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Olive by-products in animal feeding: improvement and utilization

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SUMMARY - Olive cultivation and manufacturing produces many by-products that can be improved and utilized in animal feeding representing an important recovery of fodder. In some cases also a dangerous pollution can be avoided.

RESUME - "Sous-produits de l'olivier en alimentation animale: amélioration et utilisation". La culture et la transformation des olives produisent beaucoup de sous-produits qui ont une utilisation dans l'alimentation des animaux. Cela représente une importante source d'aliments et une réduction de la contamination du milieu.

Introduction

Olive trees are spread over the five continents, although olive production prevails in the Mediterranean Basin (98% of the area and 97% of the trees cultivated in the world). Spain, Italy, Tunisia and Greece particularly represent 74% of olive production in the world.

The main products of this cultivation are: Edible olives, Virgin and solvent extracted oil. The technologies used for oil manufacturing are very different so that a wide range of by-products are obtained: Estraction by pressure (Nefzaoui, 1983) and centrifugation (Martillotti, 1983) are the most diffused. Therefore few other procedures exist, like the Acapulco process; in this case the olive pulp is previously separated from the stone. For this reason there are many oil extraction by-products that can be defined as follows:

– Crude olive cake; the residue of the first extraction of the oil pressure from the olives.

– Exhausted olive cake; the residue from the solvent extraction of the crude olive cake.

– Partly destoned olive cake; residue from the partial separation of the stone from the pulp by screening or ventilation.

– Vegetation water; the liquid obtained during oil manufacturing and separated by centrifugation or sedimentation after pressing.

– Leaves and prunings; the branches, twigs and leaves obtained after pruning or at the oil mill.

All these by-products can be improved through industrial process, chemical agent treatments and ensilage to increase the feeding value.

Olive cake

The olive kernel shell, the skin and the crushed pulp, that remain after oil extraction, contains still water (about 25%) and a little amount of oil. After solvent extraction process the remaining exhausted olive cake contains obviously a smaller amount of oil and water because of dehydration. Partly destoned olive cake contains a small proportion of shell which cannot be separated from the pulp. For this reason it shows a lower fibre content in comparison with crude olive cake. Although variable according to kind of cake, the protein content remains relatively low. In addition, a large part of the proteins are linked to the ligno-cellulose fraction (Nefzaoui, 1983). The high content of crude fibre, mainly constituted by lignin lowers bio-digestion of olive cake.

This may be caused by decreased microflora activity negatively influenced by high lignin content. This evidence induced many studies to improve nutritive value of olive cake. Alkali treatments have been the most studied procedures. In more details, treatments with NaOH (Abdouli, 1979; Nefzaoui, 1983) improved in vitro digestibility of olive cake. The proteins and dry matter in vivo digestibility of exhausted ensiled screened olive cake also increased with the same treatments (Nefzaoui, 1982). Ammonia treatments were also performed injecting anhydrous ammonia in olive cake, added with molasses, stored in PVC sheets (stack method). The improvement of nutritive value was considerable especially regarding the nitrogen percentage absorbed by olive cake, and the digestibility of the other nutrientes (Martillotti et al., 1984).

The partial destoning is referred as the more economic possibility to improve the nutritive value of this by-product because it increases the digestibility of protein and organic matter (Nefzaoui et al., 1982).

Unremarkable results were obtained with biological treatments.

Both crude and partly destoned olive cake, as such or treated, are used in animal feeding in many countries. Usually they are added with molasses because of its low palatability and can substitute a part of roughage for its high cellulose content. Its conservation is ensured by ensilage and both the ammonia and soda teatments appear to be effective in increasing nutritive value, although the latter is limited in field practice because of high investment costs.

Olive branches and leaves

Olive leaves and branches are available in a considerable amount during pruning. This occurs in October and March. Non trascurable amounts of leaves and twigs are available at the oil mill after olive cleaning. Chemical composition is varied as a consequence of pruning severity, but always the fibre and lignin content is high and crude protein content is low. Olive prunings are distributed as fresh in many countries, but the low nutritive value of this by-product involves a low digestibility coefficent (Maymone et al., 1950; Alibes and Berge, 1983). As indicated in advance it seems clear that the separation of the leaves from the wooden parts is an effective procedure to improve its nutritive value. This treatment leads to strong chemical variations, particularly lowering fibre percentage as shown by Alibes et al. (1982).

Unnoticeable results were obtained with soda and anhydrous ammonia treatments, probably because of the high content in lignin (Alibes et al., 1982). Better results were obtained with crushed olive branches preserved for 60 days in plastic recepticles after alkali treatments.

In vitro digestibility was hardly increased with 4.7% NaOH, 2.5% NH3 and especially when soda and ammonia were used together, ammonia particularly showed a positive effect increasing the digestible crude protein content (Martillotti et al., 1984).

To sum up, it can be assumed that olive pruning residues can be administered to ruminants as fodder, and when dried as poor quality roughage.

Vegetation waters

Vegetation waters are a brown watery liquid with a pleasant odour but a bitter taste. Because of the high content in organic matter they represent a source of pollution for the olive manufacturing industry. The average chemical composition is rather different in relation to many factors, mainly the oil extraction process. Although the documentation on this subject is scarce, Martillotti (1983) has described a method developed in Italy (Dalmolive; table 1). By this method, that combines vegetation waters, partly destoned olive cake, and several by-products, a pelletted feed is produced.

The Dalmolive method consists in the following processes: sterilization, double layer evaporation (using olive kernel as fuel), fractionated separation producing alcohol, sodium phenolates, and concentrated vegetation waters (CVW) with 48.4% D.M.

CVW was administered to adult rams in addition to alfalfa hay to determine the in vivo digestibility at maintenance level (Verna et al., 1988). The results indicated that CVW rose from 54.6% to 61.4% and from 56.9% to 61.9% respectively the dry and organic matter digestibility (table 2).

A feeding trial was performed by Martillotti (1986) on growing fresian young bulls comparing a traditional ration (composed by concentrate and corn silage), with an experimental diet including CVW and exhausted olive cake as fodder. The experimental group showed lower performances than control considering daily growth rate and feed conversion index (table 3).

In conclusion CVW seems to be suitable to be included in diets well integrated in proteins as a proportion of energetic source.

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Table 1

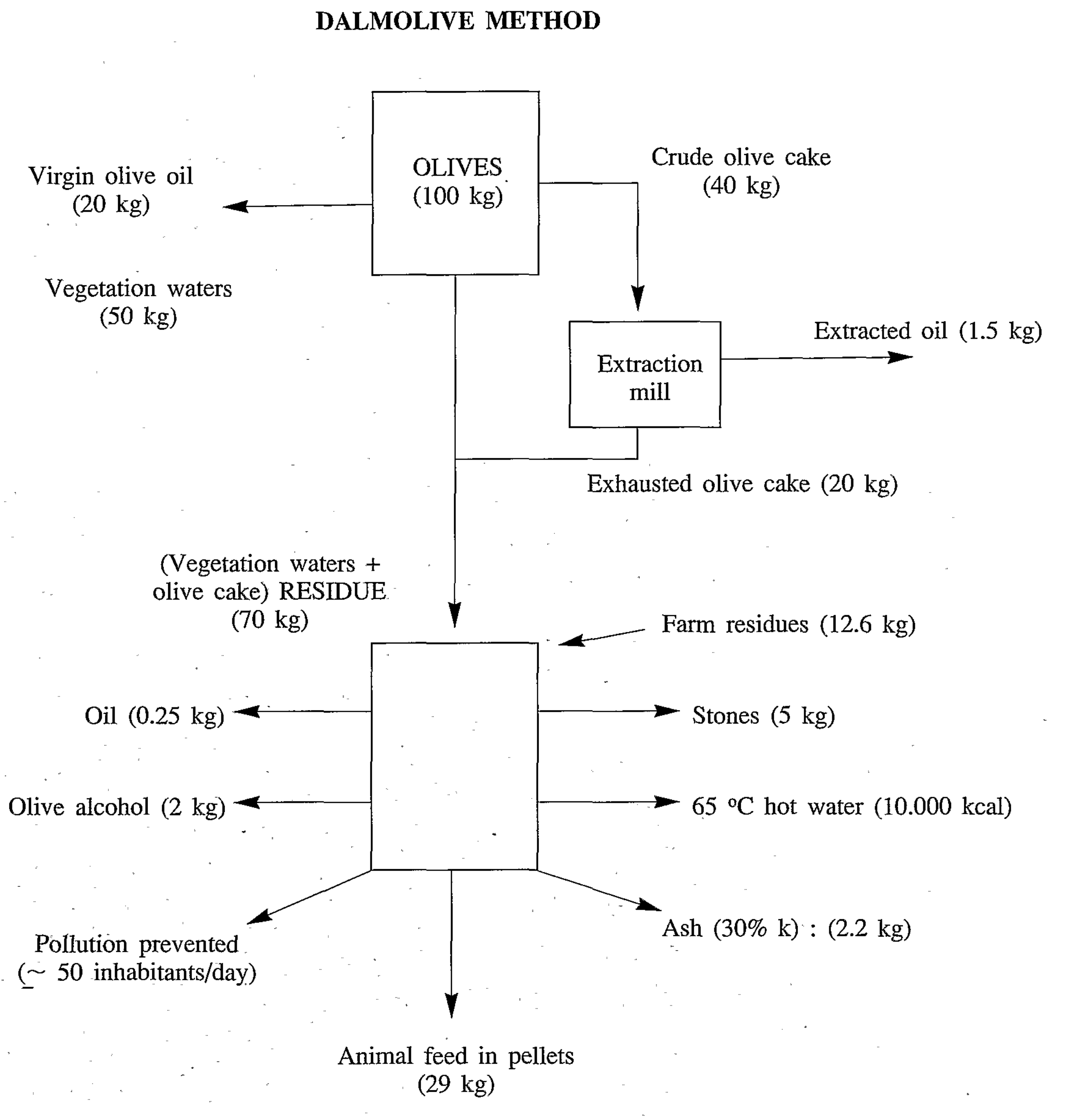

Table 2. In vivo digestibility coefficients of the two diets and those of the CAV mathematically determined.

	100% hay	50% CAV-50% hay	CAV
DM	54,6	61,4	73,5
OM	56,8	61,9	72,0
CP	68,1	63,7	37,8
EE	64,2	61,1	59,2
CF	49,8	46,6	—
NFE	59.5	69,4	78,3

Table 3. *In vivo* growing and feeding performances of young bulls fed with CAV.

	Experimental Diet	Control Diet
Initial live body weight Kg	193.1 +35.5	184.4 +42.3
Final live body weight Kg	342.0 +38.7	384.5 +47.0
Daily growth rate Kg	0.86+ 0.08	1.16+ 0.09
Daily feed intake (SS) Kg	7.70+ 0.15	6.73+ 0.12
Feed conversion index ss/Kg	8.95+ 0.68	5.82+ 0.57

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