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Opening session

Theme 1.
Extensive animal production systems and product

Feeding value of Portuguese Mediterranean annual-type rainfed pastures

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Abstract

Subterranean clover pastures (SC) have a higher nutritive value than Portuguese natural pastures (NP). However, this assumption does not include anti-quality factors and intake (determined by stocking rates – SR). Therefore, we tested the hypothesis that advantages of SC over NP are different if we consider feeding value (FV = nutritive value × intake) instead of nutritive value (NV) alone. Productivity of SC and NP was compared in the Castelo Branco region, Portugal. NV was determined by dry matter (DM), metabolisable energy, crude protein (CP) and acid detergent fibre (ADF) concentrations. Nutrient requirements of a merino ewe (50 kg live weight, 0.53 kg milk day^{-1}) were considered and a daily intake of 1.48 kg DM with 21% ADF. Apparently, NV limits milk production only at the end of spring, due to CP%. However, considering FV and the limitations of intake, autumn and winter periods presented stronger limitations to sheep production on SC than NP. Decreasing SR or a correct supplementation strategy can alleviate FV negative balances.

Keywords: biodiverse pastures, natural pastures, subterranean clover, grazing, nutrition

Introduction

Mediterranean pastures consist mainly of annual species which undergo strong variations in their nutritional value during the year (Molle *et al.*, 2008). In Portugal, since 1989, the surface area of Mediterranean pastures has increased from 828,691 ha to 1,738,185 ha (2009), mainly due to natural pastures (NP) – 77% of the total (INE, 2012). During the same period, the area of sown mixtures (SC), e.g. annual legume species (*Trifolium*, *Medicago*, *Ornithopus*), with *Lolium rigidum* Gaudin, *Dactylis glomerata* L. or *Phalaris aquatica* L., has remained almost constant (INE, 2012). Research reports (from Almeida, 1988 to Barradas *et al.*, 2006) highlighted the advantages of these mixtures on DM yield and on their nutritive value (NV), which would allow higher stocking rates (SR) compared with NP. However, until now, no research has been presented concerning the feeding value (FV) of these pastures, i.e. the interaction between DM intake (allowed by pasture growth limited by SR) and NV. Therefore, considering that intake is determined by both factors – NV and pasture DM availability per animal (Avondo *et al.*, 2002) – we tested the hypothesis that 'feeding value' of SC relative to NP would be different from the nutritive value comparison *per se*, assuming a constant SR during the year. Lactating merino ewes (50 kg live weight) were used as reference.

Materials and methods

In a randomized complete block design the natural pasture (NP) was compared with a sown subterranean clover mixture (SC), on a lithosol under a Mediterranean climate at Castelo Branco, Portugal. Three replicates of 660 m^2 plots, were grazed by lactating ewes in five cycles for the vegetative phase of pastures (autumn – end spring); herbage samples were collected before and after grazing, for growth and nutritive value determination. Total dry matter (DM) and crude protein (CP) were determined according to AOAC (2000); acid detergent fibre (ADF) according to Van Soest *et al.* (1991); metabolisable energy (ME) by prediction equations (NRC, 2007 and Bath and Marble, 1989, cit. by Coppock, 1997).

During the pasture vegetative period (201 days) we considered the following daily nutritional requirements of a merino ewe (50 kg live weight, 0.53 kg milk day^{-1}): 1.48 kg DM intake, 11.81 MJ ME, 153 g CP and 311 g ADF (NRC, 2007). The SR for each pasture type was derived from 50% annual total DM production (Dikman, 1998) divided by annual ewe intake. These SR remained constant along year; for each growth period, FV was obtained through the difference between pasture allowance (daily kg DM × nutritive value kg^{-1} DM) and ewe requirements (SR × DM intake ewe^{-1} × nutrient). For the pasture dry herbage phase (201-365 days), sheep grazed herbage surplus from later phases (FV of this phase was not studied). Univariate anova (GLM) and Bonferroni tests for LSMeans were used for statistical analysis.

Results and discussion

Except for the winter period (73-116 days), pasture growth was significantly higher in SC, as compared with NP (Table 1). NV (Table 1) showed higher CP concentrations in SC after 117 days of growth; SC had statistically higher ME concentrations and lower ADF concentration but no significance on Pasture type × growth period. From the NV, as suggested by Molle *et al.* (2008), we expected unbalanced CP:ME ratios on both pastures: for the first 150 days above requirements (12.96 g CP MJ ME^{-1}) and below them, after day 166, in NP, thus limiting milk production, reinforced by the highest ADF values.

Differences in total pasture DM production resulted in SR of 3.55 (NP) and 6.74 ewes ha^{-1} (SC). Considering these SR, pasture growth for the first 116 days was not enough to ensure daily DM intake per ewe (Table 2); this effect seems to be enhanced by the very low fibre content, revealed through an apparent unbalance on ADF requirements. For pastures with CP higher than 16% DM, Avondo *et al.* (2002) observed an intake limitation if biomass falls below 1 t ha^{-1}; that was the case in our results (447 and 547 kg DM ha^{-1} in NP and SC, respectively for the initial 116 days). After day 117, CP was higher in SC, and ME was higher in NP for 151-165 but lower for 166-201 days and ADF higher in NP for 166-201 days of growth. However, in these growth periods, NP feeding values were still enough to ensure ewe nutritional requirements, at the studied SR level (3.55), therefore not limiting animal production. Negative FV highlighted from Table 2, can be alleviated by decreasing SR or by roughage and concentrates supplementation.

Table 1. Natural pasture (NP) and subterranean clover pasture (SC) growth (kg DM ha^{-1} day^{-1}) at different periods after germination (0 = average germination date) and nutritive values.[1,2]

Period (days)	Pasture growth		CP (g kg^{-1} DM)		ME (MJ kg^{-1} DM)		ADF (g kg^{-1} DM)	
	NP	SC	NP	SC	NP	SC	NP	SC
0-72	4.1	5.4	223	179	9.6	9.5	248	255
73-116	3.5	3.7	221	223	9.6	10.1	248	200
117-150	11.0	23.0	155	232	9.2	9.8	287	235
151-165	42.0	59.1	100.0	186	9.0	9.5	305	255
166-201	11.8	38.1	68	78	7.9	8.0	399	392
SE	3.0		11		0.2		14	
Past	$P<0.001$		$P<0.01$		$P<0.01$		$P<0.01$	
Past × per	$P<0.01$		$P<0.001$		ns		ns	

[1] CP = crude protein; DM = dry matter; ME = metabolisable energy; ADF = acid detergent fibre; SE = standard error.

[2] Past = statistical significance for pasture type; Past × per = statistical significance for pasture type × growth period effects. ns = not significant.

Table 2. Natural pasture (NP) and Subterranean clover pasture (SC) daily feeding values per ewe (i.e. differences between requirements and pastures allowances at stocking rates of 3.55 and 6.74 ewe ha^{-1}, respectively).[1,2]

Period (days)	Pasture intake (kg ewe^{-1})		CP (g ewe^{-1})		ME (MJ ewe^{-1})		ADF (g ewe^{-1})	
	NP	SC	NP	SC	NP	SC	NP	SC
0-72	-0.33	-0.68	103	-32	-0.8	-4.2	-26	-107
73-116	-0.50	-0.94	64	-5	-2.3	-6.3	-73	-202
117-150	1.62	1.93	314	634	16.5	21.5	588	490
151-165	10.35	7.29	1,006	1,465	94.0	71.7	3,309	1,917
166-201	1.84	4.17	71	301	14.4	33.2	1,011	1,902
SE	0.57		71		5.2		195	
Past	ns		$P<0.01$		ns		ns	
Past × per	$P<0.01$		$P<0.01$		$P<0.05$		$P<0.001$	

[1] CP = crude protein; DM = dry matter; ME metabolisable energy; ADF = acid detergent fibre; SE = standard error.

[2] Past = statistical significance for pasture type; Past × per = statistical significance for pasture type × growth period effects. ns = not significant.

Conclusions

Nutritive value alone seems to be a weak indicator of Mediterranean pasture production potential. In our study, the lower nutritive value of NP as compared with SC contrasts with the feeding values, at the different SR levels studied. Therefore, pasture herbage intake (determined by herbage growth and SR) should be considered together with nutritive values, to evaluate the feeding value of Mediterranean pastures production more accurately.

References

Almeida J.P.F. (1988) O Melhoramento de Pastagens de sequeiro em olivais marginais da região de Castelo Branco. *Pastagens e Forragens* 9, 83-94.

AOAC (2000) *Official Methods of Analysis*, 17th edition, Association of Official Analytical Chemists, Gaithersburg, Maryland, USA.

Avondo M., Bordonaro S., Marletta D., Guastella A.M., and D'Urso G. (2002) A simple model to predict the herbage intake of grazing dairy ewes in semi-extensive Mediterranean systems. *Livestock Production Science* 73, 275-283.

Barradas A., Carneiro J.P., Amante H., Simões A.M., Olea L. and Almeida J.P.F. (2006) Does the response of natural pastures to improvement techniques depend on soil fertility level? *Grassland Science in Europe* 11, 101-103.

Coppock C.E. (1997) Adjusting rations to forage quality, and suggested criteria to use in buying forages. In: Gamroth M. (eds.) *Proceedings of the 3rd Western Dairy Management Conference*, March 13-15, 1997 Las Vegas, Nevada, pp. 137-143.

Dikman J. (1998) *Carrying capacity: outdated concept or useful livestock management tool?* Overseas Development Institute, Pastoral Development Network, FAO. Available at: http://www.odi.org.uk/pdn/drought/dijkman.html.

INE (2012) *Dados Estatísticos – Principais Indicadores*. Instituto Nacional de Estatística, Portugal. Available at: http://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_main.

Molle G., Decandia M., Cabiddu A., Landau S.Y. and Cannas A. (2008) An update on the nutrition of dairy sheep grazing Mediterranean pastures. *Small Ruminant Research* 77, 93-112.

NRC (2007) *Nutrient Requirements of Small Ruminants – Sheep, Goats, Cervids, and New World Camelids.* National Academic Press, Washington, DC, USA.

Van Soest P.J., Robertson J.B. and Lewis B.A. (1991) Methods for dietary fiber, neutral detergent fiber, and nonstarch polysaccharides in relation to animal nutrition. *Journal of Dairy Science* 74, 3583-3597.