Range Cattle Research and Education Center - Ona FL

Silage and Haylage of Warm-Season Grasses

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Definition

- ✓ Silage is the feedstuff produced by the fermentation of a forage crop of high moisture concentration, typically greater than 60%
- ✓ Haylage, baleage, round bale silage, are products of fermentation with ~ 50% DM

Definition

- ✓ “Ensiling is the name given the process of making silage and is defined as a forage preservation method based on spontaneous fermentation under anaerobic conditions”

Desirable material to be ensiled

- ✓ Adequated moisture
- ✓ High water soluble carbohydrates concentration (WSC)
- ✓ Compactation

Ensiling process

- ✓Aerobic phase
- ✓Fermentation phase
- ✓Stable phase

Warm-Season Grasses Characteristics

- ✓ High water concentration – Low DM concentration ~ 20%
- Increase maturity will increase DM concentration
- High *Clostridium* activity

Warm-Season Grasses Characteristics

- ✓ Low water soluble carbohydrates

- Temperate grasses – fructans
- Tropical grasses – Starch
- LAB do not have the ability to ferment starch directly (McDonald et al., 1991)

Treatments: Warm-season grass species with or without inoculant (Si-All)

	Forage Name							
Item	Elephantgrass	Stargrass	Mulato	Limpograss	Jiggs	Tifton 85	*P* value	SE
DM, %	18	44	37	41	45	43	<0.01	4
CP, %	3.4	10.9	8.1	6.8	9.7	9.0	0.03	2.8
ADF, %	46.1	41.3	40.1	44.1	43.7	41.1	0.04	2.1
NDF, %	66.6	65.1	57.6	63.1	69.0	69.3	<0.01	2.0
IVTD, %	50.8	62.5	63.5	58.7	56.2	56.0	0.03	2.1
NDFD, %	40.7	50.5	56.0	48.5	44.7	46.9	0.20	3.2

	Forage Name							
Item	Elephantgrass	Stargrass	Mulato	Limpograss	Jiggs	Tifton 85	*P* value	SE
pH	8.3	7.5	7.4	6.5	8.6	8.2	0.04	0.5
Lactate, %	0.1	2.1	0.7	2.6	0.4	1.2	0.04	0.5
Acetate, %	3.6	2.4	3.8	1.4	1.1	2.0	0.10	0.6
NH3, % N	41	27	19	16	29	31	0.09	6.0
Mold, log cfu/g	5.8	3.6	5.6	3.0	5.7	5.6	0.03	0.5

Losses

- ✓ Ensiling losses
- Highest DM / energy losses from fermentation are those related to *Clostridium* activity.
- Low DM, high T^0, and pH >5.0
- Final products: butyric acid, water, and CO_2

Losses

- ✓ Effluent Losses
- Factors related with effluent losses: DM concentration, type of silo, degree of packing, and pre-treatment of the crop (McDonald et al., 1991)
- DM concentrations between 28% and 30% decrease effluent losses

Losses

- ✓ Gaseous Losses
- Homofermentative bacteria utilizing glucose as a substrate reduce gaseous losses
- Heterofermentative bacteria producing alcohol, acetic acid and CO2
- Particle size play a important role in gaseous losses

Losses

Energy losses based in different fermentation pathways

Microorganism	**Substrate**	**End product**	**Losses (% energy)**
Homoferment.	Glucose	Lactate	0
Heteroferment.	Glucose	Lactate, Ethanol and CO_2	1.7
Clostridium	Lactate	Butyrate and CO_2	18.4

Source: Adapted from Balsalobre et al. (2001)

Losses

- ✓ Feedout Losses
- Aerobic microorganisms consuming sugars, fermentation products an other nutrients
- Aerobic stability during feedout was decreased when homofermentative bacteria or citrus pulp was added at silo filling (Veiga et al., 2000)

Additives

- ✓ Additives are used to improve silage preservation
- Fermentation stimulants
- Fermentation inhibitors
- Aerobic deterioration inhibitors
- Absorbents

Additives

- ✓ Citrus pulp and Molasses
- Addition of WSC and increase DM concentrations
- Faster drop in pH
- Reduced ammonia-N concentration

Additives

Effects of particle size, citrus pulp addition, and forage wilting on attributes of Tanzania guineagrass silage

Parameters	Wilting			No Citrus pulp			Citrus pulp (100 g kg^{-1} fresh weight)		
Particle size	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small
DM (g kg^{-1})		309			204			272	
Effluent (L Mg^{-1} fresh)	0.86^{c‡}	1.48^{c}	2.07^{c}	15.5^{a}	14.4^{a}	10.5^{a}	2.56^{bc}	3.96^{b}	4.21^{b}
Gases (g kg^{-1} DM)	125^{cd}	145^{bcd}	123^{cd}	195^{a}	150^{bc}	136^{cd}	145^{bcd}	142^{bcd}	87^{e}
pH	5.55^{bc}	6.44^{a}	5.51^{bc}	5.61^{b}	5.35^{bc}	5.15^{cd}	4.91^{de}	4.71^{e}	4.65^{e}
Bulk density (kg m^{-3})	305^{b}	303^{bc}	310^{b}	255^{e}	281^{d}	314^{b}	307^{b}	292^{e}	354^{a}

Adapted from Aguiar et al. (2001)

‡Means within a row not followed by the same letter are different ($P<0.05$).

Tifton 85 – 4 wks regrowth

Treatments: Control, Ecosyl, and Molasses (2% As Fed)

	Tifton 85				
Item	Control	Ecosyl	Molasses	*P* value	SE
DM, %	58	59	61	0.28	1.4
CP, % of DM	12.7	13.0	12.4	0.54	0.4
ADF, % of DM	37.4	37.4	37.1	0.96	1.1
NDF, % of DM	71.5	70.5	69.9	0.76	1.4
IVDOM, % of DM	51.0	52.7	53.1	0.24	1.1
pH	4.8	4.8	4.9	0.86	0.1
Lactate, % of DM	2.60	2.37	2.02	0.40	0.3
Acetate, % of DM	0.62	0.51	0.33	0.02	0.1
NH_3-N, (%, total N)	8.0	6.4	6.0	0.05	0.4
Mold, log cfu/g	3.32	3.00	4.15	0.27	0.4

Species = Jiggs (J) and Tifton 85 (T)
Moisture = 53% (D) and 23% (W) DM
Inoculants = Ecosyl (E), B500 (B), Molasses 2% (M), Control (C)

Variables		**Treatments**	
	Species	Moisture	Inoculant
DM, %	=	D>W	=
CP, % of DM	=	=	=
ADF, % of DM	T>J	D>W	M<Other
NDF, % of DM	T>J	W>D	M<Other
pH	=	D>W	M<Other
Lactate, % of DM	=	W>D	M>Other
Acetate, % of DM	=	W>D	=
IVDOM, % of DM	=	W>D	M>Other
NDFD, % of DM	T>J	=	=

Conclusion

- ✓ In general, tropical grasses have undesirable characteristics to be ensiled. However, management practices, such as wilting and additives, may enhance warm-season grass silage nutritive value and fermentation characteristics
- ✓ Do we have a choice?

Thanks!
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