the quality of silage is achieved when acid production is dominated by lactic acid, the pH dropped faster and perfect fermentation process in a short time, so that more nutrients can be maintained. The dominance of the growth of lactic acid bacteria are characterized by low pH values can reduce the growth of unwanted microorganisms, such as Clostridia can not survive below pH 4.6-4.8.

NH_3 concentration, the duckweed silage with the addition tricoderma lower ($P < 0.01$) in comparison with no tricoderma silage (Table 3). This suggests that during ensilase 21 days, degradation of protein in silage plus tricioderma lower than that without tricoderma. Ohshima *et al.*, (2009) states that occur during protein breakdown ensilase into peptides and free amino acids were performed by plant enzymes. While Leibeinsperger (1988) states that $N\text{-}NH_3$ is an indicator of the proportion of total N were experiencing degradation during enslase and $N\text{-}NH_3$ concentration is the best indicator for the presence of secondary fermentation. $N\text{-}NH_3$ concentration less than 50 g N / kg total N categorized very well, whereas good quality silage with N-NH3 concentrations between 50-100 g N / kg total N and in good quality silage. Under the category of K2 and K4 includes good quality silage, whereas K1 and K3 relatively good quality.

The concentration of total VFA in the duckweed silage with the addition tricoderma lower than without tricoderma silage ($P<0.05$). This is due to the concentration of acetate, propionate and butyrate in the silage more redah, thus indicating that the duckweed silage fermentation tricoderma plus more efficient. Bureenok *et al*, (2006) states that good silage is characterized by a high concentration of lactic acid, acetic acid concentration on the contrary, propionate and butyrate were low.

Value Fleigh silage of K2 and K4 was higher ($P < 0.05$) compared with other treatments, the highest in the treatment of K4 at 34.6 this suggests that the quality of the fermentation with the addition tricoderma, this result is lower than the research Santoso *et al.*, (2009) produces Value Fleigh silage of 41.7 with the addition of additive BAL efipit.

Conclusion

Characteristics and nutritional quality of silage dukcweed based on physical observations that include color, odor, texture, protein content, and organic acid content showed good results.

Acknowledgement

The authors would like to thank directorate general of higher education, research and community service department that has provided funding of this research by competitive grants program by 2014.

Reference

Antaribaba MA, Terro NK, Hariadi BTj, Santoso B. 2009. Effect of level of lactic acid bacteria inoculum prepared from king grass extract on fermentation quality of king grass silage. Indonesia Journal of Animal and Veterinary Science **14,** 278-283.

Bureenok S, Namihira T, Mizumachi S, Kawamoto Y, Nakada T. 2006. The effect of epiphytic lactic acid bacteria with or without different byproduct from defatted rice bran and green tea waste on napiergrass (*Pennisetum purpureum* Schumach) silage. Journal Science and Food Agriculture **86,** 1073–1077.

Bolsen KK, Brent BE, Pope RV. 2001. The ensiling process: Basic principles.
http://www.oznet.ksu.edu/pr_silage/basic_principle

s.htm

Chamberlain AT, Wilkinson JM. 1996. Feeding the dairy Cow. Chalcombe Publication. Lincoin.

Cherney DJR, Cherney JH, Cahse LE. 2004. Lactation performance of holstein cow fed fescue, Orchardgrass or Alfalfa silage, Journal of Dairy Science **87,** 2268-2276. http://dx.doi.org/10.3168/jds.S00220302(2004)79677-0

Hatta U, Rusdi, Arief R. 2009. The Adding duckweed (Lemnaceae spp) mash in broilers feed on relative weight of their liver and pancreas. Journal Agroland **18(1),** 85-89.

Joseph J, Nocera GJ, Parsons G, Milton R, Alan H, Fredeen, 2005. Compatibility of delayed cutting regime with bird breeding and hay nutritional quality. Journal Agriculture Ecosystems and Environment **107,** 245-253. http://dx.doi.org/10.1016/j.agee.2004.11.001

Leibeinsperger RY. 1988. Modeling the effects of formic acid and molasses on ensilage. Journal of Dairy Science **71,** 1220-1231. http://dx.doi.org/10.3168/jds.S00220302(88)79677-0

Leng RA, Stambolie JH, Bell R. 1994. Duckweed - a potential high-protein feed resource for domestic animals and fish**.** J. Nutritional Research Reviews **3,** 277-303.

Lopez J. 2000. Probiotic in animal nutrition. Asian-Aust Journal Anima Sci ence. **13,** 12–26.

Lukkananukool A, Paengkoum P, Bureenok S, Paengkoum S, Yuangklang C, Kawamoto Y. 2013. Effect of Forage Species and Additives on Quality of Tropical Forage Silage. Journal of Animal and Veterinary Advances **12,** 153-150. http://dx.doi.org/ 10.3923/javaa.2013.153.159

Muck RE. 1990. Prediction of lactic acid bacteria numbers on lucerne. J. Grass and Forage Science. **45,** 273-280. http://dx.doi.org/10.1111/j.13652494.1990.tb01950.x

Muck RE, Kung I. 1997. Effect of silage additive on ensiling. Proceeding from the silage proceeding FAO E-Conf. on Silage. FAO Plant Production and Protection. 51-164 P.

Okone A, Yimamu A, Hanada M, Izumitta M, Zinong M, Okamoto M. 2007. Ensiling characteristic of daikon (Raphna satimus) by product and its potentials as an animal feed resource. Journal Animal. Feed Science and Technology **136,** 248-264. http://dx.doi.org/10.1016/j.anifeedsci.2007.248-264

Ohshima M, Kimura E, Yokota H. 2009. Methods of making good quality silage from direct cut alfalfa by spraying previously fermented juices. Journal Animal Feed Science and Technology **66,** 129-137. http://dx.doi.org/10.1016/j.anifeedsci.2009.129.137

Rostini T. 2004. Combination of Crop Density and Corn Varieties to Characteristic and Persentage of the Optimum Silage Successfulness the Livestock's Forages. Majalah Ilmiah Ziraah **5,** 76-81.

Rostini T, Abdullah L, Wiryawan KG, Karti PDMH. 2013. Effect of *Lactobacillus plantarum* inoculan to chemical composition and nutrient quality of silase produced from local swamp forage. Internasional Seminar on Tropical Bio-resources for Sustainable Bio-Industry.30-31 October 2013.

Rusoff LL, Blackeney EW, Culley DD. 1980. Duckweeds (Lemnaceae Family): a potential source of protein and amino acids. Journal of Agriculture and Food Chemistry **28,** 848-85. http://dx.doi.org/10.1021/jf60230a040

Santoso B, Hariadi B, Manik H, Abubakar H. 2009. Quality of tropical Grasses ensiled with lacticacid bacteria prepared from fermented grasess.

J. Media .Peternakan. **32,** 137-144.

Saun RJV, Heinrichs AJ. 2008. Troubleshooting silage problems: How to identify potential problem. In: Proceedings of the Mid-Atlantic Conference; Pennsylvania, 26–26 May 2008. Penn State's Collage. 2–10.

Schroeder JW. 2004. Silage fermentation and preservation. Extension Dairy Speciaslist. AS-1254. www.ext.nodak.edu/extpubs/ansci/dairy/as 1254w.htm.

Steel RGD, Torrie JH. 1999. Statistics Principles and Procedures.2ED.Translation: B. Sumantri. PT Gramedia Pustaka Utama. Jakarta.

Wilkinson JM, Huber JT, Henderson HE. 1976. Acidity and proteolysis as factors affecting the nutritive value of corn silage. Journal of Animal. Science **42,** 208–218.

Weinberg ZG, Muck RE, Weimer PJ, Chen Y, Gambung M. 2004. Lactic acid bacteria used in inoculants for silage as probiotics for ruminants. Applied Biochemistry and Biotechnology **118,** 1-10.

Widyastuti Y. 2008. Silage fermentation and silage for ruminant probiotic benefits. J. Media Peternakan. **31(3),** 225-232.

Yahaya MS, Goto M, Yimiti W, Smerjai B, Kuwamoto Y. 2004. Evaluation of fermentation quality of a tropical and temperaturate forage crops ensiled with additives of fermented juice of epiphytic lactic acid bacteria (FJLB). Asian-Aust.Journal Anima Science **17,** 942-946.