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Silage — Specification

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This African Standard was prepared by ARSO/TC WG 17, Animal feeding, feeds and feeding stuff

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Introduction

In modern ruminant animal husbandry, forage crops are harvested at a stage when yields and nutritional value are optimal; they are then preserved in order to ensure a continuous and consistent supply throughout the year. The major goal of preservation is to retain the highest possible proportion of the original nutritional value of the feed during storage. Ensiling is a preservation method for moist forage crops. It is based on solid-state lactic acid fermentation under anaerobic conditions whereby lactic acid bacteria (LAB) convert water-soluble sugars into organic acids, mainly to lactic acid. As a result the pH decreases, and the moist crop is preserved. Air is detrimental to silage because it enables plant respiration and the activity of aerobic spoilage microorganisms such as yeasts and moulds. It is possible to ensile almost any plant material including plant by-products. The most important crops for ensiling worldwide are whole-crop, corn/maize, alfalfa and various grasses. Other crops include whole-crop wheat, sorghum and various legumes.

Silage is used to feed several animals, including cattle, buffaloes, goats, sheep, and camel. Feeding ruminant animals with silage helps produce better wool, meat, milk, and other products. Harmonizing standards for silage encourage stakeholders in the value chain to adhere to safety and quality standards. This raises the safety and quality characteristics of the produced silage, which promote trade exchange between African countries and facilitates export operations outside Africa, as well as has a positive impact on the quality and safety of animal products. Therefore, this standard contains the technical requirements on safety and quality of silage as animal feed.

Silage — Specification

1 Scope

This Draft African Standard specifies the requirements, sampling and test methods of silage for feeding ruminant animals.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CDARS 2139 Code of practice on good animal feeding

CDARS 1828 – Code of practice for production, processing, storage, transportation and distribution of animal feed.

ISO 6496, *Animal feeding stuffs — Determination of moisture and other volatile matter content*

ISO 6497, *Animal feeding stuffs — Sampling*

ISO 6654, *Animal feeding stuffs — Determination of urea content*

ISO 6869, *Animal feeding stuffs — Determination of the contents of calcium, copper, iron, magnesium, manganese, potassium, sodium and zinc — Method using atomic absorption spectrometry*

ISO 14718, *Animal feeding stuffs — Determination of aflatoxin B_1 content of mixed feeding stuffs — Method using high-performance liquid chromatography*

ISO 16634-1, *Food products — Determination of the total nitrogen content by combustion according to the Dumas principle and calculation of the crude protein content — Part 1: Oilseeds and animal feeding stuffs*

ISO 16050, *Foodstuffs – Determination of aflatoxin B1 and the total content of aflatoxins B1, B2, G1 and G2 in cereals, nuts and derived products – High-performance liquid chromatographic method*

ISO 17375, *Animal feeding stuffs — Determination of aflatoxin B_1*

ISO 27085, *Animal feeding stuffs — Determination of calcium, sodium, phosphorus, magnesium, potassium, iron, zinc, copper, manganese, cobalt, molybdenum, arsenic, lead and cadmium by ICP-AES*

CODEX STAN 192, *General standard for food additives*

CODEX STAN 193, *General standard for contaminants and toxins in food and feed*

EN 13207 - Thermoplastic silage films and tubes for use in agriculture

EN 14932 - Thermoplastic stretch films for wrapping silage bales.

3 Terms and definitions

For the purpose of this standard the following terms and definitions apply.

3.1
silage
feed from an anaerobic fermentation process of sugars in forage with a high moisture content and that is preserved in succulent condition

3.2
feed additive
substance intentionally added to silage and/or water, not consumed as feed by itself, whether or not it has a nutritional value, that affects the characteristics of silage including organoleptic properties, animal products, animal production, performance, welfare, and the environment

3.3
crude protein
CP
total protein content of a silage which is determined by analysing the nitrogen content of feed and multiplying the result by a factor

3.4
feed
feeding stuff
single or multiple materials, whether processed, semi-processed or raw, and whether or not containing additives, for oral animal feeding

3.5
feed ingredient
component part or constituent of any combination of mixture making up a feed, whether or not it has a nutritional value in the animal's diet, including feed additives
3.6
moisture content
mass fraction of substances lost on drying the sample by using the accredited procedure

3.7
undesirable substances
contaminants and other substances, which are present in feeds, feed ingredients and which constitute a risk to the health of consumer, including food safety related animal health issues

4 Requirements

4.1 General requirements

4.1.1 All harvested crops and raw materials shall be palatable, of good quality and shall be of sound condition and not deteriorated. Annex A provides further information on some plants that may be used for silage.

4.1.2 Silage shall be free from;

a) metallic and glass objects
b) adulterants
c) physical moulds
d) insect infestation
e) mustiness
f) any objectionable odours

4.1.3 Silage shall not contain any hormones or growth factors that are prohibited internationally.

4.2 Natural properties

4.2.1 Silage shall have a distinctive smell and a pleasant acidic taste that is not bitter.

4.2.2 The colour shall range from dark yellow to greenish-brown, and it shall be free of black and burnt brown.

4.2.3 Silage shall be regular and uniform in moisture content.

4.3 Types of silage

The Silage may be of the following types:

a) Grass silage eg. corn, sorghum, elephant grass
b) Legumes silage eg. Alfalfa
c) Mixed silage

4.4 Specific requirements

Silage shall conform to the requirements in Table 1 when tested with the methods specified therein.

Table 1 — Specific requirements for silage

Parameters	Limits	Test methods
Dry matter, %	30 - 35	ISO 6496
pH value	3.5 - 5	Annex C
Lactic acid, %	3 - 10	
Propionic acid, % (max.)	0.1	
Acetic acid, %	0.5 - 3	
Butyric acid, % (max.)	0.2	
Ethanol, %	0.5 - 3	
Ammonia nitrogen (NH_3-N), % of total N (max.)	10	

5 Feed additives

Additives in the following categories may be used in silage: antioxidants, colourants, emulsifiers, stabilisers, thickeners and gelling agents, binders, anti-caking agents and coagulants, aromatic and appetising substances, and preservatives. Further information on the classification of additves and supplements have been provided in Annex B

NOTE Material intended for mixing with animal feed as additives for use as feeding stuff should specify the kind of and, if appropriate the age group of the animal for which the feed is intended. In addition, the quantity in grams per kilogram (or % by weight) of the complete feed which conform to the provisions of this standard should be stated in the label.

No antibiotic substance or drug may be added to or included in a feed.

Where a consignment or a batch of feed or concentrate is prepared specifically for a consumer or group of consumers, substances may be added upon the express written instructions of the consumers provided that:

a) such additions are made in accordance with the provisions of the competent authority and / World Organization for Animal Health (WOAH), and

b) the nature and quantities of such additions are clearly stated upon each and every container of the feed or concentrate.

c) Annex D provides further information on the additives requirements for silage.

6 Contaminants

6.1 Aflatoxins

Silage shall comply with the maximum limits for aflatoxins specified in Table 2 when tested with the methods specified therein.

Table 2 — Aflatoxin limits for Silage

S/N	Aflatoxin	Maximum limits µg/kg	Test method
i	Total aflatoxins	20	ISO 16050
ii	Aflatoxin B1	10	ISO 17375

6.2 Heavy metals

Silage shall comply with the maximum limits of heavy metals specified in Table 3 when tested with the methods specified therein.

Table 1 — Heavy metals limits for Silage

S/N	Heavy metals	Maximum limits mg/kg	Test method
i	Arsenic	4.0	ISO 27085
ii	Lead	3.0	
iii	Cadmium	1.0	
iv	Mercury	0.1	

6.3 Pesticide residues

Silage shall not exceed the limits of pesticide residues established in the Codex Alimentarius Commission on pesticides (Codex online database – Pesticide database).

7 Hygiene, Storage, Receiving and Transportation

Silage shall be produced, transported, received and stored in accordance with the procedure described in the appropriate sections of FDARS 1828 and FDARS 2139

8 Packaging and Labelling

8.1 Packaging

8.1.1 Silage shall be packaged in containers strong enough and sufficiently sealed to withstand reasonable handling without tearing, bursting or opening.

8.1.2 Containers shall be clean and for single use.

8.1.3 Silage shall be packed in the form of bales and bags.

8.1.4 Silage shall be firmly packed to minimize the oxygen content to prevent spoilage. The thermoplastic used in packaging silage shall conform to the specifications in EN 13207 and EN 14932.

8.2 Labelling

Each package of silage shall be legibly and indelibly marked with the following information:

a) name and type of the Silage;
b) name, physical address or contact information of manufacturer/producer;
c) Quality requirements
d) list of feed ingredients and their percentages, including appropriate reference to additives;
e) urea percent, if present;
f) instruction for storage;
g) directions and precautions for use,
h) batch or Code number;
i) net weight in SI units;
j) country of origin;
k) date of manufacture; and
l) best before date.

9 Sampling

In addition to the sampling requirement indicated in Annex C, samples shall be done in accordance with the requirements of ISO 6497.

Annex A
(informative)

List of some Plants that are commonly used in silage

a) Corn / maize
b) Sorghum (Milo)
c) Barely
d) Wheat
e) Oat
f) Triticale
g) Milt
h) Permudagrass and stargrass
i) Limpograss (*Hemarthria*)
j) Other improved perennial grasses
k) Sudangrass and sorghum x sudangrass hybrids
l) Pearl millet
m) Small grains and ryegrass
n) Alfalfa
o) Soybean
p) Clover
q) Safflower
r) Red clover and other cool-season legumes
s) Sunn hemp
t) hairy indigo,
u) alyceclover,
v) *Aeschynomene*, and
w) rhizoma perennial peanut
x) Guinea grass
y) Mixed grasses
z) Lablab
aa) Buffel grass

Annex B
(informative)

Classification of feed additives and supplements

Feed additives for silage may be classified under three main groups:

a) Additives that activate the fermentation process (e.g. molasses, grains, bacterial/yeast inoculants, enzymes and acids to help increase acidity and the fermentation process)
b) Additives that inhibit undesirable fermentation (e.g. organic acids and their salts)
c) Additives that enhance nutritional value (e.g. grains, mineral salts, limestone, salt).

Annex C
(informative)

Assessment of silage nutritional quality

C.1 Sampling

Collecting a representative sample on farm is vital if the laboratory analysis is to reflect what is actually being fed. To help ensure representative samples are taken, the following key procedures are recommended:

Wait at least six weeks after harvesting before sampling silage, to ensure fermentation has completed.

Representative samples should be made by taking 1 kg - 5 kg of silage from different locations of the freshly open front silo. Avoid taking samples from the periphery of the silo and from mouldy or damaged parts. The face of the silo gives a better sample of the silage the animals are actually eating.

Samples should be thoroughly mixed and if the final sample has to be reduced before being sent to the laboratory, it should be prepared by the quartering method outlined below:

a) Tip the sample onto a clean surface such as a clean board or worktop. Rough concrete is not suitable;
b) Thoroughly mix the sample ensuring an even distribution of material;
c) Using a clean board or card, halve the sample by dividing across the pile and separating into 2 piles. If one pile is approximately 1 kg, carefully place this into a clean plastic bag ensuring all the material in the pile is included;
d) After placing in the plastic bag, remove as much of the air as possible by squeezing the bag, and seal. This will help reduce silage changes during transport and make your analysis more accurate;
e) Label the bag clearly with sample number, forage mixture, stage of maturity and date harvested, and store immediately in a cold place, preferably in a freezer to prevent bacterial decay, until analyzed.

C.2 Silage Quality Assessment

Figure 1 presents the different steps of silage nutritional quality assessment. There are two major procedures:

i. Assessment of fermentation quality and

ii. Conventional feed analysis. The latter has similarities to the general methodology of feed analysis procedures already described. Focus will be made on fermentation quality assessment. Special mention is made for dry matter that needs to be corrected for volatile components including ammonia and volatile organic acids (acetic, propionic, butyric, isobutyric).

C.3 Dry Matter (DM)

This is the material left after all water has been removed by drying. Values given are ‘corrected values’ to allow for volatile fatty acids and other components lost during oven drying.

DM = 100–MC

Where

-MC: sample moisture content in %

-%MC = W1–W2

-Wsi: weight of the sample in gram

-Wsf: weight of the sample after drying at 105 °C in air-circulation oven and up to constant weight in gram

-W1 = (100×Wsf)/Wsi

-W2: Weight of volatile acids in %

C.4 Extraction of Silage "Juice"

Silage "juice" extraction is made on fresh or frozen samples. Frozen samples should be kept in tight bags and left in room temperature (15 °C - 20 °C) overnight. Juice may be extract by pressing or maceration.

Maceration is recommended because pressing is not applicable for silages with high dry matter contents. The following procedure is recommended:

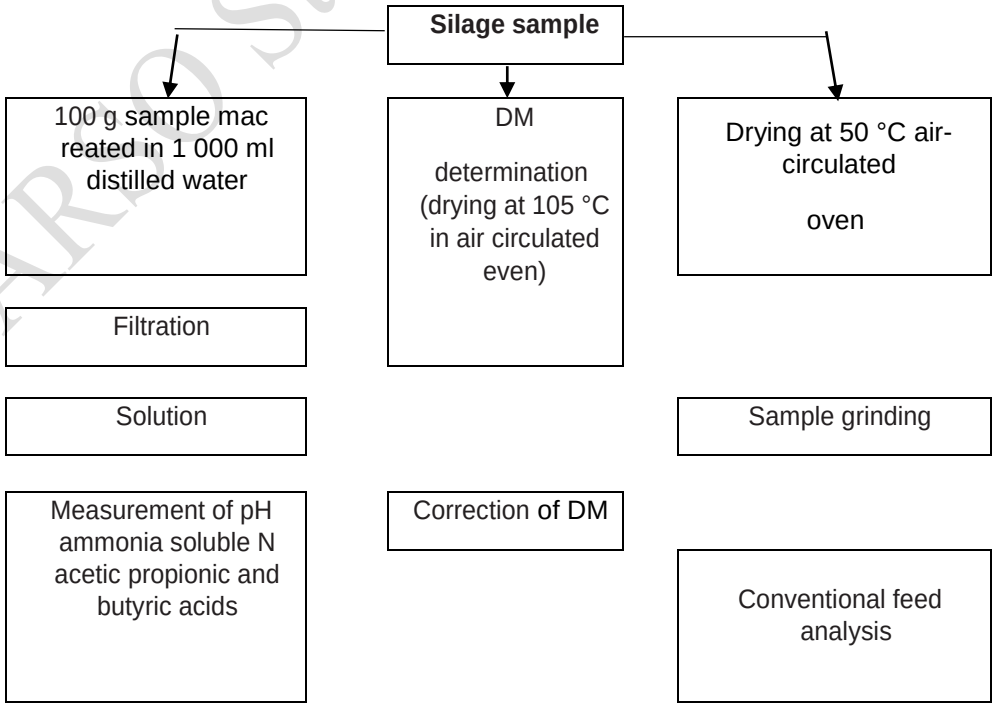
i. 200 g of wet silage sample are weighed in a 1-L beaker to which 1 L of distilled or de–ionized water is added. Mix carefully and leave overnight at 4 °C

ii. Blend the sample for 2 min and filter through coarse (20 µm – 25 µm particle retention) filter paper.

The extract will be used to determine pH, ammonia, volatile fatty acids (Acetic, Proprionic, Butyric, & Iso–butyric acids) and lactic acid.

C.4.1 pH

pH is a key criterion to evaluate silage fermentation. Generally, the lower the pH, the better preserved and more stable is the silage.



Assessment of fermentation quality

Figure 1 — Major steps in silage nutritional quality assessment

Haylage should reach a final pH of around 4.5 and corn silage near 4.0. The pH of the forage alone is not a good indicator of the quality of the silage, or the type of fermentation that occurred. Forages ensiled at moisture levels greater than 70 % may develop large populations of clostridia bacteria, which produce butyric acid rather than lactic acid. This may result in sour silage with a pH of 5.0 or above.
pH is measured directly using a conventional digital pH meter.

C.4.2 Ammonia

Ammonia Nitrogen (NH3) N shows the proportion of N (including protein) that has been broken down during ensilage and is the best indicator of silage fermentation. A value <50 g/kg N indicates an excellent fermentation, a stable silage and minimal nutrient loss. Values >150g/kg indicate a poor fermentation.
The methodology used is adapted from Weatherburn (1967).

C.4.2.1 Reagents/Solutions

Solution A

- Phenol (6 B4): 10 g/l
- Sodium nitroprusside with FeIII (4A1): 0.05 g/l (0.05687 if it's dehy- drated)

Solution B

- Na OH: 5 g/l
- NaClO: 8.4 ml/l
- If using NaClO (commercial containing 40 g of active Chlorine per liter): 10.5 ml are needed, equivalent to 0.42 g of NaClO)

C.4.2.2 Preparation of ammonia solution (100 µg N–NH4 / ml)

- Dry the (NH4)2SO4 at 105 °C in an oven for one hour
- Dissolve 4 714 g of the previous dry reagent in 1 000 ml of distilled water
- Using the basic solution of ammonia, prepare a solution containing 10 µg of N–NH4/ml (add 99 ml of water to 1 ml of the basic solution of ammonia)
- Prepare a standard curve using the previous solution (10 µg (NH4)2SO4 /ml), as follows: put 0, 1, 2, 4, 6, 8 and 10 ml of the solution in 7 test tubes, adjusting the volume to 10 ml with distilled water. Stir the tubes.

C.4.2.3 Silage extract conditioning

- Pipette 5 ml of the silage extract in a centrifugation tube, keeping it cold on ice
- Centrifuge at 4 000 rpm for 20 min at 4 °C
- Take 0.1 ml from the supernatant and add 4.9 ml of distilled water. Stir and keep cold on ice.

C.4.2.24 Procedure

- Take 1 ml of each tube from the standard curve and the unknowns
- Add 5 ml of solution A and stir
- Add 5 ml of solution B and stir
- (Up to this step, keep the samples on ice)
- Prepare a blank containing 1 ml water, 5 ml of solution A and 5 ml of solution B

- Incubate at 37 °C for 20 min. Optionally, keep at 20 °C or more, for at least 30 minutes
- Read with the spectrophotometer at 625 nm
- Make a standard curve using the concentrations of N–NH4 in µg / ml as abscissas and the optical density as the ordinates
- From the calibration curve, calculate the concentration of the unknown samples, by interpolation.

The ratio ammonia nitrogen/total nitrogen is used as indicator of the fermentation quality.

C.5 Determination of volatile fatty acids

C.5.1 Total fermentation acids (TFA) – the total amount of acid produced during fermentation. It includes lactic, butyric and acetic acids, and may also extend to propionic acid and ethanol.

C.5.2 Volatile fatty acids (VFA) – will be high when fermentation is poor. The undesirable VFAs are butyric and, to a lesser extent, acetic acid. These are associated with high total VFA and give a distinctive and persisting smell to badly made silages.

C.5.3 Acetic acid – is looked upon as a normal constituent of silage, but less desirable than lactic acid. High levels can restrict intake.

C.5.4 Butyric acid – production indicates poorly fermented silage. This can be produced under anaerobic conditions due to a variety of factors including high soil contamination, slow rate of fermentation, low DM content and secondary fermentation. The butyric acid content will often be added to the acetic acid content, termed total volatile fatty acids VFA s, and expressed as a percentage of total fermentation acids (TFA).

C.5.5 Better quality silages with low acetic, ammonia–N, butyric and high lactic and sugars are more prone to aerobic spoilage.

C.6 Procedure

The methodology used is based on the one developed by Jouany (1981).

C.7 Sample preparation

The silage juice should be stabilized immediately. For this purpose, the following steps are recommended:

- Preparation of a conservation reagent: a solution is prepared byadding ortho H_3PO_4 (5 % v/v) and $HgCl_2$ (1 % w/v)
- To 10 ml of silage juice add 1 ml of the conservation reagent.
- Store at –15 °C in a deep freezer
- Prior to analysis, fresh or frozen samples are centrifuged at 2 000 rpm for 5 min at 4 °C.

C.8 Chromatography

- Equipment: Gas chromatograph equipped with flame ionization detector. The column is made of glass, 1.5 m long and with an internal diameter of 2.17 mm. The column is filled with chromosorbW–AW–60 – 80 mesh, and impregnated with 10 % (w/w) SP 1200 (Supelco) and 1 % (w/w) ortho H_3PO_4. It is conditioned at 160 °C overnight with a nitrogen flux of 30 ml/min.
- The analysis is conducted by injecting 1 ml sample (including theconservation reagent) to which is added 0.1 ml of internal standard composed of 1% (w/v) 4–methyl valeric acid.
    - Working conditions:
        - N_2 (vector gas): 30 ml/mn.

- H_2 (detector): 40 ml/mn.
- Air (detector): 400 ml/mn.
- Temperature: 125 °C (oven), 155 °C (detector), 165 °C (injector).
- Volume of the sample to inject: 5 µl.

C.9 Calculations

VFA analysis is based on (i) A standard solution (solution A) and an internal standard, which help determine the "response factor" used for calculation.

Determination of the response factor

The following formula is used to calculatete response factor (Ka)

Ka = (Sa/S)/(1/Ca)Where:
Ka: response factor of component "a".
Sa:pic surface of component "a"
S" pic surface of the internal standard
Ca: concentration of component "a" in the standard solution "A"

The composition of standard solution "A" is as follows:

- Acetic acid (C_2) 6.00 g
- Propionic acid (C3) 1.00 9
- Isobutyric acid (IC_4) 0.125g
- Butyric acid (C_4) 1.75 g
- Isovaleric acid (IC_5) 0.25 g
- Valeric acid (C_5) 0.25 g

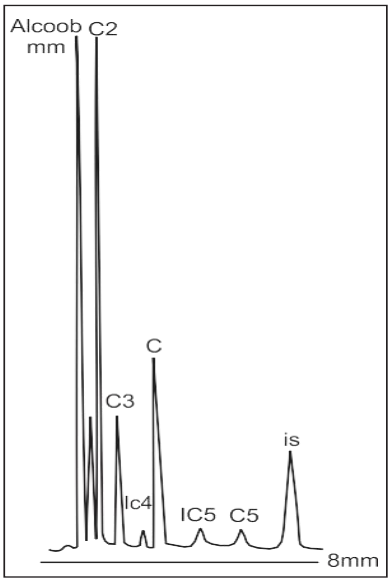


Figure 43. Typical chromato-gram of silage juice (C2: acetic acid; C3: propionic acid; IC4: Iso-butyric acid; C4: butyric acid; IC5: Iso- valeric acid; C5: Valeric acid; IS: Internal standard

After injecting the silage sample, VFA contents are determined according to the formula:
Ca = (Sa/S)/(1/Ka)

Where

Ca: concentration of component "a" in the silage sample
Sa: Pic surface of component "a" of the silage sample
S: Pic surface of the internal standard injected concomitantly with thesilage sample
Ka: Response factor of component "a"
References: Jouany JP. 1981.

C.10 Lactic Acid

Lactic acid gives an indication of the quality of forage fermentation, being produced almost exclusively by the lactobacilli responsible for good silage fermentation and effective preservation. Grass silages typically have lactic acid contents of 60–150 g/kg, higher values suggesting more rapid fermentation, better protein preservation and less likelihood of fermentation of by-products that reduces intake. Like butyric acid, lactic acid contents maybe expressed as a proportion of the total fermentation acids; higher levels indicating better fermentations, and values over 70% TFA being ideal.
Lactic acid should be the primary acid in good silage. This acid is stronger than other acids in silage (acetic, propionic and butyric) and thus usually responsible for most of the drop in silage pH. Secondly, fermentation that produces lactic acid results in the smallest loss of dry matter and energy from the crop during storage.

1. **Some common reasons for low lactic acid content are as follows:**

- Restricted fermentation due to high DM content (especially legumes and grasses with >50% DM)
- Restricted fermentation due to cold weather
- Sample taken after considerable aerobic exposure that has de-graded lactic acid
- Silages high in butyric acid (Clostridial silages) are usually low inlactic acid.

C.11 Determination of lactic acid in silage juice

The method suggested uses a simple colorimetric assay based on the method developed by Barker and Summerson (1941), and modified by Kimberley and Taylor in 1996.

In this method, acetaldehyde is released from lactic acid by hot sulfuric acid. The acetaldehyde is reacted with copper and p–phenylphe- nol (pPP) to yield a chromagen, which absorbs at 570 nm.

C.12 Reagents/Solutions

- Concentrated H_2SO_4 (96 %)
- 4 % CuSO4.5H_2O in dd H_2O
- 1.5 % p–phenylphenol in 95 % ethanol.

C.13 Development of the standard curve

To develop a lactic acid standard curve:
• Add 0 to 30 micrograms of lactic acid to 16 mm × 150 mm borosilicate tubes. The curve should be in 5–micrograms increment or less
• Add 3 ml of concentrated H_2SO4 and mix with a vortex mixer. This quantity of acid is defined here as 82% acid.
• Incubate at 95 °C – 100 °C for 10 min in a steam water bath
• Cool at room temperature using a water bath.
• Add 50 µl $CuSO_4$ reagent and then 100 µl of pPP reagent; mix well on vortex mixer keeping the tube at room temperature
• Leave the tubes at room temperature for at least 30 min and then read absorbance at 570 nm
• Blanks will show values of 0.2 – 0.5 compared to water.

The typical assay involved 1 ml of silage juice sample to which reagents and procedures described above for the standard curve are applied. Absorbance obtained is plotted against the standard curve to calculate the amount of lactic acid.

C.14 Assessment of silage quality using fermentation end products

The following table summarizes normal values for pH, ammonia, volatile fatty acids and lactic acid in different silage types. These values will help assessing silage quality.

Table 2 — Recommended values for quality assessing for ensiled forage sample fermentation

Item	Corn silage	Alfalfa silage	Grass silage	(+) or (-) effect	Action(s)
pH	3.7- 4.2	4.3 - 4.5	4.3 - 4.7	+	Low pH inhibits bacterial activity
Ammonia N% total N	5-7	10-15	8-12	-	High levels indicate exces- sive protein breakdown

Lactic acid	4-7	7-8	6-10	+	Inhibits bacterial activity by lowering pH
Butyricacid	0	<0.5	<0.5	-	Associated with protein degradation, toxin formation, and large losses of dry

Annex D
(informative)

Additives used in silage

D.1 Requirements for antioxidants

Goats and sheep feed shall contain no added antioxidant other than an antioxidant of a name or description specified in the first column of the table below, where an antioxidant if added should not exceed the maximum content, if any, specified in the second column of the Table 3.

Table 3 — Requirements for antioxidants in goats and sheep feeds

Name or description	**Maximum content in complete feed stuff,** mg/kg
L-Ascorbic acid Sodium L-ascorbate Calcium di (L-ascorbate) 5,6-Diacetyl-L-ascorbic acid 6-Palmitoyl-L-ascorbic acid Tocopherol-rich extracts of a natural origin Synthetic alpha-tocopherol Synthetic gamma-tocopherol Synthetic delta-tocopherol	According to the recommendation of GMPs
Propyl gallate Octyl gallate Dodecyl gallate	100, singly or in combination
Butylated hydroxyanisole (BHA)	150

D.2 Requirements for colourants in goats and sheep feed

Goats and sheep feed shall contain no colorant other than a colorant named or described in Table 4 in accordance with the maximum content specified.

Egg yolk colouring or flavourings designed to improve the palatability of the feed may be included at the manufacturer's discretion.

Table 4 — Requirements for colorants in goats and sheep feeds

Name or description	**Maximum content in complete feed, mg/kg**
Patent Blue V Acid brilliant green BS	No limits

D.3 Requirements for emulsifiers, stabilisers, thickeners and gelling agents

D.3.1 General

Goats and sheep feed shall contain no added emulsifier, stabiliser, thickener or gelling agent other than an emulsifier, stabiliser, thickener or gelling agent of a name or description, specified hereunder.

D.3.2 Name or description

Lecithins; Alginic acid; Sodium alginate; Potassium alginate; Ammonium alginate Calcium alginate; Prophylene glycol alginate (propane- 1,1-diol alginate) Agar; Carrageenan; Furcellaran; Locust bean gum (carob gum); Tamarind seed flour Gurar gum (gua flour); Tragacanth; Acacia (gum Arabic);

Zanthan gum; D-glucitol (sorbitol); mannitol; Glycerol; Pectins; microcrystalline cellulose; Methylcellulose; Ethylcellulose; Hydroxylpropyl cellulose;Hydorxyprophylmethylcellulose; Ethylmethlcellulose; Carboxymethylcellulose;sodium salt; Sodium, potassium and calcium salts or edible fatty acids alone or in mixtures, derived from edible fat or distilled fatty acids Monoacyl and diacylglycerols esterified with the following acids: (a) acetic (b) lactic (c) citric (d) tartaric (e) monoacetylatartaric and (f) diacetyltartaric.

D.3.3 Sucrose esters or fatty acids

The following sucrose esters fatty acids may be added to goats and sheep feeds:

a) mixture of sucrose esters of monocyl and diacylglycerols (sucroglycerides, polyglycerides);
b) polyglycerol esters of non-polymerised edible fatty acids;
c) propylene glycol esters of fatty acids (propane-1,2-diol esters of fatty acids);
d) stearoyl-2-lactylic acid; sodium stearoyl-1,2-lacylate; calcium stearoyl-1,2-lactylate;
e) stearoyl-1-tartrate; glycerol poly (ethylene glycol) ricinolcate; dextrans; sorbitan monostearate;
f) sorbitan tristearte; sorbitan monolaurate; sorbitan mono-eleate; sorbitan monopalmitate;
g) partial polyglycerol esters of polycondensed fatty acids of castor oil (polyglycerol polyricinoleate) polyoxyethylene (20) sorbitan monolaurate;
h) polyoxyethylene (20) sorbitan monopalmitate, polyoxyethylene (20) sorbitan monostearate;
i) polyoxyethylene (20) sorbitan tristearate, polyoxyethylene (20) sorbitan monocleate;
j) polyoxyethylene (20) sorbitan tricleate, polyoxyethylene (8) sorbitan stearate; and
k) polyoxyethylene (40) stearate.

The emulsifiers, stabilisers, thickeners and gelling agents listed in Table 5 shall conform to the requirement in Table 5.

Table 5 — Requirements for emulsifiers, stabilisers, thickeners and gelling agents in goats and sheep feeds

Name or description	Kind of animal	Maximum content in complete feed, mg/kg
Poly (ethylene glycol) 6 000	All goats and sheep	300
Polyoxypropylene-Polyoxyethelene polymers (M.W 6 800-9 000)	All goats and sheep	50
Propane-1,2-diol	Lambs , kids	36 000

D.4 Requirements for binders, anticaking agents and coagulants

D.4.1 General

Goats and sheep feed shall contain no added binder, anti-caking agent or coagulant other than a binder, anti-caking agent or coagulant of a name or description specified in D.4.2.

D.4.2 Name or description

Lignosulphonates; Colloidal silica; Silicic acid, precipitate and dried; Sodium aluminosilicate, Sodium, potassium and calcium stearate; Kaolin and Kaslinitic clays free of asbestos- natural accruing mixtures of minerals containing at least 65% complex hydrated aluminium silicates whose main constituent in Kasolinite; Bentonite and other montmerillonitee clays; Vermiculite-hydrated silicate of magnesium, aluminium and iron; Citric acid; Kieselguhr (diatomaceous earth, purified); Calcium silicate (synthetic); Natural mixtures of steatite and chlorite free of asbestos.

D.5 Requirements for aromatic and appetising substances

Goats and sheep feed shall contain no added aromatic or appetising substance other than an aromatic or appetising substance of a name or description specified in Table 6 and taking account of any such substance which is naturally present, without exceeding the maximum content specified.

Table 6 — Requirements for aromatic and appetising substances

Name or description	Maximum content in complete feed, mg/kg
Saccharin	No limits
All natural products and corresponding synthetic products	No limits

D.6 Permitted preservatives

Goats and sheep feed shall contain no added preservatives other than a preservative of a name or description specified hereunder.

a) sorbic acid, sodium sorbate, potassium sorbate, calcium sorbate;
b) folic acid;
c) ammonium formate, sodium formate, calcium formate;
d) acetic acid, potassium acetate, sodium diacetate;
e) latic acid, sodium lactate, potassium lactate, ammonium lactate, calcium lactate;
f) propionic acid, sodium propionate, potassium propionate;
g) L-Tartaric acid;
h) citric acid, sodium citrates, calcium citrates;
i) orthophosphoric acid;
j) fumaric acid;
k) DL-Malic acid; and
l) hydrochloric acid or sulphuric acid for use in silage only.

D.7 Requirements for aromatic and appetising substances

The presence in goats and sheep feed and feed ingredients of undesirable substances such as industrial and environmental contaminants, pesticides, radionuclides, persistent organic pollutants, pathogenic agents and toxins such as mycotoxins shall be identified, controlled and minimised.

Animal products that could be a source of the Bovine Spongiform Encephalopathy (BSE) agent should not be used for feeding directly to, or for feed manufacturing for goats and sheep.

Control measures applied to reduce unacceptable level of undesirable substances shall be assessed in terms of their impact on food safety.

Bibliography

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