Southeast Dairy Producer's Check-Off Program

Research Summary

Nutritive value and fermentation characteristics of cool-season grasses and whole-plant sorghum silage used in the Southeast

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Objective

This study evaluated the effects of harvest maturity, microbial inoculation, and ensiling duration on the nutritive value and fermentation characteristics of four sorghum hybrids under warm, humid conditions. Results demonstrated that microbial inoculation significantly improved aerobic stability and fermentation quality at both 30 and 90 days of ensiling, primarily by increasing acetic acid concentration and reducing yeast counts. Harvesting at approximately 30% dry matter optimized fermentation outcomes. While hybrid-specific responses were noted, the combined strategy of timely harvest and inoculant use showed strong potential to enhance silage preservation and reduce spoilage, offering practical recommendations for forage-based livestock systems in the southeastern U.S.

Methods

Four sorghum hybrids (H1, H2, H4, H5) were grown in replicated plots and harvested at two stages of maturity (low~30% Dry matter and high ~37 % dry matter). Forages were ensiled with or without a microbial inoculant containing Lactobacillus buchneri and Lactococcus lactis (150,000 cfu/g at 30 mL/kg). A total of 128 mini silos were prepared in a 2 × 4 × 2 × 2 factorial arrangement (maturity × hybrid × inoculant × ensiling duration: 30 or 90 days), with four replicates per treatment. Silages were analyzed for dry matter recovery, fermentation profile, aerobic stability, and microbial counts. Data was analyzed using the MIXED procedure of SAS.

Results

At Day 30, microbial inoculation reduced yeast counts (5.40 vs. 1.28 log CFU; $P < 0.0001$), increased acetic acid concentration (1.87% vs. 4.20% DM; $P < 0.0001$), and improved aerobic stability (118 vs. 293 h; $P < 0.0001$). No significant interactions were detected for these variables. Fermentation pH was influenced by an interaction between hybrid and maturity ($P = 0.0001$), and lactic acid concentration was affected by an interaction between hybrid and treatment ($P = 0.04$).
At Day 90, yeast and water-soluble carbohydrate concentrations were influenced by hybrid × maturity interactions ($P = 0.01$). Acetic acid concentration (1.46% vs. 4.30% DM; $P < 0.0001$) and aerobic stability (62 vs. 317 h; $P < 0.0001$) were greater in inoculated silages, although aerobic

Table 1. Microbial count,fermentation profile and chemical compositon of Sorghum hybrids after ensiling for 30 days with or without inoculant

	Sorghum Hybrids				Microbial Inoculation		Maturity			P-values					
Item	Opal	Pearl	Supersile30	Fivestar	CON	INOC	High	Low	SEM	Hybrids	INOC	Maturity	Hbd*Mat	Hbd*Trt	Mat*Trt
DM%	28.05	31.28	29.41	30.81	30.42	29.35	31.93	27.84	0.33	<.0001	0.01	<.0001	<.0001	0.8009	0.4774
Yeast (log CFU)	3.59	3.98	2.82	2.60	5.40	1.28	2.82	3.86	0.34	0.01	<.0001	0.00	0.03	0.37	0.10
LacBact (log CFU)	8.16	8.03	8.47	8.43	7.49	9.06	8.53	8.01	0.11	0.06	<.0001	0.00	0.03	0.24	0.63
LacticAc %DM	10.56	8.63	9.40	9.15	9.10	9.77	11.16	7.71	0.52	0.15	0.27	<.0001	0.04	0.15	0.43
AceticAc %DM	3.41	3.01	2.84	2.88	1.87	4.20	3.39	2.68	0.19	0.23	<.0001	0.00	0.16	0.84	0.42
ButyricAc %DM	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.27	0.05	0.15	0.36	0.27	0.16
T. OrgAc %DM	13.98	11.64	12.24	12.03	10.98	13.97	10.39	14.55	0.64	0.13	0.00	<.0001	0.06	0.21	0.37
pH	3.75	3.93	3.92	3.84	3.83	3.88	4.04	3.68	0.02	<.0001	0.07	<.0001	0.00	0.05	0.26
AerStaHo (Hours)	176	162	256	229	118	293	216	195.56	17.32	0.00	<.0001	0.27	0.27	0.30	
CP %DM	6.22	5.65	5.76	8.19	6.88	6.03	5.62	7.28	0.78	0.18	0.35	0.07	0.55	0.31	0.14
NDF %DM	49.98	48.26	49.32	52.98	48.75	51.51	49.32	50.97	1.69	0.36	0.40	0.16	0.04	0.33	0.37
WSC %DM	2.27	1.83	1.93	3.25	3.03	1.60	2.11	2.53	0.20	0.00	<.0001	0.07	0.13	0.17	0.55
ASH% %DM	3.09	3.73	4.07	3.47	3.66	3.52	3.75	3.43	0.13	0.00	0.32	0.03	0.49	0.42	0.03
OM% %DM	96.92	96.27	95.93	96.53	96.34	96.48	96.25	96.57	0.13	0.00	0.32	0.03	0.49	0.42	0.03

Table 2. Microbial count,fermentation profile and chemical compositon of Sorghum hybrids after ensiling for 90 days with or without inoculant

	Sorghum Hybrids				Microbial Inoculation		Maturity			P-Value					
Item	Opal	Pearl	Supersile30	Fivestar	CON	INOC	High	Low	SEM	Hybrids	INOC	Maturity	Hbd*Mat	Hbd*Trt	Mat*Trt
DM%	26.54	29.90	29.06	32.51	30.48	28.52	31.51	27.49	0.33	<0.0001	0.00	<0.0001	<0.0001	0.0138	0.0735
Yeast (log CFU)	2.64	2.56	1.96	2.80	4.99	0.01	2.52	2.46	0.28	0.25	<0.0001	0.85	0.01	0.22	0.80
LacBact (log CFU)	7.93	7.51	7.29	7.27	6.75	8.25	7.57	7.44	0.11	0.19	<0.0001	0.58	0.91	0.09	0.58
LacticAc %DM	6.12	4.49	4.59	6.22	6.58	4.13	5.74	4.97	0.55	0.10	0.00	0.23	0.55	0.07	0.7465
AceticAc %DM	2.73	3.34	2.32	3.31	1.46	4.30	3.18	2.58	0.19	0.10	<0.0001	0.05	0.37	0.50	0.54
ButyricAc %DM	0.05	0.06	0.07	0.05	0.12	0.00	0.07	0.04	0.01	0.87	<0.0001	0.20	0.52	0.88	0.19
T. OrgAc %DM	8.90	7.90	6.97	8.84	8.16	8.15	8.72	7.59	0.64	0.14	0.99	0.09	0.17	0.17	0.90
pH	3.96	4.04	4.12	3.92	3.98	4.04	4.08	3.94	0.02	0.00	0.13	0.00	0.26	0.01	0.83
AerStaHo (Hours)	170	177	204	204	62	317	189	190	17.32	0.00	<0.0001	0.91	0.59	0.00	1.00
CP %DM	6.13	5.71	5.75	6.65	6.10	6.02	5.77	6.35	0.78	0.00	0.59	0.00	0.04	0.28	0.13
NDF %DM	50.72	48.34	47.00	51.86	50.35	48.61	49.53	49.42	1.01	0.01	0.11	0.92	0.01	0.08	0.78
WSC %DM	1.41	1.11	1.78	2.53	2.08	1.34	1.58	1.83	0.19	0.00	0.00	0.25	0.04	0.01	0.51
ASH% %DM	3.22	3.49	4.04	4.06	3.64	3.77	3.68	3.73	0.13	<0.0001	0.73	0.30	0.22	0.01	0.01
OM% %DM	96.78	96.51	95.96	95.94	96.36	96.23	96.32	96.27	0.13	<0.0001	0.30	0.73	0.22	0.01	0.01

Implications

This study supports the use of microbial inoculants to enhance the aerobic stability of sorghum silage, particularly in warm and humid climate. Inoculant use improved silage stability at both 30 and 90 days of fermentation, although some hybrid-specific responses were observed. Harvesting sorghum at approximately 30% dry matter promoted more favorable fermentation conditions. Moreover, combining microbial inoculants with timely harvest may enhance silage preservation and reduce spoilage in forage-based livestock systems. Overall, the findings of this experiment help producers make more informed decisions about hybrid choice and harvest timing to achieve a better balance between forage yield and silage preservation

References of Published Work

Poster and paper submission to XIX International Silage Conference (ISC), August 8-10, 2023 Beijing, China. Title: Evaluating the effects of maturity at harvest, microbial inoculation, and ensiling durations on nutritive value, and fermentation characteristics of sorghum hybrids.