



Utre Romsdal og Nordmøre Forsøksring

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Report of ensiling research - first cut 2003

Round bale ensiling with 5 different remedies and no additives on pre-dried first cut.

Background

Usually, round bales are made without any adding of ensiling remedies. Addition of remedies and the economical aspects related to this costly addition is a much-discussed subject. By ensiling of pre-dried forage the main purpose of the additives is to prevent mould, while conservation of sugar and reduction of acid production and butyric acid formation is the main purpose of the additives by ensiling of only moderately pre-dried forage.

Remedies used in the research

- **Terra Biosa** is a new remedy for versatile uses in agriculture. Lactic acid is one of Terra Biosa's main ingredients and thus an effective control of lactic acid production is expected in grass ensiled with the use of Terra Biosa as an additive. The remedy is activated locally by adding molasses and water to a start culture. In price terms, this is a good alternative to other official remedies on the market. Therefore, it has been of major concern for this research to test if Terra Biosa has the same secure and good ensiling effects as other remedies and a presumed better effect than no additives at all.
- **Howden silo fluid** is recognized for a low production of mould and a good taste of the ensilage. The effect of the remedy considering pH development and mould reduction is evaluated through comparison with other products.
- **GrasAAT Lacto** is said to be particularly effective against production of butyric acid and this is why the remedy was included in the research. In addition, it provides an important basis for comparison.
- **GrasAAT pluss** is designed especially to counteract the production of mould as well as being sugar conserving.
- **Kofasil Ultra** is effective against the production of mould and butyric acid.
- **No additives** is often thought to be reasonable as long as conditions are fine and the work is done properly. It is important to also include no additives as a parameter of comparison with the test results.

Provider of assignment

The research has been initiated on the Ytre Romsdal and Nordmøre (Norway) research group's own incentive. The suppliers have provided the remedies free of charge.

Biosa Norge A/S has funded the analysis of the ensilage at the coarse feed centre (Grovfodersenteret på Hellerud), three samples from each test, and a water soluble sugar analysis at the North Norwegian centre of competence (Nordnorsk kompetensesenter Holt), 6 samples from the first cut.

Application

17.06.2003: First cut of meadow containing a mixture of meadow seeds; approx. 30% timothy, 30% meadow-fescue, 10% perennial ryegrass and 15% clover plus some different kinds of weeds.

Cut with a disk mower with a 9ft stem cutter and pre-dried for approximately 24 hours before being pressed with the Orkel 1202 round bale presser. The ensiling remedies are added with a so-called Serigstad pump and two nozzles on the grass jet in the compressor chamber.

A dosage of 1.0 gallon/ton was aimed at but controls show that there was a slightly varying amount added resulting from an uneven distribution in the cut and in the driving force. On an average there was added ≤ 1.0 gallon /ton since there were used 6.5 gallon on 9 bales, which had an average weight of 118,107lb.

Even if the dry matter level is 30% the dosage is a little under the recommended amount for some of the remedies, but this is normal procedure for the measuring of doses. These facts must be kept in mind when the results are evaluated.

The bales were rapped in six layers of stretch film and marked immediately after. Bales that had a doubtful quality due to admixture of soil or edgings were excluded from the research.

The first pH measurement was taken after 24 hours. It was carried out with an $\varnothing 1.9$ " test drill, which was hit approx. 15.7-19.7" into the bale from between 2 and 10 o'clock towards the centre.



Figure 1. Test samples.

From the grass sample, local grass sections were pressed through a garlic press and the juice was measured with a transportable pH-meter. The pH development is a good indicator of how successful the fermentation is and gives a picture of the fermentation activity. New measurements were taken every 24 hours in the beginning with slightly longer intervals as the pH values levelled off.



Figure 2. Test equipment

The taken samples were continuously laid aside and exposed to outdoor temperatures and an air supply to examine how quick a mould attack would occur and to see to what extent the remedies hamper mould in fresh ensilage (packing conditions – meaning to what extent the remedies influence the grass during and directly after the packaging of the bales) and also after the ensiling of the roughage is completed and considered being stable (ready fermented conditions).

The samples for the analysis at the Crude Feed Laboratory in Hellerud, Norway, were taken with a test drill as described above after 11 weeks. The samples were immediately frozen and sent late the next day.

There were not noted any accidents or unfortunate circumstances during the research, so reliable results from the tests were expected.

Results

1. Mould test. Mould at packing conditions – testing of crude grass after addition of remedies.

Storage time	Howden	GrassAAT+	GrasAATL	TerraBiosa	No add.	Kofasil U
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28 days	1	5	3	0	0	0
27	4	2	2	1	2	4
25	3	3	5	3	3	1
22	4	2	5	2	3	2
19	5	4	4	0	1	1
Avrg.	4,4	3,2	3,8	1,2	1,8	1,6

Rating system: 0 = free of visible mould 6 = maximum mould cover

2. Mould test. Mould in half finished ensilage.

Samples taken 7/7 were put aside for free exposure to oxygen. Observations were carried out after 4 weeks.

Graduated after the same scale, these ratings are found:

Storage time	Howden	GrasAAT+	GrasAAT L	Terra Biosa	No add.	Kofasil U
28 days	2	6	6	0	0	5

Figure 3. Mould in half finished ensilage.

3. Mould test. Mould in ready ensilage

Samples taken 13/11 were kept at room temperature and exposed to a free supply of oxygen. Observations carried out after 3 weeks.

Storage time	Howden	GrasAAT+	GrasAATL	Terra Biosa	No add	Kofasil U
3 weeks	1	0	6	0	0	6

Ingen T Terra Biosa GrasAAT + GrasAAT L Kofasi U Howden



Figure 4. Mould on ready ensilage.

Discussion

These tests do not show if certain treatments present a big risk of rapid mould developments but they show fluctuations between the different treatments and how severe the mould development will be under the right circumstances. During the research, a visible mould development was registered already after the first day on fresh grass (packing conditions), while more time passed for the ready ensilage (4-5 days).

Mould is an important dimension in measuring how good the ensilage is as feed but is not normally measured in feed analysis.

There were also measured large amounts of red mould on fresh and half finished samples of GrasAAT Lacto. These have not been analysed for toxins and therefore it is uncertain if there is reason for concern.

It is rather surprising that Kofasil Ultra had good effects at the packing conditions but bad effects on the ready ensilage.

GrasAAT plus seems to have a bad effect on mould at packing conditions but good effects in ready ensilage. GrasAAT Lacto has no effect on mould neither at packing conditions nor when unwrapped. Howden has no mould reducing effects during packaging but good effects when unwrapped. Terra Biosa and No additives have good effects both during packing and unwrapping. This can be explained mainly by the fact that sugar, which mould fungus live off, undergoes a vast decomposition by lactic acid bacteria and ethanoic acid bacteria from the first day and that the sugar content in the ready ensilage is low because there is a high consumption during these treatments. The formation of acid, especially propionic acid, butyric acid and ethanoic acid hampers mould formation.

Conclusion – mould appearance

There is a good correspondence between the appearance of mould and the sugar content and acid content in the ensilage. The research confirms the theory saying that formic acid as an additive does not hamper mould formation but rather assists it as the sugar is conserved and not many mould hampering acids are produced. The compression of the grass and the exclusion of fresh air (oxygen) is thus very important when formic acid is used. Also during unwrapping the admission of air should be restricted, but GrasAAT Plus seems to moderate the formation of mould at unwrapping (also applies if the stocked bales break).

The ensiling process evaluated by the pH level

It is an objective for an effective ensiling that the pH level is lowered rapidly. Through addition of acid the pH should immediately be lowered to approx. 4,5. For the application of organic active material like bacteria or molasses or other sugar sources, the lowering of the pH should start after a few hours and make effective progress down to a pH of approx. 4,2 or lower, not below pH=3,9 though as it will have a negative influence on the appetite, digestion and rumen functions.

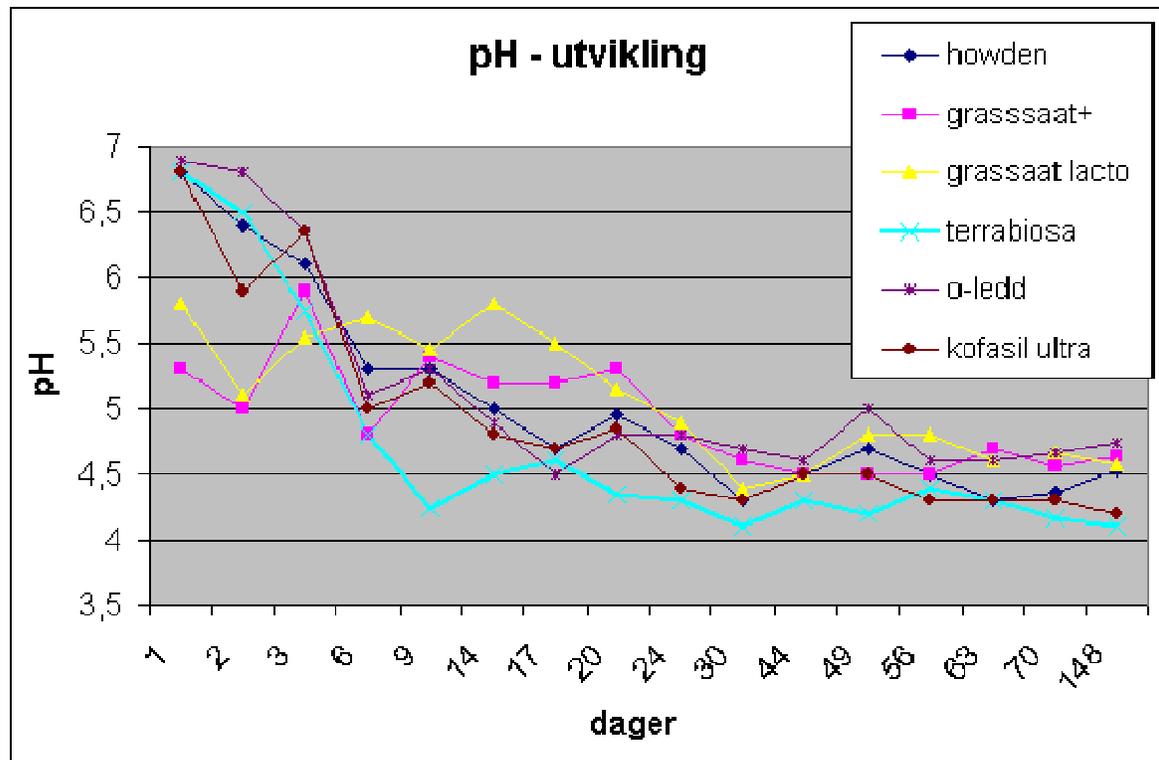


Figure 5. pH development over time.

The diagram showing the pH development clearly indicates that the acid dosage has been too weak to achieve an immediate lowering of the pH. It shows clearly though that biological activity has lowered the pH to the same level as the acidification after approx. 1 week and that the pH is lower for organic than for acid-based ensiling up to 30 days after cutting. Subsequently, the pH is relatively equal whatever treatment has been applied, but Terra Biossa generally has a lower pH than the others.

Considering that these are round bales with a dry matter content of approx. 30 per cent a pH of about 4,5 is acceptable. There is a production of butyric acid in the bales, which suggests that the percentage of dry matter is too low to hamper a butyric acid fermentation. The production of butyric acid might stem from a local area in the bale, which has not been pressed very hard.

Conclusion

The pH development is a good indicator of the biological activity in the round bale after the pressing and wrapping. Using acids as ensiling remedies gives an immediate lowering of the pH and thereafter almost 20 days pass before the bacterial lowering of the pH is started in the bales ensiled with GrasaAT Lacto and a good 20 days for the bales ensiled with GrasaAT Pluss. Addition of lactic acid bacteria (Terra Biossa) has had a clear effect on a quick and effective lowering of the pH.

Statistic Analysis of acid parcel 2

Ensiling test 03 – first cut

	No additives	GrasAAT L	GrasAAT +	Kofa	Howden	Terra Biosa
Dry matter, %	28,9abc	32,1a	30,7ab	26,3c	27,7bc	31,2ab
PH	4,67a	4,67a	4,57ab	4,30bc	4,37abc	4,17c
Amm. N, % of						
Total N	13,2a	9,9b	8,9b	7,3b	9,1b	8,7b
g pr. kg dry matter:						
Lactic acid	35,0bc	12,8d	16,5cd	63,7a	52,3ab	66,4a
Ethanoic acid	27,4b	2,4d	4,0d	15,8c	13,6c	50,3a
Butyric acid	24,6a	3,5b	4,0b	0,0b	6,3b	0,0b
Formic acid	0,0b	7,1a	6,6a	0,0b	0,0b	0,0b
Ethanol	19,4a	8,2cd	9,5bcd	3,4d	12,7bc	15,2ab
Avrg. Water soluble Sugar	3,0	23,8	20,0	15,2	11,3	2,3
Absorption	89,6c	104a	103a	95,7b	99ab	88,7c

Discussion

The pH is the main parameter for the sum of artificial and natural preservation effect based on acidification. Terra Biosa has given the lowest pH in this research.

Decomposition of protein will influence the ammoniac values and it is clear that the samples with no additives have the largest and statistically most significant variations. All the others are too equal to be ranked.

Formation of lactic acid is desired, in particular when no acid is used to lower the pH. Terra Biosa (and Kofasil Ultra) clearly have the highest level. The least lactic acid was produced in the GrasAAT Lacto bales.

Ethanoic acid is pH lowering and hampers the creation of mould. In larger amounts however the ethanoic acid will influence the eating desire negatively. It is shown that Terra Biosa gives high ethanoic acid levels with no additives as a clear number two. (Hereafter the Kofasil Ultra, Howden and GrasAAT remedies).

Butyric acid is undesired and the maximum permitted value is 4,0. High, statistical significant values were measured in the bales with no additives, low values for GrasAAT Lacto, GrasAAT+ and Howden, while there was not found any butyric acid in the bales that are treated with Kofasil Ultra and Terra Biosa. Because there are large fluctuations in all the material these measurements are not really significant.

Formic acid is found in the bales added GrasAAT+ and GrasAAT Lacto while the others do not contain formic acid.

Ethanol is rich in energy but undesired because there is danger of taste defects in the milk and negative effects in the digestion. Bales with no additives contain most ethanol and Terra Biosa is a clear number two. Kofasil Ultra has the lowest content but not significantly lower than GrasAAT+ and GrasAAT Lacto.

Water soluble carbohydrates in the ready ensiling shows that much of the sugar is converted into acid in the bales where a natural (organic) ensiling process has taken place, meaning no additives and Terra Biossa; the GrasAAT remedies clearly show higher sugar values. This was expected and helps to explain the variations concerning production of mould and variations in the digestion index.

The digestion index is a theoretical parameter for the taste and the digestion ability of the feed.

It is clear that the GrasAAT remedies are the highest with a value of over 100 and that Howden is in the same group, statistically evaluated. No additives and Terra Biossa certainly are statistically lower than the others.

Taste was not measured but an estimated evaluation has been made on a herd level and further odour and colour/consistency of the feed was registered during unwrapping of the bales. These registrations show a tendency towards no additives smelling of butyric acid and having a dark colour while the Terra Biossa bales have a particular harsh smell (probably ester), which can influence the appetite. The colour on the other hand is light and pleasant.

Conclusion

In this research all ensiling remedies have given clear positive results compared to no additives.

During packaging the risk of mould production is highest with Howden, GrasAAT Lacto and GrasAAT Pluss. Rapid packaging and airtight storage will prevent the growth of mould.

For feeding with ready ensilage GrasAAT Pluss and Howden show good effects against mould while Kofasil Ultra has not worked convincingly.

Organic ensiling (no additives and Terra Biossa) has shown to be very mould reducing both during packaging and feeding. Further, the content of water-soluble carbohydrates in the ensilage is the lowest while the total acid amounts are the highest.

Butyric acid has shown the highest variations comparing the use of remedies with no additives. Bales with no additives were of bad quality in this research due to high values of butyric acid (not suitable for feeding of dairy cows). The best were Terra Biossa and Kofasil Ultra.

The use of formic acid based remedies like GrasAAT Pluss and GrasAAT Lacto have given positive fluctuations on the sugar preservation and reduced the acid production. The digestion index is best for these remedies together with Howden.

Evaluation of the Terra Biossa effect:

(Biossa Norge AS (Norway) has funded the analysis of all remedies and has requested a status rapport of Terra Biossa).

- 1. Mould.** Terra Biossa distinguishes itself through being especially effective against mould. This goes from packaging of fresh grass to half finished ensilage to ready ensilage. Statistic calculations of these observations have not been made but the fluctuations have been clearly defined.

2. **pH development.** Terra Biosa has given the fastest lowering of the pH compared to all the other remedies if the formic acid derivatives of chemical pH reduction are excluded. The rapid lowering of the pH shows that the added lactic acid bacteria have controlled the process and influenced the pace of the ensiling period. The final pH is lower than all the other treatments.
3. **Value of analysis – reached through addition of Terra Biosa**
 - **Ammonia:** statistically secure lower value than no additives – consequently certain effect.
 - **Lactic Acid:** highest of all the remedies and statistically the level has been higher than that of no additives and of the formic acid derivatives GrasAAT Plus and GrasAAT Lacto.
 - **Ethanoic acid:** statistically secure higher than all the other remedies.
 - **Butyric acid:** no appearance in any of the three repetitions with Terra Biosa and the level was statistically secure better compared to no additives.
 - **Ethanol:** high and on the same level as no additives.
 - **Remaining sugar:** low as in no additives, signifying a high activity in the transformation of carbohydrates to organic acids.
 - **Digestion index.** Becomes low as a result of a high acid- and ethanol content. There is reason to point out that 0 in butyric acid pulls in a positive direction but the high ethanoic acid content is rather negative for the taste. The absorption index is a theoretical parameter with a high uncertainty which cannot be used immediately as an index of the animals actual feed absorption. Only the animals themselves have the answer to this question.

As a main conclusion there is no doubt that Terra Biosa has a documented effect in this research. The registered changes are in accordance with what can be expected considering Terra Biosa's composition.