



A CENTURY OF SILAGE QUALITY INDICES AND CURRENT CHALLENGES

Siriwan D. Martens¹ and Christof Löffler²

¹Saxon State Office for Environment, Agriculture and Geology, Köllitsch, Germany

²Agricultural Centre Baden-Württemberg (LAZBW), Aulendorf, Germany

siriwan.martens@lfulg.sachsen.de



Fig. 1. Prof. Werner Kirsch (1901-1975)

Introduction

- The advancing adaptation of ensiling as a measure of forage conservation in the first half of the last century entailed the question of quality criteria for this novel feed in Europe.
- The development of silage evaluation is shown with a focus on the German speaking area.
- Current challenges are named and approaches offered.

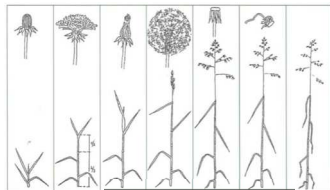
History

The aim of silage evaluation was to determine:

- The fermentation quality to explain the conservation process and to get indications on the palatability, digestibility, and feed value.
- The nutrient content and composition, which should ideally be evaluated in the farm animal → "true" feed value.

The evaluation by

- senses** of colour, smell, structure, DM content
- chemical** analysis of protein quality and losses, losses of energy, fermentation acids, ethanol and ester
- botanical** description (composition, phenological stage, origin, degree of wilting, chop length)



- bacteriological** analysis (total number of germs, type of bacteria, degree of moulding, stability)
- feeding** trials (intake, gain/loss in milk/meat, health effects, fertility, faeces)

was discussed already in the 1920s even though the analytical possibilities were limited (Kuchler 1926).

Chronology (Table 1):

- Late 1920s: probably first scoring system invented by Werner Kirsch (Fig. 1) based on sensory assessment: "Königsberger Schlüssel".
- 1938: W. Lepper (Augustenberg) standardized the determination of lactic, acetic and butyric acid. Oscar Flieg (Agricultural Experimental Station Limburgerhof, I.G. Farbenindustrie, later BASF) included these fermentation acids in the "Flieg Schlüssel".

Königsberger Schlüssel zur Beurteilung der Gärfutter:					
A. Äußerer Befund. Sinnesprüfung, Höchstpunktzahl 15.					
a) Farbe	0-4 Punkte				
b) Geruch — Geschm.	0-7 Punkte				
c) Gefüge (Struktur)	0-4 Punkte				
B. Analytischer Befund. Chemische Untersuchung, Höchstpunktzahl 20.					
Säurewert (pH)	bis 4 Punkte	4,01—4,25	3 Punkte		
unter 3,00	0 Punkt	4,26—4,50	2 Punkte		
3,00—3,30	1 Punkt	4,51—5,00	1 Punkt		
3,31—3,50	2 Punkte	über 5,00	0 Punkt		
3,51—4,00	4 Punkte				
Gesamtessigsäure	bis 4 Punkte	Gesamtbuttersäure	bis 12 Punkte		
bis 0,40%	4 Punkte	bis 0,05%	12 Punkte		
0,41—0,60%	3 Punkte	0,06—0,15%	10 Punkte		
0,61—0,80%	2 Punkte	0,16—0,25%	8 Punkte		
0,81—1,00%	1 Punkt	0,26—0,35%	4 Punkte		
über 1,00%	0 Punkt	0,36—0,50%	2 Punkte		
		über 0,50%	0 Punkt		
Aus der Summe der erreichten Punkte ergibt sich folgender Bewertungsmaßstab:					
sehr gut	92—95 Punkte				
gut	88—91 Punkte				
befriedigend	84—87 Punkte				
mäßig	78—83 Punkte				
schlecht	unter 78 Punkte				

Fig. 2. Combination of Königsberg and Flieg evaluation keys published in the Book of Methods by the Association of German Agricultural Analytic and Research Institutes (VDLUFA 1951)

Summary & Outlook

- Silage quality evaluation was recognized very early as a key for improvement in ensiling practice
- Awareness of complexity despite limited analytical tools at that time
- Analytical progress allowed for development of broader scoring systems
- Nowadays, rapid methods at low cost available
- However, physical aspects need more attentiveness. A more holistic evaluation system is crucial to enhance ensiling management.

- 1951: the Königsberg key was supplemented by pH, acetic and butyric acid and published in the Book of Methods (VDLUFA, Fig. 2).
- 1959: first DLG key for sensory evaluation. Ernst Zimmer highlighted the importance of the smell in the scoring system.
- 1966: Flieg-Zimmer key based on chemical evaluation. Presence of butyric acid strongly downgraded the fermentation quality score. Low acetic acid and high lactic acid content desired.
- In the 1970s, in the then German Democratic Republic, extension of Flieg score: pH evaluation depending on dry matter content plus $\text{NH}_3\text{-N}$ in relation to crude protein indicating protein degradation: "Lettiner Schlüssel" in 1983.
- After German reunification, keys revised in the 1990s, adapted to the increased practice of higher wilting and concomitant mould occurrence as well as growing use of biological ensiling agents, limiting butyric acid fermentation: DLG keys. Updates in 2004 (sensory) & 2006 (chemical).

Dr. Walter Schmidt
Dr. Harald Beyrich
Zentralstelle
für Futtermittelprüfung
Halle-Lettin

Table 1. Chronology of the silage quality keys developed with different foci

Year	Key	Authorship	Sensory	Chemical
Late 1920s	Königsberg	Kirsch	X	
1932	Stollenwerk-Siebold	Stollenwerk		X
1938	Flieg	Flieg		X
1951	Königsberg+Flieg	VDLUFA*	X	X
1959	DLG**	Zimmer	X	
1966	Flieg-Zimmer	Zimmer/DLG/VDLUFA		X
1983	Lettin	Schmidt, Beyrich	X	X
1988	GDR***	Weissbach, Reuter	(X)	X
1992	DLG	Weissbach, Honig		X
1997	DLG	Weissbach, Honig		X
2004	DLG	DLG	X	
2006	DLG	DLG		X

*VDLUFA Association of German Agricultural Analytic and Research Institutes; **DLG German Agricultural Society; ***GDR German Democratic Republic

CHALLENGES

There have been changes in agricultural practice in the last decades, which present a challenge for silage quality assessment, such as:

- Large stockpiles in huge silos, e.g. for biogas plants
- Powerful harvesting technology in conflict with needed time for compacting
- Different forage species and cultivars
- High quality demands for high performing dairy cows
- Total mixed ration including silage as dominant type of year round feed presentation

These and other more recent phenomena with their side effects require special consideration in silage troubleshooting.