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ENSILING MOIST CEREAL-LEGUME INTERCROPS: A PROMISING TECHNIQUE, REDUCING ANTI-NUTRITIONAL FACTORS IN FABA BEANS

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INTRODUCTION

Increasing self-sufficiency for protein sources in animal feed is crucial for sustainable agriculture throughout the world. Europe depends heavily on imported soybean to meet its protein needs, next to local legumes like pea (*Pisum sativum*) and faba bean (*Vicia faba*). Their amino acid composition is less optimal than soybean, which can be overcome by intercropping with cereals. The seeds from these cereal-legume intercrops can be harvested dry, followed by toasting or expanding/extruding to improve the digestibility. Another option is ensiling the seeds upon harvest at dough stage. To gain more insight into the silage properties of these intercrops, microsilos experiments were conducted to evaluate the fermentation characteristics of the obtained silages. Additionally for the intercrops with faba beans, the effect of the ensiling process on the anti-nutritional factors vicin and convicin was investigated.

MATERIALS & METHODS



Figure 1. Microsilos.

During the growing seasons 2020-2021 and 2022-2023, intercrop trials were laid out at the Research Farm Bottelare in Belgium. A selection of 15 intercrops was threshed at the hard dough stage, milled to 3-5 mm particles and treated with different silage additives: in both 2021 and 2023, organic acids (propionic acid and formic acid 1:1 at 6 l ton⁻¹ fresh matter (FM)) and Magniva Platinum Wholecrop (MPWC; 2 gram ton⁻¹ FM; Lallemand sas, France) were compared to a negative control treated with water; in 2021 and 2023, resp. Magniva Classic+ (MC+) or Magniva Platinum 3 (MP3) (both at 2 gram ton⁻¹ FM; Lallemand sas, France) was included as third additive. Four replicates per treatment were ensiled in microsilos with a volume of 2.75 liter (Figure 1). After an ensiled period of 90 days, the fermentation characteristics were determined per replicate, except for the acids that were determined on pooled samples. For the intercrops containing faba beans, vicin and convicin were additionally quantified pre- and post-ensiling.

RESULTS & CONCLUSION

The silage fermentation characteristics of the intercrop seeds ensiled at dough stage are presented in Table 1, not per individual intercrop but per crop combination. For intercrops with faba beans, the reduction in vicin and convicin is given.

Table 1. Effect of silage additives on the fermentation characteristics and reduction of anti-nutritional factors in the intercrops barley-pea, triticale-faba bean and wheat-faba bean: dry matter (DM), crude protein (CP), NH₃-N/total N (Amm.fr.), pH, lactic acid (LA), acetic acid (AA), alcohol (Alc.), and reduction of vicin (VIC) and convicin (CON) compared to levels pre-ensiling. Butyric acid (BA) was below the limit of detection in all samples, as was propionic acid (PA) except for the acid-treated silages; therefore BA and PA are not mentioned in this table. Different letters point to significant differences between the additives per intercrop.

Crop	Additive	DM	CP	Amm.fr.	pH	LA	AA	Alc.	VIC	CON
		g kg ⁻¹ FM	g kg ⁻¹ DM	%			g kg ⁻¹ DM		% reduction	% reduction
barley-pea	control	712 c	162 a	3.17 a	4.80 a	16.0 d	4.37 b	5.68 a	No faba beans in this intercrop	
	acids	720 a	156 bc	2.00 a	4.60 b	0.22 e	0.73 d	0.60 c		
	MPWC	710 bc	166 a	2.86 a	4.27 c	27.9 b	12.7 a	6.04 a		
	MP3	692 d	143 c	2.93 a	4.13 d	21.8 c	10.2 a	3.57 ab		
	MC+	720 ab	159 ab	3.13 a	4.22 d	35.2 a	3.26 c	4.07 b		
triticale-faba bean	control	708 a	187 a	2.63 c	4.67 a	13.4 c	3.79 c	3.36 b	92 a	80 a
	acids	711 a	183 ab	1.83 d	4.72 a	0.41 d	0.46 e	1.36 c	92 a	74 ab
	MPWC	698 c	189 a	3.81 b	4.21 c	19.4 b	7.37 b	4.89 a	86 a	66 bc
	MP3	702 bc	177 b	4.42 a	4.17 d	24.5 a	8.22 a	4.12 a	89 a	67 bc
	MC+	705 ab	190 a	2.81 c	4.39 b	14.1 c	1.79 d	4.72 a	86 a	62 c
wheat-faba bean	control	691 bc	255 b	2.48 a	4.73 a	14.4 d	3.69 b	4.00 b	88 ab	91 b
	acids	705 ab	255 ab	0.97 c	4.86 a	1.51 e	0.45 d	1.95 c	79 b	81 c
	MPWC	703 ab	222 b	2.57 a	4.30 c	19.4 c	10.1 a	7.03 a	97 a	97 a
	MP3	690 c	318 a	1.80 b	4.35 bc	27.1 a	9.70 a	4.58 ab	100 a	100 a
	MC+	710 a	219 b	2.10 ab	4.39 b	20.7 b	2.14 c	5.72 ab	76 b	70 d

The control silage showed a good acidification in combination with a low ammonia fraction. The inoculants stimulated the fermentation process, resulting in a reduced pH and increased LA levels; the AA and Alc levels differed in function of the inoculant composition. A very strong reduction of VIC and CON levels was observed for all treatments, with significant differences between treatments for both ANFs in the intercrop wheat-faba bean and for CON in triticale-faba bean. This reduction facilitates the inclusion of faba beans in the ration of monogastric animals.

From this study it can be concluded that the cereal-legume intercrops barley-pea, triticale-faba bean and wheat-faba bean harvested at hard dough stage can be converted into a qualitative feed source by ensiling. Despite the high DM and CP contents, which might hamper the ensiling process, the silage quality is good even without application of an additive. However, additives can steer the fermentation process into the desired direction. An additional benefit when faba beans are ensiled is the strong reduction of VIC and CON, rendering the silage suitable as both ruminant and monogastric feed.