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LCA of Packed Food Products

– the function of flexible packaging –
– Case Study: Butter –

Sybille Büsser

Roland Steiner

Niels Jungbluth

ESU-services Ltd., Uster, Switzerland

Commissioner

Flexible Packaging Europe (FPE)

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ESU-services Ltd.
Rolf Frischknecht
Niels Jungbluth
Sybille Büsser
Matthias Tuchschmid
www.esu-services.ch

Kanzleistrasse 4
T +41 44 940 61 91
T +41 44 940 61 32
T +41 44 940 61 35
T +41 44 940 67 94
F +41 44 940 61 94

CH - 8610 Uster
frischknecht@esu-services.ch
jungbluth@esu-services.ch
buesser@esu-services.ch
tuchschmid@esu-services.ch

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Title	**LCA of Packed Food Products: the function of flexible packaging**
Authors	Sybille Büsser Roland Steiner Niels Jungbluth ESU-services GmbH, fair consulting in sustainability Kanzleistr. 4, CH-8610 Uster www.esu-services.ch Phone +41 44 940 61 35
Customer	Flexible Packaging Europe (FPE) Stefan Glimm Am Bonneshof 5, D - 40474 Düsseldorf enquiries@flexpack-europe.org www.flexpack-europe.org Phone +49 211 4796 150; Fax +49 211 4796 25 168
Steering Group	Gerald Rebitzer (Alcan Packaging Food Europe) John Fairweather (Amcor Flexibles) Jörg Schäfer (Gesamtverband der Aluminiumindustrie) Hans-Jürgen Schmidt (Hydro Aluminium) Jean-Paul Duquet (Novelis)
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Executive Summary - Case Study: Butter

"LCA of Packed Food Products: the function of flexible packaging"

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The evaluation of the environmental performance of packaging usually concentrates on a comparison of packaging materials. Other aspects including sustainable consumption and production of packed goods are often neglected. The same applies to the functional role of flexible packaging, which is the distribution of goods to society to satisfy human needs.

Broader approaches, which focus on the life cycle of packed goods, including the entire supply system and the consumption of goods, are necessary to get an environmental footprint of the food supply system with respect to sustainable production and consumption.

And as the only reason to produce packaging is to enable the consumer to consume products the relevant question from a sustainability point of view can be only to optimize the sustainability along the total supply chain of consumer goods rather than focussing on parts of it.

The three main targets of this study are:

- the investigation of the environmental performance of flexible packaging with respect to its function within the life cycle of goods, i.e. within the supply chain and consumption of goods,
- the investigation of the role of flexible packaging in view of resource efficiency and prevention of spoilage of packed goods, and
- the investigation of the environmental relevance of stages and interdependencies within the life cycle of goods while taking consumers' patterns and portion sizes into consideration.

The study illustrates the environmental relevance of flexible packaging within the supply chain. While the results of this study are not immediately transferable to other packaging systems or types of products this study shows that the environmental impact from the packaging of the investigated sample products is minor in comparison to the impact from the production of the product, its processing and the consumer behaviour in the use of the product. Additionally, depending on the product, packaging can contribute to minimise the environmental impact of production, processing and use by reducing spoilage and overconsumption.

The results of this study are calculated for eight environmental indicators based on the CML 2001 method. The main impact assessment and discussion is based on five indicators which 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.)
- Eutrophication (kg PO_4^{3-} eq.)

Case Study: Butter

The life cycle of butter encompasses the whole food supply system from the milk production to the storage of butter in the consumer's fridge. The process steps range from the separation of raw milk into low-fat-milk and cream to the pasteurisation of cream, cooling, ripening, and churning.

In this study conventional butter without any ingredients (e.g. salt) is considered. Butter is stored and transported under chilled conditions. The cold chain consists of one cold store, the supermarket and refrigerated transports. At home butter can be stored in fridge up to one month, but some consumers may freeze and store butter for a longer period.

Butter has to be wrapped in a greaseproof material that is impervious to light, flavouring and aromatic substances. The analysed packaging consists of three layers (aluminium foil, synthetic wax and paper). The packaging systems shown in this study represent the flexible packaging of one butter cube of 250 gram and 15 gram, respectively.

The functional unit concerning butter in this study is 'the provision of one kilogram of butter ready to eat at home'.

The impact assessment of butter consumption includes a standard case with the following assumptions: average production of butter (i.e. 22.5 litres of milk to produce one kg of butter), packaging is incinerated, industrial and commercial distribution: refrigerated storage and transportation between 0 and 4°C, domestic storage: 30 days in fridge, no spoilage.

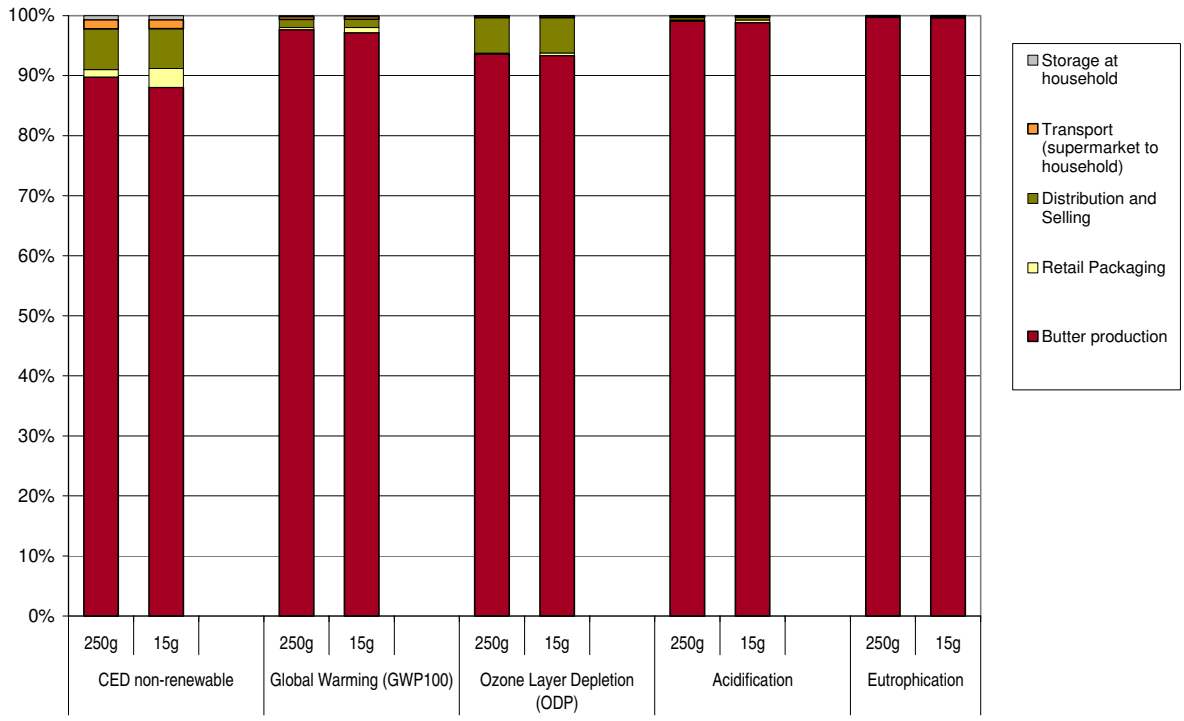

Figure 1: Results of the standard case for butter with regard to the selected five indicators. The results are scaled to 100 %.

The most relevant aspect regarding the life cycle of butter is butter production where the provision of milk dominates the results. Regarding global warming potential methane and dinitrogen monoxide emissions of milk cows are most relevant. Regarding acidification and eutrophication fertilisation during livestock husbandry is responsible for most burdens. The distribution and selling stage has a not negligible influence to the indicators CED and ODP. The reason is that the storage in supermarkets is quite energy intensive compared to the other processes and therefore responsible for most impacts in the distribution and selling

stage regarding CED. Most impacts in case of ODP originate from emissions of refrigerants during storage and transportation of butter.

With regard to all calculated indicators the impact of packaging varies between 0.05 percent for eutrophication and 3.4 percent for human toxicity in case of the 250 gram packaging system. If butter is served in smaller amounts, the influence of packaging increases for all indicators due to the higher amount of packaging material used to pack one kilogram of butter (0.13 percent in case of eutrophication and 9.2 percent in case of human toxicity). In general, the environmental impact of packaging is of minor importance compared to butter production and distribution and selling.

Influence of transportation packaging for the butter cubes is less than 0.1 percent to the whole life cycle of butter consumption.

The sensitivity analysis compares modified parameters to the standard scenario. Modified parameters are 20 and 25 litres of milk instead of 22.5 litres, no storage resp. 180 days in freezer and 30 days in fridge, landfill of used packaging, urban and countryside shopping instead of an average distance, 33 percent spoilage and a best and worst case scenario.

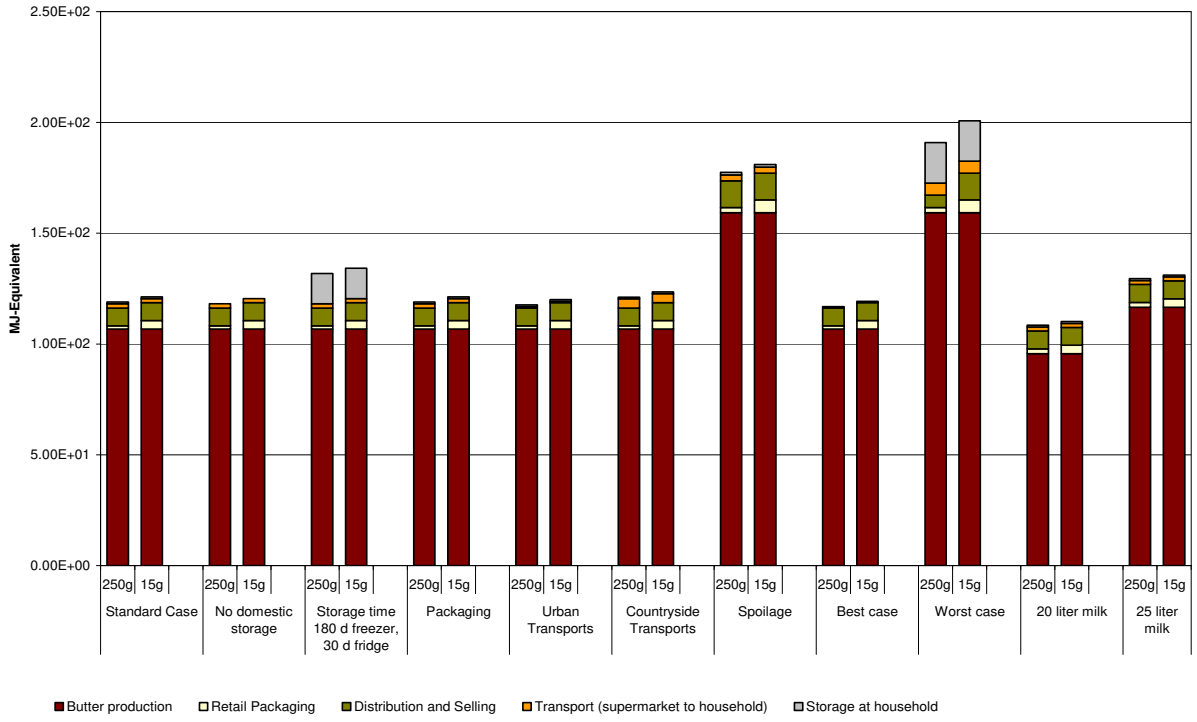

Figure 2: Sensitivity analysis with regard to non renewable cumulative energy demand

The sensitivity analysis has shown the following results: Storing butter in the fridge up to one month has no relevant environmental impacts. More important is the storage of butter in the freezer due to the higher electricity consumption and longer storage time. The kind of disposal of the packaging system has practically no influence on the results. Grocery shopping is of limited importance no matter which means of transport are used or which distances are regarded. Spoilage is of great importance: a spoilage of one third results in an increase of the impacts of about 49 percent in case of all indicators calculated.

The best case consists of no domestic storage, packaging is disposed in incineration, for grocery shopping the urban scenario is chosen and there is no spoilage of butter. The worst case applies to 180 days of storage in a freezer and 30 days in a fridge, landfilled packaging, the countryside grocery shopping scenario and a spoilage of 33 percent. Differences between the worst case and the standard scenario originate mainly from the spoilage scenario and the domestic storage process. Differences between the best-case

scenario and the standard scenario are very small because butter production is not influenced and no spoilage was assumed for the standard case.

Unsurprisingly, the less milk is used to produce butter the lower are the environmental impacts in all indicators.

Conclusions for the consumption of butter: the most relevant factors concerning the environmental impacts from the whole supply chain are, for most indicators, the butter production, spoilage, domestic storage in case of the freezer scenario and refrigerated storage and transportation in case of ODP. As a consequence the most relevant measures reducing the environmental impacts would be the optimisation of the milk and butter production. Another important factor is the consumers' behaviour, i.e. the reduction of leftovers. A high share of leftovers results in higher impacts. The consumer can also influence impacts of domestic storage by reducing the storing time of butter in the freezer and by using an efficient freezer.

Regarding the impacts of packaging in the life cycle of butter it is to say that they are small and not of primary importance.

Summary

It should be the aim of every type of industry to minimize the environmental impacts directly related to their products. This study shows that in case of packaging industry this goal can only be reached if also aspects indirectly influenced by the product are taken into account. Thus, the packaging industry does not only aim to improve the production process of their packages, but also to provide packages whose functionality helps to reduce other more relevant environmental impacts in the life cycle. Depending on the product tailor-made packaging may also help to increase overall resource efficiency.