Effect of Moisture Addition on Fermentation of High Moisture Corn

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Story in Brief

High moisture corn harvested at 21 to 33 percent moisture was ensiled following addition of various amounts of water and fermented for 60 days. With greater moisture, solubility of protein increased and pH decreased. Whether moisture was present in the grain at harvest or added to the ground grain prior to fermentation did not influence pH, protein solubility, starch content or availability. Results indicate that when corn grain harvested as dry as 21 percent moisture is rewetted to 30 percent moisture prior to fermentation, it possesses all the chemical properties of grain harvested at 30 percent moisture.

Introduction

During the last 20-24 years, ensiling corn and sorghum grain has become popular. High moisture corn harvested and stored at 20 to 24 percent moisture is markedly inferior in digestibility and feed efficiency to corn harvested at 28 to 30 percent moisture. Unfortunately, it is impossible to harvest all the grain at the ideal moisture level, although water often can be added to grain at ensiling time to increase moisture content. The purpose of this study was to determine if water addition to drier grain prior to fermentation would cause the dry corn to ensile similarly to grain harvested at a higher moisture level.

Materials and Methods

Samples of corn grain from the Southern High Plains, upon delivery of truckloads to one feedlot in Garden City, Kansas, was subdivided by moisture content and compiled to form seven different moisture levels: 21, 23, 25, 27, 29, 31, and 33 percent. Each of these samples was ground and reconstituted with water to form all possible final moisture levels for fermentation at 25, 27.5, 30, 32.5 and 35 percent moisture. Each sample was placed in a plastic bag and stored anaerobically at 102°F for 60 days of fermentation. Initial frozen samples and final samples were analyzed for pH, dry matter, total protein, soluble protein, starch, and available starch (not gelatinized prior to adding amylase). Available starch should be an index of the amount of carbohydrate which is soluble and not bound in particles which limit attack by ruminal microbes.

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Results and Discussion

All the variables were found to be related to final, not initial dry matter content of the corn grain. Plots (Figures 1, 2 and 3) show these relationships. In Figure 1, the relationship of pH and dry matter is shown. The final pH was reduced with added water or higher moisture in the grain. This probably is due to dilution of acid permitting more lactic acid to be produced which causes pH to decline (Thornton et al., 1977). For every 1 percent added moisture, pH decreased a mean of .06 units. Figure 2 shows that as grain moisture increased, the percent of total protein which was soluble increased. For every 1 percent increase in final moisture content, percent of protein which was soluble increased by 1.9 percent.

Available starch as percent of total starch (Figure 3) also tended to increase as the amount of water in the corn to be fermented increased. This trend would support the finding of increased starch digestibility for wetter high moisture corn.

Results indicate that final, not harvest moisture level, alters fermentation of corn grain. All chemical properties of ground grain reconstituted from as low as 21 percent moisture were similar to corn harvested at higher moisture levels. Animal experiments are needed to examine changes with moisture levels on feed intake, site of digestion and efficiency of utilization.

Literature Cited

Thornton, J.H. et al. 1977. Okla. Agr. Expt. Sta. MP-101:56.

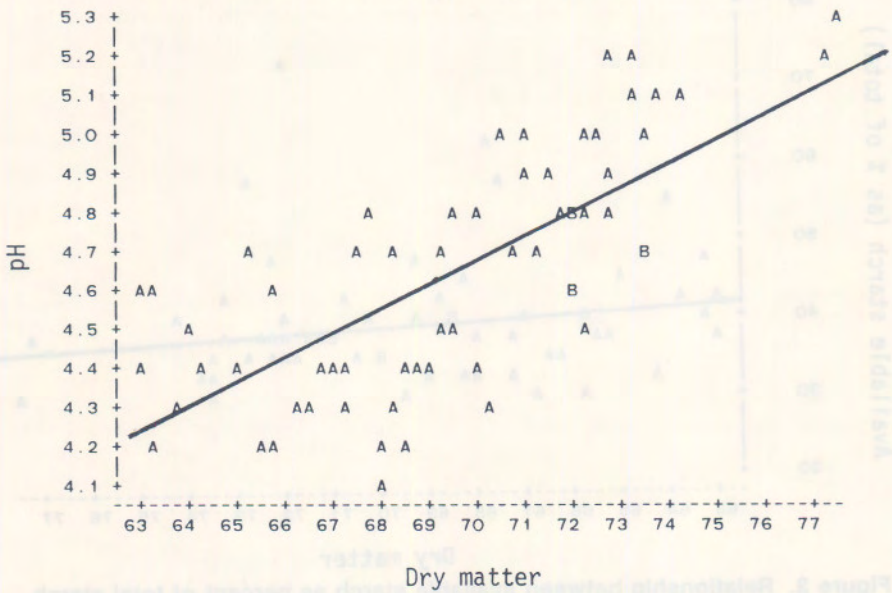

Figure 1. Relationship between pH and dry matter

$Y = .179 + .064\ X$ $N = 62$ $R^2 = .538$ $SE_{yx} = .008$

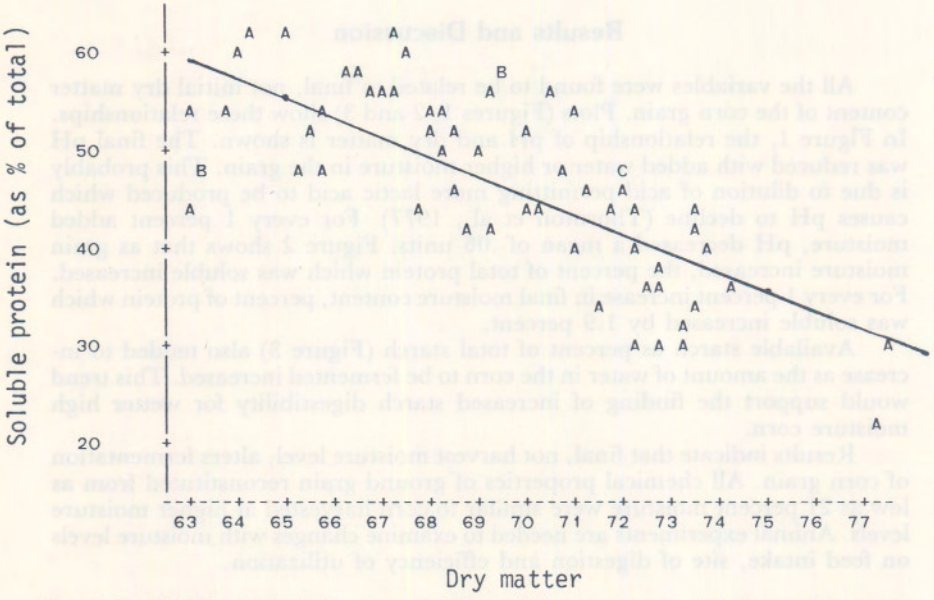

Figure 2. Relationship between soluble protein as percent of total protein and dry matter.

$Y = 180.981 - 1.930X$ $N = 62$ $R^2 = .520$ $SE_{yx} = .239$

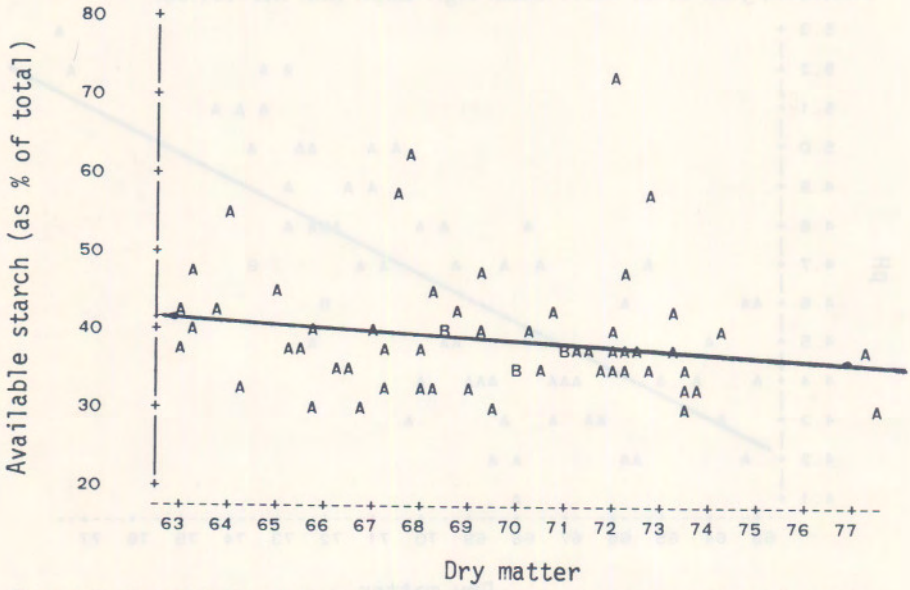

Figure 3. Relationship between available starch as percent of total starch and dry matter.

$Y = 61.424 - .320X$ $N = 60$ $R^2 = .019$ $SE_{yx} = .299$