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## Technical Literature

# Efficacy of Silage SAVOR<sup>®</sup> Plus<sub>brand</sub> Silage Preservative in the Fermentation of Whole-plant Corn Silage

### Introduction

When silage producers consider the use of a silage additive, they must first understand the differences between the different kinds of silage additives available to them. There are two basic types of silage additives used in the production of high quality silage – bacterial inoculants and organic acid based preservatives.

Bacterial inoculants provide supplemental acid-producing bacteria to the silage to assist in fermentation. In silage fermentation, lactic acid is the primary organic acid that helps reduce the pH in the silage. Therefore, most commercial silage inoculants contain lactic acid-producing bacteria. Although many species of lactic acid producing bacteria exist, *Lactobacillus plantarum* is the most commonly used in commercially available bacterial inoculants. While *Lactobacillus plantarum* silage inoculants assist in the fermentation phase of silage production, they have an inherent inability to provide aerobic stability when oxygen is introduced to the silage (Muck and Kung, 1997). Some test work has shown that the use of *L. buchneri*, another lactic acid-producing species, will provide aerobic stability (Kung and Ranjit, 2001).

Organic acid based preservatives function differently than bacterial inoculants. Addition of organic acid preservatives assists silage fermentation by providing an environment that is optimal for epiphytic lactic acid producing bacteria to grow. Then, as these naturally occurring bacteria grow, the result is a drop in silage pH to provide stable silage.

The objective of this experiment was to evaluate and compare the effects of Silage SAVOR<sup>®</sup> Plus<sub>brand</sub> silage preservative from Kemin Americas and a bacterial inoculant on the fermentation and aerobic stability of whole-plant corn silage under ideal silage fermentation conditions.

### Experimental Procedures

Whole-plant corn silage was harvested in mid-September at approximately 55% dry matter, as determined by moisture probe. Treatments were 1) untreated silage, 2) 1 lb/ton of Silage SAVOR<sup>®</sup> Plus<sub>brand</sub> silage preservative and 3) An inoculant comprised of commercially available *L. plantarum* and *L. buchneri* used according to the manufacturer's recommendation.

Immediately after harvest, the silage treatments were applied and the silage was packed by a hydraulic press into laboratory mini-silos in triplicate for each pre-assigned time period (1, 3, 7, 14, and 44 days). For the final time period, 4 mini-silos were used. A sample was collected of the untreated silage for analyses of day 0. The sample was sent to an independent laboratory for wet chemistry analysis of crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), acid detergent insoluble crude protein (ADICP), protein solubility, total digestible nutrients (TDN), and net energy of lactation (NEL) (Table 1).

**Table 1.** Initial nutrient composition of and microbial counts in the whole-plant corn forage.

Component	%
DM, %	47.93
CP, %	8.43
ADF, %	17.60
NDF, %	32.31
TDN, %	74.25
NE <sub>L</sub> , Mcal/kg	1.70
Protein Solubility, %	14.03
ADICP, %	.80
Mold Count, cfu/g	17.6 × 10 <sup>6</sup>
Yeast Count, cfu/g	16 × 10 <sup>5</sup>

All replicate mini-silos were opened on days 1, 3, 7, and 14, temperature of the silage was recorded, and sub samples from each replicate were stored in a refrigerator until pH determination. The pH was determined in a 10% (silage fresh weight/volume) solution after a 2 hour-equilibration period.

On day 44, the four mini-silos for each treatment were opened. A representative sample was collected from each replicate and sent to an independent laboratory for analysis. Samples were analyzed as stated previously and by wet chemistry for fermentation characteristics.

To measure aerobic stability, the four mini-silos for each treatment were reconstituted into two replicates that were placed in foam coolers and covered with cheesecloth. A data-logger temperature probe (IQ Temp-XT, Computerboards, Inc.), measuring silage temperature and ambient temperature was placed in each replicate. Temperature was measured every 2 minutes and averaged every 2 hours. Aerobic instability was declared when silage temperature was consistently 2° C above ambient temperature (Moran et al., 1996).

## Results and Discussion

The silage pH over time is shown in Table 2. By day 14, samples treated with Silage SAVOR Plus silage preservative and with the inoculant had a significantly lower ( $P < .05$ ) pH than the untreated corn silage. The lower pH at this time point demonstrates that the treated corn silage had a faster rate of pH drop than the untreated corn silage. This increased rate of pH drop means the treated silage reached a stable condition sooner than the untreated corn silage. Therefore, reduced dry matter loss should be expected due to plant cell respiration, as should potentially less microbial growth. At day 44 of ensiling, the inoculated silage had the highest ( $P < .05$ ) pH of all treatments.

**Table 2.** Corn silage pH over the 44 day ensiling period.

Day	Untreated	Silage SAVOR Plus	Inoculant	SE
1	4.13	4.18	4.18	.04
3	3.89	3.83	3.90	.03
7	3.64	3.70	3.71	.02
14	4.06 <sup>b</sup>	3.96 <sup>a</sup>	3.98 <sup>a</sup>	.01
44	3.88 <sup>a</sup>	3.80 <sup>a</sup>	4.00 <sup>b</sup>	.04

<sup>a,b</sup>Means with in the same row differ ( $P < .05$ ).

There was no significant difference in nutrient composition on treated vs. untreated silage (Table 3). However, corn silage treated with Silage SAVOR Plus silage preservative had numerically higher protein solubility. This increase in protein solubility should result in greater protein digestion. In addition, silage treated with Silage SAVOR Plus silage preservative had numerically the lowest ADICP. The ADICP is a result of heating and thus is an estimate of bound protein caused by Maillard (browning) reactions. Therefore, the lower ADICP percentage suggests improved protein availability.

**Table 3.** Nutrient composition of whole-plant corn silage after 44 days of ensiling.

Item	Untreated	Silage SAVOR Plus	Inoculant	SE
DM, %	52.83	53.25	53.01	.85
Crude Protein, %	8.60	8.57	8.75	.15
ADF, %	17.72	19.39	19.99	1.20
NDF, %	33.37	34.80	35.38	1.82
TDN, %	75.56	74.85	73.42	1.02
NE <sub>L</sub> , Mcal/100 lbs	78.70	77.91	76.31	1.14
Protein Solubility, %	15.24	18.69	13.71	4.14
ADICP, %	.72	.56	.67	.06

Silage SAVOR Plus silage preservative resulted in a 3.5% improvement in dry matter recovery over untreated corn silage and was much favorable to the inoculated silage which had a 4.7% decrease in dry matter recovery when compared to untreated silage (Table 4). Therefore, in this trial, the silage treated with Silage SAVOR Plus silage preservative had an 8.2% improvement in dry matter recovery compared to the inoculated corn silage. Consistent with the lower acid content, the

corn silage pH was highest ( $P < .05$ ) for the inoculated corn silage and lowest with the Silage Savor Plus silage preservative treatment. Lactic acid percentage tended to be improved by 11.3% over untreated and 12.7% over inoculated silage when Silage SAVOR Plus silage preservative was used.

**Table 4.** Fermentation profile of whole-plant corn silage after 44 days of ensiling.

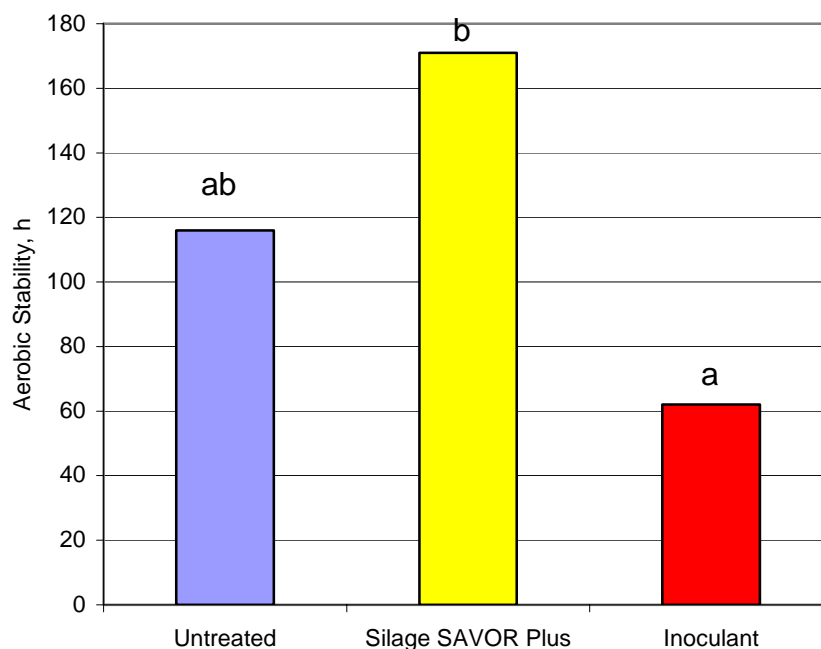
Item	Untreated	Silage SAVOR Plus	Inoculant	SE
Dry matter recovery, % of untreated	-	+3.5	-4.7	-
PH	3.88 <sup>a</sup>	3.80 <sup>a</sup>	4.00 <sup>b</sup>	.04
Lactic Acid, %	2.48	2.76	2.45	.15
Acetic Acid, %	.52 <sup>b</sup>	.56 <sup>b</sup>	.35 <sup>a</sup>	.05
Propionic Acid, %	< .01	< .01	< .01	-
Butyric Acid, %	< .01	< .01	< .01	-
Total Acids, %	3.00	3.32	2.80	.18
Lactic Acid, % Total Acids	82.8	83.2	87.7	1.01

The microbial counts of the silage are presented in Table 5. Mold counts in this silage were low and not different amongst treatments. In contrast, yeast counts were high and approaching or exceeding concern levels. Yeast counts were reduced for the Silage SAVOR Plus treated silage by one log (compared to control) or two logs (compared to the inoculant). This reduction in yeast counts, combined with the increase in acetic acid described above, should result in more stable silage after the silo is opened and exposed to oxygen (aerobic stability) for the Silage SAVOR Plus treated silage.

**Table 5.** Mold and yeast counts of whole-plant corn silage after 44 days of ensiling

Item	Untreated	Silage SAVOR Plus	Inoculant
Mold, cfu/g	$1.3 \times 10^3$	$2.0 \times 10^3$	$2.5 \times 10^3$
Yeast, cfu/g	$5.7 \times 10^6$	$2.5 \times 10^5$	$1.6 \times 10^7$

Aerobic stability results, assessed after 44 days of ensiling, are presented in Figure 2. The corn silage treated with Silage SAVOR Plus silage preservative resulted in 55 hours improvement in aerobic stability over the untreated corn silage and 109 hours over the inoculated silage. This significant improvement in stability should result in less microbial growth and dry matter loss between feed out times of the corn silage.



**Figure 2.** Aerobic stability of whole-plant corn silage after 44 days of ensiling.

When Silage SAVOR Plus silage preservative was used, aerobic stability was improved 55 hours over untreated and 109 hours over corn silage inoculated with *L. buchneri*. These results are consistent with expectations due to the numerically higher yeast counts in the inoculant treated silage compared to Silage SAVOR Plus silage preservative and the untreated control, and to the higher acetic acid levels in the Silage SAVOR Plus silage preservative treated silage. When evaluating the use of Silage SAVOR Plus silage preservative and an inoculant containing *L. buchneri* at recommended application rates, corn silage pH was decreased more rapidly with Silage SAVOR Plus silage preservative. In addition, the use of the inoculant resulted in a higher final pH than the untreated corn silage. Furthermore, lactic acid, acetic acid and total acids levels were higher for the silage treated with Silage SAVOR Plus silage preservative than with the inoculated or untreated silage.

The more extensive and consistent packing with a hydraulic press used in this experiment should result in optimal silage fermentation conditions and may result in less distinct differences in silage fermentation characteristics than under packing conditions and density in field situations. Kemin Americas, Inc., research has shown that more distinct differences are seen in silage fermentation characteristics of treated silage if packing density is more representative of field conditions than under packing densities seen with a hydraulic press. Even when silage management is very good, as in this experimental situation, Silage SAVOR Plus silage preservative demonstrated improvements in fermentation, dry matter recovery, and aerobic stability. Therefore, even when Silage SAVOR Plus silage preservative is used in the field and conditions are not always optimal, a producer should observe dramatic improvements in silage quality and stability.

## References

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