Olive by-products in animal feeding: improvement and utilization

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Olive cultivation and that can be avoided.

- 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 nutrients (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 treatments 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 coefficient (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 receptacles 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 (Dal-moline; table 1). By this method, that combines vegetation waters, partly destoned olive cake, and several by-products, a pelleted feed is produced.

The Dal-moline 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 fressian 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.

References

ABDOULI, H. 1979. Essai d'amélioration de la valeur nutritive de la pulpe d’olive par la soude. Mémoire du 3ème cycle INAT.


Table 1

**DALMOLIVE METHOD**

- Virgin olive oil (20 kg)
- Vegetation waters (50 kg)
- (Vegetation waters + olive cake) RESIDUE (70 kg)
- Olive alcohol (2 kg)
- Pollution prevented (~ 50 inhabitants/day)
- Animal feed in pellets (29 kg)

- Crude olive cake (40 kg)
- Extracted oil (1.5 kg)
- Farm residues (12.6 kg)
- Oil (0.25 kg)
- Stones (5 kg)
- Ash (30% k) : (2.2 kg)

- Exhausted olive cake (20 kg)
- 65 °C hot water (10,000 kcal)


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

<table>
<thead>
<tr>
<th>Component</th>
<th>100% hay</th>
<th>50% CAV</th>
<th>50% hay CAV</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM</td>
<td>54,6</td>
<td>61,4</td>
<td>73,5</td>
</tr>
<tr>
<td>OM</td>
<td>56,8</td>
<td>61,9</td>
<td>72,0</td>
</tr>
<tr>
<td>CP</td>
<td>68,1</td>
<td>63,7</td>
<td>37,8</td>
</tr>
<tr>
<td>EE</td>
<td>64,2</td>
<td>61,1</td>
<td>59,2</td>
</tr>
<tr>
<td>CF</td>
<td>49,8</td>
<td>46,6</td>
<td>59,2</td>
</tr>
<tr>
<td>NFE</td>
<td>59,5</td>
<td>69,4</td>
<td>78,3</td>
</tr>
</tbody>
</table>

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

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


NEFZAQUI, A., HELLINGS, Ph., VANBELLE, M. 1983. Ensiling olive pulp with ammonia: effects on voluntary intake and digestibility measured by sheep. 34th Annual Meeting of the EAAP Study Commisision, Madrid.