



By-product valorization strategies implemented by small Mediterranean olive oil farmers

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1. Introduction

Olive oil is one of the most important agri-food products in the Mediterranean, the region that supplies most of the worldwide production (Donner & Radic, 2021). In the growing sector of Mediterranean olive oil, commercialization is dominated by a few big manufacturing companies and retailers, which are generally the ones that reach the final consumer and determine the price of olive oil (Rodríguez-Cohard & Parras, 2011). However, most of the production of olives and olive oil still remains in the hands of small farmers, often organized around agrarian cooperatives and social mills (Karanikolasa et al., 2018).

As it is the case with most agri-food sectors, the growth in Mediterranean olive oil production is tied to intensification in all stages of the production chain, a strategy that yields serious negative environmental externalities (Donner & Radic, 2021). The waste generated by olive oil production, particularly the by-products of the milling process, is challenging to manage, as it might be phytotoxic, and it has created an environmental problem in the region (Pantziaros et al., 2021). However, current research indicates that olive oil by-products can also be a source of valuable uses if handled with circular economy practices that valorise them (Souilem et al., 2017). These uses range from applications such as bioenergy, animal fodder and biofertilizer, to products for human consumption, such as food or cosmetics (Berbel & Posadillo, 2018; Donner & Radic, 2021). A big part of the bioeconomy debate on olive oil by-products focuses on the necessary technological resources, such as the extraction of phenols, needed for their valorisation (Berbel & Posadillo, 2018; Donner & Radic, 2021; Pantziaros et al., 2021). On the other hand, some studies also show the potential benefits that implementing by-product valorisation practices could have for small olive oil farmers. The different potential uses of olive oil by-products could be an extra source of income for small farmers and make the farm more resilient and sustainable by re-circulating internal resources (D'Adamo et al., 2019; Pardos i Jordana & Alamon i Beas, 2018; Rodríguez Cohard et al., 2017).

In this paper, we look at what by-product valorisation strategies are implemented by small olive oil producers in the region of Terres de Ponent (Catalonia – Spain) and how these farmers perceive these practices in the context of their farm.

2. Methodology

This research project is part of the EU 7th Framework Programme project COLIVE – *Collective marketing strategies and circular business models for valorizing local food, agro-waste and by-products: example of the olive oil chain*. Fieldwork was done in the region of Terres de Ponent (Catalonia – Spain), which is one of the most relevant olive oil producing regions in the Spain. We chose the potential informants based on the size of their farms and the diversity of the farmers. We established that in this geographical context, a small olive oil production means a farm with less than 100ha dedicated to olive trees. Within this guideline, we looked for different approaches to farm management and the economic activities that complement olive oil production.

We applied a descriptive statistics analysis and a qualitative analysis (using a QDAS) to the data we obtained. We focused on how the small olive oil farmers in the sample manage the most relevant olive oil by-products; olive tree pruning biomass (OTPB), olive pomace and olive stones (Berbel & Posadillo, 2018). The assessment of the strategies and by-product uses implemented by farmers is based on previous studies that indicate that uses for human consumption have a higher value, while uses such as bioenergy or biofertilizer have the lowest value (Donner & Radic, 2021).

3. Results and discussion

In the studied sample, the olive oil by-product most commonly valorised by farmers is OTPB. The valorisation of olive oil pomace is also widely implemented in the sample, while olive stones are valorised less frequently. To properly contextualise these results, it is important to note the access to milling infrastructure highly determines what olive oil by-products farmers need to manage. While all the farmers in the studied sample produce olives for olive oil, not all of them incorporate the manufacturing process in their farm's project. In our sample, only 52% of olive oil farmers can fully control the manufacturing process and have

to deal with the waste related to olive and olive oil production. Of the remaining farmers, 17% of them sell their olives unprocessed and 31% commercialize their own olive oil but outsource the milling process, which means they only need to manage olive production by-products.

The main by-product in olive production is OTPB, the waste resulting from the yearly pruning of olive trees and made of branches and leaves. While the traditional practice in the area is to simply burn OTPB, this is changing and 72% of the olive oil farmers of the sample choose to valorise it. The most common use for OTPB is to shred it with special machinery and either leave it in the fields as soil coverage or incorporate it as organic matter. Some farmers value this strategy as a more sustainable approach to fertilizing, while for others shredding OTPB is an alternative to burning now that the regulations for burning on field have gotten stricter in the area. In both cases, most farmers supplement the added organic matter of OTPB with other sources of fertilizer.

As indicated in literature, we have found that the main by-products being valorised out of the olive oil making process are olive pomace and olive stones. Olive pomace is the resulting paste of extracting the oil, made out of olive pulp, skins, stones and water. 40% of the farmers in the sample valorise olive pomace (Berbel & Posadillo, 2018). By far, the most common strategy to use olive pomace is selling it as raw matter to an oil refinery, but some olive farmers also add part of it to the soil as biofertilizer. The farmers in the sample express that they sell olive pomace out of necessity, since it is a type of waste they cannot manage in their own facilities, and not because of the added value it brings. The price of olive pomace is very low and it fluctuates every year (Sanz Cañada & Macías Vázquez, 2005), to the point that some years the money farmers make barely covers the cost of transporting the olive pomace to the refinery. Because of that, they don't perceive this practice as a valuable source of income, but rather as a waste management strategy. Using olive pomace as biofertilizer would be an alternative, but this practice is highly limited by agriculture regulations and it is implemented by only 10% of the farmers.

Circular uses for olive stones are not as widely implemented, but it is an upward trend among the olive oil farmers in the sample. Currently, only 12% of the farmers in the sample valorise olive stones; with special machinery, part of the milling infrastructure, the stones are separated from the wet olive pomace and then let to dry. Later, the olive stones are used as bioenergy for the heating in the milling facility or sold locally for domestic boilers. Even the farmers that don't implement such strategy, look at it favourably as an added resource. However, they express that the equipment to separate stones from olive pomace is an expensive investment.

4. Conclusion

Small olive oil farmers incorporate several strategies to valorise the by-products of olive and olive oil production. Among the different strategies we found, using shredded OTPB as organic matter for the soil and selling olive pomace to oil refineries are the most widespread and solidly established practices in small olive oil farms. Other practices, such as the use of olive stones for bioenergy or olive pomace as fertilizer are less common but gaining acceptance among farmers for their benefits in terms of by-product management. However, all the uses implemented in the studied sample could be defined as low value uses. Using olive pomace to make olive pomace oil, that is, for human consumption, could be defined as a higher value use, but small olive oil farmers perceive it differently. Because of the low price of olive pomace and difficulty to manage it, small olive oil farmers don't perceive any added benefit from valorising it. Overall, the valorisation of olive oil by-products tends to be viewed by small olive oil farmers in Terres de Ponent (Catalonia – Spain) as waste management practices rather than as sources of income or value.

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