Improvement of degraded calcareous soils using pastures for grazing ewes

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Abstract

The soils located in the Middle Western coast of Portugal are dominantly calcareous, with limiting nutritional factors. The objective of this study was to implant pastures to improve soil quality and to evaluate its nutritive value for grazing ewes (Serra da Estrela breed) from a PDO cheese production region.
In two different locations, five experimental swards of 1 ha each were implanted in 2001. Different seed mixtures of legumes and grasses were used. The grazing periods lasted from March to June-July, depending on the pasture availability and after the animals were fed alfalfa hay. During the grazing period, pasture samples were collected for chemical characterisation. Sixty days after parturition, milk was sampled every fortnight, and analysed for fat, protein, Ca and P. The collected data of two years of observations was compared using ANOVA.
Spring pastures were obtained in enough quantity and nutritive value to support the stocking rate (10 ewes/ha) for five months, but the amount and nutritive value of the pastures will fall as the season goes on. Milk composition was the adequate to produce the typical cheese of that region. The recycle of nutrients from animal origin to the pastures, together with the organic matter of plant origin, would contribute to improve soil characteristics.

Introduction

The permanent botanic cover reduces the risk of erosion, increases organic matter contents, enhances soil aggregate stability and contributes to the carbon storage, which potential has increased interest in its relation to the greenhouse effect. Grassland-based farming systems are the end product of complex socio-cultural processes, radicated in history and tradition (Porqueddu et al., 2003). PDO systems are defined as the result of interactions between a region (physical environment, men and societies), plants, animals, microrganisms, practices and production systems, transformation and sale related to local history and culture and the products resulting from this combination of physical, biotechnological and historical factors (Béranger, 2003).
In Portugal, the soils located in the Middle Western coast are derived from Jurassic and Cretacic formations. Most are calcareous soils and due to geologic, orographic and climatic factors they are susceptible to erosion. Its botanical cover is characterised by herbaceous wild flora of poor quality. The establishment of swards will be an important way of soil protection and of improving its quality. Besides it will allow the improvement of the grazing production system, with limited resources, of this unfavoured region, contributing to the fixation of the rural populations and to the development and valorisation of local products (PDO Rabaçal cheese).
The objective of this study was to promote with the farmers new technologies of forage production by the implantation of pastures to improve soil quality and to evaluate its dry matter yield, botanical

composition and nutritive value for small ruminant feeding, promoting the increase of ewe's milk (quantity and quality) regarding its aptitude for the production of Rabaçal cheese.

Besides, this approach will allow the reclamation, in a sustainable way, of abandoned traditional olive yards, important for the farmers' economy, for the rural development and the quality of life for local communities.

Materials and methods

The experiment was carried out in the Middle Western coast of Portugal, in calcaric Leptosols, with pH (1:2.5 in H_2O) values between 7 and 7.5, very high in available K, normal in available Mn and Fe and low in available P, Cu and Zn. In two different locations (Santiago and Rabaçal), four experimental fields of 1 ha each were implanted in November 2001. Two mixtures (A, B) of legumes and grasses were used (Table 1). The grazing periods lasted from March to June-July, depending on the pasture availability. The pasture was grazed during the gestation period and after the animals were fed with alfalfa hay (19.5% crude protein and 55% dry matter digestibility). The stocking rate was 10 ewes/ha. During the grazing period, pasture samples were collected in exclusion cages (8/ha) on March, May and July and dry matter yield, botanical composition and nutritive value were evaluated. Sixty days after parturition, milk was sampled every fortnigh, freeze-dried and analysed for fat, protein, Ca and P content.

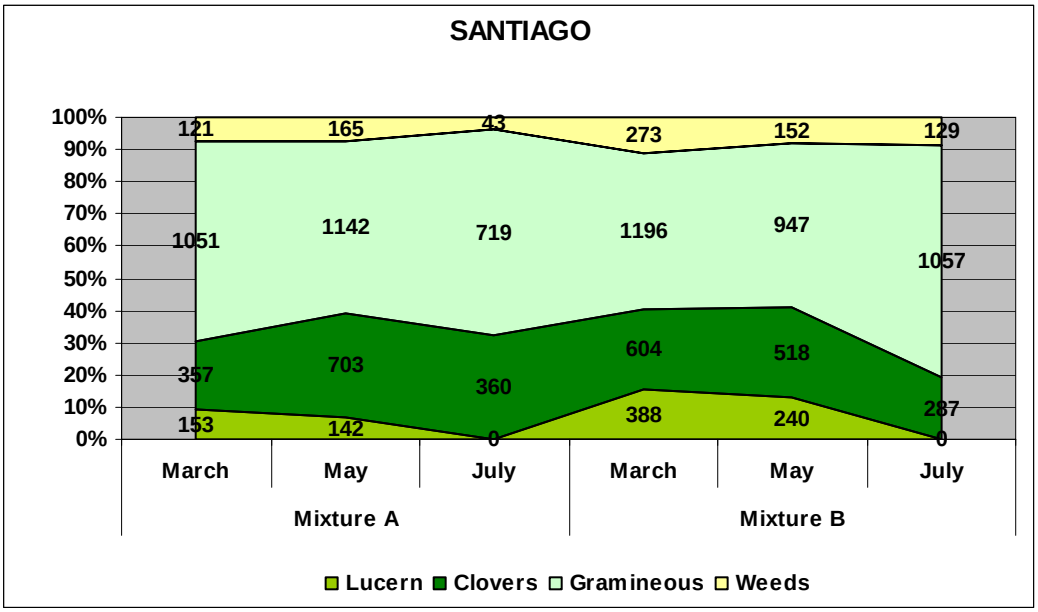
Pasture samples were analysed for dry matter (DM), ash and nitrogen (N) (AOAC, 1990), for fibre composition (Goering & Van Soest, 1970) and for *in vitro* dry matter digestibility (DMD) (Tilley and Terry,1963). Determinations of minerals were made after dry ashing of the samples, by atomic absorption spectrometry (Shimadzu Corporation, 1991) and phosphorus (P) was measured colorimetrically (AOAC, 1990). The collected data of two years of observations were compared using ANOVA.

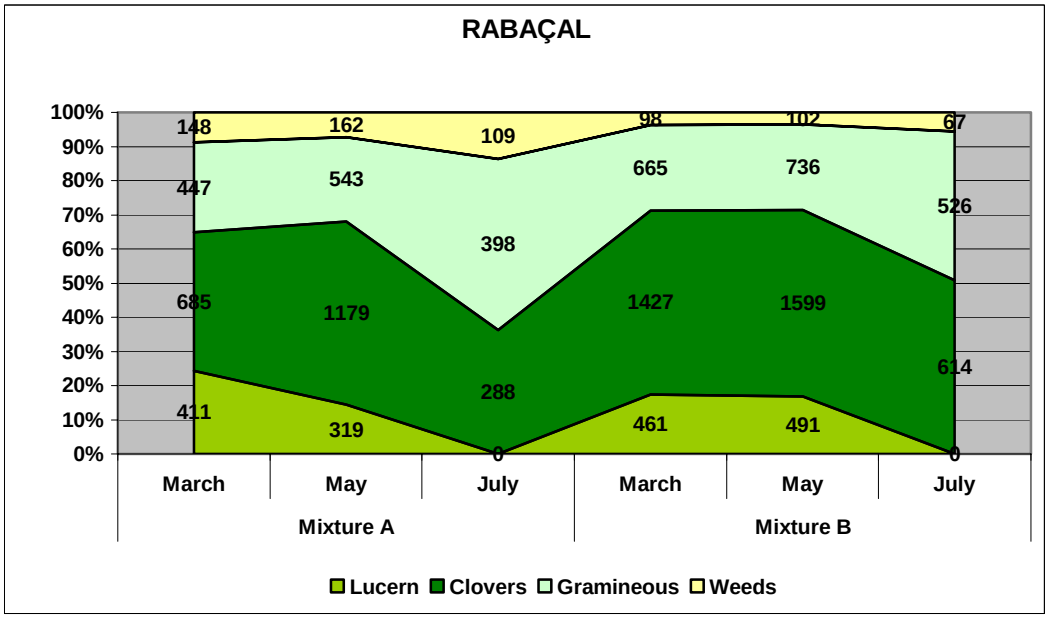
Table 1 – Seed mixtures sown

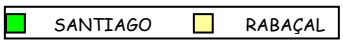
Mixture A	Mixture B
Lolium perene L.	*Lolium perene* (2 cvs)
Dactylis glomerata L.	*Dactylis glomerata L.*
Medicago scutela.	*Medicago scutela.*
Medicago polymorpha	*Medicago polymorpha*
Medicago rugosa	*Medicago rugosa*
Trifolium subterraneum (2 cvs)	*Trifolium Subterraneum* (3 cvs)
Trifolium resupinatum L.	*Trifolium resupinatum L.* (2 cvs)
Trifolium michelianum	*Trifolium michelianum*
Trifolium fragiferum L.	*Trifolium fragiferum* L.
	Trifolium vesiculosum Cav.

Results

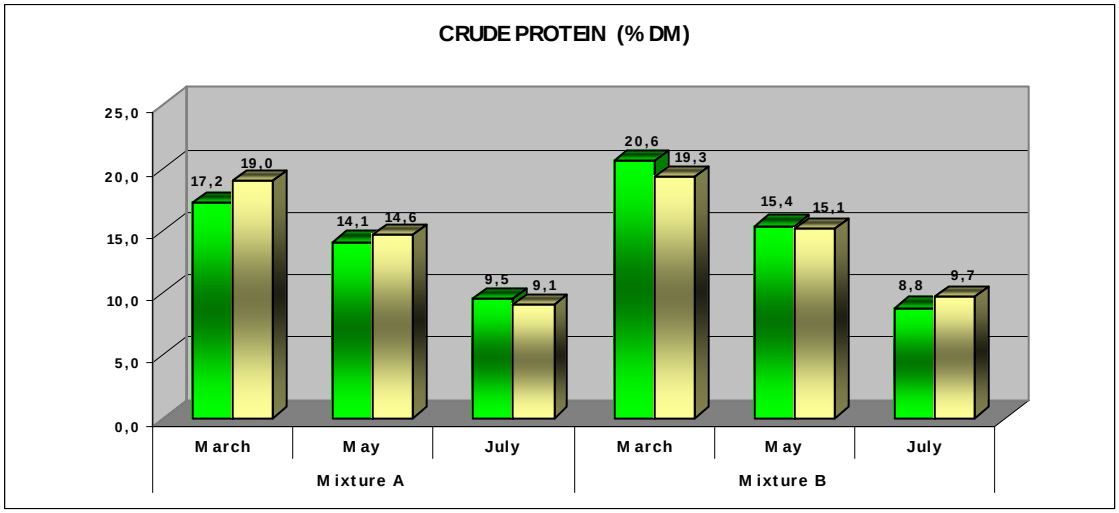
CONTRIBUTION OF THE DIFFERENT PASTURE SPECIES TO THE DRY MATTER PRODUCTION (kg/ha)

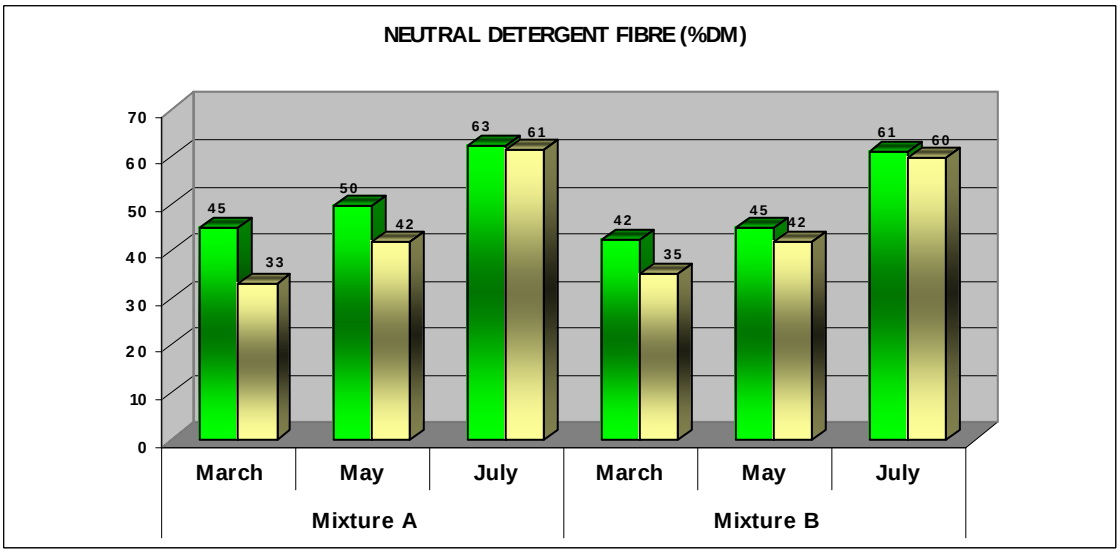


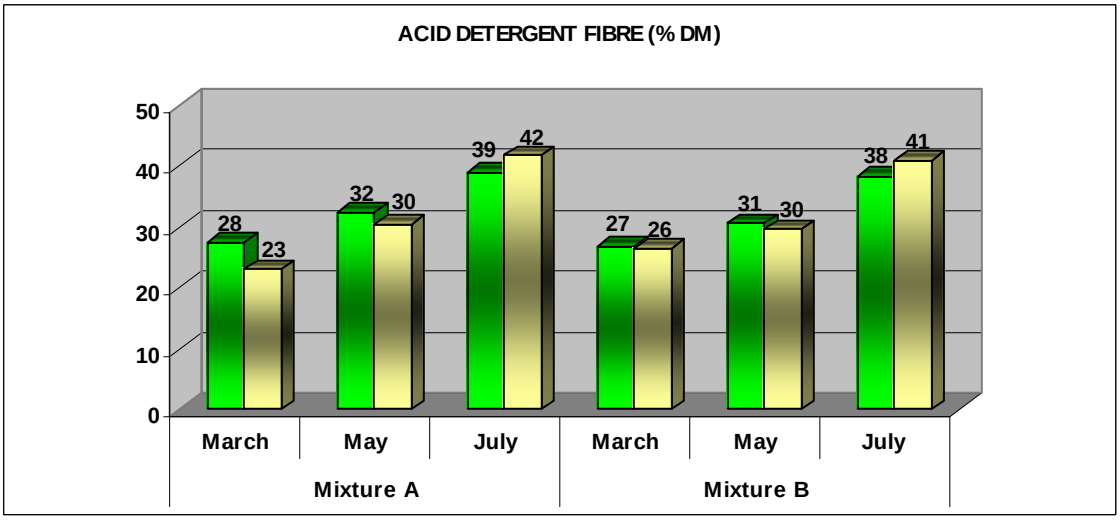


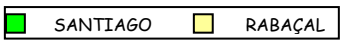


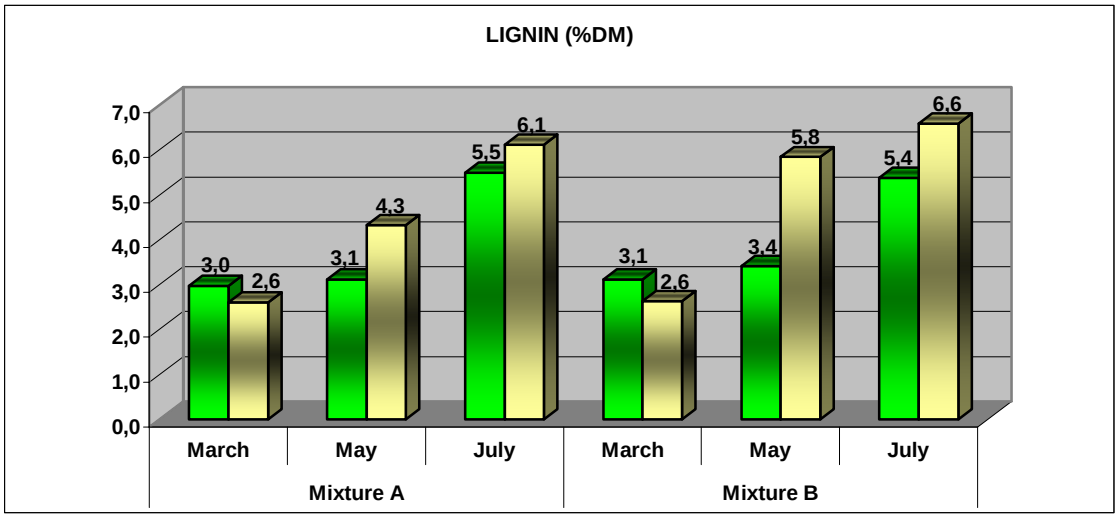
NUTRITIVE VALUE OF THE IMPLANTED PASTURES IN THE TWO EXPERIMENTAL FIELDS (n=8 per mixture and sampling date)

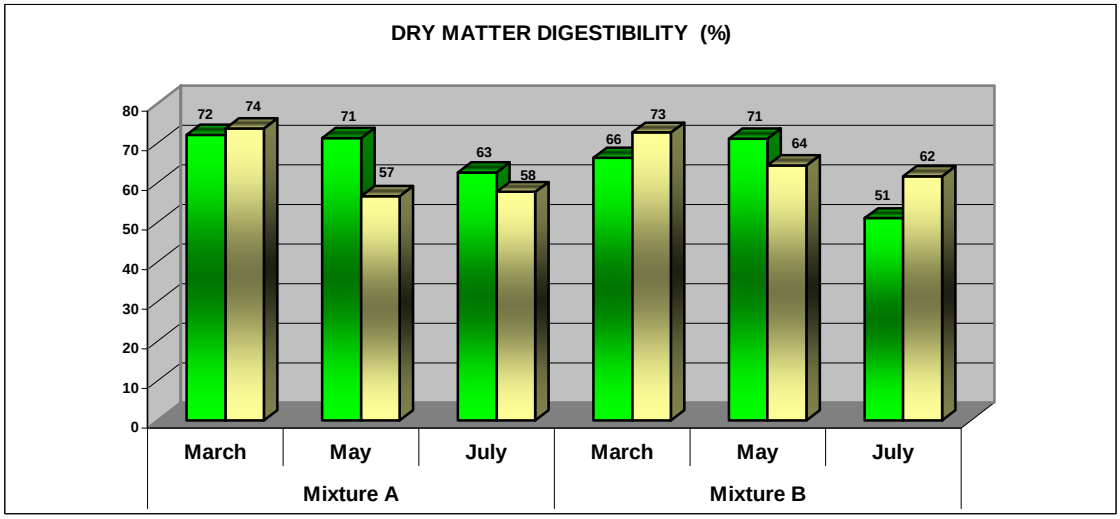




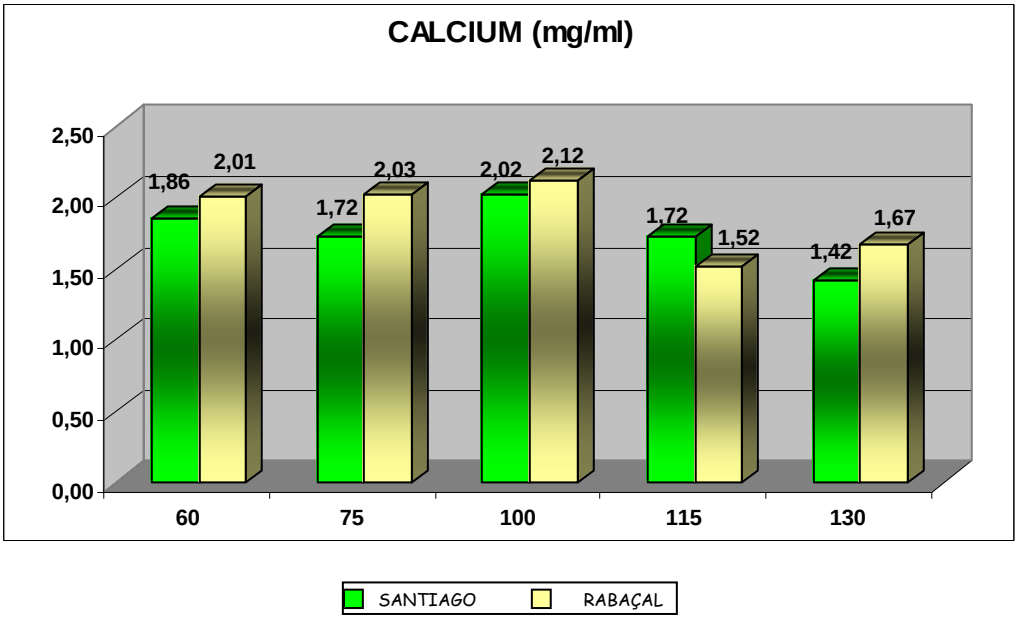


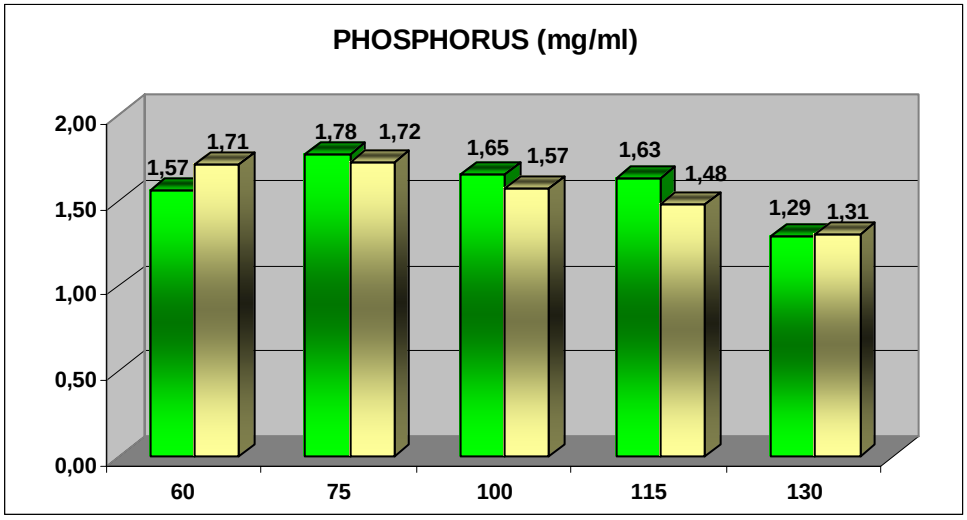


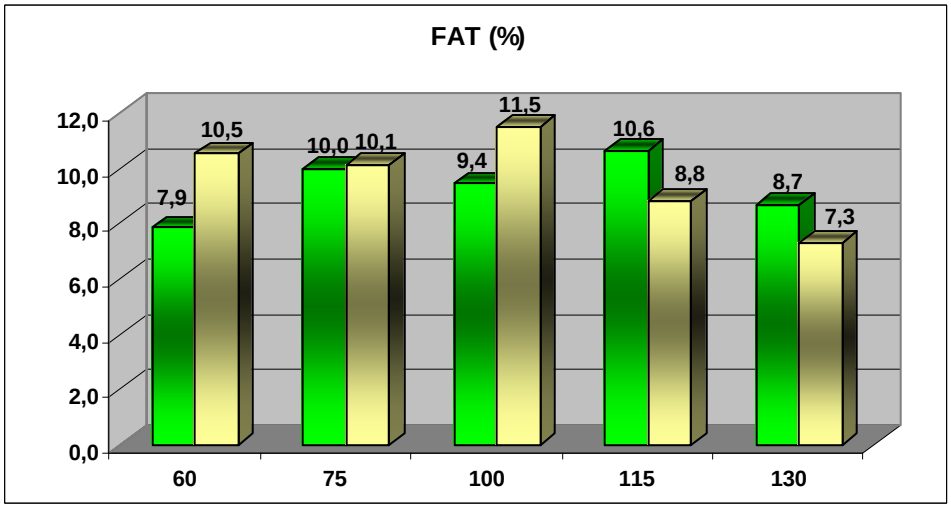


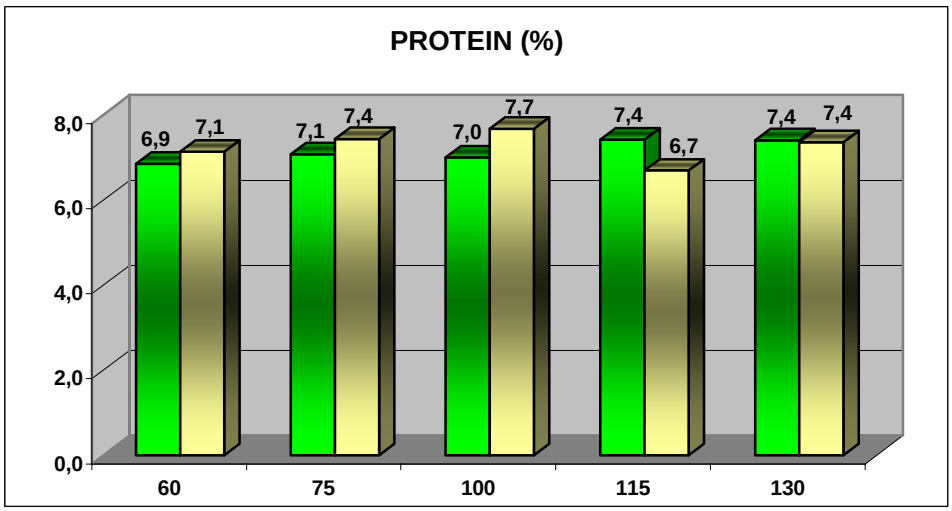


MILK COMPOSITION OF GRAZING EWES IN THE TWO LOCATIONS, FROM 60 TO 130 DAYS OF LACTATION









SANTIAGO RABAÇAL

Conclusions

Whenever the location and the seed mixture, dry matter (DM) productions varied between 4686 and 6783 kg/ha. The lowest value was observed for mixture A, at Rabaçal. In both locations mixture B presented the highest DM productions (5786 and 6783 kg/ha, at Santiago and Rabaçal, respectively).
Regarding pastures nutritive value, only the effect of cutting date was statistically significant ($P<0.001$). Crude Protein (CP) content decreased with the progress of the season, presenting in July values near 9-10 % DM. Assuming the requirements of the grazing ewes, these values would not meet them, however at this time, animals had lucerne hay as a complement. As expected fibre contents increased from March to July, which together with the reported lowest CP concentrations was responsible by the observed simultaneous decreases in DM digestibility.
The values found for milk composition varied between: 1.4 and 2.1 mg/ml for Ca, 1.29 and 1.78 mg/ml for P, 7.3 and 11.5% for fat and 6.7 and 7.7 % for protein.

The obtained results show:

- The potential for the production of improved pastures, with the seed mixtures used, as well as their adaptation to these type of soils.
- The potential of the implanted pastures for the feeding of local breeds of milking ewes, from a PDO cheese production region, even at highest stocking rates then the one (10 ewes/ha) used in this experiment.
- The potential for soil improvement through the recycle of nutrients from animal origin to the pastures, together with the organic matter of plant origin.

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References

Association of Official Analytical Chemist (AOAC). 1990 Official Methods of Analysis. Ed. S. Kenneth Helrich. USA.

Béranger, C. 2003. Dossier: Systèmes d'élevage et typicité des produits laitières. Introduction. INRA Prod. Anim. 16, 271-273.

Goering, H. K. & Van Soest, P. J. 1970. Forage fibre analysis. Agric. Handb. 379. US Dep. Agric., Washington D.C., 20 pp.

Porqueddu, C.; Parente, G. and Elsaesser, M. 2003. The potential of grasslands. In: Optimal Forage Systems for Animal Production and the Environment. Ed. A. Kirilov, N. Todorov, I. Katerov. Grassl. Sc. in Europe, vol. 8, 11-20.

Shimadzu Corporation 1991. *Analysis Guide for Flame Atomic Absorption Spectrophotometry*. Shimadzu Corporation. International Marketing Division. Kyoto. Japan.

Tilley, J. and Terry, R. 1963. A two stage technique for in vitro digestion of forage crops. J. Brit. Grass. Soc. 18, 104-11.