

## **INFLUENCE OF AGRO-FOOD WASTE ON SUSTAINABLE FOOD CONSUMPTION**

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### **ABSTRACT**

Food waste is generated along the whole product life cycle. For this reason, when calculating the carbon footprint of food, waste must be taken into account. From the literature data about food waste along the food chain, the carbon footprint of two daily menus was calculated according to PAS 2050. The results highlight the environmental consequences of decreasing food waste along the food chain. Processing was the stage that generated more waste. The agricultural and post-harvest stages generated a lower amount of waste. The amount of waste during the consumption stage presented a high variability. Results show the influence of consumer practices on the reduction of global warming of food products.

### **INTRODUCTION**

Food production is a basic activity because food provides energy and nutrients to humans. During its production, energy and resources are consumed, thus causing different impacts on the environment. In fact, food contributes with 20% to 30% to the environmental impact caused by European consumption (Stuart, 2011).

Food waste is generated along the whole product life cycle, thus the amount of food produced is higher than the amount of food finally consumed. According to the European Parliament Resolution 2011/2175(INI), every year a growing amount of edible food (some estimates say up to 50%) is lost along the entire food supply chain in Europe. The environmental relevance of food losses does not only depend on the amount, but also on the type of food, where in the food value chain it is lost, and how it is recycled or disposed of. Therefore, food losses should not only be quantified, but also evaluated by life cycle assessment or carbon footprint. This would allow more accurate quantification of the environmental benefits of reducing food waste and help us define fields of priority (Beretta et al., 2013).

The carbon footprint (CFP) is a tool for calculating the quantity of greenhouse gases released to the atmosphere along the life cycle of a product. It is expressed as kg CO<sub>2</sub> equivalent. Among the methodologies proposed to quantify CFP, the PAS 2050 (BSI, 2011) is one of the most used.

The goal of this work was to evaluate the contribution of waste along food chain to the CFP of two daily menus. To this aim, the CFP of the menus was calculated to highlight the environmental consequences of food waste and the importance of food choices in the CFP.

## METHODS

The CFP was calculated according to PAS 2050. One of the menus corresponded to a Mediterranean consumption pattern and the other one to a Western style diet. The functional unit was a ready to eat daily menu for an adult person (table 1).

Table 1. Menus designed based on Mediterranean and Western diets.

MENU	BREAKFAST	SNACK	LUNCH	DINNER
Mediterranean	150 g milk 16 g sugar 20 g coffee 60 g white bread 5 g olive oil 30 g tomato	125 g raspberry yoghurt 500 g water 100 g whole grain bread	100 g lettuce 150 g carrot 25 g olive 20 g olive oil 5 g lemon juice 100 g pork 150 g corn 125 g apple 75 g rice 1000 g water	250 g broccoli 100 g cod 25 g olive oil 150 g oranges 100 g whole grain bread 90 g wine 500 g water
Western	250 g coffee 40 g sugar beet 50 g cheese 60 g whole grain bread	50 g coffee 8 g sugar 50 g pistachios	200 g veal 200 g potato chips 30 g ketchup 100 g corn 125 g ice cream 10 g walnut 500 g beer 75 g white bread 1000 g water	80 g pasta 75 g beef 75 g tomato sauce 75 g grinded cheese 30 g chocolate 500 g water

For both menus, it was taken into account that all the food was produced in Spain. For all food products, CFP data were obtained from literature. When necessary, CFP data were modified to include missing life cycle stages according to PAS 2050. To reach a geographical specificity where literature from other countries was used, the modular method for the extrapolation of crop LCA (MEXALCA, Roches et al., 2010) was applied.

Data about the percentage of waste along food chain were also obtained from literature (Grolleaud, 2002; Jones, 2006; Buzby et al., 2009; Lebersorger and Schneider, 2011; Gustavsson et al., 2011; Muth et al., 2011). According to these percentages, the quantities of food of the menus were increased in each stage of the food chain and the CFP was calculated considering the total amount of food.

## RESULTS

For the Mediterranean menu, the CFP was 6.3 kg CO<sub>2</sub>-eq, from this value 2.5 kg CO<sub>2</sub>-eq corresponded to waste. For the Westernized menu the CFP was 16.4 kg CO<sub>2</sub>-eq, from which 7.2 kg CO<sub>2</sub>-eq corresponded to food waste.

As can be observed in Figure 1, waste generated at each stage along the food chain has a different contribution to CFP. For the two menus, the waste generated during the primary production and post-harvest stages contributed to CFP in a similar way. The contribution of

the processing, distribution and consumption stages was different for each menu, being higher for the Western one.

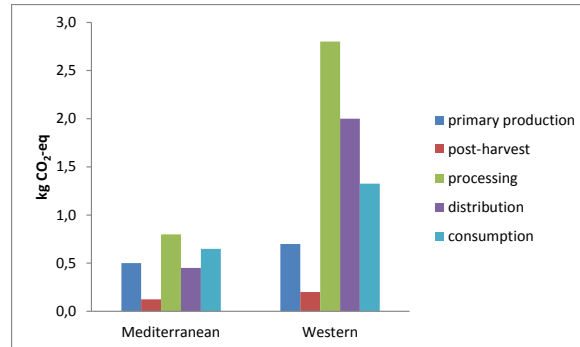


Figure 1. Contribution to CFP of waste generated at each stage considered along food chain

Although some of the waste cannot be avoided, it is very important to implement practices to decrease the avoidable fraction. Regarding to the consumption stage, consumer awareness, good planning, and correct storage of food could cause a 67% and 75% decrease of the CFP for the Mediterranean and the Westernized menu, respectively.

## DISCUSSION

Waste contributed to more than 50% to the CFP of both menus. These results highlight the importance of food waste in the CFP of food products. The CFP of the proposed Western was more than twice higher than the Mediterranean one. In the Western menu, processed food and animal products are responsible of most of the global warming emissions.

Processing was the stage that generated more waste, although by-products are included in this fraction, which can be used as raw material in other processes. The agricultural and post-harvest stages generated a lower amount of waste. These residues are generally unavoidable and difficult to diminish. Nevertheless, they could be reduced by changing food quality requirements, usually related to size and shape of products.

The amount of waste generated during food distribution is variable. This waste is higher for fresh products than for processed products with a long shelf life. A suitable storage and transport would allow decreasing this waste. It is also important to adapt the production of fresh products to the demand to decrease the spoilage during distribution (Beretta et al., 2013).

Consumer practices, that is, the choice of food products and their management (storage and cooking) have a great influence on the CFP. Thus consumers, through a responsible behavior towards food, can contribute to decrease the contribution to global warming of food products.

## CONCLUSIONS

Food waste has a great contribution to the CFP of food products. For that reason, food waste should be decreased along food chain to improve the environmental impact of food products. The results also show the influence of consumer practices on the reduction of the CFP of food products. Consumers can diminish it through the choice of a diet, because each food has a different CFP and generates a different amount of waste. The management of food (storage



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and cooking) at home is also important. To carry out awareness campaigns addressed to consumers would be a useful tool.

Due to data lack about food waste in Spain, data from other countries have been used. Nevertheless, disparities in food habits across countries stress the need of specific data for Spain.

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