Jurnal Peternakan Indonesia, Oktober 2021
ISSN 1907-1760 E-ISSN 2460-6626
Accredited: 14/E/KPT/2019

JPI Vol. 23 (3): 240-246
DOI: 10.25077/jpi.23.3.240-246.2021
Available online at http://jpi.faterna.unand.ac.id/

Effect of Different Feed Additives on Ensiled Carrot Straw as an Animal Feed

Pengaruh Pemberian Pakan Aditif yang Berbeda terhadap Silase Jerami Wortel sebagai Pakan Ternak

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(Diterima: 27 Agustus 2021 ; Disetujui: 3 Oktober 2021)

ABSTRACT

The problem that often comes by farmers is a shortage of feed in the dry season; one of the technologies that can be used is silage. Carrot straw (CRS) can be used as a silage material because of its abundance and nutritional value, which is good for the livestock. The purpose of this study is to know about the differences in the provision of feed additives, i.e., *Lactobacillus casei*-A, *Lactobacillus plantarum*, and *Lactobacillus casei*-B of the composition of CRS silage. Making silage by means of CRS was weighed, CRS was placed on a tray and added with feed additives based on experimental treatment, CRS was mixed thoroughly, stored, and closed in a laboratory-scale silo then placed at 26-28oC. CRS was given with three different feed additive treatments: CRS + 0.01% *Lactobacillus casei*-A, CRS + 0.01% *Lactobacillus plantarum*, CRS + 0.01% *Lactobacillus casei*-B. Ensiling was carried out for 21 days in four replications for each treatment, and each replication was made in duplicate. Statistical analysis after the data was obtained was using the SAS University application specification 4.0 red hat (64-bit) with code, and the difference between the treatment means (P<0.01) was determined using Duncan's Multiple Range Test (DMRT). This study resulted that the different types of use of lactic acid bacteria had a significant effect (P<0.01) on organic matter content (OM), crude fiber content (CF), extract ether content (EE), nitrogen-free extract (NFE), neutral detergent fiber (NDF) and acid detergent fiber (ADF). This study concludes that the difference in the provision of feed additives affects the chemical composition of carrot straw silage. To sum up, *Lactobacillus casei-A* has a good value on NFE while *Lactobacillus casei*-B has a good value on OM, CF, EE, NDF, and ADF.

Keywords: carrot straw, chemical composition, silage

ABSTRAK

Masalah yang sering dihadapi peternak adalah kekurangan pakan dimusim kemarau, salah satu teknologi yang bisa digunakan adalah pembuatan silase. Jerami wortel bisa digunakan sebagai bahan silase karena ketersediaan yang melimpah dan kandungan nutrisinya yang baik untuk ternak. Tujuan dari penelitian ini adalah pengetahuan mengenai pengaruh perbedaan pemberian bahan tambahan pakan meliputi Lactobacillus casei-A, Lactobacillus plantarum, dan Lactobacillus casei-B pada komposisi kimiawi silase jerami wortel. Pembuatan silase dengan cara: jerami segar ditimbang, ditempatkan di atas nampan, dikombinasikan dengan aditif sesuai dengan perlakuan eksperimental, dicampur secara menyeluruh, dan disimpan dalam timbangan laboratorium silo. Silo ditutup rapat untuk mempertahankan kondisi anaerobik dan ditempatkan pada suhu kamar (26-28^{o}C). Jerami wortel diberi tiga perlakuan aditif yang berbeda: jerami wortel segar + 0,01% Lactobacillus casei-A, jerami wortel segar + 0,01% Lactobacillus plantarum, jerami wortel segar + 0,01% Lactobacillus casei-B. Ensiling dilakukan selama 21 hari dalam empat ulangan dan setiap ulangan dibuat rangkap dua. Analisis statistik setelah data diperoleh adalah menggunakan aplikasi SAS University spesifikasi 4.0 red hat (64-bit) dengan kode dan perbedaan antara rata-rata perlakuan (P<0,01) ditentukan menggunakan Uji Jarak Berganda Duncan

(UJBD). Penelitian ini menghasilkan bahwa adanya perbedaan jenis penggunaan bakteri asam laktat memberikan pengaruh nyata (P<0,01) pada kandungan bahan organik, kandungan serat kasar, kandungan lemak kasar, bahan ekstrak tanpa nitrogen, neutral detergent fiber (NDF) dan acid detergent fiber (ADF). Kesimpulan penelitian ini adalah perbedaan pemberian bahan tambahan pakan mempengaruhi komposisi kimiawi silase jerami wortel. Penggunaan Lactobacillus casei-A memiliki nilai yang baik pada bahan ekstrak tanpa nitrogen sedangkan Lactobacillus casei-B memiliki nilai yang baik pada bahan organik, serat kasar, lemak kasar, NDF dan ADF.

Kata kunci: kualitas kimia, jerami wortel, silase

INTRODUCTION

Agro-industrial waste that has not been utilized optimally is straw, where straw can be used as animal feed. Every year, residues of the agricultural, industrial sector are produced in large quantities. These residues will have harmful effects on the safety of animals and humans if thrown into the environment and not handled properly. So far, agro-industrial waste is only disposed of, burned, and stockpiled. Agroindustrial waste has not been used optimally (Sjofjan *et al*., 2021). One of the products that can't be utilized is carrot straws (CRS); environmental pollution can occur if the residue is not appropriately managed. Research shows that CRS contains rich chemical components and can be used as animal feed. There is a need for development and skills in feeding by improving the quality of grasses, legumes, and agricultural by-products (Khan *et al*., 2009). Optimum productivity can reach with balanced and economical feeding practices of livestock. Feed costs and labor can minimize feed from comprised locally available by-products (Beigh *et al*., 2017). Feeds in animal diets can come from vegetable by-products (Rinne *et al*., 2019). One of the vegetable by-products is carrot. Carrots have a large quantity which discarded annually, the problem of this chase is an economic loss to the producers and environmental problem (Clement *et al*., 2019). Carrot can cultivate throughout the year then made excess top available. Carrot leaves were a natural source of antioxidants, minerals such as potassium (975.00 ppm), carbohydrates, protein, dry weight (61.36% and 20.27%) (Goneim *et al*., 2011). Venkataramanan *et al*. (2015a) stated that the composition (g/kg) of carrot tops was CP (144.0), EE (25.1), CF (150.8), NFE (493.4), TA (189.2), AIA (20.2), Calcium (24.3), and Phosphorus (07.7). Carrot by-products can be processed as feed during seasons of fodder shortage to be feed blocks and silage (Venkataramanan *et al*., 2015b). Silage is a solution when foraging limitation in the dry season. The advantage of silage is that it has the same nutritional value as forage. Silage can reduce the risk of weather damage compared to dry hay of forage crops (Coblentz and Akins, 2018). Zivkov-Balos *et al*. (2015) was stated that in the ensilage method, particles size was reduced, and placed the harvest materials in a silo, then sealed to make anaerobic conditions. Silage can use after several weeks or months. In silage production, microbes must convert soluble carbohydrates into lactic acid. To make silage, lactic acid bacteria are needed in moist forages in the preservation process (Santos *et al*., 2013). Wati (2018) was stated that Lactic acid bacteria produce lactic acid so that it can increase the nutrition of dadih. Lactic acid bacteria are bacteria, including a heterogeneous group that can use for fermentation and preserves some food (Bintsis, 2018). Characteristics of lactic acid bacteria were Rods, Cocci, and Cocco-bacilli, Gram-positive, non-respiring but aerotolerant, non-spore-forming, catalase-negative, fastidious, and acid-tolerant (Gupta *et al*., 2018). Patil *et al*. (2015) stated that probiotics (lactic acid bacteria) could be used as a feed additive. Need some studies to know the effects of some inoculum lactic acid bacteria on silage qualities (Oliveira *et al*., 2017). Feed additives such as lactic acid bacteria can increase silage nutrition. The purpose of this study is to know about the differences in the provision of feed additives, i.e., *Lactobacillus casei*-A, *Lactobacillus plantarum*, and *Lactobacillus casei*-B of the composition of CRS silage. Soundharrajan *et al*. (2020) state that *Lactobacillus casei* and *Lactobacillus plantarum* are often used in making silage. *L. plantarum* and *L. paracasei* have high growth when used in the fermentation process (Reyes- Gutiérrez *et al*., 2018).

METHODS

Ethical Approval

The microbial inoculum used in the manufacture of silage in this study was the isolation of CRS that contained solid particles selected based on cell growth and the ability to produce lactic acid. The research was conducted at the Faculty of Animal Husbandry, Islamic University of Malang, East Java, Indonesia.

Sample Collection and Ensiling Procedure

May to June 2020 is the date of the implementation of this research. The SCRs were obtained from an industrial and local farmer in the Batu city area. The material for making silage is 10 kg CRS (wet basis) which is still fresh and immediately processed into silage. The SCRs 1000 g was added with 10 ml of inoculum, which contains 10^7 CFU. This means that 10 ml (inoculum) divided by 1000 g (SCR): 0.01%. Making silage by means of CRS was weighed, CRS was placed on a tray and added with feed additives based on experimental treatment, CRS was mixed thoroughly, stored, and closed in a laboratory-scale silo for 21 days then placed at 26-28^{o}C (Kondo *et al*., 2016; Adli *et al*., 2020). .

The Observed Variables

The variables observed in this study were the composition of CRS fermentation, including organic matter content (OM), crude fiber content (CF), ether extract content (EE), nitrogen-free extract (NFE), neutral detergent fiber (NDF), and acid detergent fiber (ADF). Determination of OM, CF, EE, and NFE using AOAC (1995) while NDF and ADF were determined according to the Association of American Feed Control Officials (AAFCO, 2018).

Experimental Design

CRS was given with three different feed additive treatments: CRS + 0.01% *Lactobacillus casei*-A, CRS + 0.01% *Lactobacillus plantarum*, CRS + 0.01% *Lactobacillus casei*-B. Ensiling was carried out for 21 days in four replications for each treatment, and each replication was made in duplicate.

Statistical Analysis

Statistical analysis after the data was obtained was using the SAS University application specification 4.0 red hat (64-bit) with code, and the difference between the treatment means ($P<0.01$) was determined using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

The results of nutrient composition ensiled CRS treated with three feed additives are shown in Table 1.

Nutrient Composition to Organic Matter (OM)

The organic matter of this experiment was above 30% (Table 1) *Lactobacillus casei*-A was lower than *Lactobacillus plantarum* and *Lactobacillus casei*-B. The ensiling method with different feed additives can improve nutrient content. The definition of organic matter was dry matter minus ash content (weight loss of dry matter that has been combustion process (Fuller *et al*., 2004). The difference between organic and dry matter, organic matter contains all nutrients except ash, while dry matter contains all nutrients (Al-Arif *et al*., 2019). Silage was made from a mixture of cassava pomace, rumen content, and molasses with different

Table 1. Effect of different feed additives on the nutritional composition of CRS (%DM)

Treatments	Variables					
	OM	CF	EE	NFE	NDF	ADF
L.Casei-A	78.60[a]	37.90[a]	1.03[b]	25.19[a]	25.59[a]	21.74[a]
L.Plantarum	79.92[b]	42.90[b]	1.05[ab]	21.52[b]	30.15[b]	24.77[b]
L. Casei-B	80.71[c]	46.82[c]	1.14[a]	19.93[c]	31.77[c]	28.93[c]
SEM	4.50	1.34	0.34	10.33	5.66	7.65

[a, b, c] Means with different superscripts within same collumn are highly significant different (P<0.01). OM=Organic matter, CF= Crude Fiber, EE=Ether extract, NFE= Non-Nitrogen Extract, NDF= Neutral Detergent Fiber, ADF= Acid Detergent fiber; Fresh CRS, ensiled CRS + 0.01% *Lactobacillus casei-A*, ensiled CRS + 0.01% *Lactobacillus plantarum*, ensiled CRS + 0.01% *Lactobacillus casei-B*.

lactic acid bacteria had organic matter: 5.21 (*L. plantarum* week III), 6.05 (L. mixed week III), and 6.07 (L. spp rumen content week III) (Isnandar *et al*., 2010).

These results were higher than the literature; the higher organic matter in this study had the best nutrients, Borreani *et al*. (2018) were stated that when silage reduces qualities, it must be exposed to air should be avoided, and aerobic damage to silage should be minimized. Different inoculation of lactic acid bacteria can change all compositions of organic matter. Alhaag *et al*. (2019) was stated that ensiling process increases lactic acid, acetic acid, ammonia-N, butyric acid, and propionic acid; on the other hand, ensilage can decrease microbial counts and water-soluble carbohydrates. In this study, *L. casei*-B was the best inoculum based on the organic matter because *L. casei*-B had the highest organic matter. Organic matter intake is used for VFA's rumen production, which uses to give a positive advantage for cattle itself and to maximize rumen microbe synthesis (Mayulu *et al*., 2013).

Different Inoculum Lactic Acid Bacteria of Crude Fiber (CF)

In this experiment, different types of lactic acid bacteria had (P<0.01) crude fiber. The *L. casei*-B had the highest crude fiber, 46.8%, *L. casei*-A had a lower, 37.9%. Furthermore, *L. plantarum* had 42.2%. Ensiling can reduce crude fiber. Venkataramanan *et al*. (2015d) stated that the whole carrot top had crude fiber 150 g. The higher microbial activity in silage fermentation will more decrease crude fiber content. During ensilage, lignocellulose enzymes will produce microbes that degrade fibers (Muhakka *et al*., 2015).

The amount of crude fiber was dependent on the cow's requirement. Indonesian Agency for Agricultural Research and Development (2012) was stated that economically, feed with crude fiber content can be applied to pregnant cows because it can produce calves with pre-weaning average daily gain (ADG) for 10% crude fiber resulted (0,56 kg ADG), 15% crude fiber resulted (0,48 kg ADG), and 20% crude fiber resulted (0,56 kg ADG). After cows give birth, the ability of cows to heat was: 5 cows (100% from the population with 10% crude fiber of feed), four cows (80% from the population with 15% crude fiber of feed), and four cows (80% from the population with 15% crude fiber of feed). Pregnant cows can feed 10%, 15%,20% of crude fiber. Based on this literature, *L. casei*-B was the best inoculum to make silage because *L. casei*-B had the highest crude fiber.

Different Inoculum Lactic Acid Bacteria of Ether Extract (EE)

The different types of lactic acid bacteria affect (P<0.01) Ether Extract. *L. casei*-B had the highest Ether Extract 1.14%. *L. casei*-A had a lower 1.03%. Furthermore, *L. plantarum* had 1.05%. Ether Extract in a feed was the number of fat plant pigments (xanthophylls, chlorophyll, carotene) and fat soluble vitamins (A, D, E, K). Hartati *et al*. (2014) was stated that fat has highly dense energy that can provide an energy source for livestock and reduce the heat stress of lactating cows during hot weather. The yield and concentration of milk fat were affected by the feed nutrition of the dairy cow. Fat supplements were commonly used to increase support milk production and dietary energy density (Lock *et al*., 2013).

Ensilage can reduce crude fat of feed, Venkataramanan *et al*. (2015c) were stated that fat in carrot tops was 25.1 g. The results showed that *L. casei*-B was the best inoculum from crude fat because *L. casei*-B was the highest crude fat. Feeds with high-fat content were increase calories, more energy per unit of weight, more energy-dense, provided essential fatty acids, improved palatability, and maintaining feed mixing equipment.

Different Inoculum Lactic Acid Bacteria of Nitrogen-Free Extract (NFE)

Differences of feed additives (lactic acid bacteria) affecting nitrogen-free extract (P<0.01). *L casei*-A had the highest NFE, 25.1%. *L. casei*-B had a lower 19.9%. Furthermore, *L. plantarum* had 21.5%. NFE consisted of carbohydrates, such as starches, sugars, solubilized hemicellulose, and lignin ensilage decrease NFE of carrot tops. Venkataramanan *et al.* (2015e) was stated that carrot tops had 493 g NFE. The results showed that *L. casei*-A was the best inoculum to make silage based on NFE because *L. casei*-A has the highest NFE. Nearly all livestock species can utilize the NFE fraction.

Different Inoculum Lactic Acid Bacteria of Neutral Detergent Fiber (NDF)

Neutral Detergent Fiber affected by different types of lactic acid bacteria (P<0.01) NDF. The *L. casei*-B had the highest NDF, 31.7%, *L. casei*-A had the lowest 25.5%, and *L. plantarum* 30.1%. The NDF value was showed the percentage of total fiber in a feed. The NDF included: cellulose, hemicellulose, silica, lignin, ash, and CP. The NDF influences the level of intake, a high level of NDF will limit intake, but set a minimum level of NDF was needed to maintain a healthy rumen and prevent fattening throughout pregnancy. The results showed *L. casei*-B was the best inoculum based on NDF because *L. casei*-B had the highest NDF. Ertekin and Kızılşimşek (2020) were stated ruminants digestibility, and feed intake is influenced by many factors, especially the NDF and ADF content of the feed.

Different Inoculum Lactic Acid Bacteria of Acid Detergent Fiber (ADF)

The results showed that the different types of lactic acid bacteria had (P<0.01) of ADF. The *L. casei*-B had the highest acid detergent fiber, 28.9%, *L. casei*-A had the lowest 21.7%. Furthermore, *L. plantarum* had 24.7%. The assumption of ADF was the waste from the use of the detergent was made of lignin and cellulose (Jaimes *et al*., 2019). The results showed that *L. casei*-B was the best inoculum in silage because *L. casei*-B had the highest ADF. The straw silage process often uses various types of microorganisms. Need further discussion about straw silage and its effects to create silage products that have added value.

CONCLUSION

Food processing industries such as meat, chips, juices, and agricultural industries such as CRS produce a lot of organic residues every year. These various organic residues are better used as products that have added value, such as feed. It can be concluded the use of different feed additives had beneficial effects on the composition of carrot straw silage (CRS) without any negative effect. Moreover, *Lactobacillus casei*-A has a good value on NFE, while *Lactobacillus casei*-B has a good value on OM, CF, EE, NDF, and ADF.

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