Fermentation Quality of Italian Ryegrass (*Lolium multiflorum* Lam.) Silages Treated with Additives

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Introduction It is well documented that addition of FJLB to silages is effective in improving the fermentation quality of silage, and often results in increased LA and reduction of ammonia-N (AN) even when the addition of commercial LAB was ineffective (Ohshima et al., 1997). Woolford (1975) confirmed that sorbic acid had a strong inhibiting effect on the growth of yeast and molds, and was used as an additive to depress the loss of WSC by undesirable organisms during the initial phase of ensiling, to save the WSC for lactic acid bacteria (Shao et al., 2004). Glucose addition compensates the WSC loss caused by the initial plant respiration and undesirable bacteria activity and ensures that sufficient WSC remains at the vigorous stage of LAB growth and produces lactic acid (LA). Encapsulated-glucose might be expected to give slower release rates of glucose into silage mass to coincide with early growth of LAB by providing additional substrate when needed. The objectives of the present study were to evaluate the effects of these additives on the fermentation quality and residual mono-and disaccharides of Italian ryegrass silages.

Materials and methods The silage treatments were as follows: (1) control (no addition), (2) encapsulated-glucose addition at 0.5% for glucose, (3) glucose addition at 1%, (4) sorbic acid addition at 0.1%, (5) FJLB addition at a theoretical application rate of 2.67×10^5 CFU g^{-1}, on a fresh weight basis of Italian ryegrass, respectively. All silos were opened after 30 days of storage.

Results The improvement in fermentation quality with additives was ranked in the following order: treatment with FJLB>sorbic acid>glucose> encapsulated-glucose>control. This suggested that adding a number of species of domestic LABs (FJLB) and an aerobic bacteria inhibiter (sorbic acid) to plant materials such as Italian ryegrass, which contained almost sufficient amounts of WSC but low DM content and a low population of epiphytic LAB in the present case, are more important and efficient than adding fermentable substrates (glucose and encapsulated-glucose) for improving the fermentation quality of the silage.

Table 1 *Chemical composition of Italian rygrass silages treated with some additives.*

Item	Treatments				
	Control	Encapsulated -0.5% glucose	Glucose (1%)	Sorbic acid (0.1%)	FJLB
pH (SD)	4.38 (0.06)[c]	4.17 (0.13)[bc]	4.00 (0.20)[b]	4.05 (0.15)[b]	3.59 (0.01)[a]
DM (SD) (g kg^{-1})	154.90 (0.35)[a]	164.44 (2.03)[b]	177.46 (4.64)[c]	183.15 (2.33)[d]	182.06 (1.90)[cd]
Lactic acid (SD) (g kg^{-1} DM)	46.85 (10.80)[a]	49.11 (5.77)[a]	50.13 (12.24)[a]	49.78 (8.03)[a]	121.76 (3.67)[b]
Acetic acid (SD) (g kg^{-1} DM)	10.70 (6.16)[b]	7.18 (4.36)[a]	5.32 (0.75)[a]	3.87 (0.15)[a]	5.30 (2.07)[a]
Propionic acid (SD) (g kg^{-1} DM)	2.53 (1.26)[b]	1.27 (0.68)[ab]	0.59 (0.52)[a]	0.45 (0.28)[a]	0.12 (0.11)[a]
Butyric acid (SD) (g kg^{-1} DM)	33.45 (3.03)[c]	21.50 (3.02)[b]	8.50 (3.15)[ab]	4.88 (2.61)[a]	0.34 (0.22)[a]
Ethanol (SD) (g kg^{-1} DM)	2.42 (0.40)[b]	2.09 (0.32)[ab]	1.84 (0.10)[ab]	1.26 (0.97)[a]	1.67 (0.10)[ab]
Total VFAs (SD) (g kg^{-1} DM)	46.68 (8.66)[c]	29.95 (10.26)[b]	14.41 (6.16)[ab]	9.20 (6.01)[a]	5.76 (1.77)[a]
AN/total N (SD) (g AN kg^{-1} TN)	114.91(3.97)[c]	87.01(8.01)[b]	65.91 (12.99)[a]	55.12 (16.37)[a]	65.58 (4.64)[a]
Lactic acid/acetic acid (SD)	4.39 (3.02)[a]	6.84 (5.46)[a]	9.42 (2.90)[ab]	12.86 (0.83)[b]	22.97 (6.52)[c]

Values followed by different letters in the same row show significantly differences at $p<0.05$.

Table 2 *Residual mono-and disaccharides composition of Italian rygrass silage.*

Item	Treatments				
	Control	Encapsulated -0.5% glucose	1% Glucose	0.1% Sorbic acid	FJLB[2]
Fructose (SD) (g kg^{-1} DM)	7.44 (4.04)[a,1]	13.91 (2.49)[a]	38.32 (13.14)[b]	53.48 (10.02)[b]	52.35 (9.72)[b]
Glucose (SD) (g kg^{-1} DM)	0.00 (0.00)[a]	0.00 (0.00)[a]	0.25 (0.43)[a]	0.00 (0.00)[a]	0.11 (0.20)[a]
Sucrose (SD) (g kg^{-1} DM)	3.10 (0.83)[a]	2.64 (0.45)[a]	4.29 (1.79)[a]	4.02 (0.54)[a]	3.01 (0.85)[a]
Mono-and disaccharides (SD) (g kg^{-1} DM)	10.54 (3.20)[a]	16.55 (2.04)[a]	42.86 (14.28)[b]	57.49 (10.56)[b]	55.47 (9.19)[b]

Values followed by different letters in the same row show significantly differences at $p<0.05$.

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