Migration of chemicals specific to active and intelligent packaging

Area of research interest: Chemical hazards in food and feed
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Conducted by: TNO Quality of Life (lead contractor) and Fera (sub-contractor)
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Background

Active packaging is intended to change the condition of the packed food while maintaining freshness and quality. In intelligent packaging, the food is intended to influence the packaging so that the condition of the food is monitored. A literature and Internet search was performed to identify retail active and intelligent materials. Following this, 25 packaging materials were obtained and analysed to identify and quantify the chemicals that made up the active or intelligent component. The migration behaviour of the substances associated with the active/intelligent (A/I) component was then investigated to establish compliance with European legislation. In addition, the efficacy of ten active/intelligent packaging systems was investigated.

One of the most innovative developments in food packaging in recent years is the application of active and intelligent packaging. Active packaging is intended to change the condition of the packed food, to extend shelf-life or improve sensory properties while maintaining the freshness and the quality of the food. To do this, the packaging should absorb food-related chemicals or it should release substances such as preservatives, antioxidants, flavourings or colours. For intelligent packaging, the food is intended to influence the packaging so that the packaging gives information about the current condition of the food and/or its storage history.

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Research Approach

A thorough literature/internet search was performed to identify active (A/I) materials on the market. Following this 25 packaging materials were obtained and analysed to identify and quantify the chemicals that made up the active or intelligent component. The migration behaviour of the substances associated with the A/I component was then investigated to establish compliance with European legislation. In addition the efficacy of ten A/I packaging systems were investigated.

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Results

Examples of 25 A or I packaging materials were obtained and screened for potential A or I specific migrants. In many cases it was not possible to separate the A or I component from the rest of the packaging material, and therefore it was generally very difficult to identify the A and I ingredients in the absence of product formulation. As not all packaging materials were suitable for standard migration tests, alternative migration tests were undertaken where required. Under the test conditions used, one of the oxygen scavenging systems (a label) transferred the active component, iron, to acidic food simulant and tomato sauce at a level which could lead to an exceedance of the Tolerable Daily Intake (TDI). No conditions of use were supplied with this packaging format but these results would indicate that there should be restrictions on the use of this sort of material.

A large number of substances remained either unidentified or with an ambiguous identification only. As a result these findings support the need for an ‘authorised list’ of active and intelligent ingredients as now required by the EU regulation (EC) No 450/2009 on these materials. Seven of the ten samples tested for efficacy behaved in the way claimed by the suppliers/manufacturers. Detailed instructions of how the products should be used were not always given and it is recommended that these be provided.

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Additional Info

Over 60 companies were identified world-wide marketing active and intelligent packaging materials. These included; oxygen scavengers, moisture absorbers, ethylene scavengers, amine/aldehyde and/or sulphide scavengers, carbon dioxide regulators, antimicrobial releasing systems, nitrogen releasers, heat releasers, flavour releasers and monitoring systems.

Screening experiments were performed to identify active and intelligent components. In most cases it was not possible to separate the active or intelligent part of the packaging from the regular packaging.

Active/intelligent packaging materials are not always suitable for direct contact with liquid food simulants. Therefore, dedicated migration tests, developed in the EU Actipak project were performed, where direct contact with a liquid simulant is replaced by contact with a tissue soaked in simulant. Most of the migration experiments using the tissue showed higher migration than into real foods. This is an essential requirement of any migration test in order to ensure consumer protection. The exception to this was for the oxygen absorbing label, for which the migration of iron into cheese was greater than into the paper soaked in fatty simulants. However it is recognised in EU legislation for plastics that some cheeses are acidic and in these cases 3% acetic acid should be used as a simulant. Migration of iron into acidic stimulant or food exceeded the restriction (the maximum tolerable daily intake of iron is 48mg of iron per kg of food). Results indicate that the label should not be used for direct contact with acidic foodstuffs.

The migration of silver from antimicrobial releasing systems and butylated hydroxyltoluene from flavour releasing films did not exceed restrictions set.

The efficacy of ten samples was investigated: an oxygen scavenging label, an oxygen scavenging sachet, an antimicrobial film, an antimicrobial food storage liner, an anti-mould pad, an absorbent pad, an ethylene scavenging sachet, an anti-mould bag, a heat sensing spoon and a time indicator. Seven of the ten samples behaved in the way claimed by the suppliers/manufacturers.

Neither the antimicrobial film nor the antimicrobial storage liner reduced the microbial growth on their food contact surfaces and on the surface of a meat sample compared to a material without antimicrobial properties. The mould growth on cheese stored in the anti-mould bag did not differ from cheese stored in a polyethylene bag with no anti-mould properties. For these samples detailed instructions as to how the samples should be used were not given. It is recommended

that these are provided to maximise the probability that the claimed activity of these materials will be achieved.

Research report

England, Northern Ireland and Wales

PDF
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