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## Abstract

A previous publication described methods for assessing and reporting uncertainty in dietary exposure assessments. This follow-up publication uses a case study to develop proposals for representing and communicating uncertainty to risk managers.

The food ingredient aspartame is used as the case study in a simple deterministic model (the EFSA FAIM - Food Additives Intake Model - template) and with more sophisticated probabilistic exposure assessment software (FACET - Flavourings, Additives, and food Contact Materials Exposure Tool). Parameter and model uncertainties are identified for each modelling approach and tabulated. The relative importance of each source of uncertainty is then evaluated using a semi-quantitative scale and the results expressed using two different forms of graphical summary.

The value of this approach in expressing uncertainties in a manner that is relevant to the exposure assessment and useful to risk managers is then discussed. It was observed that the majority of uncertainties are often associated with data sources rather than the model itself. However, differences in modelling methods can have the greatest impact on uncertainties overall, particularly when the underlying data are the same. It was concluded that improved methods for communicating uncertainties for risk management is the research area where the greatest amount of effort is suggested to be placed in future.

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## Outlook and Challenges of Nanotechnologies for Food Packaging

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Nanotechnology has been considered to have high potential for food packaging applications very early on. The ability to provide additional consumer benefits through the improvement of key properties of packaging materials and the creation of new functionalities means that the increased use of nanomaterials and nanotechnologies is highly likely. It has however up to now failed to reach the widespread use that was initially expected, mainly because of remaining uncertainties on the safety of these materials during the various stages of their life-cycle, which limit legal and consumer acceptance.

This paper aims at presenting the latest developments in the field of nanotechnologies for food packaging applications, describing the legal framework linked to their usage and attempts to clarify the current knowledge of the safety of these materials both for the consumer and the environment.

It is shown that particulate migration into foodstuff is absent in many applications, which drastically reduces the potential risk during the use phase of packaging materials, i.e. the exposure of the consumer to nanoparticles. Other release routes are also evaluated, showing that, although safe in normal use conditions, evidence should still be used, especially with regard to release after disposal of the materials. Copyright © 2016 The Authors. Packaging Technology and Science Published by John Wiley & Sons Ltd

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## INTRODUCTION

The concept of nanotechnology refers to the manipulation of materials at a nanometric scale to benefit from the specific physico-chemical properties occurring in this size range. The concept was first mentioned in a speech by Richard Feynman given in December 1959 at the annual meeting of the American Physical Society.<sup>1</sup> Theoretical knowledge and analytical tools were developed over the next two decades leading to the discovery of fullerenes in 1985 (resulting in a Nobel prize in 1996)<sup>2</sup> and carbon nanotubes a few years later.<sup>3</sup>

From the early days nanotechnology was identified by the packaging industry as a potential enabler of increased functionality in packaging materials. This was initially in the domain of barrier and

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## A nanotechnológiák kilátásai és kihívásai az élelmiszer-csomagolásban

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## Összefoglalás

A nanotechnológiáról a kezdetektől fogva úgy gondolták, hogy nagy lehetőségek rejlenek benne az élelmiszer-csomagolási alkalmazások számára.

A további fogyasztói előnyök nyújtásának képessége a csomagolóanyagok kulcsfontosságú tulajdonságainak javítása és új funkciók létrehozása révén azt jelenti, hogy nagyon valószínű a nanoanyagok és nanotechnológiák fokozott használata. Mindazonáltal az eredetileg elvárt széles körű alkalmazás eddig nem valósult meg, főleg azért, mert még mindig vannak olyan bizonytalanságok ezen anyagok biztonságossága tekintetében életciklusuk különböző szakaszaiban, amelyek korlátozzák jogi és fogyasztói elfogadottságukat.

Ennek a dolgozatnak a célja a legfrissebb nanotechnológiai fejlesztések bemutatása az élelmiszer-csomagolási alkalmazások területén, leírva a használatukhoz kapcsolódó jogi kereteket, valamint megkíséréljük ezeknek az anyagoknak a biztonságosságára vonatkozó jelenlegi tudás tisztázását, mind a fogyasztók, mind a környezet tekintetében.

Bemutatjuk, hogy sok alkalmazás esetén nincs jelen az anyagrészecskék vándorlása az élelmiszerekbe, ami drasztikusan csökkenti a potenciális kockázatot a csomagolóanyagok felhasználása során, vagyis a fogyasztók nanorészecskéknek való expozícióját. Egyéb kibocsátási utakat szintén értékelünk, bemutatva, hogy bár normál felhasználási körülmények között ezek az anyagok biztonságosak, körültekintőnek kell lenni, különös tekintettel az eldobás utáni kibocsátásra.

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