Research Application Summary

Development and evaluation of models for predicting chemical contaminant migration in foods

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Abstract

Polyethylene bags have become very popular for wrapping ready food or during cooking. Polythene materials are known to contain a wide range of potential migrants such as residues from the polymerisation process, degradation compounds and additives, many of which are toxic. There is need therefore to assess the potential danger posed to humans by migration of chemicals from polyethylene. Analysis of migrants in food is expensive and time consuming because of low concentrations of migrated substances and the complexity of the food matrix. Therefore, dependable models that accurately predict the progress of chemical contaminant migration in food is needed. This research therefore aims to develop, simulate and validate models capable of predicting the migration of chemical contaminants by identifying and, quantifying plastic bag contaminants so as to contribute to understanding of contaminant migration, organoleptic changes, contaminant diffusion and dispersion in "posho".

Key words: Contamination, colour degradation, modeling, migration, food safety

Résumé

Les sacs en polyéthylène sont devenus très populaires pour l'emballage des aliments préparés ou pendant la cuisson. Les matériaux en polyéthylène sont reconnus de contenir un grand nombre de migrants potentiels, tels que les résidus du procédé de polymérisation, les produits de dégradation et les additifs, dont beaucoup d'entre eux sont toxiques. Il est donc nécessaire d'évaluer le danger potentiel pour l'homme par la migration de produits chimiques de polyéthylène. L'analyse des migrants dans les aliments est coûteuse et prend du tempsà cause de faibles concentrations de substances migrées et la complexité de la matrice alimentaire. Par conséquent, les modèles fiables qui puissent prédire avec exactitude l'état d'avancement de la migration des contaminants chimiques dans les aliments,sont

nécessaires. Cette recherche vise donc à développer, simuler et valider des modèles capables de prédire la migration des contaminants chimiques par l'identification et la quantification des contaminants des sacs en plastique afin de contribuer à la compréhension de la migration des contaminants, des modifications organoleptiques, de la diffusion des contaminants et leur dispersion dans le "posho".

Mots clés: Contamination, dégradation des couleurs, modélisation, migration, sécurité alimentaire

Background

Wrapping food in banana leaves for the purposes of keeping it hot/warm has been practiced for centuries across communities in Uganda. However, the use of polyethylene bags as opposed to banana leaves is on the steady increase. Increase in the use of polyethylene bags in this role is due to their high thermo-sealability and barrier properties to water. Commercial food vendors are sure to serve a hot meal without necessarily spending a lot on energy. However, it is recommended that food materials should not interact with the food components in any way to produce undesirable effects, such as food contamination or food safety problems. A number of studies (e.g., Gosselin and Mondy, 1989) have suggested that polythene materials contain a wide range of potential migrants for example residues from polymerisation process, degradation compounds and additives; including lead and cadmium. Lead is toxic to human beings. Lead is also a cumulative poison which poses a possibility of bioaccumulation in man even when exposed to low concentrations continuously (Agboola *et al*., 2005). Therefore, dependable models that accurately predict the progress of chemical contaminant migration taking place in a homogeneous liquid or semi-solid during thermal degradation would be an indispensable tool for public health and legislation.

Literature Summary

Packaging makes food more convenient and gives the food greater safety assurance from microorganisms, biological and chemical changes such that packed foods can enjoy a longer shelf life. As a result, packaging became an indispensable element in the food manufacturing process. In order to meet the huge demand for the food industry, there was a remarkable growth in the development of food packaging in the past decades. And now, a wide variety of different plastics are being used as packaging material. In the area of packaging material, plasticiser migration from food contact materials into food has raised many concerns in communities since the early eighties. This was

attributed to the demonstrated carcinogenic effect in rodents and potential estrogenic effect in humans as revealed by toxicology studies of several commonly used plasticisers (NTP Technical Report Series, 1980). Such incidence indicated that the packaging could itself represent a source of contamination through the migration of substances from the packaging material into food. Hence, regulatory authorities around the world have recognised that it is necessary to control such contamination, and many have enacted extensive legislation on migrants. However, analysis of migrant in the food stuff or stimulant can be very expensive and time consuming because of low concentrations of migrated substances found in the food stuff and the complexity of the food matrix. Different modeling procedures have thus been established in an effort to overcome these difficulties.

Study Description

Posho cubes each 5cm × 5cm will be prepared using a mould. The posho cubes will then be wrapped in black polyethylene bags (Plasto-Foam brand), medium size 22" gauge of 30 micrometer thickness commonly used for wrapping foodstuffs. Sample tests will be prepared and placed in a well-stirred thermo-stated water bath (Grant instruments, Cambridge England), each pre-set at temperatures of 65, 90 and 100°C. For a given water bath, three sample tests will be placed in at the same time and sampling will be done at intervals of 15 minutes for the different water baths . After 1 h of cooking, sample tests will be taken out from the respective water bath and samples drawn. Sampling will be carried out using a manual stainless steel device. AKTS SML software will then be used to determine the amount of contaminant into the food at distances of 0 to 1.5, 1.5 to 3.0 and 3.0 to 4.5 cm from the surface in contact with the black polyethylene bag.

The above process will then be repeated for the second and third hours and samples extracted at the end of each hour. At each hour the food samples will be analysed for texture and color. Profiles of contaminant migration at different time-temperature combinations will then be developed. Based on the diffusion, partition coefficients and fick's law, models that predict the evolution of these contaminants will be developed.

Research Application

This work is ongoing and it is expected that on completion: (i) lead flux migration profiles in thermal treated foods will be determined, (ii) health hazards related to lead contamination and consumption will be identified and (iii) decision support

systems based on predictive models during thermal processing of foods will be developed.

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