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The effects of a new plastic film on the microbial and fermentation quality of Italian ryegrass bale silages

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Introduction Problems associated with big bale silage include the high permeability of plastic wrapping films to O₂, their low resistance to damage and the large amount of plastic that must be used to limit aerobic deterioration during conservation. Low permeability film, used in the packaging of food and recently proposed for bunker silos (Degano, 1999), could reduce fungal development in bale silage. The aim of this work was to compare the microbial and fermentation quality of big-baled silage, wrapped with commercially available plastic film and a new stretch film with low O₂ permeability, over different conservation periods.

Materials and methods Silage was made from a permanent pasture (80% Italian ryegrass) in the Po Valley, NW Italy. Herbage was field wilted for 2 days to a DM content of approximately 300 g/kg. Forage was baled (150 cm diameter) from alternate windrows and individually wrapped (6 layers) with one of two plastic films: a conventional polyethylene film (standard - ST) and a triple co-extruded stretch film with two outer layers of polyethylene and a central layer of polyamide (low permeability - LP), specifically produced for this experiment (IPM, S.p.A, Mondovì, Italy). The thickness of the two plastic films was 0.25 µm and O₂ permeability was 7120 and 400 cm³/m² per 24 hours at 23°C for the ST and LP respectively. Six bales were allocated to each treatment. Bales were sampled after 2 and 4 months of conservation using a steel corer. Two cores were taken from each bale. One core was split into two portions: 1-20 cm (peripheral) and 21-55 cm (centre) which were analysed for yeast, mould and clostridia spores. The second core was analysed for fermentation quality.

Results All the silages were well fermented with no butyric acid and low ammonia concentration, with the exception of those wrapped with ST film after 4 months of conservation (Table 1). The yeast, mould and clostridia spores increased in the ST silage over the conservation period, especially in the peripheral zone of the bale, which is more prone to oxygen penetration (Table 2). No differences in microbiological quality were found after 4 months of conservation in the LP silage, showing the lower oxygen permeability of the wrapping.

Table 1 Fermentation characteristics of baled silages wrapped with low permeability and standard plastic films after two and four months of conservation

Plastic film	2 months of conservation					4 months of conservation				
	pH	lactic	acetic	butyric	NH ₃ -N	pH	lactic	acetic	butyric	NH ₃ -N
LP	4.1	47	16	n.d.	85	4.3	48	16	0.3	77
ST	3.8	52	15	n.d.	50	4.1	67	21	0.3	113

Lactic, acetic and butyric acids (g/kg dry matter); NH₃-N (g/kg total nitrogen); n.d. not detected.

Table 2 Mould and yeast colony forming units and clostridia spores in baled silages wrapped with low permeability and standard plastic films after two and four months of conservation

Plastic film	Bale zone	Yeast (log cfu/g)		Mould (log cfu/g)		Clostridia spores (log MPN/g)	
		2 months	4 months	2 months	4 months	2 months	4 months
LP	Peripheral	3.60bc	3.14bc	1.58a	1.06a	1.96a	1.52a
	Centre	<1.00a	1.74ab	<1.00a	1.11a	1.57a	1.55a
ST	Peripheral	2.60bc	4.26c	<1.00a	2.72b	1.71a	3.12b
	Centre	3.13bc	3.12bc	<1.00a	1.24a	1.71a	2.82b

Values with a different letter are significantly different within each parameter for $P < 0.05$; values lower than 1 were set to 0.7 for statistical analysis.

Conclusions The results showed that the experimental stretch film with low oxygen permeability was able to reduce moulds and clostridia development during conservation and to maintain high quality silages for longer period than conventional polyethylene film.

References

Degano, L. (1999). Improvement of silage quality by innovative covering system. *13th International Silage Conference*, 296-297.

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