Public summary Wrap or Waste

Case ‘Packaging bakery ingredients’

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Many food companies are facing dilemmas in their search for more sustainable packaging. When is packaging more sustainable? How to compare packaging? How to include the effects of packaging on shelf life and risk of losses?
Dawn Foods, which supplies raw materials for bakeries, would like to switch to more sustainable packaging, but lacks information to make a good decision. This topic was tackled in a case within the Wrap or Waste PPP project by researchers from Wageningen University & Research (WUR), with funding from TKI Agri & Food and Dawn Foods.

Packaging dilemma: Bakery ingredients

Bakery products like flour and bakery mixes are currently packed in bags that are composed of an inner bag of HDPE (High Density Polyethylene) and two outer paper bags that are attached to each other. These traditional packages render the products a shelf-life of one year. After usage, these bags are discarded by the bakeries and incinerated or land-filled. depending on the waste management infrastructure present. Therefore, these packages do not fit in a transition towards a more circular economy. Two alternative packages might be more suitable for the circular economy; a plastic-based bag and a paper-based bag But which packaging is most suited to fit a circular economy? To answer that question the packages are assessed on multiple dimensions of sustainability in which the shelf life of the packed products is taken into consideration.

Experimental steps

Inventory current packaging and selection of alternatives

The currently used 20-25 kg bag for bakery ingredients was selected as reference bag. This is a thin HDPE bag, inside and two layers thick paper layers on the outside (Bag 1). Two alternative bags were selected; one based on MDPE (Medium Density Polyethylene), Bag 2, and the other based on impregnated paper (Bag 3). They were chosen to have the potential to replace the current packaging in the filling operations of Dawn Foods.

Material properties

To estimate the impact of the alternative packaging systems on the shelf life of the products, the water vapour transmission rate of the materials was measured and compared to the one of the current packaging. The numbers were used to model and predict the moisture content of the product in time and to estimate food losses.

Sustainability analysis – calculation tool

The sustainability of the different types of packaging has been assessed with a calculation tool. This calculation tool calculated the CO_2 emissions related to the packaged products, including the effects of shelf life and food losses and waste. Besides, aspects such as the recyclability, littering potential and circularity of the different packages were quantified.

Results

The shelf-life of bakery ingredients is generally limited by the water content of the product, which is determined by the initial water content and the moisture vapour transmission rate of the packaging. When the product absorbs too much moisture it starts to form lumps. Modelling with the measured transmission rates resulted in an estimated reduction of shelf life by 3 months for the paper based bag (9 months), whereas the plastic based bag showed results comparable to the reference bag (12 months).

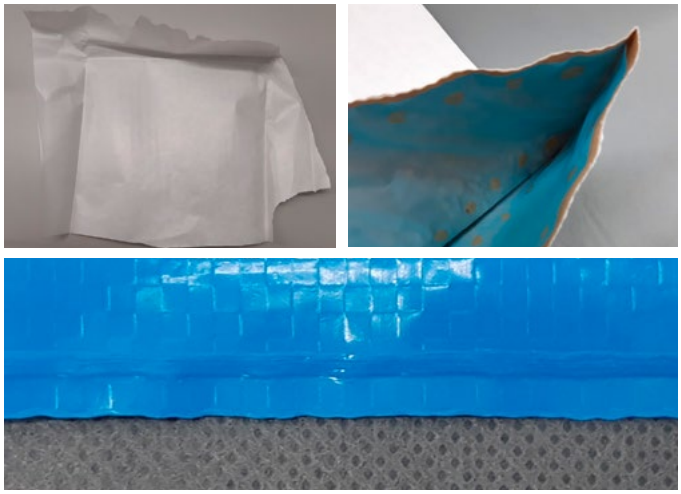

Figure 1 Impressions of the packaging materials. Left: Bag 1, showing the 3 layers. Right detail of the MDPE Bag 2. Bottom: the impregnated paper material for Bag 3.

A formula that describes a general reciprocal relationship between food loss and shelf life was used to predict food loss due to exceedance of the expiration date (Table 1). Since it is the company's experience that no bakery products are lost that have a shelf life of 12 months, a correction of the predicted values was applied. The number of 0.11% food loss was included in the CO_2-calculations of the paper bag.

Table 1 Predicted and corrected shares of food loss for bakery products with 12, 9 and 6 months of shelf-life, [%].

Shelf life, [months]	Calculated food loss, [%]	Corrected food-loss, [%]
12	0.38	0.00
9	0.49	0.11
6	0.69	0.31

Packaging scenarios

Several scenarios were defined for sustainability calculations of the 3 different bags. The end-of-life fate for the two alternatives was defined: if the packaging would be incinerated or completely recycled. For Bag 2 a scenario was included with plastic instead of paper labels, which would make it more suitable for recycling. For the paper bag we do not know what type of coating is used by the producer. Therefore 2 options were included, silicon oil and vegetable oil. See Table 2.

Table 2 Scenarios that are considered relevant for the bakery product bags.

No.	Bag type & modifications	Berekend productverlies [%]	Gecorrigeerd productverlies [%]
A	Bag 1 (reference)	12 months	Incineration
B	Bag 2 (MDPE)	12 months	Recycling
C	Bag 2 (MDPE)	12 months	Incineration
D	Bag 2 (MDPE) with plastic instead of paper labels	12 months	Recycling
E	Bag 3 (Paper) with silicon oil	9 months	Recycling
F	Bag 3 (Paper) with silicon oil	9 months	Incineration
G	Bag 3 (Paper) with vegetable oil	9 months	Recycling
H	Bag 3 (Paper) with vegetable oil	9 months	Incineration

Lowest CO_2 impact when recyclable bags are in fact recycled

Figure 2 shows that the production of bakery products represents far more CO_2 emissions, than the production of the packaging materials. This includes the waste management of the food waste and the packaging waste. However, when looking at the packaging system in combination with the End-of-Life option, the CO_2 emission related to the packaging can clearly be reduced when the packages are recycled. This positive result is most evident for the plastic packaging with a plastic label (D) and the paper bags (E, G).

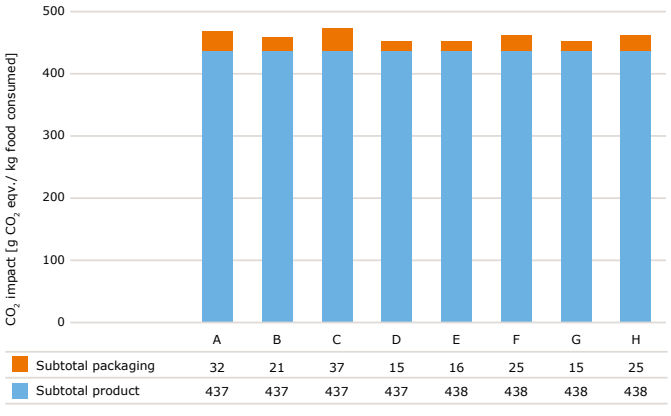

Figure 2 CO_2 impact of the packed bakery ingredients, in 3 bags, eight different compositions/ End-of-Life options as explained in Table 2, [g CO_2 eqv./ kg food consumed]

Figure 3 shows that the reduction of CO_2 impact is less substantial (Reduction GWP-100) when the bags are not actually being recycled. For recycling of the plastic-based packaging it is important that both labels are modified

from paper labels to plastic (LDPE) labels (recyclability indicator of scenario B versus D). Recycling of plastic bags also requires a separate collection infrastructure for post-industrial packaging waste, which is not present in all countries. The main advantage of the paper-based bag is that it can be recycled and degrades relatively quick when ending up in nature. It will not contribute to the formation of long lasting litter (high littering prevention indication). The slightly reduced shelf life in the paper bag and potential increase in food loss rate is relatively low and has limited effect on total CO_2 impact of the product package combination.

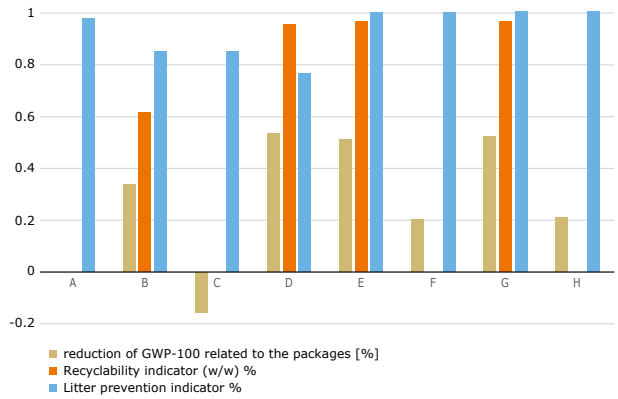

Figure 3 Dcores of sustainability indicators for the various packaging-product scenarios

Conclusions

The relative impact on the greenhouse emissions of packaging alternatives in this case was small (3-4% lower for both alternative packages), because it was dominated by the contribution of the food production. Nevertheless, the greenhouse gas emissions could be reduced with alternative packaging. Plastic-based and paper-based recyclable bags both can successfully reduce greenhouse gas emissions and contribute to a recycling economy.

Based on the collected data and the development of a calculation tool, it is possible to compare different packaging scenarios and to analyse various sustainability aspects The results of this analysis show a nuanced picture in which the actual sustainability of the alternatives depends on the context in which the packaging is produced, used and processed.

More information about the project

In the Wrap or Waste public-private partnership project, various product, packaging and recycling experts from Wageningen University & Research and industrial partners join forces to find a new, more sustainable balance in packaging and packing. In this project, concrete business cases are used to compare current packaging and alternatives on sustainability indicators throughout the entire life cycle of the packaging, including effects related to recyclability and effects on shelf life and potential food losses.
The quantitative results from the project can be used by companies to make informed decisions about sustainable packaging choices. This will not only lead to the use of sustainable materials, but also contribute to more sustainable production chains; from (fresh) product to waste processing and recycling. More information can be found on the website of the PPP Wrap or waste.

Information

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