The effect of neutralising formic acid on fermentation of fresh and wilted grass silage

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Keywords: grass silage, additive, formic acid, ammonium formate

Introduction Rapid drop in pH is essential for minimising proteolysis and successful ensiling. Use of acid additives typically reduces protein degradation and restricts fermentation. The effects of acid additive depend on application rate and type of herbage. Corrosiveness and risks in handling formic acid (FA) can be reduced by using salts of FA like ammonium formate (AF). Increasing proportions of AF replacing FA were applied into grass at two dry matter (DM) contents to evaluate the effects of neutralised FA on silage pH and fermentation.

Materials and methods First cut timothy-meadow fescue grass was wilted for 1.5 (Fresh) or 21 h (Wilted) prior to chopping and ensiling in mini silos (120 ml). Herbage DM was 210 and 406 g/kg, crude protein 172 and 180 g/kg DM, and water soluble carbohydrates (WSC) 151 and 137 g/kg DM for Fresh and Wilted, respectively. Six additive treatments consisted of untreated (UT), and AF:FA (w:w %) 0:85 (AF0); 10:75 (AF10); 20:65 (AF20); 30:55 (AF30) and 40:45 (AF40). In addition, all contained 15% water. The application rate was 6 g/kg grass. Two silos per treatment were opened after 1, 3, 7, 21 and 97 days of ensiling. The data were tested for each DM separately with a GLM model using SAS. Sum of squares for treatment effect was further separated using orthogonal contrast into single degree of freedom comparisons.

Results The increasing proportion of AF affected the drop in pH at the beginning of ensiling (Figure 1). Still, pH was lower with all AFs compared to UT. In Fresh UT pH dropped below that of AFs between days 3 and 7 while in Wilted UT pH remained higher than in AFs until day 97 (Table 1). The fermentation quality of all silages, including UT, in either DM was good. Based on ammonia-N (NH_3-N, g/kg N), after subtracting the amount applied in additive, all AFs restricted proteolysis compared to UT.

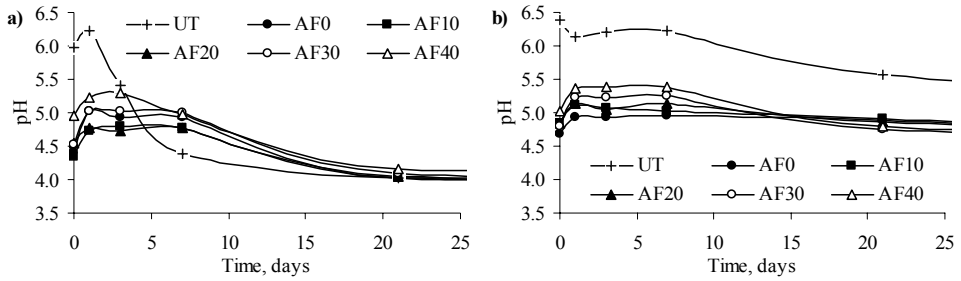

Figure 1 Effect of additives on silage pH at the beginning of ensiling in (a) Fresh and (b) Wilted grass silage

Table 1 Effect of additives on silage quality after 97 days of ensiling. For NH_3-N: a analysed, b analysed-added

	Treatment							Statistical significance				
FRESH	UT	AF0	AF10	AF20	AF30	AF40	SEM	UT vs AF	AF lin	AF quad	AF cub	AF quar
pH	4.03	4.07	4.00	4.04	4.08	4.16	0.008	***	***	***	*	
WSC (g/kg DM)	17	25	27	26	27	21	1.0	***	*	**		
Lact.acid (g/kg DM)	121	71	66	71	71	91	1.1	***	***	***	*	**
VFA (g/kg DM)	35	25	24	25	24	34	4.4					
NH_3-N (g/kg N) (a)	61	29	35	48	64	95	1.1	***	***	***	*	
NH_3-N (g/kg N) (b)	61	29	15	7	4	11	1.5	***	***	***		
WILTED												
pH	4.46	4.20	4.27	4.25	4.23	4.27	0.015	***			*	
WSC (g/kg DM)	15	32	39	35	22	19	3.9	**	*			
Lact.acid (g/kg DM)	69	54	50	56	57	62	2.9	**	*			
VFA (g/kg DM)	17	16	16	16	17	18	0.5					
NH_3-N (g/kg N) (a)	29	17	24	33	43	49	1.4		***			
NH_3-N (g/kg N) (b)	29	17	15	13	13	9	1.6	***	**			

Conclusions In this experiment silage quality was not compromised by replacing a part of FA with AF. Only the highest level of AF decreased the restrictive effect of FA on fermentation especially in Fresh silage. Still AF40 restricted fermentation compared with UT when recommended application rate (5 l/t) was used.