

Effect of PBS packaging on food shelf life

One of the aims of the SUCCIPACK project was the evaluation of the performances of the novel packaging materials in maintaining quality and safety of selected food products as **no or little information is actually available in literature**. In fact no papers reporting experimental results on the use of PBS packaging for food application has been recently published.

This objective was achieved through **systematic tests on several products representative of different food categories**, processing technologies and storage conditions, which in turn have different requirements in terms of preservation. In particular, the following products characterised by short and medium shelf-life values have been taken into consideration:

- Raw and smoked poultry meat packed under vacuum;
- Raw beef meat packed in air;
- Heat treated vegetarian burgers packed in air;
- Grilled peppers packed in air;
- Ricotta cheese packed in air;
- Minimally processed lettuce packed with MAP;
- Roasted peanuts packed under modified atmosphere.

As a result, successful PBS materials and conditions have been found for all the selected foods, and the applicability of the innovative packaging under the form of trays, cups or pouches has been proved.

In general the PBS materials produced within the project were characterised by the same efficiency in preserving food quality and safety as the reference ones. This is the case of the 2 PBS films used to pack under vacuum raw chicken and turkey meat as well as smoked turkey meat, which are quite highly perishable products mainly due to levels of nutrients available, high pH and Aw values. In fact, thanks to the appropriate thickness, good barrier properties towards gases and vapour, all the 3 meat products were stable and no changes in the chemico-physical and colour were observed compared to the reference (PA/PE) film. Also for the spoilage microflora, no significant differences could be detected between samples packed with the conventional film and the PBS ones thus resulting in the same shelf-life values, i.e. 5 days for raw poultry and turkey breast, and 15 days for smoked meat.

PBS films suitable for the storage of heat treated vegetarian burgers and grilled peppers were also produced. In fact, their use in the form of pouches (for the burgers) or as topfilm for bioPBS cups (for grilled peppers) allowed to protect the food from undesirable chemical/enzymatic reactions that lead to discoloration and change in flavor, odour, consistency. Moreover, the growth of the contaminating microflora responsible for food spoilage was prevented over 50 days of refrigerated storage for grilled peppers and up to 60 days for spinach burgers, i.e. 15 days beyond the shelf-life actually given by the producers to this food.

A targeted application of PBS films was achieved also for minimally processed lettuce by playing on the barrier properties of 3 different films. In fact their use as pouches for ready-to-eat salad was successful in delaying and limiting the growth of the spoilage

mesophilic microbiota. This effect contributed to an increase in the lettuce shelf-life compared to the conventional packaging (BOPP).

The barrier properties of 2 bilayer PBS films were also exploited for roasted peanuts. While this product does not present microbiological concerns, one of the main factors affecting its quality is lipid oxidation, which not only influences sensory and nutritional quality of foods, but also impacts the food product's shelf-life. On the other hand, both the PBS films developed for this application were characterised by a higher barrier against oxygen compared to the control one (PET), thus limiting quality loss for this type of product.

Unlike peanuts, ricotta cheese has a limited shelf-life (~ 10 days) due to its low salt concentration, high water activity and pH values which make it highly susceptible to microbial spoilage. Since no preservative or MAP is used, its stability simply relies on Good Manufacturing Practices, chilled storage and proper packaging materials and conditions able to retard microbial growth. Therefore, several PBS materials were tested in the form of trays, cups and pouches used alone or in combination in order to find an application able to preserve the shelf-life compared to the control packaging (PP).

Overall, none of the tested PBS materials and packaging conditions significantly influenced the main chemico-physical and quality parameters monitored for this product compared to the control packaging. In fact pH and A_w values were almost stable over storage, while main changes observed for the colour, which tended to a shift to yellowness during storage, followed the same trend in the PBS-packed samples and in the control ones.

On the other hand, different behaviours were observed for the microbiota of ricotta in relation to various PBS materials and packaging combinations developed. In general lactic acid bacteria, enterobacteria and yeasts showed limited growth extents, while aerobic mesophilic and psychrophilic ones reached maximum values of 7 Log CFU/g which is the critical threshold level for the product quality. Therefore these 2 microbial groups were responsible for spoilage of ricotta cheese, i.e. for the definition of its shelf-life. Taking into consideration that oxygen in the headspace of packages is one of the main factors affecting food spoilage, as it is required by mesophiles and psychrophiles for their growth, films with good barrier properties were produced. When employed for pouches, such PBS films ensured shelf-life values comparable to the reference packaging. By enhancing their barrier properties with a surface coating their use in combination with bioPBS cups resulted in a significant extension (2-3 days) of ricotta shelf-life compared to the reference packaging. On the other hand also the composition of the material in direct contact with the food proved to affect microbial spoilage. In fact PBS cups with specific formulations were effective in delaying spoilage processes and preserving food quality, thus acting as a sort of antimicrobial packaging which allowed to achieve a 3 days longer shelf-life compared to the control packaging.

Overall, **results collected showed that several PBS-materials produced in the frame of the SUCCIPACK project have good potential for packaging applications in the food industry**. In fact PBS materials performing in a similar way as the conventional packaging were successfully developed for all the tested foods, which represent a rather wide range of products with differentiated requirements in terms of preservation. Moreover, **enhanced shelf-life was achieved** by acting on PBS formulation or improving its barrier properties, thus indicating that further applications (e.g. MAP,

active packaging...) can be investigated and exploited in the future for other more or less perishable products like raw meat, minimally processed vegetables, fruit salads, bakery products....