THE EFFECT OF VARIOUS ADDITIVES ON LACTIC ACID PRODUCTION IN ENSILED SORGHUM (SORGHUM VULGARE)[1]

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Sorghum (variety Rio) harvested after 89 days was chopped and ensiled for 30 days in 3 kg laboratory silos with the following additives: (A) no addition, (B) 3.8% molasses, (C) 0.9% urea, (D) 0.9% urea, 0.4% calcium hydroxide, (E) 0.9% urea and 3.8% molasses, (F) 0.61 urea and 0.178 ammonia, (G) 0.51% ammonia. Dry matter losses for all treatments were less than 10% and final pH was between 3.0 and 4.0. Addition of molasses alone, urea with calcium hydroxide, and ammonia all led to large increases of lactic acid production over the control with no additives.

Key words: Sweet sorghum, silage, lactic acid

Sorghum, due to its resistance to drought and disease, is an attractive forage crop for many tropical and subtropical areas. Because of its high sugar content it is also readily ensiled for dry season feeding.

Silage quality seems to be related to lactic acid content (Klosterman et al 1960) and a number of additives including urea (Essig 1968), calcium carbonate (Klosterman et al 1960) and ammonia (Henderson Huber and Purser 1973) have been used to increase the lactate content of maize silage. Additional readily fermentable carbohydrates in the form of molasses may also be expected to favour rapid fermentation and lactic acid production (Klosterman et al 1960).

In the present experiment comparisons of various additives were made singly and in combination in promoting lactate formation in sorghum silage.

Sweet sorghum (var Rio), was harvested after 89 days and chopped finely in a high speed forage cutter. Four 3 kg quantities for each treatment of chopped

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sorghum with and without additions (table 1) were mixed rapidly and compacted manually in plastic bags before sealing tightly.

Two replicates for each treatment were analysed immediately, the remaining two being left at ambient temperature (30°) for 30 days. Measurements of pH (by potentiometer) and of Brix (by refractometry) were determined on liquid expressed from the silage material under pressure. Samples for lactate determination were prepared from 25 g silage, 2.5 ml of saturated mercuric chloride and 22.5 ml distilled water, and stored at - 15° before analysis by gas chromatography on 150 x 0.2 cm columns of LAC - AIR 296 (15%) on Chromosorb W in a Carle AGC-311 chromatograph (flow rate of H2 carrier gas 25 ml/min, thermal conductivity detection at attenuation X-8).

Table 1:
Composition of silages (fresh weight basis)

Treatment		Sorghum (fresh basis)	Urea	NH_4OH[1]	Molasses	$Ca(OH)_2$	H_2O
Control	A	100	-	-	-	-	-
Molasses	B	96.0	-	-	4.0	-	-
Urea	C	97.6	.9	-	-	-	I.5
Urea/molasses	D	93.6	.9	-	4.0	-	I.5
Urea/lime	E	97.2	.9	-	-	0.4	I.5
NH_3/urea	F	94.4	.45	.50	4.0	-	0.65
NH_3	G	44.5	-	1.50	4.0	-	-

[1] Contains 230g NH_3/litre

Results and Discussion

Changes in DM due to ensiling were all less than 10%. The presence of molasses appeared to dismiss DM loss while the highest DM losses were associated with urea, ammonia and ammonia plus additives (figure 1). Brix readings on the silages did not show large changes due to ensiling suggesting that fermentation products, were largely compensating for disappearing sugars in this measurement (figure 2).

Urea did not change lactate formation, the value with urea as additive not being significantly different from the control and that for urea/molasses being the same as the treatment with molasses alone (figure 3). These urea treatments had highest final pH.

Figure 1 :
Percent dry matter in sweet sorghum silages with different additives at days 0 and 30

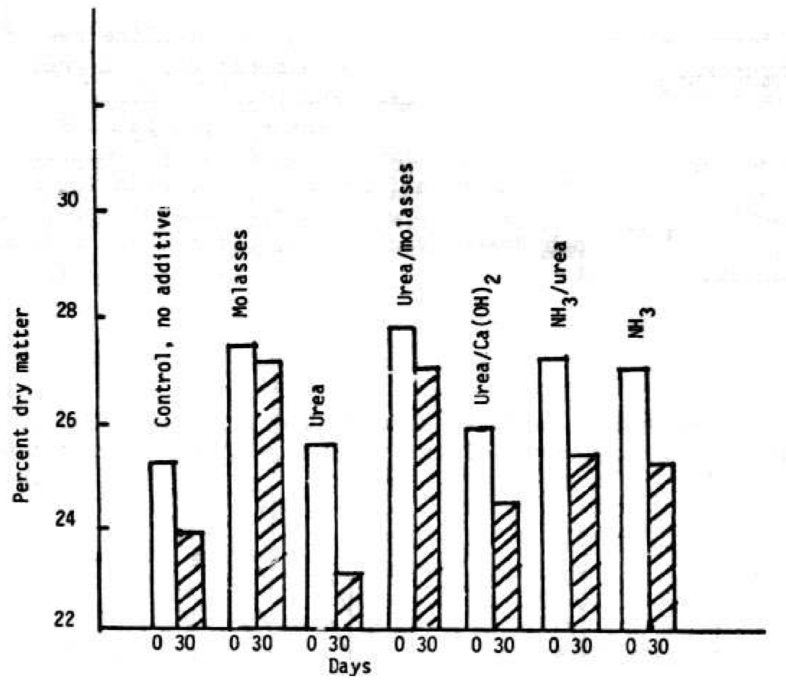
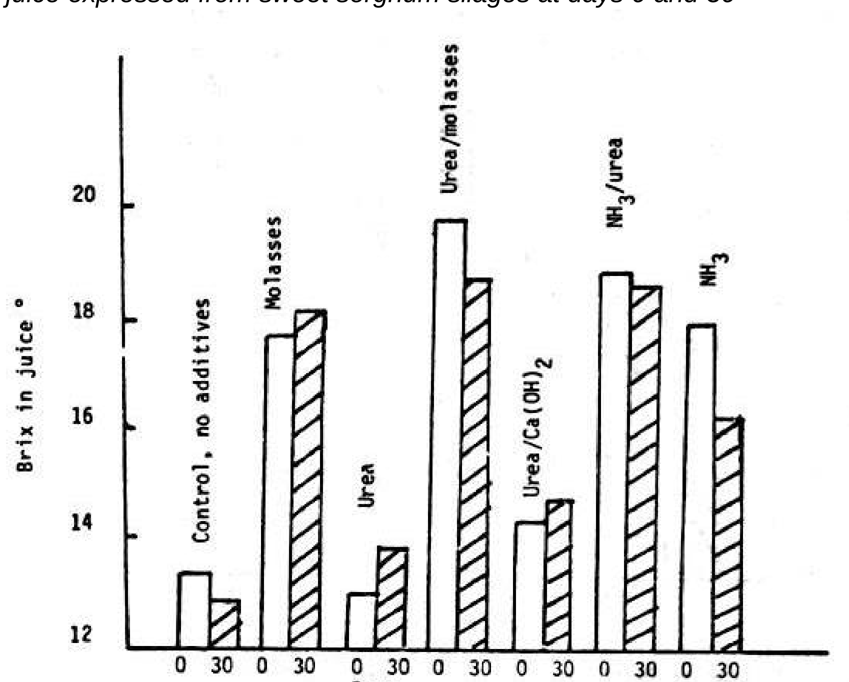
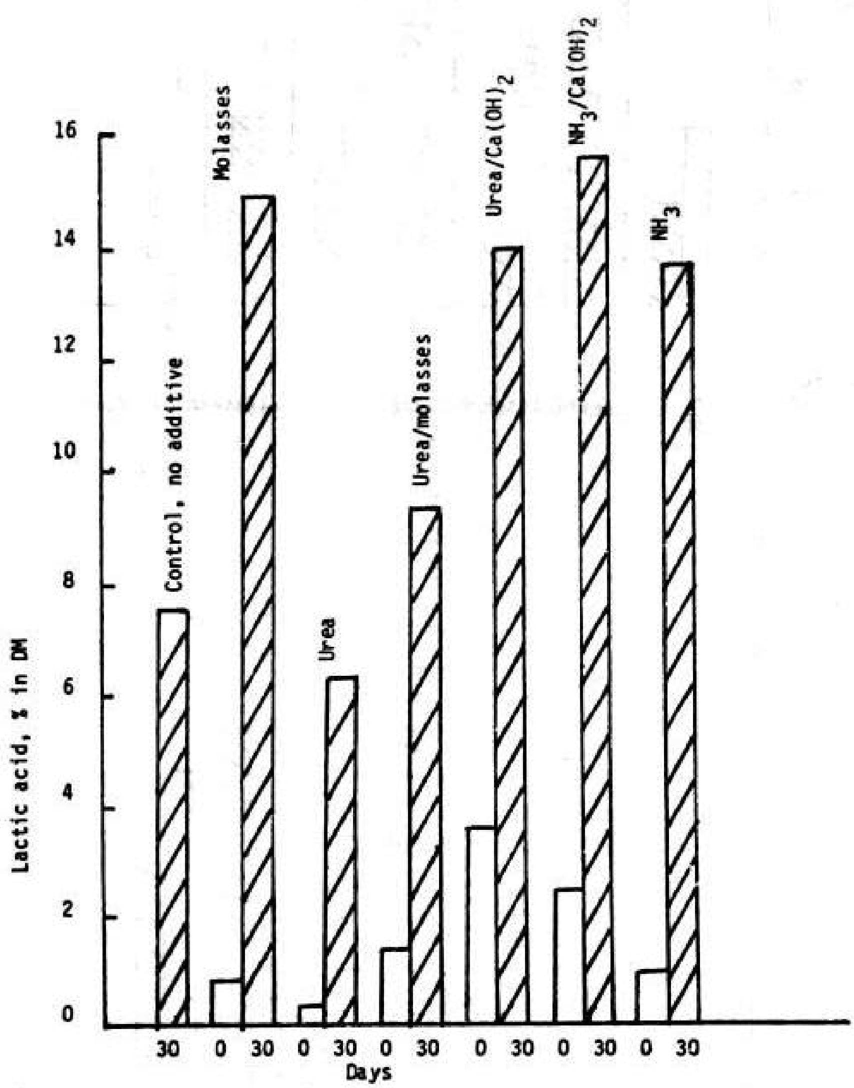


Figure 2 :
Brix value in juice expressed from sweet sorghum silages at days 0 and 30



The fermentations which started off in the alkaline region with calcium hydroxide urea, ammonia/urea or ammonia all had greatly increased lactate formation. Moreover, each of these fermentations reached pH values below 4.0. In the molasses fermentations, despite the increase in lactate over the control, the final pH was higher suggesting an appreciable buffering effect due to salts in the molasses. It would appear from the results presented that lactate production was not limited by carbohydrate availability but rather by the buffering capacity present.

Figure 3:
Concentration of lactic acid in ensiled sweet sorghum (% in DM)



The values for lactic acid reported here for the sorghum silage without additives are similar to those reported by Klosterman et al (1960) and Henderson et al (1971) for corn silages. The values for calcium hydroxide treated silages are similar to those reported by Klosterman et al (1960) but the ammonia treated silages have higher values than those reported by Henderson et al (1971) probably due to the fact that in the present experiment the levels of ammonia used were some three times higher.

Conclusions

It is concluded that high lactate silages can be readily made from sweet sorghum using molasses, calcium hydroxide or ammonia as additives.

References

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