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LCA of Ready-to-Serve Goulash Soup Packed in Stand-Up Pouches

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Executive Summary

"LCA of Ready-to-Serve Goulash Soup Packed in Stand-Up Pouches"

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Packaging within the food supply chain has to fulfil a variety of purposes: the protection of the packed product, the warranty of a safe transportation and storage at the retailers and households and the supply of food in perfect condition and in the right portion.

Goulash soup is a typical convenience food which is stored over longer periods in family and single portion packs. Flexible stand-up pouches are used to store freshly prepared food without refrigeration over months on shelf and allow a long term storage also at home without additional cooling.

The study should illustrate the environmental relevance of ready-to-serve goulash soup packaging consisting of a flexible packaging made from a laminate out of plastic and aluminium foil with regard to the consumption of such a product in Europe. The functional unit for the ready-to-serve goulash soup life cycle is defined as **"the preparation of 1 package containing 570 ml goulash soup packed in stand-up pouch ready to consume at the household"**. The content of the package (570 ml) corresponds to 2 portions.

The aims of the study are as follows:

- Investigate the environmental performance of the packaging with respect to its function within the life cycle of ready-to-serve goulash soup.
- Investigate the environmental relevance of stages and interdependencies within the life cycle of ready-to-serve goulash soup while taking consumption patterns into consideration.

For the soup a recipe was chosen with the main ingredients by mass: water (58.9 %), potatoes (5 %), onions (5 %), beef (5 %) and plant oils (4.8 %).

The packaging of the here investigated product is consisting of laminate with a number of layers made of different materials. Each material is serving a specific purpose such as temperature resistance, stiffness, appearance, feel, etc. In combination they are chosen to allow efficient filling, sterilizing, sealing and transportations realizing a small package to product ratio. The barrier properties towards light, gases and aromas are tuned to support a long shelf life without refrigeration during transport or storage.

The life cycle inventory for ready-to-serve goulash soup encompasses the whole food supply system starting with the cultivation of the raw materials as potatoes, tomatoes, onions, paprika, etc. and animal husbandry ending with ready-to-serve goulash soup ready to be eaten at home. Included are the production of ingredients (yeast, wine sugar, etc.), production and disposal of packaging, transports, distribution processes, and domestic heating in a stove. The pot for cooking and dishwashing are not included. All process stages occur in Europe.

As sets of indicators the cumulative energy demand, the ReCiPe method (midpoint level on the Hierarchist perspective) and CML 2001 is used.

The results of this study are calculated for all environmental impact category indicators. To be consistent with former studies the main impact assessment and discussion will be based on a selection of the most widely accepted indicators. These are CED, non-renewable [MJ-eq.], Climate change [kg CO_2-eq.], Ozone layer depletion [kg CFC-11-eq.], Terrestrial acidification [kg SO_2-eq.], and Freshwater eutrophication [kg P-eq.]. In those cases where additional indicators become relevant, this is mentioned and discussed.

For the standard case following assumptions apply:

- Goulash soup production and consumption in Europe
- Average transport distances for grocery shopping

- Preparation on an electric stove
- Disposal of packaging: 51% incineration, 42% recycling, 7% landfill

The indicators for the selected impact categories using the most recent characterisation factors from ReCiPe and CED non-renewable are plotted in Figure 1.

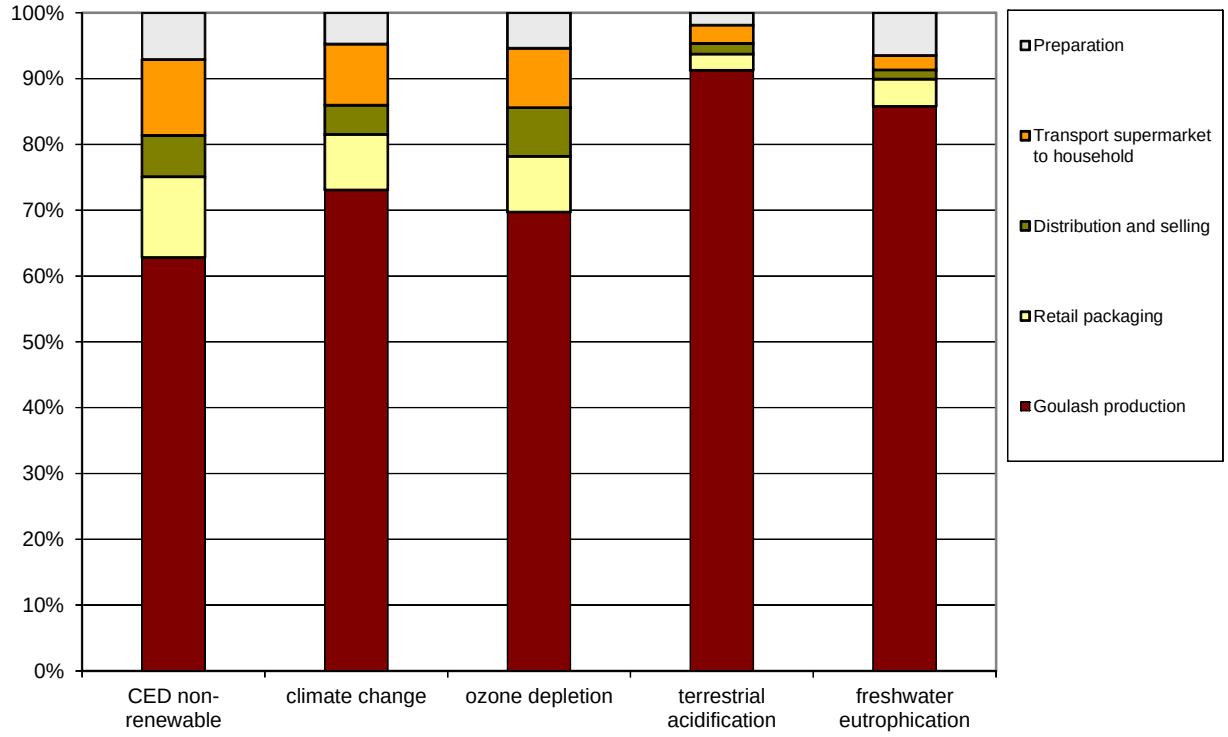

Figure 1: Results of the standard case per package ready-to-serve goulash soup for the five indicators considered. The results are scaled to 100%.

Considering non-renewable cumulative energy demand 1 package of ready-to-serve goulash soup eaten at home consumes 16 MJ-eq. The overall goulash soup life cycle emits 1.2 kg CO_2-eq per 570 ml.

Apparently goulash soup production including the necessary raw materials, grocery shopping and retail packaging contribute most to the energy-related indicators (CED non-renewable, climate change, and ozone depletion). In case of acidification preparation, transport, distribution, and retail packaging are of minor importance. Regarding eutrophication the preparation on an electric stove is important next to the goulash soup production.

The share of packaging to the total environmental burdens of the ready-to-serve goulash soup supply chain is between 2.5% (acidification) and 12.3% (CED non-renewable). For packaging important issues are the lamination process and impacts associated with the production of the raw materials polypropylene, aluminium and polyamide. Depending on the category indicator the importance and order of the mentioned processes can change.

Another important issue for most indicators in the life cycle of ready-to-serve goulash soup is grocery shopping. In the chosen grocery shopping scenario (average transport distances) the car ride exhibits clearly the highest burdens.

Distribution and selling includes the supermarket and the transportation from the production plant to the supermarket. As the soup neither needs to be transported nor stored under refrigerated conditions energy consumption is relatively low and no additional emissions of refrigerants occur.

Domestic preparation on electric stoves has an influence of between 1.9% and 7.1% for terrestrial acidification and CED non-renewable, respectively.

The results shown above are in their indication similar to most other indicators calculated. Goulash soup production is responsible for between 60% (depletion of fossil resources) and 99% (terrestrial ecotoxicity) of the potential impacts. The shares of packaging vary between 0.5% (terrestrial ecotoxicity) and 14% (depletion of fossil resource). This value derives mainly from the use of plastics in the packaging. Crude oil used in plastic production is considered as fossil resource.

In former studies CML category indicators were used for the life cycle impact assessment. In the meantime ReCiPe was published. ReCiPe is a method which combines and updates the endpoint and midpoint indicator Eco-indicator 99 and CML 2001. It has to be noted that CML (Institute of Environmental Science at the University of Leiden) was involved in the development of ReCiPe and CML.

The indicators CED non-renewable and global warming potential 2007 are not part of the original method CML 2001. Thus, there are no differences with respect to these two indicators. Differences exist in the impact potentials ozone layer depletion (ODP), acidification (AP) and eutrophication (EP). The results assessed with both indicators are shown in Figure 2.

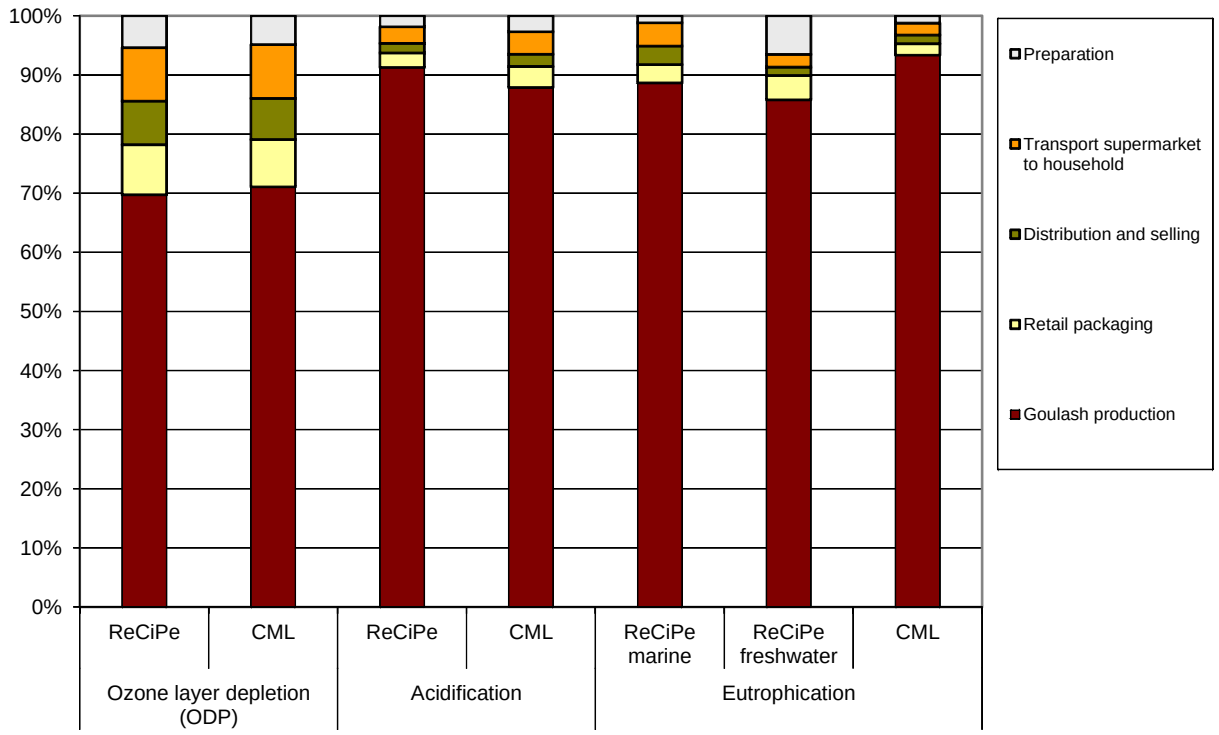

Figure 2: Comparison of ReCiPe midpoint and CML 2001 category indicators per package goulash soup.

It becomes evident that despite minor variations the results are not changed significantly and similar conclusions might be drawn for these three indicators either by using CML or ReCiPe.

Within the sensitivity analysis several aspects have been modified to study the impact of the assumptions in the results. Variations covered organic production of the food soup ingredients instead of conventional production, different shopping scenarios (urban and countryside), and cooking in a microwave. The results for the environmental impact category indicator climate change are shown in Figure 3.

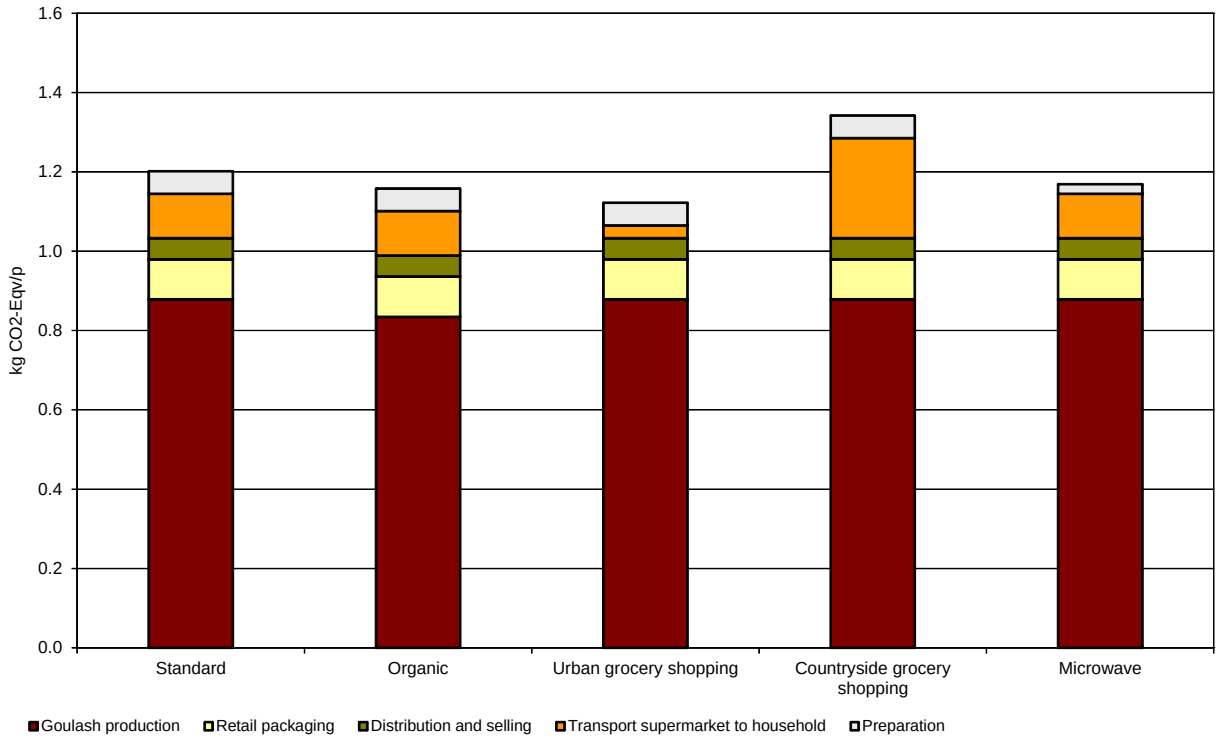

Figure 3: Sensitivity analysis with regard to climate change per package ready-to-serve goulash soup. Shown in absolute values.

In view of the scenario variations and data quality consideration it can be concluded that the most relevant factors concerning the environmental impacts from the whole supply chain of ready-to-serve goulash soup are for the majority of indicators:

- **Goulash soup**: In most indicators goulash soup production has the highest impact on the overall results. Due to the importance of meat amount in the recipe it can be concluded that goulash soup with lower share of meat will show lower impacts. However, a share of 5% meat is already considered to be low. Another important issue is the share of water in the recipe. As impacts of water are comparable low, overall environmental burdens of soup production will increase the lower the share of water is.
- **Transport to the household**: Taking public transportation or bicycles for shopping, if possible, improves the results widely. Also by good planning of grocery shopping, i.e. reducing numbers of trips, impacts can be reduced.
- **Agricultural production of raw materials**: The agricultural production of raw materials (wheat, meat, vegetables) is quite important. Thus, food producers should search for options to reduce these environmental impacts.
- **Packaging**: The share of packaging to the overall impacts can not be neglected. Therefore, the packaging manufacturers need to further optimize the relevant processes (e.g. by increasing energy efficiency with an optimized recovery of thermal energy from solvent treatment) thus contributing to the efforts of minimizing environmental impacts of the full life cycle. However optimization may not be followed at the expense of the protective function allowing a long shelf life of the soup without refrigeration.
- **Preparation in the household**: Microwaves can heat up ready-to-serve goulash soup faster and more efficient than electric stoves. This reduces the electricity consumption. Using microwaves instead of electric stoves reduces environmental impacts.

This study showed that in the standard case the production of goulash soup has the highest impact share on the five indicators investigated. The importance of the packaging varies depending on the indicator. It can be almost negligible (as in the case of acidification) or relevant (as in the case of CED non-renewable). Other aspects as e.g. grocery shopping and food losses are important as well. Therefore, it remains also in the responsibility of the consumers to plan grocery shopping and prevent wastage to finally lower the environmental impacts.

This study gives the industry and consumer guidance on how to contribute to a better environmental performance of the entire supply and consumption chain of goulash soup packed in stand-up pouches.

Investigated was ready-to-serve goulash soup. Thus, no conclusions can be drawn for options not investigated as e.g. other products sold in stand-up pouches, other ingredients, other packaging sizes, other packaging materials nor other ways of preparation, etc.