Methodology of ensiling trials and effects of silage additives

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Overview

- Introduction
- National silage additive schemes in Europe
- The EU authorisation of silage additives
- The German DLG additive approval scheme
- Comparison of the German DLG and the French INRA schemes
- Testing silage additives in round bales
- Conclusions

Characteristics of European silage additive approval schemes active in 1996

Country	Start	Compulsory	Positive control required	Farm or lab scale silos	Reference
Finland	1987	Yes	Yes	Both	Mannerkorpi et al. 1996
France	1979	Yes	Yes	4m^3-silo	Demarquilly and Andrieu 1996
Germany	1990	No	No	Lab	Honig and Pahlow 1993 Pahlow and Honig 1996 Staudacher et al. 1999 Honig and Thaysen 2002
Ireland	1994	No	No	Both	Fitzgerald et al. 1996
UK	1995	No	No	Both	Haigh et al. 1996 Weddell et al. 1996 Weddell et al 2002
Switzerland	1979	Yes	Yes	Lab	Wyss and Vogel 1997 Wyss 1997

The EU authorisation of silage additives

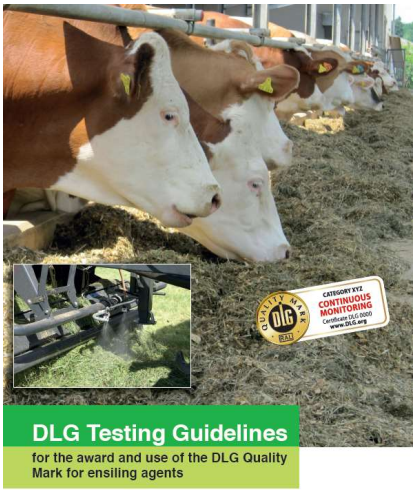
- since 2004 all silage additives in the European Union (EU) require authorisation according to EC Regulation No. 1831/2003 (Article 10)
- EC Regulation distinguishes between '**technological additives**' (improved silage quality) and **zoo-technical additives** (improved animal performance)
- EU authorisation process focuses on **single, active components** of an additive re. safety (handling and intake) and efficacy (improved fermentation or aerobic stability)
- once an active component is authorised, it can be used by any additive company thereafter within the EU
- but most silage additives contain more than one active component →EU certification has only limited value for farmers
- main objective with the EU approval system is to make sure that only safe additives (re. health risks) are sold within the EU

The German DLG additive approval scheme

- German approval system for silage additives was introduced in 1990 by DLG (German Agricultural Society in Frankfurt: www.dlg.org/en/)
- DLG is a non-governmental agricultural organisation that has a long history in quality approval of agricultural commodities
- quality approved additives receive a '**DLG Quality Mark**' ➡

- signals to the user that this product had passed through a series of tests and complies with the minimum quality criteria set up by DLG
- Sweden has joined the German approval scheme in 1993 and Switzerland uses DLG results for its own approval scheme
- all tests must be carried out at independent research institutes and in accordance to detailed **DLG guidelines :**

DLG Testing Guidelines for the award and use of the DLG Quality Mark for ensiling agents



www.DLG.org

Citation:

DLG e.V., 2016. "DLG Testing Guidelines for the award und use of the DLG Quality Mark for ensiling agents", prepared under the auspices of the DLG commission for ensiling agents, at order: m.eise@DLG.org or d.kampf@dlg.org

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The German DLG additive approval scheme

Action category 1 Field of application	Improved fermentation processes
a	Difficult to ensile forages Fermentability coefficient (FC) < 35 Roughage forages with an insufficient content of water-soluble carbo-hydrates and/or dry matter (DM)
b	Moderately difficult to easy to ensile forages in the lower DM range FC ≥ 35; DM < 35% e.g. grasses, forage legumes, silage maize, whole cereal plants, millet, Sudan grass
c	Moderately difficult to easy to ensile forages in the upper DM range FC ≥ 35; DM ≥ 35 to ≤ 50% e.g. grasses, forage legumes, silage maize, whole cereal plants, millet, Sudan grass Each with a sufficient content of water-soluble carbohydrates
d	Grain silage e.g. corn cob mix, earlage, moist cereal grains
e	Special types of forages Forages requiring ensiling agents to develop specific actions e.g. beets, pulps, pressed pulp, stillage, brewers grains or forages for which an ensiling agent is specifically designed

FC = DM + (8*WSC/BC)
DM in %FM
WSC in %DM
Buff.capacity: g lactate/100gDM (pH 6.0 to 4.0)

Ref: Weissbach, F. 1996. 11th Intern. Silage Conf., p.11.

The German DLG additive approval scheme

Action category 2	Improved aerobic stability
Forage/substrate type	• Grasses or forage legumes, preferably wilted • Silage maize and maize cob products • Whole cereal plants • Cereal crops (cereals, maize) and forage legumes • Root crops • By-products of the food and fermentation industries Depending on the test reports submitted with the application, the use of the DLG Quality Mark may be limited to specific forages/substrate types

Glass jar silos with holes for air stress treatment ➡

The German DLG additive approval scheme

Action category 3	Reduced effluent production
Field of application	Forage with low dry matter contents

⬅ absorbents, gels, etc.

Action category 4	Secondary effect ➡animal performance
a	Ensiling agents also capable of improving the feed intake value of treated silage
b	Ensiling agents also capable of improving the digestibility of treated silage
c Meat	Ensiling agents also capable of improving the beef production value of treated silage
c Dairy	Ensiling agents also capable of improving the milk production value of treated silage

The German DLG additive approval scheme

Action category 5	Additional effects
a	Prevention of Clostridium endospore reproduction
b	Specific effects defined by the applicant

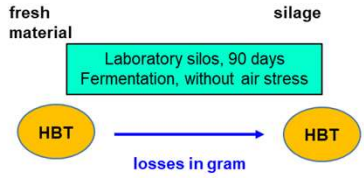
➡wetter silages inoculated with clostridia (>10^3 cfu/gFM)

Action category 6	Improved methane yield value of silage by:
a	Reducing fermentation losses
b	Preventing secondary heating
c	Specific effects defined by the applicant

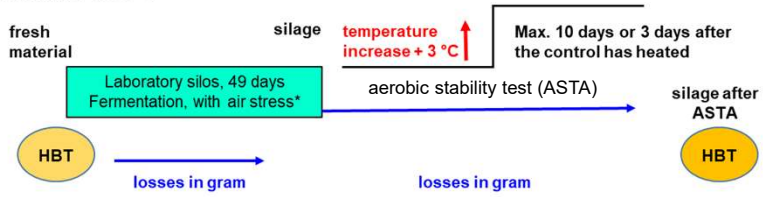
➡main losses during harvest, fermentation and feeding

AC 6 test schemes (→methane yield)

Procedure test 1



Procedure test 2



* air stress: full-day exposure to air on the 28th and 42th day of fermentation

AC 6: Determination of methane yield of treated + untreated silage with the 'Hohenheimer Biogas Yield Test' (HBT, *in vitro* assay)

129 glass syringes (100ml) in a rotor for 48 h at 37□

per syringe:
30 g inoculum (sewage)
0.300 – 0.800 g FM silage

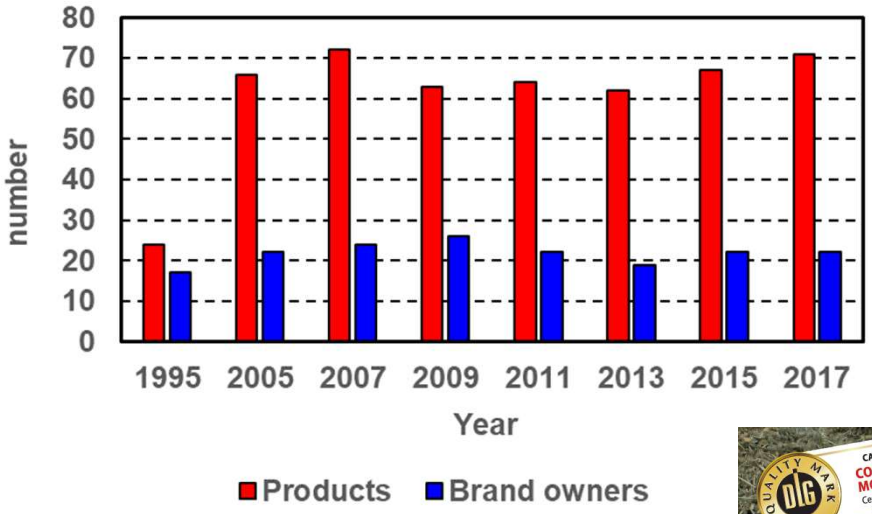
3 repetitions incl.3 blanks + 3 reference samples

produced gas volume read on each syringe

methane conc. in gas analysed and volumes corrected to NPT

HBT method:
Landtechnik 58(3): 148-149
Eng. Life Sci. 12(3): 270-278

Products and brand owners with a DLG Quality Mark



Products with a DLG Quality Mark 2017

Action category	Chemical products	Inoculants	Combinations chem. + Inoc.	Total (Σ 158)
1 a	7		1	8
1 b	3	23	2	28
1 c	1	13	1	15
1 d				-
1 e				-
2	14	22	2	38
3				-
4 a	4	15		19
4 b		20		20
4 c - Dairy		16		16
4 c - Meat		6		6
5	5	1		6
6 a				-
6 b		2		2
6 c				-

Osmotolerance

All biological ensiling agents are additionally tested for osmotolerance during the annual quality test. Lactic acid bacteria with a low osmotolerance do not perform well in high DM silages such as in AC1c.

Where the detected osmotolerance levels in products certified for action category 1c are below 30% of the declared microbial counts over three consecutive years, the respective manufacturer is advised accordingly.

The osmotolerance-test or “Rostock Fermentation Test” (RFT) is an *in vitro* test using forage juice in test tubes.

Comparison of the German DLG and the French INRA schemes

Laboratory silos 1,5 l **or** **4 m³ silo**
3 repetitions **1 repetition**

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Comparison of the German DLG and the French INRA schemes

In 1994 and 1995 comparative ensiling trials with the same forage and the same wilting degree were carried out in Theix, France, for a direct comparison between the DLG and INRA schemes. In 1995, Switzerland joined in on the comparison.

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Comparison of the German DLG and the French INRA schemes

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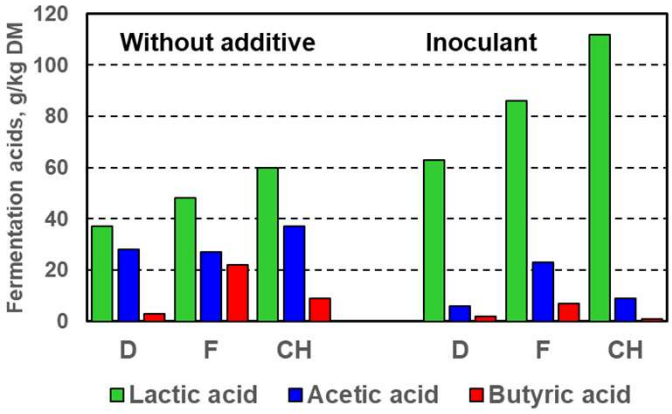
Comparison of the German DLG and the French INRA schemes

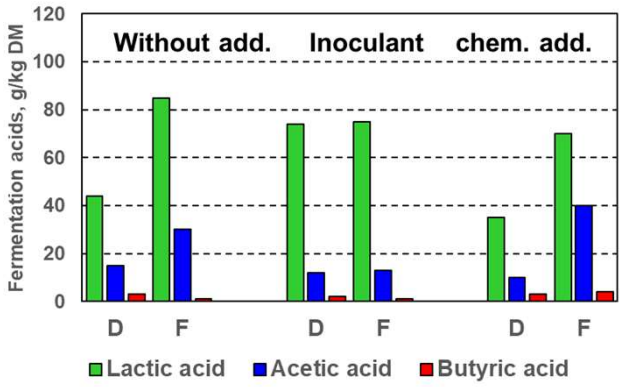
Results of trial 1 in 1995 – ryegrass, second cut, 25% DM, 84 g crude protein/kg DM and 120 g WSC/kg DM
D: Germany; F: France; CH: Switzerland



Comparison of the German DLG and the French INRA schemes

Results of trial 2 in 1995 – ryegrass, second cut, 25% DM, 80 g crude protein/kg DM and 122 g WSC/kg DM

D: Germany; F: France



Comparison of the German DLG and the French INRA schemes

➡ **In general, the aim of the silage additive testing system was fulfilled with both methods.**

Testing silage additives in round bales 2010 and 2011

Trials in Germany

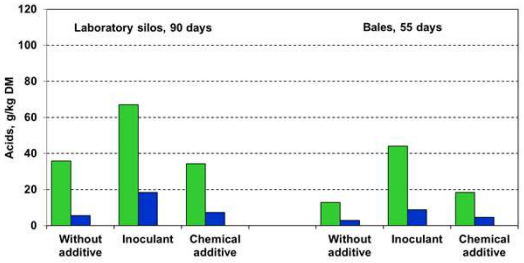
Trials in Sweden

Trials in Switzerland

Testing silage additives in round bales – trial 2010

Silage quality
silages from Sweden

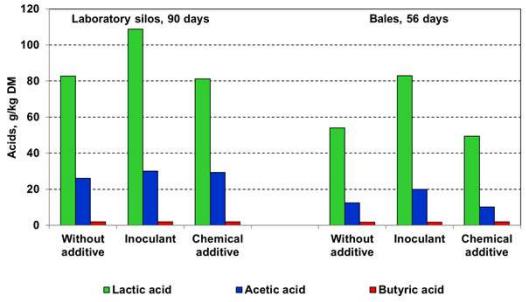
DM 50.2%
Crude protein 116 g/kg DM
NDF 495 g/kg DM
WSC 153 g/kg DM



Silage quality
silages from Switzerland

DM 38.0%
Crude protein 195 g/kg DM
Crude fibre 214 g/kg DM
WSC 145 g/kg DM

Laboratory silos: chopped forage
Bales: unchopped forage



Testing silage additives in round bales – trial 2011

Stress 1
Laboratory silo
2 holes diameter 6 mm
opened for 24 h one
week before opening
silos

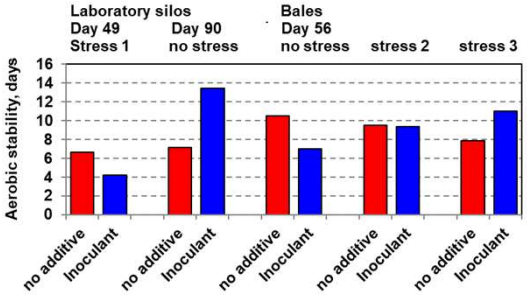
Stress 2
Bales
4 holes diameter 20 mm
opened for 24 h one
week before opening
silos

Stress 3
Bales
20 holes diameter 2 mm
were made with a nail
one week before opening
silos

Testing silage additives in round bales – trial 2011

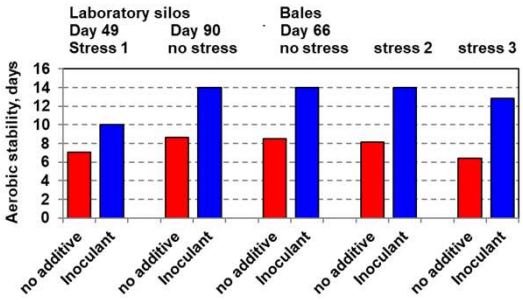
Aerobic stability of the silages from Germany

DM 37.1%
Crude protein 128 g/kg DM
Crude fibre 290 g/kg DM
WSC 98 g/kg DM



Aerobic stability of the silages from Switzerland

DM 40.6%
Crude protein 147 g/kg DM
Crude fibre 231 g/kg DM
WSC 167 g/kg DM



Testing silage additives in round bales – trial 2011

The experiments indicated that silage additives can be tested in round bales when treated and untreated forages have the same DM content and when silage additives have been applied evenly and at the targeted dose. Furthermore, it is possible to expose round bales to an air stress treatment and thereby create more suitable conditions (i.e. aerobically instable controls) for the testing of silage additives

Conclusions

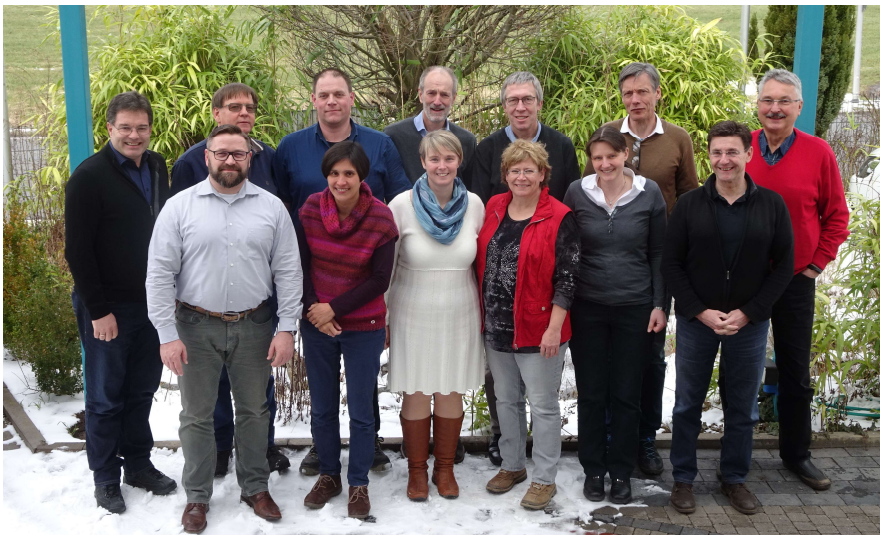
In the period between 1979 and 1995 several national silage additive approval schemes appeared in Europe. Today only two approval schemes are still in use, the EU authorization of additive components (compulsory) and the German DLG approval scheme of complete additives (voluntary).

The DLG approval scheme has a more consumer-oriented approach and can test complete additives under a rather large variety of conditions.

Comparative trials between the German and the French approval schemes showed that the aim of the silage additive testing system was fulfilled with both methods.

Guidelines for the test of silage additives should not be static but should be updated regularly to meet new arising challenges. The DLG Commission for Silage Additives investigates currently the possibility to introduce new test protocols for: a) silage additives, which show a positive response after a shorter storage time (AC2), b) silage additives that reduce the extent of protein degradation during ensilage or c) TMR additives, which extend the aerobic stability of total mixed rations (TMR)

DLG committee for silage additives



Thank you for your attention