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Dehydrated sulla forage to improve sustainability of sheep milk production

M. Ponte, A. Di Grigoli, M. Pipi, G. Maniaci, R. Gannuscio, A. Di Trana, M. Alabiso, M. Todaro and A. Bonanno

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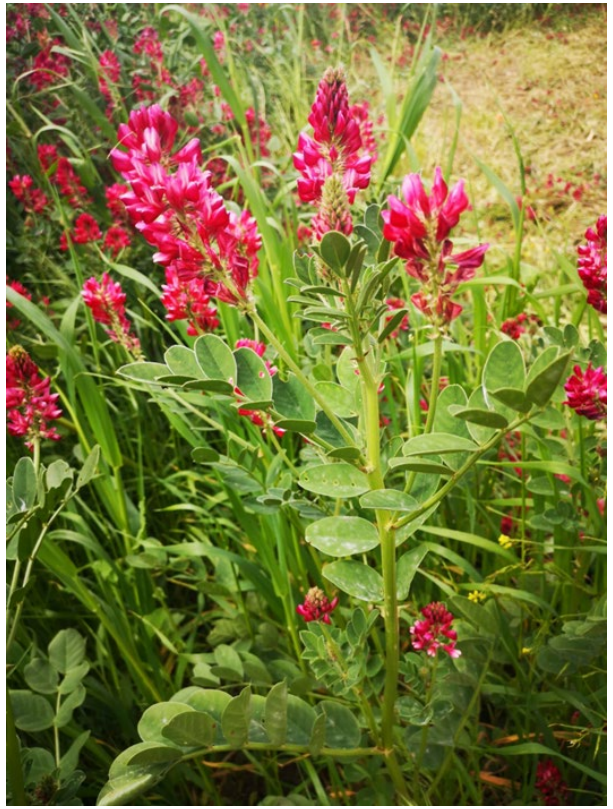

rate and level of DM intake

efficiency of nutrients utilization

Sulla coronaria (L.) Medik.

...on animals productivity

milk yield and milk casein content

health milk fatty acid profile (+ CLA)

Balanced nutritional composition

- high protein content
- low NDF content
- high ratio of degradable to structural carbohydrates
- moderate (<6% DM) presence of condensed tannins (from 0.8 to 5% of whole plant DM)

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CONDENSED TANNINS

in the ruminants diet

(<6% DM)

- mitigation of CH_4 and nitrogen emissions in the environment
- improvement of **oxidative status, welfare** and **health** of animals
- improvement of technological (**casein, oxidative stability**) and **health**

properties (antioxidant compounds, PUFA) of dairy products

Beneficial implications for
environment, animal well-being and health,
technological and health quality of animal-origin products

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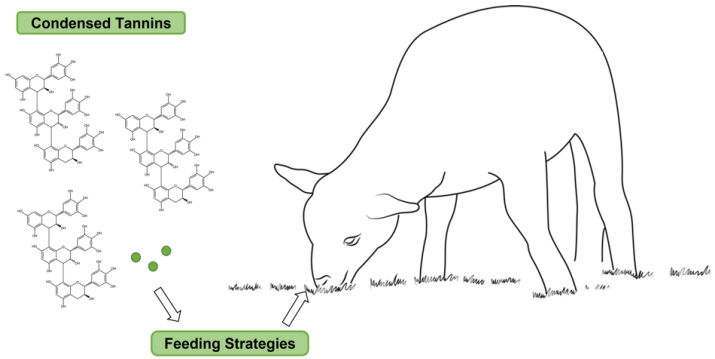
OBJECTIVES

Compare dehydrated sulla forage with sulla hay

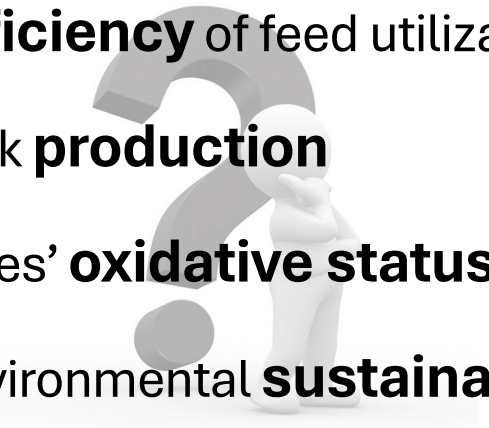


efficiency of feed utilization

milk **production**

ewes' **oxidative status**

environmental **sustainability**



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PELLETTED DEHYDRATED SULLA FORAGE




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EXPERIMENTAL DESIGN

Latin square design
3x3

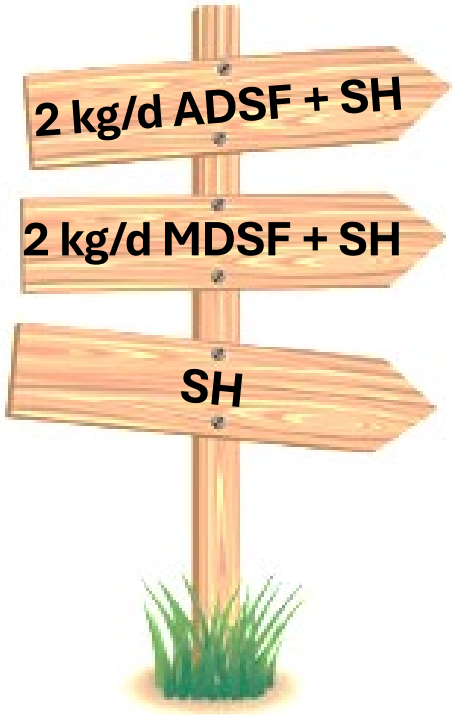
9 ewes of Valle del Belìce breed at 60 DIM

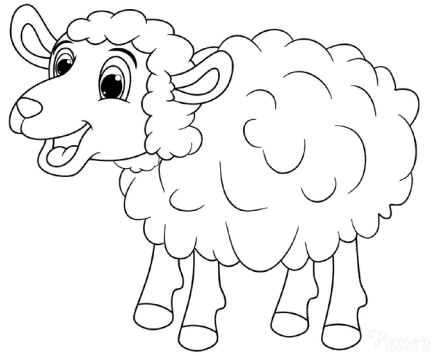
one ewe housed per box

3 groups

3 phases (10 adaptation + 5 experimental days)

3 DIETS





ADSF = pellets obtained by cuts in **April**
MDSF = pellets obtained by cuts in **May**
SH sulla hay ad libitum

+ 800 g/d concentrate

Measurements and sampling

- forages and concentrate
- weight, BCS
- feed intake, milk
- faeces
- blood

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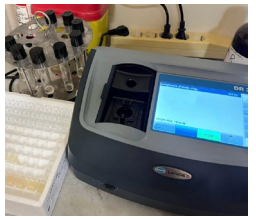
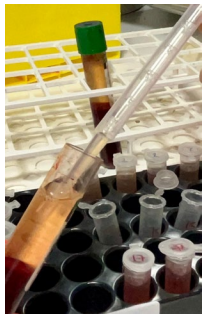
ANALYSES

FEEDS
- DM, protein, fat, ash
- NDF, ADF, ADL
- Condensed tannins
- Polyphenols



FAECES
- DM, protein, fat, ash
- NDF, ADF, ADL

BLOOD
- ROMs (Reactive oxigen metabolites)
- BAP (Biological antioxidant potential)
- Total and free polyphenols
- NEFA



MILK
- Lactose, fat, protein, urea
- CCS, pH
- Protein fractions (NT, NNC, NNP)
- Clotting parameters (r, k_{20}, a_{30})

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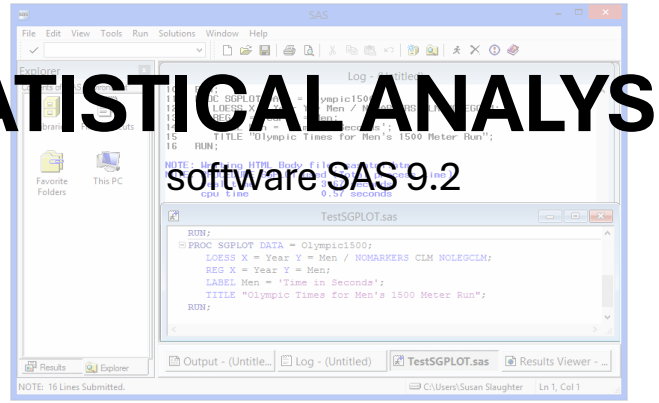
STATISTICAL ANALYSES



software SAS 9.2

INDIVIDUAL PARAMETERS

MIXED procedure

Fixed factors

- ✓experimental phase
- ✓diet (D)

Random effect

- ✓ewes

Differences between means were tested by Tukey's test

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Table 1. Chemical composition (% DM) of forages

	ADSF		MDSF		Sulla hay
	pre dehydration	*post dehydration and pelleting*	*pre dehydration*	*post dehydration and pelleting*	
DM, %	14.51	86.65	19.50	87.76	90.24
CP	16.17	15.07	12.03	11.26	11.79
EE	2.45	2.32	2.50	2.65	1.39
Ash	10.89	14.45	10.21	12.38	11.52
aNDFom	37.04	39.49	46.77	52.52	54.78
ADFom	33.57	31.99	35.08	41.27	42.93
ADL	5.28	5.31	5.25	7.17	7.88
Condensed tannins, g DE/kg DM	15.80	7.17	9.20	4.83	4.60
Polyphenols, g GAE/kg DM	18.19	13.57	11.62	10.03	9.72
Vitamin E, mg/kg DM	-	19.72	-	16.46	11.65

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Table 2. Effect of diet on individual milk yield and composition

	Diet			*p*<
	ADSF	MDSF	SHL	
Milk yield, g/d	1667 a	1557 b	1308 c	<0.0001
Somatic cells count, n*1000/ml	376.9	270.7	309.6	0.7801
Lactose, %	4.62 a	4.61 a	4.54 b	0.0011
Fat, %	6.72 b	7.38 a	7.63 a	<0.0001
Protein, %	5.90	5.91	5.99	0.5880
Casein, %	4.59	4.66	4.55	0.6285
Whey protein, %	1.06 b	1.01 b	1.19 a	0.0004
Non-protein nitrogen (NPN), %	0.040	0.039	0.040	0.7899
Urea, mg/dl	29.57 c	32.09 b	38.75 a	<0.0001
pH	6.60	6.60	6.63	0.2660
Coagulation time (r), min	20.32	21.91	18.91	0.2407
Curd firming time (k_{20}), min	1.81	1.52	1.66	0.0876
Curd firmness (a_{30}), mm	52.46	53.41	56.21	0.1893

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Table 3. Effect of diet on feed intake, digestibility, methane production, milk yield and composition

	Diet			*p*<
	ADSF	MDSF	SH	
Total DM intake, g/d	3591 a	3596 a	2959 b	<0.0001
Total CP intake, g/d	626.54 a	562.19 b	494.67 c	<0.0001
Polyphenols intake, g GAE/d	43.31 a	39.29 b	34.49 c	<0.0001
DM digestibility, %	71.56 a	57.86 b	50.43 c	<0.0001
OM digestibility, %	73.29 a	58.94 b	52.30 c	<0.0001
*CH_4 production, g/d	45.24 a	44.67 a	38.39 b	<0.0001
CH_4 production, g/kg milk	28.22 b	29.54 ab	30.53 a	0.0334
DM intake/milk yield, kg/kg	2.23	2.37	2.35	0.1922

*CH_4 production, g/d = -0.669 + (9.19**DMI, kg/d) + (0.0495*OMD, %) + (0.169* BW, kg)

Belanche et al., Journal of Cleaner Production, 2023.

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Table 4. Effects of diet on plasma oxidative status markers, polyphenols and NEFA in ewes

	Diet			*p*<
	ADSF	MDSF	SH	
Reactive Oxigen metabolites (ROMs), Unit Carr	150.8	136.5	122.5	0.1063
Biological antioxidant potential (BAP), µmol/l	3972	3810	3688	0.0704
Oxidative Stress Index (OSI=ROMs/BAP*100)	3.80	3.60	3.34	0.4026
Plasma Total Polyphenols (PTP), µg GAE/ml	25.94 a	21.85 ab	19.26 b	0.0263
Plasma Free Polyphenols (PFreeP), µg GAE/ml	13.43 a	13.02 ab	11.46 b	0.0429
Non-esterified fatty acids (NEFA), mmol/l	0.069	0.061	0.081	0.6474

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CONCLUSIONS

Improvements due to dehydrated sulla forage

- increasing digestibility
- reducing CH_4 production
- increasing milk yield
- maintaining the casein content
- increasing plasma polyphenols

Dehydration, especially from early cuts, seems to be a valid alternative to haymaking and an opportunity to fully exploit the potential of sulla forage, especially when grazing resources are scarce or climatic conditions are not favorable for haymaking, maintaining good milk yield and quality.

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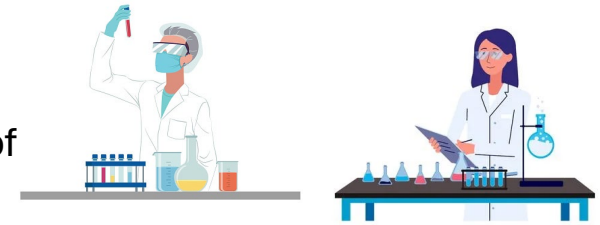
WORK IN PROGRESS

Analyses on ruminal fluid and cheese

POTENTIAL AND FUTURE PERSPECTIVES:

- Better understand the role and fate of polyphenols in the rumen and at plasma level
- Optimize crop management with regard to the number and timing of cuts to be dehydrated for pellet production
- Optimize the dehydration process through the construction of systems that also work at the farm level



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