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CHEMICAL MIGRATION IN FOOD TECHNOLOGY

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Food safety and toxicology is of great concern on the global terms. Food contamination refers the occurrence of toxic chemicals and microbial pathogens which could produce negative health implications to the humans. The impact of chemicals on consumer health is often apparent only after prolonged exposure at low levels. Chemical contaminants present in foods are often unaffected by temperature used for cooking. The scientific and public deliberates over the safety of chemical additives, contaminants and adulterants, appearing in foodstuffs have been emphasized since long time. The common contaminants and food adulteration can be classified as intentional and non-intentional chemicals. The intentional category includes deliberately added chemicals like food additives and adulterant, the latter for the purpose of disguising inferior commodities and/or earning undue profits. The second group of non-intentional contaminants can come during production, processing, packaging and storage.

Keywords: Chemical migration, Food, Food technology, Migration, Food safety.

Introduction

Packaging is beneficial. It protects the packaged foodstuff from spoilage by external agents such as pests, odours, micro-organisms, light and oxygen. However, the transfer of chemicals from packaging to food may have a negative impact on the quality and safety of food. This is why migration from packaging and other food contact materials merits study, consideration and control. Packaging is perhaps the most important and certainly the most obvious, example of a material or article intended to come into contact with food. There are many other situations where materials are deliberately used in contact with food during its manufacture, transport, storage, preparation and consumption. These include the materials used to construct storage vessels, conveyor belts, tubing, food preparation surfaces and cooking and eating utensils.

Food and beverages can be very aggressive products and may interact strongly with materials that they touch. Collectively, they are as good as many of the solvents used in a chemistry laboratory. For example, food acids can corrode metals, fats and oils can swell and leach plastics and beverages can disintegrate unprotected paper and cartonboard. In fact, no food contact material is completely inert and so it is possible for their chemical constituents to 'migrate' into the packaged food. Metals, glass, ceramics, plastics, rubber and paper can all release minute amounts of their chemical constituents when they touch certain types of foods (K. Barnes *et al.,* 2006).

Packaging Materials Used In Food Industry

Metal

Metal cans are made of tin-plate (steel coated with tin), tin-free steel (steel coated with chromium and chromium oxides) or aluminium. Tin-plate is most used for food cans and aluminium for beverage cans. Most cans are internally coated with a polymeric layer, and thus the layer of food contact is not the metal but the lacquer. The substances of concern in can systems are therefore not only the metals involved, but also components migrating from the coatings, such as starting substances and their potential derivatives. Migrants from can coatings, namely phenolic resins, often contain only small amounts of monomers, oligomers and additives, but a large amount of other unknown or undescribed components (Grob K., 2002).

Paper and Board

Paper and board are essentially composed of pulp from different vegetable sources and are most often employed in contact with dry foods. Additives used in this type of material include fillers, starch and derivatives, wet strength sizing agents, retention aids, biocides, fluorescent whitening agents and grease-proofing agents. Paper and board may also be coated with polymers as polyethylene or waxes. Recycled fibre is considered a major source of migrants (Aurela B *et al*., 1999).

Polymers

Synthetic polymers typically have high molecular weights (5000e1 million D) and therefore their biological availability is negligible. However, due to the use of lower molecular weight (<1000D) additives in these polymers as well as the presence of trace levels of unreacted monomers, there is a finite potential for human exposure to these lower molecular weight components (Leber A. P., 2001).

Substances that may migrate from plastic materials include monomers and starting substances, catalysts, solvents and additives. This latter class includes antioxidants, antistatics, antifogging agents, slip additives, plasticizers, heat stabilizers, dyes and pigments (Pocas F. M. and Timothy H., 2007).

Glass

Glass packaging has as its major components, silica, sodium and calcium oxides. These components are unlikely to have any significant effect on the safety of foods since they are natural constituents of many foods. Silica is also the major component of food-contact ceramics. Clays, another major raw material of ceramics, is composed of alumina, silica and water. Substances of concern may, however, originate from glazes and printing inks. Thus lead and cadmium are frequently controlled in such materials since they may be present as contaminants. The Food Standards Agency (UK) promoted a comprehensive overview of the potential for elemental migration from different glass types used in food-contact applications in a range of conditions of use (FSA., 2002).

Metal Lids

Metal lids used in glass jars may also be a source of potential contaminants: semicarbazide in baby food jars, resulting from degradation of azodicarbonamide used as blowing agent, and epoxidised soybean oil (ESBO) a plasticizer used in the plastisol gasket (Nestmann *et al*., 2005). EFSA recommended the decrease of the legal specific migration limit (SML) for ESBO, for infants food packaging applications, from 60 to 30 mg/kg of food or food simulant (Directive 2005/72).

Primary Aromatic Amines

Primary aromatic amines can be derived from the hydrolysis of aromatic isocyanates used in adhesives and from azo-dyes. They have been detected in kitchen utensils, particularly those made of black nylon, leading to a number of actions by the European Rapid Alert System for Food and Feed (Brede and Skjevrak, 2004; DFVF, 2004).

Contamination Factors

From Europe, intentional and unintentional origin of food contamination can be defined as follows;

Carrying home tea/coffee, hot curries which contains turmeric, alkaloids, spices and oil fried dishes in plastic bags.

The deep fried or oven cooked meat (chicken, mutton and seafood) other vegeterian food been packed in aluminum foil with extreme hot conditions.

Packing cooked food items directly in the used newspaper is most commonly seen practice.

Due to rich culinary and diversity of food menu in Europe, usage of food coloring chemicals/dyes (e.g., azo-amines, coal tar and petroleum) not only in candy, ice-cream, pharmaceuticals, cosmetics but also several of coloring chemicals was added to different food ingredients such as turmeric, chilly, garam, masala, ready to cook.

Canned foods contains environmental hormone Bisphenol-A (BPA). Usage of canned food increasing in Europe along with formation of BPA from the plastic bags during food to plastic reactions.

New environmental chemicals such as Perfluorinated Organic Chemicals (PFCs) been coated in food wrapping materials and food cartons (e.g., wrapper paper and cartons for burgers, fried chicken etc.,) becoming a new source of chemical intake in to young Europe generation. Several of foreign food units (e.g., fast foods such as burgers, sandwich, rolls, noodles/spaghetti, Chinese food, Arabian food), invade Europe and the youngsters desire to eat foreign food rather than the Indian traditional food.

In addition, additional chemicals such as pesticides and inorganic chemicals such as heavy metals already available in food and packing materials and their contribution to food contamination cannot be ruled out. The Railway stations and bus terminals can be considered to be a hot spot region of human waste matter and multiple pathogenic bacteria, virus and fungi. The food vendors in railways stations and bus terminals used to cook food in the early hours and pack them in aluminum foil or plastic bags or with paper cartons and sell even after 10-12 hours after cooking (Kurunthachalam, 2013).

The contamination of food is a major concern not only for developing countries but also for the entire world. Street food provides as a mean of livelihood for millions of people in the world with affordable price to the lower and middle income group (Tambekar *et al.,* 2011).

How Do Chemicals Migrate from Packaging into Food?

Generally, incidents where food has been contaminated by the migration of chemicals have involved packaging in direct contact with food (primary packaging). However, it is recognised that contamination may occur less frequently from secondary, tertiary and even quaternary packaging (such as corrugated carton, pallets and containers).

Some chemical components in packaging such as printing inks (e.g. photoinitiators such as benzophenone) may transfer to food contact surfaces via the ‘set-off’ process. This is a direct transfer from the external surface of the packaging to the food contact surface during stacking and storage of packaging. The chemicals may then migrate into food (Food Standards, 2014).

Transfer can also occur via evaporation and then leach into food via the gaseous phase (Johns *et al.,* 2000; Bradley *et al.,* 2013a). Furthermore, chemicals such as ink components and recycled fibres may persist in recycled packaging materials and ultimately migrate into food (Castle *et al*., 1997; Samonsek and Puype, 2013).

Factors Affecting Migration

Plastic films and packaging are widely utilized in the food industry due to their flexibility, variable sizes and shapes, relative light weight, stability, barrier properties, resistance to breaking, perceived high-quality image and cost effectiveness (Jenkins W.A. and Harrington J.P., 1991).

The tendency of food to interact with its packaging is a significant factor that can affect quality, appearance and shelf life. Adherence of food residues to the packaging may decrease product acceptability, enhance oxidation and off flavors, increase waste, and result in lowering overall product quality (Meiron T.S. and Saguv I.S., 2007).

Parameters that affect the amount and rate of migration ;
Direct or indirect contact with the food of the packaging material,
Feature of the materials in contact with food (thickness for plastics, permeability, etc.),
Migrant chemical property (vapor pressure, polarity, molecular size and structure, etc.),
Migrant initial concentration in the packaging material,
The contact time and temperature,
Components in contact with the packaging material (food or stimulants) (Altuntas *et al*., 2014).

Conclusions

Migrants can arise from classic migration or from degradation of the packaging material. Currently only plastics have EU-wide regulation. Specific chemical-by-chemical regulation of all migrants in food not effective. Potentially 10,000s of migrant chemicals may be found in food. Detailed scientific assessment of all would be enormous task.

It may involve danger to human health, the components of packaging materials must not exceed the food, the food should not result in changes in the composition and the organoleptic properties of food should not change.

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