**How to prepare a less pollutant family meal?**

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**Abstract**
The environmental impacts of three typical family meals were compared using data from the Danish LCA food database. The considered impact categories were global warming, acidification and eutrophication. It was shown that substitution of pork with vegetables reduced the environmental impact, while partly substitution of conventional produced food with organic produced food was not environmentally superior using these impact categories, which do not take into account toxic effects of pesticides use.

## 1. BACKGROUND

Food consumption is an important contributor to global warming and eutrophication but different food items impact more than other per kg consumed as demonstrated in the literature. Generally, animal food pollutes more than vegetable food, and vegetables cultivated in heated greenhouses emit more greenhouse gasses than field-grown vegetables. There are also differences between organic and conventional products. Therefore, the consumer may, theoretically, reduce the environmental impact when composing the family meal. But, given the composite nature of meals it is not easy to estimate the relative environmental impact of substituting (part of) one food item with another.

## 2. OBJECTIVE

To compare the contribution to global warming, acidification and eutrophication potentials from three types of family meals with different proportions of meat and vegetables and partly substituted by organic food.

## 3. METHODOLOGY

The functional unit is one family meal, containing sufficient food to satisfy one family of two adults and two children. LCA data are from www.LCAfood.dk, where the EDIP method is used for the impact assessment. Consequential modelling is performed and the considered impact categories are: global warming, acidification and eutrophication. For further details on life cycle inventories and modelling of emissions from agricultural production see www.LCAfood.dk and Dalgaard et al. [1].

The LCA data on organic pork production and vegetable cultivation are based on Halberg et al. [2] and Halberg et al. [3] respectively.

## 4. RESULTS AND DISCUSSION

Three different kinds of family meal, containing pork, bread, milk and vegetables were defined. In table 1 the three types of family meals are shown. The first meal (standard meal) contain pork, bread, milk, bread and vegetables, and all components are conventional produced. The second meal contain less pork but more potatoes and carrots. The third meal is similar to the second meal, but pork, bread, milk, and carrots are organic.

Table 1: Composition of the three types of family meal. Org: Organic produced. Unit: kg food

| Family meal: | Pork | Bread | Milk | Potatoes | Carrots | Onions | Total |
|---|---|---|---|---|---|---|---|
| 1 | 0.8 | 0.5 | 1 | 0.5 | 0.5 | 0.4 | 3.7 |
| 2 | 0.4 | 0.5 | 1 | 0.8 | 0.7 | 0.4 | 3.8 |
| 3 | 0.4 (org) | 0.5 (org) | 1 (org) | 0.8 | 0.7 (org) | 0.4 | 3.8 |

The results show that a reduction of meat intake from 200 g per person to 100 g and substituting with potatoes and carrots reduce the contribution to global warming, acidification and eutrophication with 27%, 35% and 33% respectively (table 2). As shown in table 3 the environmental impact of pork is 10-20 times higher per kg product compared with the environmental impact from vegetables.

However, a comparison between family meal 2 and 3 shows that a partly substitution of conventional products with organic products increases the emissions. This is mainly due to the pork, because production of organic pork emits more greenhouse gases, acidifying and nutrifying substances compared to conventional pork [2].

Table 2: Environmental impact per functional unit

| Food item | Global warming potential kg $CO_2$ eq. | Acidification potential g $SO_2$ eq. | Eutrophication potential g $NO_3$ eq. |
|---|---|---|---|
| 1 | 4.6 | 60 | 333 |
| 2 | 3.4 | 39 | 223 |
| 3 | 3.8 | 48 | 235 |

Table 3. Comparison of specific food items used in the LCA of family meal. Only a selection of the products are presented.

| Food item | Global warming potential kg $CO_2$ eq. | Acidification potential g $SO_2$ eq. | Eutrophication potential g $NO_3$ eq. |
|---|---|---|---|
| Pork | 3.3 | 55 | 288 |
| Low fat milk | 1.2. | 12 | 58 |
| Bread | 0.8 | 5 | 59 |
| Potatoes | 0.2 | 2 | 14 |
| Carrots | 0.1 | 1 | 4 |
| Onion | 0.4 | 4 | 15 |
| Tomato | 3.4 | 7 | 20 |

The study also revealed that the contribution to global warming potential is the same for pork and greenhouse cultivated tomatoes, because tomato cultivation in Danish climate demands energy for heating. Consequently a substitution of pork with tomatoes would not decrease the greenhouse gas emission. A substitution of conventional milk with organic milk would reduce the eutrophication potential, but not the global warming potential. A comparison of environmental impact from food and transport showed that the contribution to global warming potential from 'family meal 1' was equal to 14 km passenger car driving.

## 5. CONCLUSION

Substituting just half of the pork with potatoes and carrots reduce the contribution to global warming, acidification and eutrophication with 27%, 35% and 33% respectively. Substitution of pork with greenhouse cultivated tomatoes does not reduce the greenhouse gas emissions, but the emissions of acidifying and nutrifying substances.
If pork, bread, milk and carrots are substituted with organic products the environmental load of the family meal increases. Mainly because organic pork contributes more to global warming, acidification and eutrophication potential than conventional pork does. However, due to methodological difficulties the impact of pesticides was not considered. If it was, the environmental profiles of the organic products would obviously be improved.

## 6. PERSPECTIVES

Comparison of food items` environmental performance rises several questions. Is it fair to compare organic and conventional food using LCA, which presently does not adequately account for differences in pesticide emissions, animal welfare and other aspects of sustainability?
To which degree would consumers be interested in more precise information regarding the relative environmental impact if consuming different food items and choosing between organic versus conventional?
And to what extent are LCA researchers and practitioners capable of communicating our results and knowledge to consumers?

## 7. REFERENCES


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