

Acidity, Volatyl Fatty Acid and Digestibility In-Vitro of Corn Straw Silage as Energy Source

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Abstract— The research aims to determine the best silage formulation using pollard and molasses to acidity (pH), volatyl fatty acid, and in vitro digestibility. The experiment use completely randomized design (CRD) with four treatments and four times replication, so it has 16 units experiment. The four treatments are treatment A = 100% corn straw + 20% pollard + 0% molases; B = 100% corn straw + 10% pollard + 10% molases; C = 100% corn straw + 0% pollard + 20% molases; D = 100% corn straw + 10% pollard + 0% molases; E = 100% corn straw + 5% pollard + 5% molases; dan F = 100% corn straw + 10% pollard + 0% molases. Variables observe are pH, volatyl fatty acid, and in vitro digestibility in rumen fluid including dry matter, and organic matter digestibility. Results of the experiment showed that nutrient content and acidity on treatment A is highest. Level of VFA total, dry matter digestibility, organic matter digestibility are significant different ($P < 0.05$). Microbes need energy and protein for the growth and could be fullfill from corn straw silage that combination of pollard and molases. It could be concluded that combination of 10% pollard and 10% molases could use by microbes to fullfill the need of energy and protein.

Keywords— corn straw silage, pH, in vitro digestibility, VFA.

I. INTRODUCTION

Ruminant need forage as main energy and protein source, beside concentrate as feed supplement. Feed that usually give to ruminant are grass, leguminose and tree such as *Kibatalia arborea* and *Hibiscus tiliaceus*. The availability of forage especially grass is fluctuated where it will be abundant during rainy season but the availability is limmited even deficiency during draught season.

Utilization of waste of agricultural crop resources as a feed source is an efficient step to overcome the lack of grass production. Agricultural waste including an in-situ forage source is available in abundance and easily available. Most of the agricultural waste can be used for cattle feed. The

great potential of agricultural waste as a source of forage is corn straw (BPTP West Sumatra, 2011).

Corn is an agricultural commodity that is quite widely developed by farmers in Indonesia. According to Kushartono and Iriani (2003), if the high yield of corn crops can be developed in Indonesia, it is hoped that corn crops can contribute to the provision of forage beside grass, leguminous and rice straw. One of the factors causing underdevelopment of corn crop as livestock feed in Indonesia is the limited of farmer for its utilization. Therefore it is necessary to conduct an economical assessment and development of corn crops more intensive and more introducing how to grow crops and utilization of corn crops as a source of feed.

Plant sugars are fermented by anaerobic bacteria to organic acids which reduce the pH of the plant material. This process preserves the crop during long-term storage. High quality corn silage results when lactic acid is the predominant acid produced during fermentation. Lactic acid is the most efficient fermentation acid and will drop the pH of the silage the fastest (University of Wisconsin, 2017).

The principle of silage making is to maintain airtight conditions in silo to the maximum extent possible. Airtight conditions can be pursued by solidification of silage material as much as possible and the addition of fermentable carbohydrate sources (Hidayat and Indrasanti, 2011).

The advantage of silage making are stabile composition of the feed (silage) for a longer period (up to 5 years, plants can be harvested at optimal phase of development and are efficiently used by livestock, and reduction of nutrient loses (Food and Agriculture Organization of United Nation and USAID)

Retnani *et al.* (2009) study using field grass, corn leaves and corn cloves made biscuits found that 50% of field grass and 50% of corn leaves have the lowest water content and water absorption. Waste corn biscuits can be used as a substitute for the source of fiber for sheep

because it has the same palatability as the field grass biscuits.

Bahri (2012) study using field grass and complete ration diets based on corn straw for 6 weeks showed that a complete silage ration treatment based on corn straw and field grass with 60%: 40% ratio showed a better response than other rations on consumption rations and weight gain of bali cattle.

The objective of this study was to obtain a formulation of corn silage using pollard and molasses on pH, volatyl fatty acid, in vitro digestibility.

II. MATERIALS AND METHODS

Materials

The materials used in making corn silage straw are corn straw, pollard, and molasses. Tools used include knives for cutting corn straw, board as cutting pad, plastic sheet to mix silage, plastic bag, and bucket as silo.

Methods

The research was conducted at Animal Nutrition Laboratory of Faculty Animal Husbandry Udayana University and Ciawi Bogor Livestock Research Laboratory for 3 months from preparation until end of research.

Corn straw is cut into 3-5 cm, and mix with pollard, and molasses as per treatment. Then put in a plastic bag, pressed and compressed until there is no air in the plastic bag to create anaerobic state. Then tied tightly and kept in a cool place and not exposed to the sun. Laboratory analysis was conducted after 21 days of fermentation.

The design used in this study was a completely randomized design with six treatments and four replications, so there were 24 experimental units. The six treatments were: A = 100% corn straw + 20% additive (20% pollard + 0% molasses); B = 100% corn straw + 20% additive (10% pollard + 10% molasses); C = 100% corn straw + 20% additives (0% pollard + 20% molasses); D = 100% corn straw + 10% additive (10% pollard + 0% molasses); E = 100% corn straw + 10% additive (5% pollard + 5% molasses); F = 100% corn straw + 10% additive (0% pollard + 10% molasses).

Variables observed were pH (acidity), the digestibility of dry matter and organic matter in rumen fluid in-vitro, and Volatyl Fatty Acid (VFA).

The data obtained in this study were analyzed by using variance analyze, if the average value of treatment significantly affected the variables followed by Duncan test at 5% (Steel and Torrie, 1991).

III. RESULTS AND DISCUSSION

Acidity (pH value) silage of corn straw silage showed a tendency decreases with decreased pollard supplementation and increased molasses in 20% supplementation in treatments A, B, and C and 10% in treatment D, E, and F. This indicated that the type (pollard and molasses) and the amount of additives used will affect the quality of silage. The pH value of the research results ranged from 3.88-4.22 and according to the Agricultural Departement (1980) is very good criteria. The lower the pH value or the more acidic the silage, the better of silage quality. The use of molasses can decrease the pH due to molasses as a soluble carbohydrate source which will form a higher lactic acid compared with pollard. The pH value in the supplementary ingredients with different levels it is seen that the use of additives 10%, pH value is more alkaline compared to 20% because the amount of additive very decisive the formation of lactic acid from lactic acid bacteria. Microbial growth will be higher in silage containing more additives than with the use of lower additives.

pH value of corn straw silage in treatment A is higher compared with treatment B and C because the pH value is influenced by the content of VFA and NH₃. Silage of corn straw in treatment A has the lowest total VFA content so that the pH value becomes high because the higher the VFA content, so the lower pH value or will be acid. The low VFA total content of corn straw silage in treatment A is caused by the utilization of VFA by microbes in the presence of NH₃ availability of the pollard protein, so that microbial proteins are formed and after death will be able to increase the silage protein content.

Tabel.1: Acidity (pH value) and Volatile Fatty Acid (VFA) of corn straw silage

Variables	Treatments ¹⁾						SEM ²⁾
	A	B	C	D	E	F	
Acidity (pH value)	4,18 ^{d3)}	3,95 ^b	3,90 ^a	4,22 ^e	4,01 ^c	3,88 ^a	0,01
VFA partial:							
Acetic acid (mM)	16,35 ^b	25,02 ^c	25,22 ^c	22,38 ^c	10,04 ^a	6,93 ^a	1,98
Propionic acid (mM)	0,74 ^a	0,45 ^a	0,21 ^a	0,24 ^a	0,08 ^a	0,05 ^a	0,17
Iso-butyric acid (mM)	0,29 ^b	0,21 ^{ab}	0,14 ^{ab}	0,15 ^{ab}	0,04 ^a	0,04 ^a	0,06
N-butyric acid (mM)	0,29 ^{ab}	0,55 ^b	0,18 ^a	0,05 ^a	0,06 ^a	0,13 ^a	0,09
Iso-valeric acid (mM)	0,28 ^b	0,08 ^a	0,01 ^a	0,11 ^a	0,06 ^a	0,07 ^a	0,06
N-valeric acid (mM)	0,06 ^a	0,08 ^a	0,06 ^a	0,03 ^a	0,04 ^a	0,04 ^a	0,02

VFA total (mM)	18,02 ^b	26,38 ^c	25,81 ^c	22,97 ^{bc}	10,31 ^a	7,25 ^a	1,96
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Noted:

- ¹⁾ A = 100% corn straw with 20% pollard + 0% molasses supplementation; B = 100% corn straw with 10% pollard + 10% molasses supplementation; C = 100% corn straw 0% pollard + 20% molasses; D = 100% corn straw with 10% pollard + 0% molasses supplementation; E = 100% corn straw with 5% pollard + 5% molasses supplementation; F = 100% corn straw with 0% pollard + 10% molasses supplementation
- ²⁾ Standard Error of the Treatment Means
- ³⁾ Different alphabet on the same row show significantly different (P<0.05)

The highest total VFA content in treatment B was 26,3750 mM and 31,70%, 60,92%, and 72,53% significantly (P<0,05) higher than treatment A, E, and F, respectively. Whereas with treatment C and D respectively 2,13% and 12,92% not significant (P>0.05) higher (Table 4). When viewed as a whole, total VFA content in treatment B, C, and D is significantly higher than treatment A, the high total VFA levels have no positive effect on the nutritional value of silage. Trisandewi *et al.* (2016) find that treatment A contained 16.19% crude protein and significantly (P<0.05) higher than other treatments and the crude fiber content of treatment A is 15.13% and significantly lower (P<0.05) than other treatments. High levels of VFA in silage B, C, and D are not useful because nitrogen is not available for microbial growth so that VFA is remaining or not utilized by microbes. This can be attributed to the high content of crude fiber in silage B, C, D, E, and F prove that

fermentation does not work perfectly because of the low microbes in the silage treatment.

Dry matter and organic matter digestibility on treatment B supplemented with 10% pollard and 10% molasses is the highest (P <0.05) among all treatments. This occurs because the silage of corn straw on treatment B contains pollard and molasses additives where pollard and molasses are microbes nutrients. Pollard as an energy and nitrogen source and molasses as energy sources. Energy and nitrogen content in pollard and molasses for microbial growth, so could produce enzymes for in-vitro fermentation. Increasing degradation by enzymes could increase dry matter digestibility. This also occurs in silage treatment E with 5% pollard and 5% molasses additive so that the yield of dry matter digestibility in treatment E is slightly lower than treatment B but not significantly different (P>0.05).

Table.2: Dry matter and organic matter digestibility of corn straw silage

Variables	Treatments ¹⁾						SEM ²⁾
	A	B	C	D	E	F	
Dry matter digestibility (%)	54,87 ^{ab 3)}	62,77 ^d	51,32 ^a	57,37 ^{bc}	61,35 ^{cd}	56,66 ^{ab}	1,49
Organic matter digestibility (%)	56,08 ^a	64,66 ^c	52,52 ^a	58,50 ^{ab}	62,33 ^{bc}	57,73 ^{ab}	1,87

Noted:

- ¹⁾ A = 100% corn straw with 20% pollard + 0% molasses supplementation; B = 100% corn straw with 10% pollard + 10% molasses supplementation; C = 100% corn straw 0% pollard + 20% molasses; D = 100% corn straw with 10% pollard + 0% molasses supplementation; E = 100% corn straw with 5% pollard + 5% molasses supplementation; F = 100% corn straw with 0% pollard + 10% molasses supplementation
- ²⁾ Standard Error of the Treatment Means
- ³⁾ Different alphabet on the same row show significantly different (P<0.05)

Organic matter and dry matter digestibility have the same tendency where organic matter digestibility on additives with combination of pollard and molasses shows highest percentage both in 20% and 10% additive. Organic matter digestibility with 20% additive was obtained on treatment B while with additive 10% on treatment E. It showed that addition of singularly additive is not good enough because microbes require nitrogen from protein degradable and energy (VFA) from soluble carbohydrate fermentation, so that the addition of pollard and molasses will be able to meet the needs of microbes for protein and

energy.

IV. CONCLUSION

Based on results and discussion, it can be concluded that corn straw silage with combination of 10% pollard and 10% molasses supplementation or additives provides better results on pH, total VFA, and dry matter and organic matter digestibility because rumen microbes require energy and proteins that contained in pollard and molasses additives.

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REFERENCES

- [1] Bahri, S. (2012). Respon Silase Ransum Komplit Berbasis Jerami Jagung Sebagai Pakan Penggemukan Sapi Bali. Laporan Hasil Penelitian Dasar Keilmuan. Jurusan Peternakan Fakultas Ilmu-Ilmu Pertanian Universitas Negeri Gorontalo.
- [2] BPTP Sumatera Barat. (2011). Teknologi Pembuatan Silase Jagung untuk Pakan Sapi Potong. Badan Litbang Pertanian Kementerian Pertanian Republik Indonesia. Sumber: <http://sumbar.litbang.pertanian.go.id>. Diakses 15 Maret 2015.
- [3] Food and Agriculture Organization of United Nation and USAID. (-). Silage Making For Small Scale Farmers Source: http://pdf.usaid.gov/pdf_docs/PNADQ897.pdf. Acces: May 1 2017.
- [4] Hidayat, N dan Indrasanti, D. 2011. Kajian Metode *Modified* Atmosfir dalam Silo dan Penggunaan Berbagai Additif Pada Pembuatan Silase Rumput Gajah. Laporan Penelitian. Fakultas Peternakan. Unsoed. Purwokerto.
- [5] Kushartono, B. and N. Iriani. (2003). Prospek Pengembangan Tanaman Jagung sebagai Sumber Hijauan Pakan Ternak. Prosiding Temu Teknis Fungsional Non Peneliti. halm 26-31.
- [6] Retnani Y., L. Herawati, W. Widiarti, and E. Indahwati. (2009). Uji Sifat Fisik dan Palatabilitas Biskuit Limbah Tanaman Jagung sebagai Substitusi Sumber Serat Untuk Domba. Buletin Peternakan Vol. 33(3): 162-169.
- [7] Steel, R. G. D., and J. H. Torrie. (1991). Prinsip dan Posedur Statistik. Suatu Pendekatan Biometrik. Edisi Kedua. Alih bahasa B. Sumantri. Jakarta. Gramedia.
- [8] Trisnadewi, A. A. A. S., I G. L. O. Cakra., dan I W Suarna. (2017). Kandungan Nutrisi Silase Jerami Jagung Melalui Fermentasi Pollard Dan Molases. Majalah Ilmiah Peternakan Vol. 20(2): 55-59. Source: <https://ojs.unud.ac.id/index.php/mip/article/view/32217>.
- [9] University of Wisconsin, Division of Cooperative Extension. (2017). Corn Agronomy Wisconsin. Source: <http://corn.agronomy.wisc.edu/Silage/S005.aspx>. Cited May 1st 2017