Nutritional LCA improves the understanding of the environmental impacts of foods taking into account the diversity of recipes within a same food category: the case of pizzas

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Introduction

Context:

30% of the european global impact on the environnement is directly linked to our food and this number is predicted to increase in the next few years due to the rise of the world population (Tukker et al., 2006).
➡ There is a need to better understand the environmental impact of each food product so food industries can reformulate their products. Also consumers can make more sustainable food choices notably thanks to the environmental labelling.

Problems:

-Most of the studies focus on a single representant of each category of food products (Farahani et al., 2019 ; Tsarouhas et al., 2015).
➡ Lack of knowledge about the possible variability of environmental impact between several food products belonging to the same category.

-Most of the studies using LCA to evaluate the environmental impact of food products use a mass-based Functional Unit (FU) (Kim et al., 2013 ; Farahani et al., 2019) , which is not representative of food products quality. Furthermore, studies using nutritional FU mainly focus on comparing different food categories (Saarinen et al., 2017). The usefulness of nutritional FU to compare products within a same food category has not been investigated.

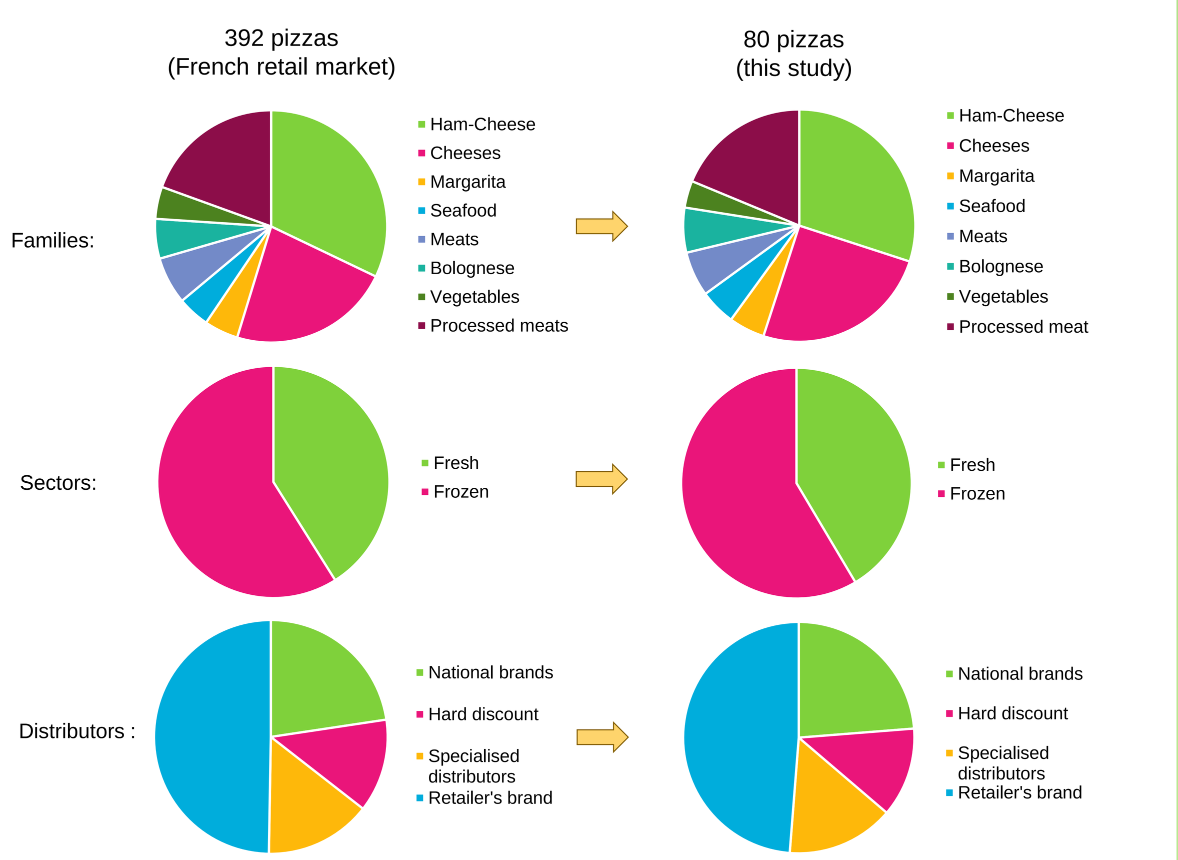
Objectives:

-To study the possible differences between a large number of products from the same food category in terms of environmental impact with the example of 80 different commercial pizzas.

-To evaluate how the use of different nutritional FU can affect the conclusions about environmental impact of 80 different pizzas.

Methodology: Pizzas selection

80 pizzas have been selected, using the OQALI database (https://www.oqali.fr/Donnees-publiques) to represent the 392 pizzas of the French retail market (2010) in terms of families, sectors, distributors and nutritional properties.
Recipes of the pizzas were calculated using product labelling.
Ingredient compositions (such as dough, tomato sauce…) are supposed to be the same for all pizzas and only their amount change between pizzas.



Percentage of pizzas from different families, sectors and distributors among the 392 pizzas of the French retail market and among the selected sample of 80 pizzas

Methodology: LCA

Data collection was obtained from environmental databases (mainly Ecoinvent and Agribalyse), literature (technical informations from suppliers) and experimental measurements of packagings.

The LCA of those pizzas were realized on SimaPro software using the « EF 3.0 Method (adapted) V1.00 / EF 3.0 normalization and weighting set ». All indicators from this methodology have been studied but this poster will present only results related to Climate Change.

Methodology: Different FU

Mass-based FU

The mass-based FU is 1kg of ready-to-eat pizza.
The links between impact on climate change of pizzas and their compositions and nutritional characteristics have been studied using a Partial Least Square Regression on XLStat software.

Nutritional FU

- Several nutritional FU have been tested.

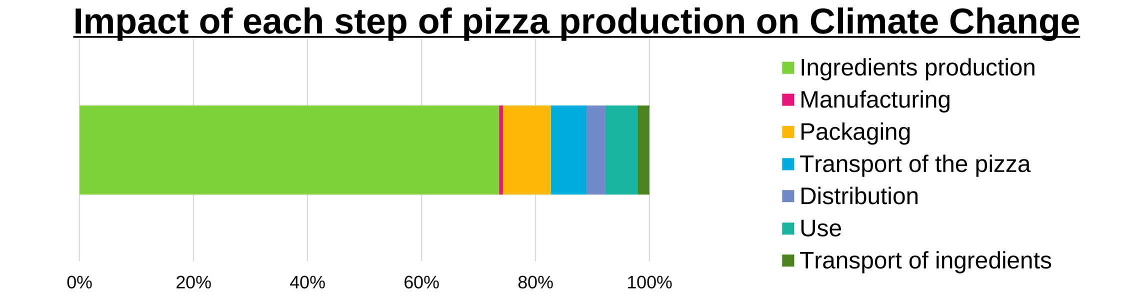
To do so, the mass of pizza needed to get a certain amount of different nutrients has been determined for each pizza and the associated impact on climate change has been calculated.

- We selected FU based on:

- Recommended portion (mass of the portion recommended on the packaging)
- Energy content (mass of pizza needed to obtain 100kcal)
- Protein content (mass of pizza needed to obtain 1/6 of daily recommandations)
- Fibre content (mass of pizza needed to obtain 1/6 of daily recommandations)
- Fibre and protein contents combined (mass of pizza needed to obtain at least 1/6 of daily recommandations in proteins and fibres)

Results with mass-based FU

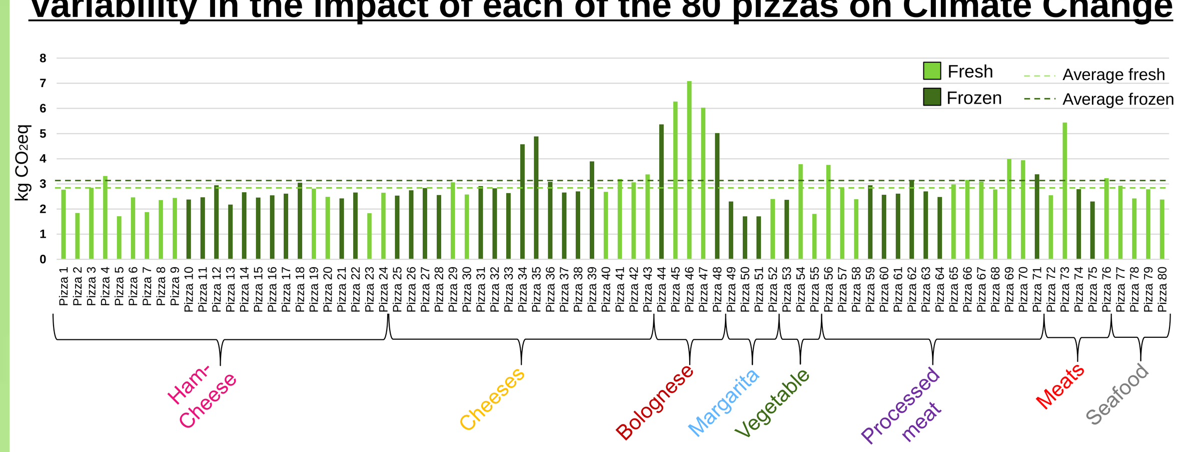
Impact of each step of pizza production on Climate Change



Proportional importance of each step of pizza production on the global impact of a pizza on Climate Change
(FU based on 1 kg of ready-to-eat pizza)
(This exemple is representative of the 80 pizzas)

➡ Ingredients production is the step of the pizza production which has the highest impact on Climate Change.

Variability in the impact of each of the 80 pizzas on Climate Change



Impact of pizzas from different families on Climate Change
(FU based on 1kg of ready-to-eat pizza)

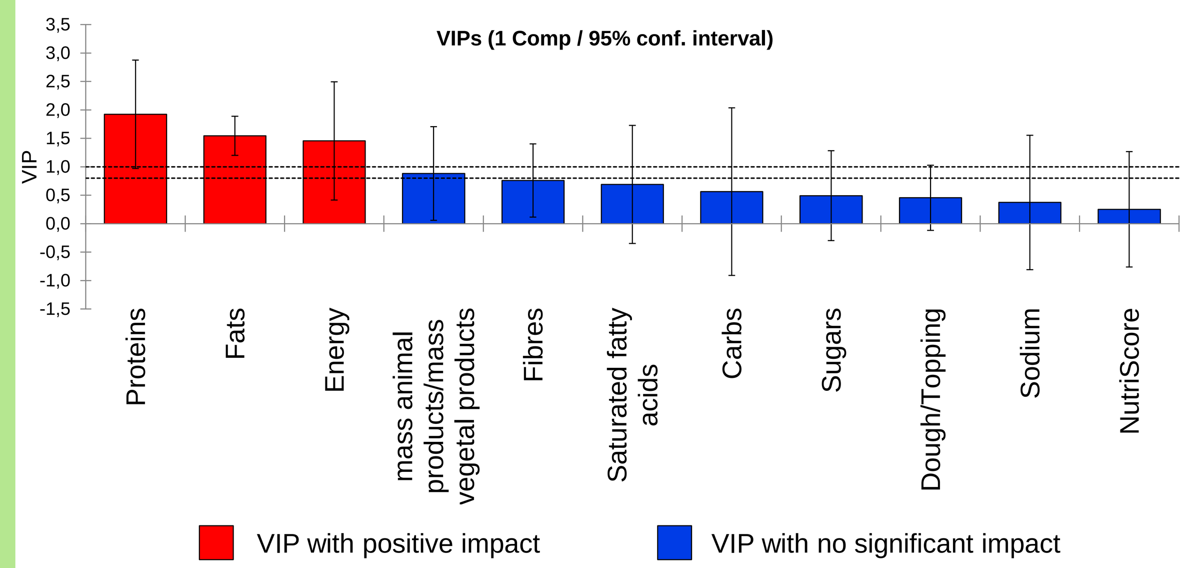
➡ The impact of pizzas on Climate Change can be different from a pizza to another (up to more than 4,5 times between the less impacting pizza and the most impacting one).

➡ Families (except from the « bolognese » family), sectors (fresh/frozen) and retailers (data not shown for retailers) don't seem to define homogene groups of pizzas in terms of impact on climate change.

➡ Pizzas with the highest impact on Climate Change are those containing beef. Nevertheless this conclusion is very sensitive of the value used for beef in the Life Cycle Inventory and this value can be different between databases.

Results with mass-based FU

Link between impact on Climate Change and compositions and nutritional characteristics of the pizzas

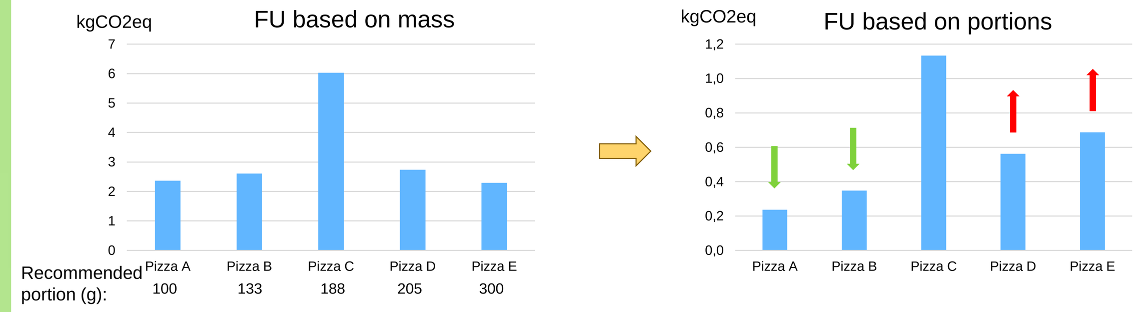


Variable Importance in Projection (VIP) of compositions and nutritional characteristics on the Impact of pizzas on Climate Change
(FU based on 1 kg of ready-to-eat pizza)

➡ The impact of pizzas on Climate Change is positively impacted by the amount of proteins, fats and energy.

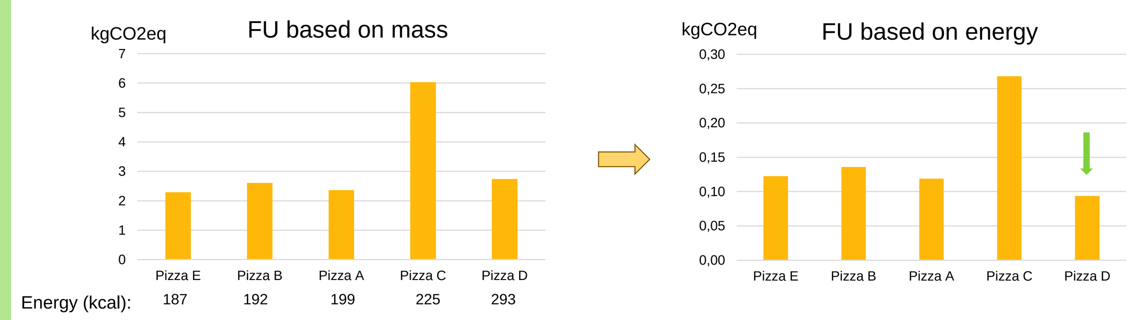
Results with nutritional FU

This chapter presents the evolution of the impact on climate change of 5 different pizzas (from the 80 pizzas) depending on the FU used. These 5 pizzas are shown with an illustrative purpose of the influence of the use of nutritional FUs on pizzas with different nutritional characteristics. The conclusions given here can be applied to the whole set of 80 pizzas.



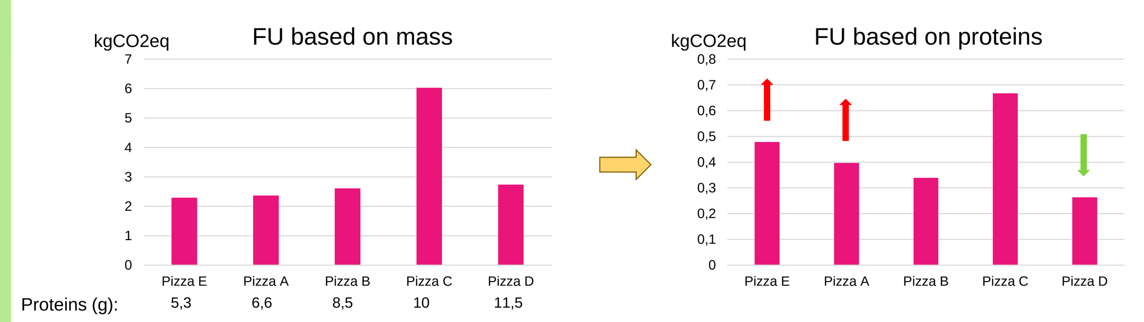
Evolution of the 5 pizzas in terms of impact on Climate Change using a mass-based FU (left) and a FU based on the recommended portion (right)

➡ The use of a FU based on the recommended portion improve the impact on Climate Change of pizzas with the smallest recommended portions which often are the biggest pizzas (which are supposed to be shared) comparing to those with bigger recommended portions.



Evolution of the 5 pizzas in terms of impact on Climate Change using a mass-based FU (left) and a FU based on energy (right)

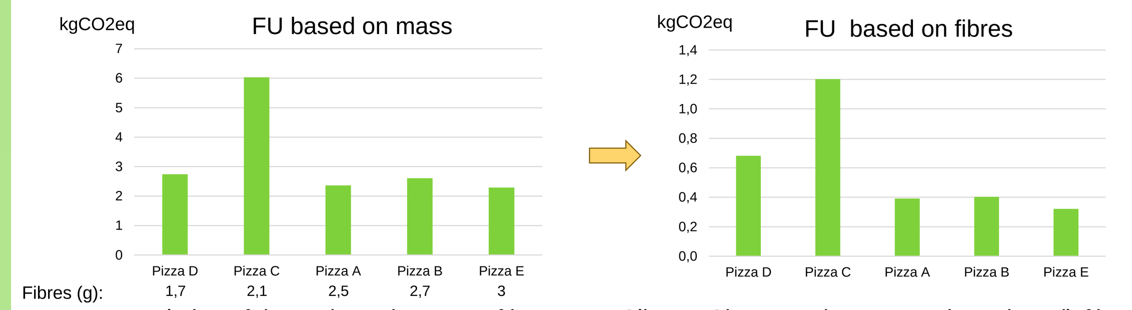
➡ The use of a FU based on energy improve the impact on Climate Change of the most energetic pizzas compared to those which contain less energy.



Evolution of the 5 pizzas in terms of impact on Climate Change using a mass-based FU (left) and a FU based on proteins (right)

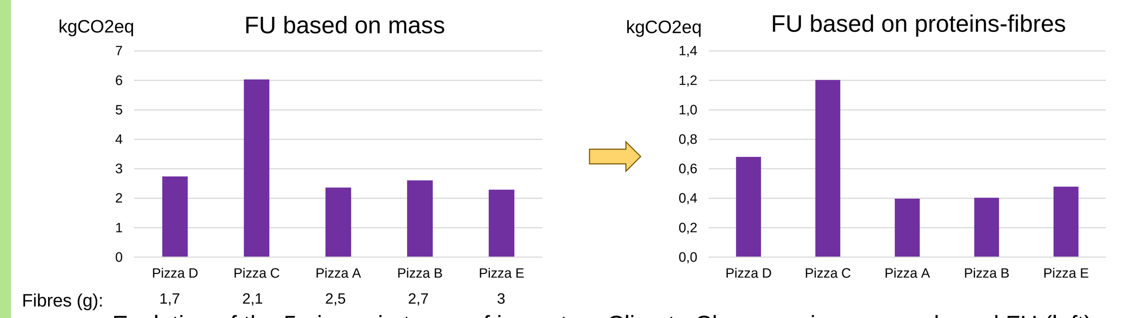
➡ The use of a FU based on proteins allows an improvement of the impact on Climate Change of the richest pizzas in proteins compared to those which contain less proteins.

Results with nutritional FU



Evolution of the 5 pizzas in terms of impact on Climate Change using a mass-based FU (left) and a FU based on fibres (right)

➡ The use of a FU based on fibres doesn't really have an impact on the pizzas ranking in terms of impact on Climate Change.



Evolution of the 5 pizzas in terms of impact on Climate Change using a mass-based FU (left) and a FU based on fibres and proteins (right)

➡ The use of a FU based on proteins and fibres combined globally has the same impact as using a FU based only on fibres because fibres are more limitant than proteins in the majority of pizzas.

Conclusion

Ingredients production is the step of pizzas production with the highest impact on Climate Change.

Impact on Climate Change can be very different between products coming from the same food category.

In the case of the 80 pizzas studied, pizzas with the highest impact are those containing beef. Nevertheless, this conclusion is very sensitive of the data chosen for beef.

Surprisingly, frozen pizzas don't seem to have a higher impact on Climate Change than fresh ones. This result may be explained by the fact that we only considered the electricity of the storage and because the use phase doesn't have a strong impact on Climate Change compared to the ingredient production.

Furthermore, the results can vary greatly depending on the UF used. In this case, the use of nutritional FU can help deciding which pizza is the most sustainable depending on what is important for the consumer.
Nevertheless, even if the use of nutritional FU might be useful for quite homogenous food categories in terms of composition, it is more delicate for heterogeneous food products categories such as pizzas.

For this reason, it would be interesting to evaluate the effect of those nutritional FU on a more homogeneous food category. It would also be interesting to evaluate the impact of the use of a more global nutritional FU on different food products belonging to the same category.

Acknowledgements

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