

Milk contact surfaces

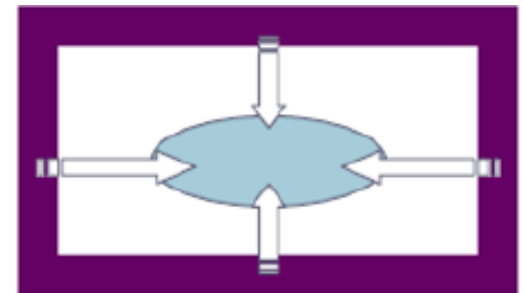
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Introduction

- Migration refers to the transfer of a substance from the packaging to the foodstuff inside and vice versa.
- Plastics are most commonly used as packaging material. They are polymers, made from monomeric units.
- The polymer as such is an inert high molecular weight structure. As substances with a molecular weight above 1000 Dalton usually cannot be absorbed in the body, the potential health risk from the polymer itself is minimal.
- Potential health risk may occur from non- or incompletely reacted monomers or from low molecular weight additives which are transferred into food via migration from the plastic food contact material.

Contamination

- Food contact materials can be constructed from a variety of materials like plastics, rubber, paper, coatings, metal etc. In many cases even their combinations are used.
- Different types of additives such as antioxidants, stabilizers, lubricants, anti-static, anti-blocking agents, etc. are added to improve performance of polymeric packaging materials.
- Direct contact between the food and its packaging may results in the migration of packaging components into food.
- Recently the packaging has been found to represent a source of contamination itself through the migration of substances from the packaging into food



Safety

- The food contact materials shall be safe.
- They shall not transfer their components into the food in quantities that could endanger human health, change the composition of the food in an unacceptable way or deteriorate the taste and odor of foodstuffs.
- During the contact of the food contact materials with the food, molecules may migrate from the food contact material to the food.
- Because of this, in many countries regulations are made to ensure food safety.
- The transfer of constituents from food contact materials into food is called migration.
- To ensure the protection of the health of the consumer and to avoid any contamination of the foodstuff two types of migration limits have been established for plastic materials by EU legislation

Specific Migration Limit (SML)

- SML means the maximum permitted amount of a given substance released from a material or article into food or food simulants.
- SMLs are a risk management tool derived from toxicological data, such as tolerable daily intakes (TDIs), or from a limited toxicological assessment ensuring safety only for a low migration
- Plastic materials and articles shall not transfer their constituents to foods in quantities exceeding the set SML.
- The SML are expressed in terms of mg of substance per kg of food
- For substances for which no specific migration limit or other restrictions are provided, a generic specific migration limit of 60 mg per kg shall apply.

Overall Migration Limit (OML)

- OML means the maximum permitted amount of non-volatile substances released from a material or article into food simulants.
- The OML may be seen as a restriction of food contamination by the sum of the substances migrating from food contact materials.
- Plastic materials and articles, intended to be brought into contact with food, shall not transfer their constituents to food in quantities exceeding 60 milligrams of total of constituents released per kg of food or food simulant.
- Therefore, plastic materials and articles shall not transfer their constituents to food simulants in quantities exceeding the stipulated limits.

Milk Contact Materials

Some common articles and material likely to come in contact with milk from production to consumption chain; at various stages like milking, storage, transport, processing, packaging, distribution and utilization are:

Active or intelligent materials	Paper and board
Adhesives	Plastics
Ceramics	Printing inks
Coatings and lacquers	Regenerated cellulose
Cork	Rubbers
Glass	Silicones
Ion-exchange resins	Textiles
Metals and alloys	Varnishes and coatings Waxes
Wood	

1. Metals

- After milking the milk is stored in a container which are usually made up of metals. As soon as milk comes in the contact of the metal, it starts reacting with the metal.
- If it is of good quality, the milk will remain good and if it is not then, it is difficult to maintain the quality of milk
- The metallurgy of the dairy plant is very different from the other industries.
- A slight change in the composition of the metal greatly affects the working quality of the equipments and wholesomeness of milk and milk products.
- The corrosive properties of milk are due not only to various mineral salts in solution but also due to its protein content.
- The solubility of metals in milk and other dairy products is having a great interest
- Aeration favors corrosion and corrosion is greatest at the milk-air junction. Acid milks are more corrosive.

1.1 Aluminium

- One of the common single metal, second best to stainless steel is used in dairy equipments.
- Aluminium is not appreciably attacked by milk. It is however strongly corroded by sodium hydroxide and by alkaline solutions.
- The pure metal is rather soft for use and usually alloys are now employed, especially those incorporating silicon.
- In cleaning aluminium plant and utensils, care must be taken to incorporate a fair proportion of sodium metasilicate in detergent.
- Souring of milk and whey also attacks aluminium and cause pitting.

- Phosphoric acid used for removing milk-stone on pasteurizing plant also attaches aluminium.
- Aluminium is non-toxic and no flavor is imparted to milk until 9 ppm is reached.
- The alloys which appear to be most suitable for use in the dairy industry are those of aluminium with silicon, manganese and magnesium.
- Now-a-days it is used in storage tanks, rail tankers, butter churns and cans.

1.2 Stainless steel (SS)

- Mostly all the modern dairies, extensively use S.S. because of its high resistance to corrosion, easy to clean, bright, good heat conductor, gives nice appearance and imparts no taints and off flavor to milk and milk products.
- The S.S. consists of 18 parts of chromium and 8 parts of nickel.
- Addition of 3% molybdenum further improves the resistance of this 18:8 to corrosive influences.

The Effects of Metals on Milk and Milk Products

- The passage into milk of any particular metal may have two undesirable consequences in addition to corrosion.
- It may impart a bitter, metallic flavor and initiate the cycle of changes leading to an oxidized taints.
- Instead, of one, if two metals enter milk to the same extent, the effect may be doubled
- Small traces of heavy metals, nickel, manganese, chromium in general and copper in particular exercise a powerful catalytic effect to develop an oxidative deteriorations.
- These metals find their way into milk through the worn coolers in which the tinned surface is no longer intact.
- Milk is thus in contact with tin and copper at the same time and copper dissolves under the influence of protein and form copper-protein complex, which become absorbed by the fat globules and in this manner, the metal is brought into contact with the fat.

- Iron, cobalt, nickel, chromium and manganese are also effective, but to a much lesser degree than copper.
- Tin and aluminum have little effect, copper is a normal constituent, being present to the extent of 0.12 ppm but if the concentration rises to 1.5 ppm, an oily taint may result.
- Cream, butter and whole milk powder are similarly sensitive to the catalytic effect of copper.
- High acidity of milk together with sugar the effect is likely to be greater.
- Fat oxidation is known to cause the losses of vitamin A and vitamin C (ascorbic acid).
- In case of whole milk powder, concentration of copper as low as 4 ppm has a strong catalytic effect on the oxidation reactions and again this is assisted by presence of moisture.

- Fishiness and tallowy flavor defects in butter due to high concentration of acid by metallic contamination.
- The possibility of metallic contamination also arises from the metal foil used for capping bottle milk.
- Aluminum foil is generally used but when lacquered zinc foil is used, lead to pass into milk to a degree which would render it unsafe for human consumption.

1. Pasteurized milk

- Milk is brought by the vendors in aluminium containers to the doorsteps of the consumers, where the required quantity is measured and given out in the customer's container.
- Plastic pouches are generally made of low-density polyethylene (LDPE film). Co-extruded LDPE-LLDPE film is also used because of its advantage of eliminating pin-hole problems. The films are of 65-70 μm thick.
- Another method is Aseptic Packaging, commonly known as the Tetra pack milk.
- In this packaging system, both the package and the product are sterilized separately and the packaging operation is carried out under aseptic (sterile) conditions.
- This system offers a long storage life of about 3 months, without the need for refrigeration or added preservatives.
- A tetrapak carton is formed from a composite material, which has 5 to 7 layers including paperboard, aluminium foil and polyethylene.

2. Flavored milk

- For flavored milk drinks the package should be leak and tamper proof, should have sufficient wet strength and should not pass on any odor or taint to the product packed inside.
- The plastic based material used for sachets is octane LLDPE (O-LLDPE).
- OLLDPE when blended with 50% LDPE provides excellent puncture resistance, excellent seal strength and hot tack.
- In India, flavored milk drinks are available in sterilisable crown cork glass bottles, glass bottles with aluminium foil lid or snap-on plastic lid, plastic sachets and aseptic packs (Tetra bricks).
- Recently 200ml, translucent bottles of HDPE with an aluminium foil cap have also been introduced.

3. Condensed and evaporated milk

- Traditionally, condensed milk was bulk packed in barrels or tinsplate containers.
- In India, sweetened condensed milk is the most popular out of all other concentrated milks and is packed in conventional food cans with double seam ends.
- Evaporated milk is recently packed in aseptic tetrapaks.

4. Butter

- Because of high moisture content, butter, unlike solid fats is susceptible to mold growth.
- Flavor and odor are easily affected by absorption from other materials or through spoilage of butter due to oxidative rancidity.
- The package should, therefore, be opaque and a high barrier against oxygen and foreign odors.
- The most commonly used butter wrap is the vegetable parchment paper of 45 gsm.
- Recently, embossed aluminium foil backed parchment paper has been introduced for UV light protection and sales appeal.
- A popular packaging style in some countries is to use plastic cups and plastic tubs with lids in different shapes and sizes.
- For such applications, PP (Polypropylene) and ABS (Acrylo-Butadiene-Styrene) are widely used.

5. Ghee

- Ghee needs to be protected from chemical spoilage and rancidity caused by oxygen, light, heat, moisture and metal ions.
- A major portion of ghee was packed in lacquered or unlacquered tinfoil containers.
- Alternate packages, which are plastic based, are now gradually replacing tins.
- Ghee is also marketed in lined cartons with flexible laminated plastics as inner liner materials and in tetrapaks.
- In both these packs long shelf-life is achieved.

6. Milk powder

- Milk powder is hygroscopic in nature and has a tendency to gain moisture from the atmosphere, which results in lumping or caking of the powder.
- In whole milk powder, presence of oxygen causes spoilage of the product due to oxidation and rancidification, therefore the packages are required to be vacuum or nitrogen flushed.
- Milk powder is bulk packed in 25 kg capacity multiwall paper sacks with plastic liner made of polyethylene.
- Alternatively, the polyethylene liner can be laminated directly to the inner wall of the paper sack.
- The flexible materials have evolved through polyethylene bags to sophisticated multi-ply laminates.
- Stand-up pouches of metalized polyester/LLDPE laminates and polyester/LLDPE laminates are used for skimmed milk powder.

7. Ice-cream

- Conventional form of packages include paperboard cartons, paper cups and in some cases even metal containers.

The various types of packages for ice-cream include:

- Paper board carton which is poly coated is poly-coated
- Thermoformed/injection moulded plastic containers made from HIPS (high impact polystyrene), PP (Polypropylene) or HDPE (high density polyethylene).

The materials used for the lids are LDPE (low density polyethylene) or PS (polystyrene).

Malted Milk Food

- Malted milk food is highly sensitive to moisture and is prone to oxidative changes in the presence of light, heat and oxygen. Aroma retention of the product and prevention of moisture and oxygen ingress, therefore, is very critical in protecting the product, and in selection of the right packaging material. The types of packages used conventionally are glass jars, tinplate containers, which are now slowly being replaced by plastic containers and flexible laminated pouches

Cheese

- Cheese needs to be protected against moisture loss and ingress of oxygen in order to maintain the desired quality characteristics. In India, the traditional package of cheese is a hermetically sealed printed tin-plate container.
- Today, the flexible packaging films and laminates generally used for packaging of cheese to provide adequate moisture and oxygen barrier properties and to retain the vacuum are:
 - Co-extruded LLDPE – TIE – Nylon – TIE – LLDPE
 - Co-extruded LLDPE – TIE – EVOH – TIE – LLDPE
 - Co-extruded film based on PVDC as the core material
 - Laminates of metalized polyester/co-extruded nylon based film

Dahi/Yogurt

- Yoghurt has a very short shelf-life at room temperature.
- The traditional pack so far was the earthenware pot with a loose cover of glassine or greaseproof paper.
- The earthenware pots are very heavy, easily breakable and because of oozing of water from its body, the product inside develops shrinkage cracks.
- Recently, injection molded polystyrene and polypropylene cups have been introduced with aluminium foil based peelable lids.

Traditional dairy products

- Traditionally, indigenous products have been packed in leaves, paper cartons or paperboard boxes.
- Consequently, the sweets soon lose their typical body and texture, absorb foreign odor and lose their aroma characteristics and show mold growth, when products are stored in open metal trays.
- Use of coated films, laminates of aluminium foil with various substrates, metalized films and combinations of various packaging materials need to be tested for suitability for these products.
- For instance, products like, gulabjamun and rasgolla need protection from light, oxygen, moisture and micro-organisms; lacquered tinfoil can is the most protective material, but this is very expensive.

Milk Capping

- Aluminium foil as a capping material introduced hygiene and high speed mechanization to milk packaging and contributed to one of the most efficient forms of re-used pack.
- The compatibility of aluminium foil with heat-seal lacquers coupled with the metal's excellent heat conductivity and stability makes it the ideal material for capping and heat-sealing of all types of plastic milk containers.
- Whether the milk is fresh, aseptically filled or sterilized in the container, the foil/coating combination can be designed to meet the demands of processing and distribution.