



Use of Seagrasses as Natural Forage Source for Small Ruminants: The Example of the Marine Plant *Posidonia oceanica*



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Abstract

The search for new sources of food that contribute to the optimization of livestock production is urgently needed, especially in the Spanish SE where rainfall is increasingly scarce and land degradation makes grazing of small ruminants difficult. This work provides *in vivo* and *in vitro* data on the nutritional composition, digestibility, inputs in sheep and goats.

Keywords: Environmental impact; *Posidonia oceanica*; Soil degradation; Marine ecosystem

Introduction

The new livestock models go through the intensification of production seeking a lower environmental impact and the enrichment of the final product by natural means [1]. In the Mediterranean coasts, the production of small ruminants is based on the feeding of residues such as barley straw. Sustainable livestock farming implies that it must be in a fair balance between the natural resources consumed (typical of the area) and the economic benefits. There are no general measures, each region has its environmental peculiarities and resources, so the use of local sources is the asset to consider. Next, we will address the use of the *Posidonia oceanica* (PO) banquettes, a residue that "dirties" the beaches in summer and is considered as annoying by bathers and inhabitants of the area [2]. Under our experience they could be used as a natural forage supplement in small ruminants in the coasts of the Spanish Southeast, as well as other Mediterranean coasts, where the lack of rain and soil degradation make grazing more and more difficult. Our results go hand in hand with the environmental concerns currently existing, and in which the disappearance of PO meadows is evident. From our veterinarian point of view and given the scarcity of plant resources in these areas, we are interested in the maintenance of this marine ecosystem, since its waste, obtained in a natural way, can be used as forage. This is proof that the advance of the agricultural sector must be directed in the coming decades to the collaboration of the most varied disciplines.

What is *Posidonia oceanica* really?

Posidonia oceanica is a marine plant, which grows along the coast forming extensive meadows from almost the surface of the

water to depths of 40 meters [3]. PO grasslands play a key role in the biodiversity cycle in the Mediterranean coasts [4]. In evolutionary terms it is more complex than algae, with which it is often confused. This plant presents an annual growth cycle characterized by the development, growth and loss of leaves. When these leaves are no longer functional (they stop carrying out photosynthesis) they lose their original green colour and acquire a brown colour until they become detached and are taken to the coast as waste or banquettes on the shores of the sea [5]. The deposits that reach the beaches (thousands of tons) during the summer season are considered a nuisance for the bathers and inhabitants, especially due to the bad smell that comes from the uncontrolled decomposition of organic matter. A recent review [2] pointed out the importance not only for the touristic sector but also for public health: the collection of PO waste during the bathing season (between April and September, when the law allows it) would diminish the presence of unpleasant odors resulting from the decomposition of the banquettes, the greater presence of parasites, vermin's and/or insects or even the dirtiness generated in the surroundings when the residues of PO are displaced by the wind. This is a factor to take into account in areas of high tourist power such as the beaches of the coasts of Spain. The current destination of this waste is incineration in landfills. Therefore, the use of their waste for animal nutrition would turn them into meat, milk, leather, cheese, etc. entering the circular economy process that is intended. This alternative, moreover, is in line with the support for the maintenance and growth of these meadows protected by the Natura-2000 network within the European Union.

Which part of the plant is the most suitable for animal feed?

Spanish and European regulations only guarantee access to wastes (banquettes), the most abundant element on beaches. In addition, it has been observed that PO leaves are nutritionally more relevant than roots and rhizomes [6]. Previous studies carried out in Australia with *Posidonia australis* recommend the collection of the easily available dry residue in large quantities, although it is necessary to wash it and dry it later in the sun, because the presence of sand can cause digestive disorders [7]. In addition, although it is true that *Posidonia* is rich in tannins with concentrations clearly higher than those provided by conventional forages, recent chemical analyses carried out on PO by Kaal et al. [8] have demonstrated that dry leaves are poor in them due to oxidation by solar action.

Results obtained with the use of *Posidonia oceanica* residues on small ruminants

The following results are the result of 10 years of experience working with dry residues (collected above the seashore) analyzing their nutritional composition, digestibility, intake, production and effect on the final product, comparing it with other forage sources and carrying out *in vivo* studies on goat species (Murciano-Granadina breed) and ovine species (Merino breed). The analysis of a series of collected samples in the region of Murcia (S.E. of Spain) revealed that the mean dry matter (DM) values of PO were 16.4%; the value of other components (over DM) were 155g/Kg for ashes; 42g/Kg for crude protein (CP); 13g/Kg for ether extract (EE); 760g/Kg for neutral-detergent fiber (NDF); 533g/Kg for acid-detergent (FAD) and 116g/Kg for lignin (LAD) [9]. Coming from a sea as polluted as the Mediterranean (the main cause of the depletion of seagrasses), the measurement of heavy metals and/or polluting microminerals was essential. In general terms, copper values were similar to those recorded for barley straw with higher zinc levels. Of significance was the high Fe content, very common in other Mediterranean areas. However, when administering the marine plant to goats, blood Fe levels were lower in the supplemented animals than those that had not received it, probably due to the low bioavailability of the mineral in the digestive tract [10]. As for Ca, P and Mg concentrations, and comparing them with those found in traditional forage sources [11], PO was richer in calcium and phosphorus but poor in magnesium. For goats, supplementation with PO showed that this animal was able to consume daily up to 450g/day without any detrimental effect at the productive level [12]. While for Merino sheep the optimal intake the ideal proportion to supplement was between 75 and 150g (as a limit) of PO/day [13].

If it was a common fact for both species the need of a time of adaptation to the product (which was never more than one week) and that the animals showed preferences for the dry plant, never wet. We consider this management factor to be of vital importance when introducing this fodder source in the new rations, which should be introduced progressively [13]. The marine plant contains more ashes than cereal or hay straw; the lignin fraction is also higher than reported values for straw, hay or silage [11] although

its ruminal degradability is greater [9]. This suggests its potential use in ruminants (such as beef cattle) that consume a high content of fast fermenting cereals encouraging salivation and chewing activity [14]. Interestingly, although PO is low in CP, it contributes to its efficient use, favoring the use of endogenous urea and therefore decreasing its elimination through urine. This means that it would be possible to reduce the high protein content of many rations for these animals, which makes the cost of production more expensive. Precisely, the elimination of ureic N is currently one of the main problems regarding the contamination of ruminant farms, together with methane emissions [1]. In relation to the quality of milk in Murciano-Granadina goats, it was recorded that the supplemented goats contained more fat and less somatic cells. It is well known that an increase in somatic cells is an indicator of mammary infection.

Several studies have detected the presence of antioxidants [15] in PO, and active agents against Gram+ and Gram- bacteria, dermatophytes and yeasts [16,17], an interesting aspect within the world scenario created in the livestock sector by the excessive use of antibiotics. It is the mature leaves that form the banquettes which contain the greatest amounts of antioxidant substances, as reflected in the study by Haznedaroglu & Zeybek [18]. The supplementation with natural products, constitutes one of the greatest demands of the consumer since it complies with the safety criterion, especially if the supplementation used is capable of enriching the food and/or minimizing the unnecessary use of antibiotics in livestock in line with what we know today as food fortification [1]. The cheese obtained from goats supplemented with PO was firmer and chewier. In addition, under different technological test conditions, milk from animals fed with PO showed greater adaptation to technological processes. In relation to minerals, neither milk nor cheese showed traces of contaminated or heavy metals, confirming that PO can be considered a supplement that presents a low risk of toxicity to the consumer [19]. Metabolic studies carried out in both species showed that neither the hepatic nor renal activity nor the mineral profile were affected by supplementation with the marine plant, presenting all the animals values within the reference ranges established for each species [20,21]. This raw material, on the basis of numerous properties, would find a niche in EU Regulation No 68/2013 on the catalogue of feed materials, since at present, international legislation does not allow the use of synthetic products that may be present in fresh milk or its derivatives. Therefore, the stability of the same must be provided by natural substances and the active principles contained in them.

Conclusion

The dry residues of the marine plant *Posidonia oceanica* can be used for animal nutrition as a forage source without detriment to production or health status, always according to the nutritional requirements of each species.

1. The plant's richness in antioxidants promotes the technological enrichment and processing of milk, providing added value within the concept of food fortification.

The use of local resources is a strategy included in what we know as sustainable livestock.

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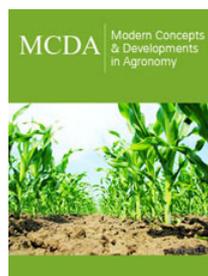
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