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LCA of Yoghurt Packed in Polystyrene Cup and Aluminium-Based Lidding

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Executive Summary

"LCA of Yoghurt Packed in Polystyrene Cup and Aluminium-Based Lidding"

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Packaging within the food supply chain has to fulfil a variety of purposes. Besides the protection of the packed product also its safe transportation and storage in supermarkets and households is of great importance. For perishable goods like dairy products spoilage protection and shelf life play an additional role in the choice of a packaging solution.

Yoghurt is a typical dairy product and an essential part of the daily nutrition, which is offered in many types, portions and in different packaging systems across Europe. Amongst others, polystyrene cups with an aluminium foil based lidding are a typical packaging solution for yoghurt. Aluminium foil is used due to its property as barrier for gases, odours and light, its grease-resistance and also its machinability. Packaging solutions based on polystyrene cups and aluminium foil lidding are investigated in this study.

This life cycle assessment of yoghurt production and consumption investigates in particular:

- the environmental performance of the packaging with respect to its function within the life cycle of yoghurt.
- the environmental relevance of stages and interdependencies within the life cycle of yoghurt including consumption patterns.

The functional unit in this study is 1 kg yoghurt to be consumed in the household in a short term.

The life cycle for yoghurt encompasses the whole food supply system starting with the production of milk and its fermentation to yoghurt in dairies where it is also mixed with other ingredients. Yoghurt is packed and transported chilled via a wholesale to the supermarket from where it is bought, brought home and consumed within few days.

A similar life cycle is modelled for the packaging. Polystyrene cups and aluminium foil are first produced, packed, and transported to the dairy to be filled. Used cups and lidding are recycled or disposed off in landfill or in an incineration plant. In the methodology used the content of recycled material for the packaging production has been considered and therefore no credits for recycling and energy recovery are given.

In this LCA a selection of common portion sizes and yoghurt types are investigated:

- Natural yoghurt as 150g and 500g portion
- Natural organic yoghurt as 150g portion
- Strawberry yoghurt with 8 % and 30% fruit content as 150g portion

In the standard case average refrigerated storage times are assumed to be 3 days in a supermarket and 5 days at home. An average shopping scenario is assumed with a shopping frequency of two times per week. Spoilage and wastage of yoghurt amounts to 3% until retail level and 5% on household level.

The results of this study are calculated for ten environmental indicators. The main impact assessment and discussion is based on a selection of five widely accepted indicators. These are Cumulative Energy Demand (CED), non-renewable [MJ-eq.], Global Warming [kg CO_2 eq.], Ozone Layer Depletion (ODP) [kg CFC-11 eq.], Acidification [kg SO_2 eq.] and Eutrophication [kg PO_4^{3-} eq.].

Fig. 1 reveals the scores for these selected indicators scaled to 100%. In total the consumption of one kg yoghurt corresponds to the emission of about 2 kg CO_2-eq. The most relevant aspect in all impact catego-

ries excluding ozone layer depletion is the production of the yoghurt itself. This corresponds mainly to the methane and nitrogen monoxide emissions of milk cows and the fodder production, respectively. Distribution and selling is the second most important aspect along the life cycle for all categories except for ozone layer depletion, which is dominated by this life cycle phase. The contribution of packaging to the overall impact lies between 1.9% (ODP) and 21.2% (CED non renewable). The figures include the cup itself as product out of fossil resources. The contribution of retail packaging to global warming amounts to 12.6% for natural yoghurt packed in 150g cups. The share of aluminium foil to the packaging burden is between 8% (eutrophication) and 47% (ozone depletion) - mentioning that cup and lidding fulfil different functions contributing to a single packaging solution.

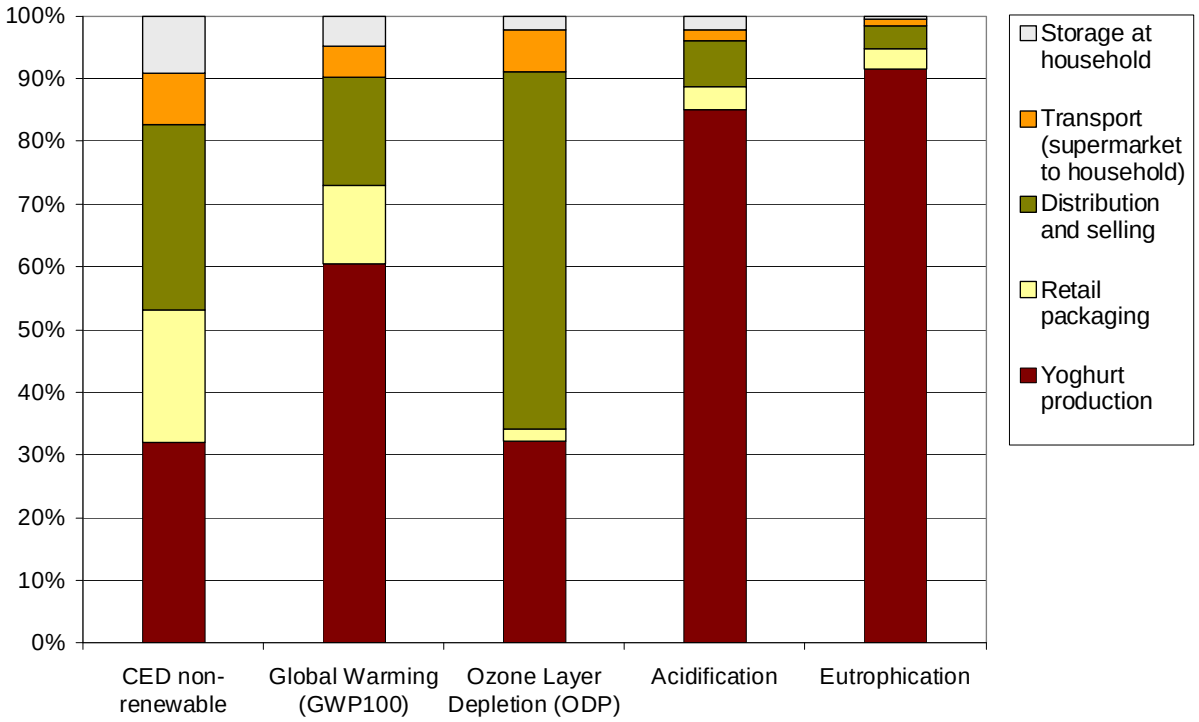

Fig. 1: Results of the standard case for 1 kg natural yoghurt packed in 150 grams polystyrene cups and aluminium based lidding with regard to the selected impact categories; the results are scaled to 100%.

Within the sensitivity analysis, the relevance of assumptions but also consumer choices and consumption patterns for the overall results are investigated. Main parameters are the commercial storage time in the supermarket (10 days instead of three), the domestic storage time at home (same periods), different shopping scenarios and the variation of spoilage and wastage assumptions.

Fig. 2 reveals the results of the sensitivity analysis for the impact indicator global warming potential [kg CO_2-eq.] for all different yoghurt types that have been investigated. The contribution of retail packaging varies between 8% and 15% of the global warming potential, depending on cup size and ingredients. As this impact score of yoghurt is dominated by the yoghurt production itself strawberry yoghurts show smaller impact scores as yoghurt is replaced by a fruit with comparably lower environmental impacts. For organic yoghurt the impact scores show no distinct superiority with the category indicators used in this study. As family packs are more efficient in terms of the ratio of packaging to filling the overall contribution of the 500g portion natural yoghurt is smaller than for 150g portion cups of natural yoghurt.

The difference between yoghurt types and portion sizes remains in the same order of magnitude for all scenarios investigated. If yoghurt is stored for longer periods (10 days instead of 3) in the supermarket the impacts of distribution and selling increase regarding energy related indicators. The same holds true for longer domestic storage.

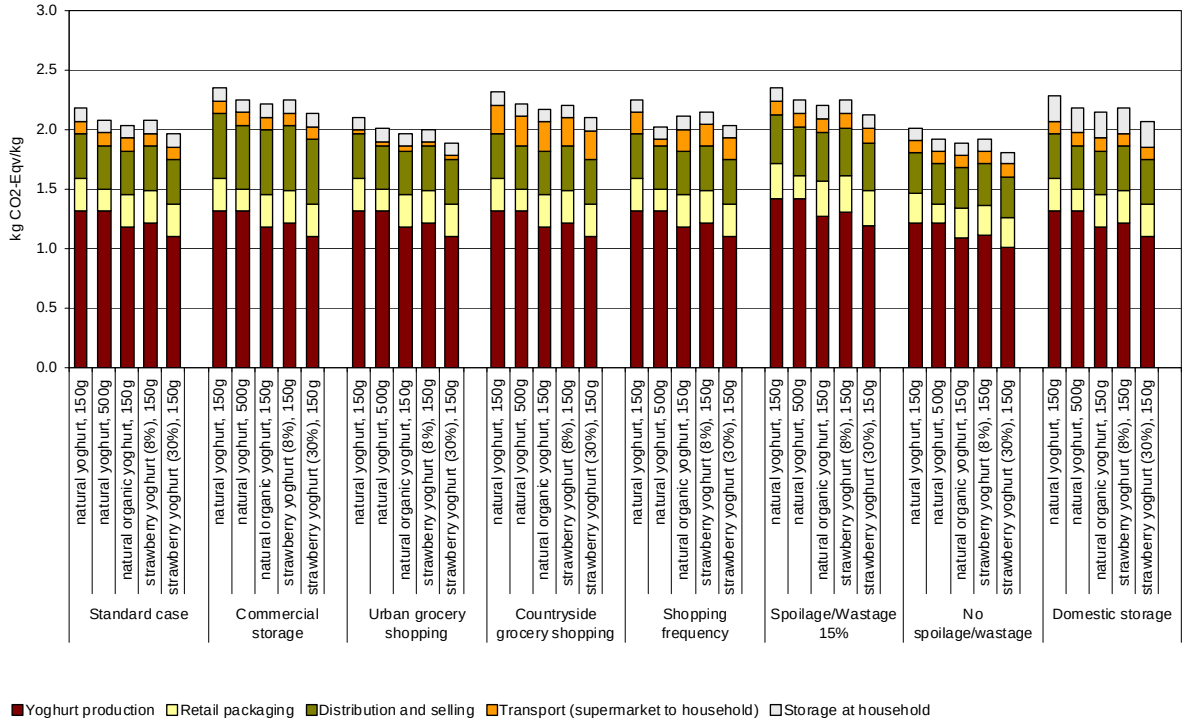

Fig. 2: Results of the sensitivity analyses of 1 kg yoghurt packed in polystyrene cups and aluminium based lidding with regard to global warming potential.

Modified shopping assumptions show a higher impact score where more motorized individual transportation is assumed (countryside grocery shopping). A lower frequency of shopping trips reduces the overall impact. An increase in spoilage and wastage has a scaling effect for all impact indicators and all life cycle phases as more manufactured, packed and transported yoghurt is needed for the consumption of 1 kg. An increase in spoilage and wastage by 7% correlates with an increase in impacts in the same order of magnitude. Without spoilage and wastage the overall impacts are reduced by 8%.

In conclusion the most relevant factors concerning the environmental impacts from the whole supply chain of yoghurt are for the majority of indicators the production of yoghurt itself mainly due to the provision of milk. Distribution and selling has the second highest share on the overall impacts, which is mainly related to refrigeration. In descending order of importance primary packaging, storage at home and grocery shopping follow.

As a consequence the most relevant measures reducing the environmental impacts would be the optimization of the yoghurt production chain – where mainly agricultural milk production contributes to the impacts - followed by improvements along distribution and selling e.g. in chilled storage. Packaging manufactures could also reduce impacts by optimizing materials and design also in view of spoilage prevention and a reduction of wastage.

The consumer can reduce environmental impacts by an environmentally conscious shopping behaviour e.g. using more frequently public transport or reducing the frequency of shopping trips. Choosing the adequate portion size for the individual consumption pattern helps in the prevention of spoilage and thereby reducing impacts along the supply chain. Another issue is cooling in the household were impacts can be minimized by energy-efficient refrigerators and adequate sizes.

The yoghurt types, portion sizes and packaging systems in this study do represent examples on the European market. Thus, no conclusions can be drawn for options not investigated as e.g. different recipes, other packaging sizes, other packaging materials.