SOLID | Sustainable Organic and Low Input Dairying

Vegetable by-products for feeding dairy goats

Introduction

Nearly 50% of all fruits and vegetables in the European Union go to waste, with losses occurring during agricultural production, processing, distribution to retailers and by the consumers. This represents a significant annual volume of potential feed that can be incorporated into animal diets. The majority of fruit and vegetable wastes are highly fermentable and perishable, mainly because of high moisture (80–90%), total soluble sugars (6–64% in DM) and crude protein (10–24% of DM). During the peak production or processing season, large quantities of these resources are available and cannot be consumed at the same location in which they become available and thus they become surplus and can cause environmental pollution.

Therefore, suitable methods should be adopted to conserve such resources for animal feeding throughout the year or specifically during the period of low green fodder production.

Storage of waste vegetables in processing plant (Motril, Spain)

Nutritional value

Cauliflower and pomegranate pulp showed variability in the chemical composition reflecting the different nature of the materials (Table 1). Some by-products had high protein contents (i.e. cauliflower), others medium (tomato and pomegranate wastes) and some rather low (olive pulp and olive leaves), yet, with high levels of fibre. This variation in nutrients highlighted the differences in the potential of the feeds tested to replace more conventional feedstuffs, depending on their chemical composition. While some would be suitable as forage alternative, others could potentially replace cereal grains in the diet of ruminants. Special attention should be paid to the moisture content, which varies considerably across by-products. This relates to the need to implement appropriate processing and storing practices to ensure sustained feed supply.

Table 1: Nutrient composition of the main vegetable by-products generated in south Spain (DM: dry matter, OM: organic matter, CP: crude protein, NDF: neutral detergent fibre, EE: ether extract, DMD: DM digestibility)

By-product	DM %	OM %	CP %	NDF %	EE %	DMD %
Tomato surplus	5.6	89.9	10.3	19.1	3.9	91.0
Olive pulp	52.1	88.9	9.9	63.2	3.4	51.2
Olive leaves	61.5	81.9	7.4	54.4	5.6	54.4
Cauliflower	52.2	87.1	25.5	21.2	0.5	81.4
Pomegranate pulp	67.1	94.8	12.1	12.5	10.8	76.0

Ensiling as a solution

There are different options available for preserving high moisture by-products. The most common for use at a farm level are sun drying, artificial forced-drying and ensiling.

Ensiling by-products is a simple and low-cost option, which can preserve feeds that are seasonally abundant for later feeding during periods of feed shortage. Essentially ensiling involves a microbial anaerobic fermentation of carbohydrates and protein that results in the production of acetic, butyric and lactic acid, which lowers pH to around 4.5-3.8. At this pH the silage can be safely stored for months provided it is not exposed to oxygen (Figure 2).

On-farm trials carried out at CSIC in Spain tested the suitability of tomato fruit silage and olive cake silage for dairy goat nutrition. The first silage included tomato fruit and straw in a 80:20 ratio on fresh weight basis and

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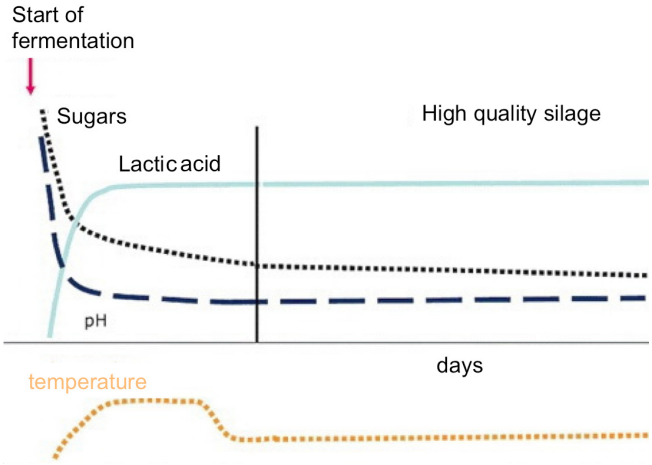

Figure 2. Representation of the ensiling process

was fermented with 0.5 % formic acid. The second silage included olive cake, olive leaves and barley grain in a ratio of 45:45:10 on fresh weight basis. These proportions were selected based on previous observations and intended to balance the dry matter content to ensure successful ensiling. The ingredients were weighed and thoroughly mixed in a feed mixer. The mix was then baled, individually wrapped with four to six layers of 'bale wrap plastic' (25 micrometre stretch film). This was performed with a bale wrapper, using a bale handler with front-loader. The bales had dimensions of 1.5 m x 1.5 m x 1.5 m and weighed around 1,000 kg.

Once opened, the silages appeared fine and were analysed for nutrient composition (Table 2). Tomato and olive silages have been tested as part of a typical diet for dairy goats, replacing oat straw, which represented 20 % of the diet. The goats were in mid lactation and the adaptation period was 30 days.

Table 2: Nutrient composition of tomato and olive silages

Silage	DM %	OM %	CP %	NDF %	pH
Tomato	5.6	89.9	10.3	19.1	3.9
Olive	52.1	88.9	9.91	63.2	3.4

Goat milk production from silage

The inclusion of olive and tomato silage in the diet of dairy goats increased dry matter intake (Figure 3), which shows that these types of silages are highly palatable and the animals accept them very easily. This is particularly important, as the use of silage in feeding dairy goats in south Spain is not common practice. Milk production did not change significantly among diets, although a numerical decrease occurred when olive silage was used (Figure 3). In the case of tomato silage milk yield was similar to the control. Considering that 20 % of the diet (oat straw) was replaced this is a great advantage in terms of reducing feeding costs. Interestingly, the somatic cell count was lower in the milk of goats fed the two silages including olive and tomato by-products (figure 4). If this is further confirmed, including these by-products in the diet of dairy goats would result in a better health status throughout the lactation.

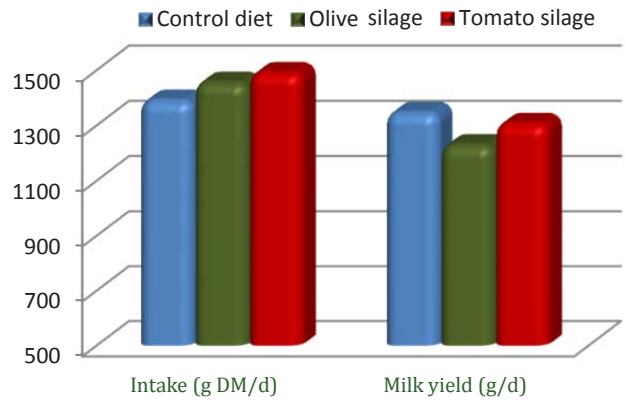

Figure 3: Effect of the diet on intakes and milk yield

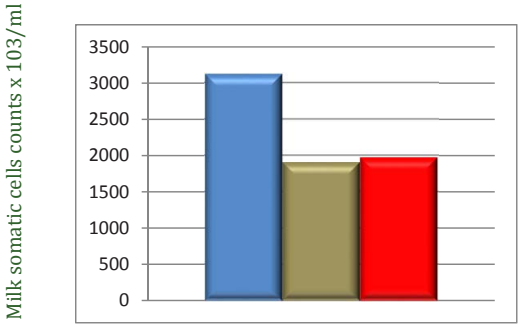

Figure 4: Effect of the diet on somatic cell count in milk

Conclusions

- A wide range of vegetable by-products can provide different nutrient resources, which have potential to be used as replacement of a range of conventional feeds in feeding dairy goats.
- Ensiling tomato and olive derived by-products represents a valid strategy to address the high moisture challenge, maintain their nutritive value and ensure supply of these by-products throughout the year.
- Feeding tomato and olive silages as a replacement for oat straw does not compromise milk yield and has beneficial effect on somatic cell count.
- This strategy can be applied to a number of potential different fruit or vegetable by-products in the future.

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