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Method of propionic acid–based preservative addition and its effects on nutritive value and fermentation characteristics of wet brewers grains ensiled in the summertime

Philipe Moriel,*†[1,2] PAS, Matheus B. Piccolo,† Luis F. A. Artioli,† Glauber S. Santos,† Matthew H. Poore,† PAS, and Luiz F. Ferraretto,‡[3] PAS

*Mountain Research Station, NC Department of Agriculture, Waynesville, NC 28786; †Department of Animal Science, North Carolina State University, Raleigh 27695; and ‡The William H. Miner Agricultural Research Institute, Chazy, NY 12921

ABSTRACT

This research evaluated nutritional value and DM loss of wet brewers grains (WBG) mixed or top-dressed with a propionic acid–based preservative. On d 0, treatments were randomly assigned to 19-L plastic buckets (6 buckets per treatment) and consisted of WBG without preservative (control), or WBG mixed or top-dressed with a commercial propionic acid–based preservative (Myco Curb; Kemin Industries) at a rate of 1 g/kg of WBG (wet weight). Buckets were individually sealed and stored at ambient temperature with exposure to sunlight and precipitation for 14 or 28 d (3 buckets per treatment for each storage day). On d 14, total DM loss was least for control, greatest for top-dressed, and intermediate for WBG mixed with propionic acid ($P \leq 0.02$). On d 28, total DM loss was similar between methods of propionic acid addition ($P = 0.64$), but both methods were less than the control ($P < 0.0001$). The TDN and NE_m concentrations did not differ ($P \geq 0.32$) between control and WBG mixed with propionic acid, but both were less ($P \leq 0.05$) than WBG top-dressed with propionic acid. Mean lactic:acetic ratio was similar between control and top-dressed WBG ($P = 0.58$), but both were greater than WBG mixed with propionic acid ($P \leq 0.03$). Overall, top-dressing and mixing the propionic-based preservative had similar reduction on total DM loss after 28 d of storage compared with WBG without preservative. However, top-dressing had minimal effects on nutritional value and is less laborious than mixing with WBG.

Key words: ensiling, propionic acid, storage, wet brewers grain

INTRODUCTION

Livestock nutritionists and producers are constantly searching for alternative feed sources that could decrease feed costs. Wet brewers grains (**WBG**) is one of the by-products of brewing commonly used as an alternative feed source for beef and dairy cattle (Preston et al., 1973; Davis et al., 1983; Ojowi et al., 1997). However, the storage of WBG is difficult because of reduced DM concentrations (200 to 300 g/kg), which may lead to undesirable fermentation (Orosz and Davies, 2015). Furthermore, most wet by-products have already lost most of their respiration capacity, leaving most of the oxygen

[1] Corresponding author: pmoriel@ufl.edu or philipemoriel@yahoo.com.br
[2] Present address: Range Cattle Research and Education Center, Institute of Food and Agricultural Sciences, University of Florida, Ona, FL 33865.
[3] Present address: Department of Animal Sciences, University of Florida, Gainesville, FL 32611.

remaining in the silo after sealing to be used by undesirable microorganisms (Orosz and Davies, 2015). These factors combined with the removal of the majority of sugars after malting and mashing processes (Westendorf and Wohlt, 2002) make the process of ensiling WBG for long periods difficult, leading to shortened storage life, offensive odors, and excessive DM loss (Allen and Stevenson, 1975).

Information from the literature shows that the addition of propionic acid to WBG improved fermentation quality and storage life (Allen et al., 1975; Allen and Stevenson, 1975; Schneider et al. 1995; Moriel et al., 2015). Mixing WBG with propionic acid–based preservative, however, may be a limiting factor in small dairy and beef operations, which lack the necessary equipment to obtain a homogenous preservative–WBG mixture. Because the top layer of WBG piles is the most susceptible to deterioration or undesirable fermentation (Allen et al., 1975; Orosz and Davies, 2015), we hypothesized that top-dressing propionic acid would maintain an adequate fermentation pattern in WBG, leading to less DM losses. Hence, the objective of the present study was to evaluate the effects of mixing and top-dressing a propionic acid–based preservative on DM loss, fermentation pattern, and nutritional value of WBG stored for 14 or 28 d.

MATERIALS AND METHODS

Treatments

All procedures for the experiment were conducted from July to August 2015 at the Mountain Research Station (Waynesville, NC; 35.48° N, 82.99° W; elevation = 659 m).

On d 1, a fresh 20,000-kg load of WBG was delivered at the Mountain Research Station and immediately stored in a single plastic silo bag. On d 0, approximately 600 kg of WBG (as-fed basis) was collected and mixed for 5 min using a vertical mixer wagon (Penta TMR Inc., Petrolia, Ontario, Canada) to obtain a uniform mixture before treatment assignment. Treatments were randomly assigned to 19-L plastic buckets (6 buckets per treatment; 18 buckets total) and consisted of WBG with no preservative (control) or WBG that was mixed or top-dressed with a commercial propionic acid–based preservative (Myco Curb; Kemin Industries Inc., Des Moines, IA). This product is a commercial liquid mold inhibitor and surfactant for processed feed ingredients that contains 660 g of total acids/kg of product, including 650 g of propionic acid/kg of total acids, and was mixed or top-dressed into buckets at a rate of 1 g/kg of WBG wet weight based on recommendations of the company. The product contains water, ammonium hydroxide, butylated hydroxytoluene, phosphoric acid, sorbic acid, benzoic acid, propylparaben, methylparaben, and butylated hydroxyanisole (individual ingredient concentrations proprietary by Kemin Industries Inc.). Buckets were sealed immediately after treatments were applied with a white, nonpermeable plastic sheet (HUSKY plastic sheeting, Poly-America, Grand Prairie, TX), and then stored at ambient temperature outdoors where it would have exposure to sunlight and precipitation for 14 or 28 d to simulate on-farm storage practice. Three buckets per treatment were opened after each storage period (14 and 28 d).

Sample Collection and Laboratory Analysis

Three buckets per treatment were unsealed for nonspoiled WBG sample collection at the end of the respective storage period (d 14 or 28). Immediately after removing the seal on d 14 and 28, each bucket was weighed and the top layer of visible spoiled WBG was carefully removed and weighed (as-fed basis). Visible spoilage was characterized by the presence of a darker color and offensive odor compared with nonspoiled WBG. This approach was selected to mimic our recommendation to producers to remove visibly spoiled WBG before feeding, and consequently, avoid potential complications with mycotoxins. Further studies are needed to compare performance of cattle fed spoiled versus nonspoiled WBG before the recommendation of feeding spoiled WBG is advised. Total DM loss was calculated as the sum of DM removed due to spoilage and resulting nonspoiled DM material obtained on d 14 or 28 divided by the total initial DM included in each bucket on d 0. After removal of spoiled WBG, each bucket was emptied and the remaining nonspoiled WBG was weighed and hand mixed for 1 min before collecting 2 samples of approximately 200 g of wet weight each. Each sample was immediately placed into sealed freezer bags and stored at −80°C until laboratory analyses.

All WBG samples were sent frozen and in duplicate to a commercial laboratory (Dairy One Forage Laboratory, Ithaca, NY) for chemical analysis of nutrient composition and concentrations of VFA. All WBG samples were analyzed for concentrations of CP (method 990.03; AOAC International, 2012), ammonia CP-equivalent (Liu, 1998), ADF (method 973.18 modified for use in an Ankom 200 fiber analyzer; Ankom Technology Corp., Fairport, NY; AOAC International, 2012), NDF (Van Soest et al., 1991; modified for use in an Ankom 200 fiber analyzer; Ankom Technology Corp.), and pH (method 973.41; AOAC International, 2012). Concentrations of TDN were calculated using equations developed by Weiss et al. (1992).

Concentrations of VFA (acetic, propionic, butyric, and *iso*-butyric acids) were determined by gas chromatography separation (Bulletin 749F; Supelco, 1975). First, 50 g of samples was blended at 479 × *g* for 2 min in 750 mL of deionized water, filtered through 4 layers of cheesecloth, and then filtered through a disposable syringe filter. Thereafter, an aliquot of extract was mixed 1:1 with 0.06 *M* oxalic acid containing 100 mg/kg of trimethylacetic acid before being injected into a gas chromatograph (Perkin Elmer Autosystem XL Gas Chromatograph, Waltham, MA).