THE INFLUENCE OF THREE DIFFERENT ROUND BALERS ON GAS PRODUCTION AND FERMENTATION PARAMETERS OF BIG BALE SILAGE

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Introduction

Big bale silage as a type of forage conservation becomes more and more popular in Germany and Switzerland.

For the production of big bales, not only round balers with fixed but also those with variable press chambers are used. The baler equipped with a variable press chamber also compresses, in contrast to the other baler type, the bale core very densly. A yet unresolved problem of big bale silage is the high risk of damaging the stretch-film, and thus resulting in air inflow. The damage (holes) is most often caused during transportation and handling of the wrapped bales or by animals during storage.

During the summer 1990, the Federal Research Centre of Agriculture Braunschweig-Völkenrode examined to what extent holes in the wrapping film of different round balers affect fermentation patterns and silage quality.

Material and Methods

At the end of May, grass (first cut, mainly consisting of Italian ryegrass) was wilted for two days, baled by three balers using different compressions and then stretch-film wrapped. 24 bales were made according to the above procedure. 12 bales were made with the baler equipped with a fixed press chamber (baler 1) and were stored in two different ways (upright or sideways). The two other balers equipped with variable press chambers (baler 2 and 3) each made six bales which were all stored in the same way (sideways). Afterwards, two holes per bale having a diameter of 2 cm were made in the wrapping film of half of the bales. One hole was located at the upper edge and the other one diagonally opposite below. Two probes per bale were placed at the centre and at the upper edge to measure CO_2- and O_2-content in the bales.

Results

After a storage of approximately three months, the bales were opened and evaluated. Samples were taken from different layers.

A rough estimate of losses showed that damaged wrapping films caused higher DM losses, irrespective of baler type (Table 1). In addition, the silage directly surrounding the upper holes was of poor quality. Part of it was completely rotten and mould infections were observed as deep as 30 cm. Also the silage around the lower holes turned mouldy but in this case, the oxygen inflow affected only a very limited area.

Results of chemical analyses of the bale core are summarized in Table 1. The holes in the wrapping film of the bales stored sideways and baled by the baler 1 caused an inferior silage quality. Due to a less densly pressed bale core, the air penetrated more easily into the centre of the bale. This deterioration of silage quality with and without holes was not observed in bales stored upright or bales from baler 2 and 3. The big bales with the highest density (baler 3) showed the best silage quality.

The continuous measuring of CO_2-content revealed substantial differences between intact and damaged bales since holes enabled the CO_2, produced during fermentation, to escape downwards (figure 1). On the other hand, oxygen was detected around the holes of the upper edge (figure 2) but not in the centre of the bales. Apparently, the oxygen penetrating through the holes was quickly metabolized by microorganisms. The big bales with holes of baler 1 stored sideways displayed a different pattern of CO_2-production and, above all, had a higher alcohol content compared to the other bales pointing to an ethanolic fermentation by yeasts.

Bales with intact wrapping films and baled by a variable press chamber always displayed higher CO_2-contents the first days following ensiling. According to these findings, it is assumed that the continuous baling system also improved the conditioning of feed particles and thus initiated a rapid lactic acid fermentation.

The aerobic deterioration losses based on temperature rise were, on average, always higher for intact bales compared to those with holes.

Conclusions

The more densly bales are pressed, the better the silage quality.

As a result of air flow, damaged stretch-films have a higher impact on silage quality when using the baler with a fixed press chamber and a sideways storage compared to balers with a variable press chamber.

Table 1: Influence of baler type and film holes on fermentation parameters
(mean values of the bale core)

	Baler 1		Baler 1		Baler 2		Baler 3	
Press Chamber	Fixed		Fixed		Variable		Variable	
Storage	Upright		Sideways		Sideways		Sideways	
Holes	No	Yes	No	Yes	No	Yes	No	Yes
Number of Bales	3	3	3	3	3	3	3	3
Density[a] (kg/m^3)	143	158	152	147	170	170	196	195
DM Content[a] (%)	36.9	37.7	36.9	37.2	37.9	37.3	36.8	37.1
DM Loss[a] (%)	6.9	8.4	10.0	11.5	8.8	13.8	9.4	11.8
pH	5.5	5.6	5.2	6.0	5.7	5.4	5.3	5.1
Alcohol (g/kg DM)	25.1	21.8	17.0	42.8	10.3	17.8	8.2	13.8
Lactic Acid (g/kg DM)	15.5	17.2	22.3	8.0	13.0	24.5	20.3	34.0
Acetic Acid (g/kg DM)	4.9	4.8	5.8	2.9	4.4	4.7	4.7	5.7
Butyric Acid (g/kg DM)	0.2	0.2	0.3	0.1	0.0	0.2	0.1	0.4
NH_3-N/total N (%)	4.0	5.7	5.3	4.2	5.6	7.1	4.4	8.3
Flieg Score	79	84	94	69	89	90	97	97
Aerobic stability (days)	2.0	3.0	3.2	2.9	3.3	4.7	2.6	4.3
Aerobic deterioration loss (% DM during 9 days)	24.8	20.0	24.0	19.4	16.1	9.7	22.4	12.9

[a] Figures are related to the whole bale

Figure 1: Evolution of CO_2-content in the bale core

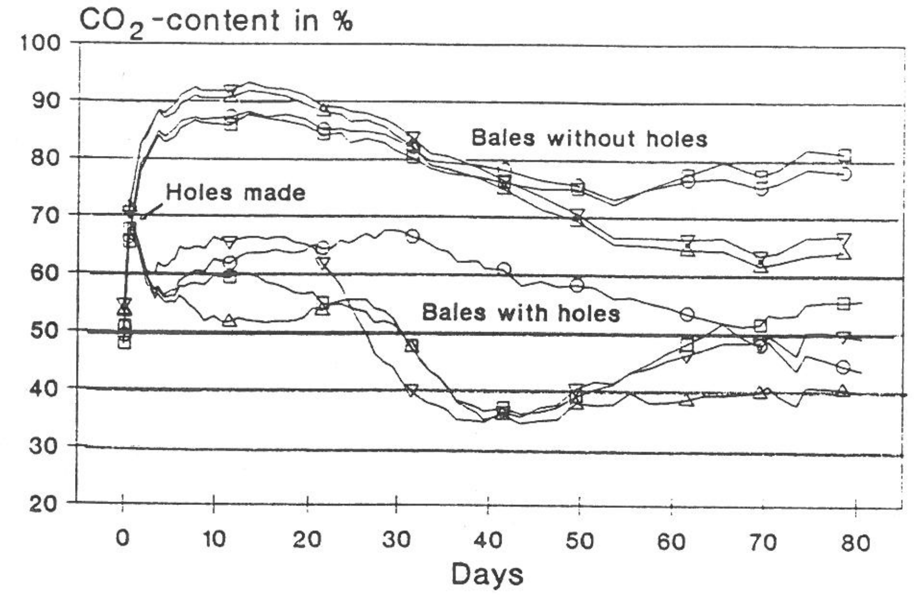

Figure 2: Evolution of O_2-content at the upper bale edge (15 cm deep)