

# Avocado puree production and waste management can offer interesting options for avocado commercialization

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## Introduction

Avocado is today's most popular fruit and there are more and more products based on it available. In a market with such accelerated growth, it is necessary to talk about the environmental impacts generated by the cultivation and industrial use of avocados. In the avocado puree production, the pulp must be separated from the peel and the seed, which represent 35% of the total weight of the fruit. Subsequently, the pulp is homogenized, in this process about 20% of the pulp is lost due to the presence of fibers or other factors that negatively affect the quality parameters of the puree. The pulp, seeds and pulp in poor condition end up becoming a waste problem for the industry. Several authors have researched ways to take advantage of this waste. The production of oils and bioactive compounds from any of these wastes are interesting alternatives. However, they can be costly and alternative processes such as energy generation can be an efficient and cheap response for the use of this waste (Dabas et al. 2013).

Based on the interest of some companies in Colombia to develop products derived from avocado and the use of the whole fruit, if possible, the main objectives of this research were: (1) To develop an avocado puree that meets the quality parameters necessary for exportation, (2) modelling the production of avocado puree with and without waste management, (3) analyse and compare the economic and environmental viability of the production process in the scenarios obtained.

## Materials and Methods

An avocado puree was developed and quality parameters such as color change, organoleptic parameters and enzyme activity that cause the deterioration of the product (polyphenol oxidase and peroxidase) were evaluated during storage (Elez-Martínez et al. 2007; Jiang et al. 2004). The simulation of the productive process was used to evaluate economically and environmentally the process and the effect of the use of waste management on it. Obtaining avocado oil, avocado seed oil, and energy from peels was also simulated according to different production processes found in the literature and in experimental tests carried out (Chimsook 2017; dos Santos et al. 2014; Qin and Zhong 2016). The mass and energy balances obtained in the simulations allow quantifying the carbon footprint generated by the process. The simulation was performed using the software Superpro Designer 10.5 (Intelligen, Inc., USA)

The environmental analysis followed the ISO 14040: 2006 standard, based on the results obtained in the simulation and the Ecoinvent 3 database as a source of data to elaborate a life cycle analysis (LCA). The software Simapro 8.3 was used to calculate the impacts. With this analysis, the impact of each stage of the process was evaluated, from the cultivation to the production and deposition of waste, as borders for the analysis were used a cradle to gate, and gate to gate systems with 1kg of avocado puree produced as the functional unit. A size up analysis was carried out to find out which production levels the different scenarios evaluated could be viable.

## Results and discussion

It was possible to produce an avocado puree with exportation quality, as well as an economically viable production process. The avocado puree obtained lasted more than a year under frozen storage conditions, without appreciable changes in its organoleptic qualities respecting to the fresh puree. As expected, taking advantage of avocado wastes reduces the environmental impact generated by the production process. In the life cycle analysis, it was found that a large part of the environmental burden of the process is generated by the cultivation of avocado and other raw materials used in the process (Figure 1). The process without waste management was viable and commercially competitive, reaching production costs below 0.5 EUR for a packed 200g avocado puree unit, about 3 tons of avocado are required to be processed daily. However, in order to make the process with waste management viable and competitive, the size up analysis showed that a production between 2 and 10 times the original is required, depending on the scenario.

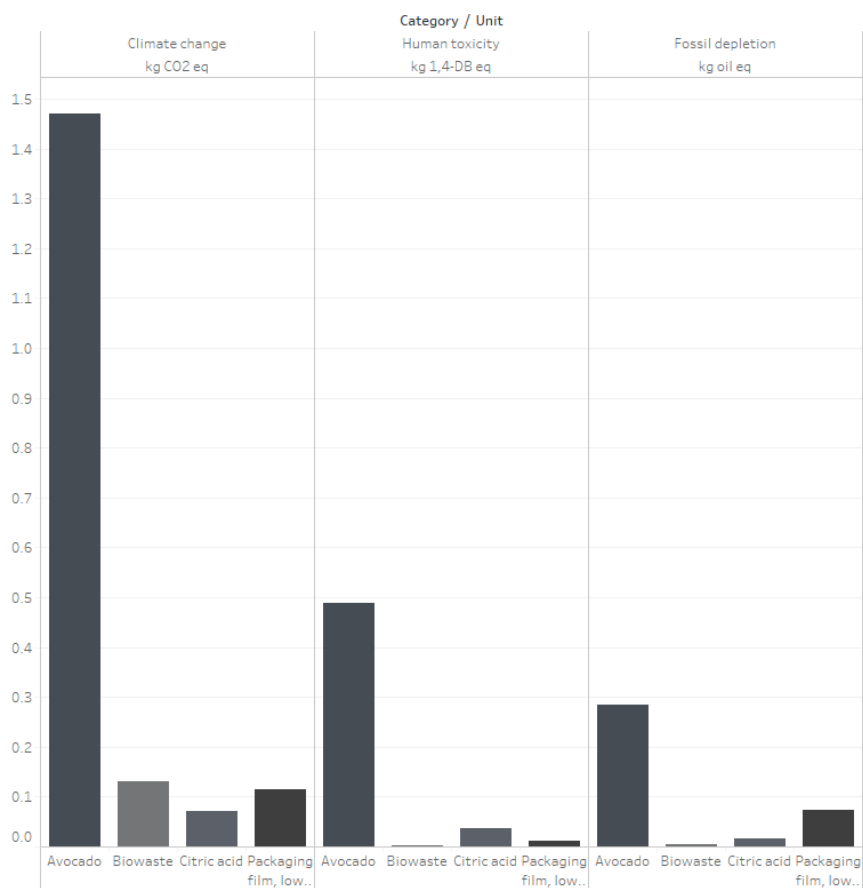


Figure 1: Most relevant impacts of the production process for a functional unit of 1kg of avocado puree without waste management in a cradle to door analysis.

## Conclusions

Although the use of waste can reduce the environmental impacts of a production process, for it to be viable it is required that the amount of wastes generated be high, which implies that the quantity processed must be greater and it becomes necessary to know if there is availability in the raw materials used and enough demand in the market for the different products obtained. The use of waste can significantly mitigate the environmental impact of the process and at the same time expand the portfolio of products that a company can offer.

## Bibliography

- Chimsook, T., 2017. Microwave Assisted Extraction of Avocado Oil from Avocado Skin and Encapsulation Using Spray Drying. *Key Eng. Mater.* 737, 341–346. <https://doi.org/10.4028/www.scientific.net/KEM.737.341>
- Dabas, D., Shegog, R., Ziegler, G., Lambert, J., 2013. Avocado (*Persea americana*) Seed as a Source of Bioactive Phytochemicals. *Curr. Pharm. Des.* 19, 6133–6140. <https://doi.org/10.2174/1381612811319340007>
- dos Santos, M.A.Z., Alicieo, T.V.R., Pereira, C.M.P., Ramis-Ramos, G., Mendonça, C.R.B., 2014. Profile of Bioactive Compounds in Avocado Pulp Oil: Influence of the Drying Processes and Extraction Methods. *J. Am. Oil Chem. Soc.* 91, 19–27. <https://doi.org/10.1007/s11746-013-2289-x>
- Elez-Martínez, P., Soliva-Fortuny, R., Martín-Belloso, O., 2007. Oxidative rancidity in avocado purée as affected by  $\alpha$ -tocopherol, sorbic acid and storage atmosphere. *Eur. Food Res. Technol.* 226, 295–300. <https://doi.org/10.1007/s00217-006-0539-y>
- Jiang, Y., Duan, X., Joyce, D., Zhang, Z., Li, J., 2004. Advances in understanding of enzymatic browning in harvested litchi fruit. *Food Chem.* <https://doi.org/10.1016/j.foodchem.2004.02.004>
- Qin, X., Zhong, J., 2016. A Review of Extraction Techniques for Avocado Oil. *J. Oleo Sci.* 888, 1–8. <https://doi.org/10.5650/jos.ess16063>