

The role and importance of packaging and labeling in assuring food safety, quality and regulatory compliance of export products II: Packaging & labeling considerations

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The importance of packaging for exporting products from developing countries to developed country markets

Background

Packaging and labeling are important to exporters as they both play a critical role in the process of getting products into the importing country and to the consumer. While some thought is often given to both, the label and its importance in meeting market requirements often gets the main focus and the choice and details of the packaging is often left up to the supplier. With the rapid and ongoing changes in regulatory requirements in the major export markets, a focus on labeling and related regulations and compliance with these is absolutely critical as the label is the first point of contact with the product for the regulator in the importing territory, the buyer/distributor and, of course, the consumer. This will be covered in detail for the European Union (EU), United States of America (USA) and Canadian markets later in the chapter. However,

even if all labeling and related requirements are met and the product is not properly packaged to be able to attract and meet the needs of the buyer and then the consumer, the product is not likely to be successful in the chosen market. If the packaging of the product does not fit with the system of handling and distribution of the importing entity or, if it does not meet the storage, display, handling and shelf life requirements of the target retail outlets, it will not succeed in the market. Finally, if the packaging is in breach of stipulated regulatory handling and disposal requirements or does not fulfill or meet the unmet needs of the final consumer (information, convenience, reusability, robustness, environmentally responsible, portion size and shelf life, among others), the product will not survive in the export market. Consequently, these technical and market-based considerations of the role and importance of packaging need further examination, particularly in light of the dramatic changes that are, and will continue to occur with food packaging in keeping with changes in populations, demographics, habits, trends and innovation.

The lack of attention and focus on the nature and role of packaging has often resulted in issues that limit the success of the exported product because of a variety of important considerations. In the previous chapter, a comprehensive introduction to the role and importance of packaging was presented. It discussed several issues, including the primary functions of packaging vis-à-vis the food being sold, including protection from the external environment and from damage, as a barrier from contamination and gas (oxygen, moisture) transfer, providing information, and convenience in handling and use. This chapter will discuss the secondary and equally important functions of packaging, food/packaging interactions, novel packaging and innovations, trends driving the sector and the impact of packaging on shelf life. Important considerations in the production and use of flexible packaging for export products and a more detailed examination of container closure and defects examination will also be discussed.

Special considerations for wood and flexible packaging

The discussions in Chapter 6, Packaging Basics, provided an introduction to plastic packaging, composites and wood-based packaging, as well as glass, metal and paper-based packaging. Traditional packaging focused heavily on glass, metal and paper packaging, with plastic-based packaging and wood often getting less attention. While glass, metal cans and paper packaging (including shipping cartons) are important for the food industry in developing countries, being among the major packaging options available, wood and, increasingly, flexible packaging are becoming more important as the industry seeks to move further up the value chain and enter into more sophisticated, mainstream areas of the markets in destination countries. Both of these packaging formats require further attention which is provided in this chapter with special considerations for wood-based packaging materials and flexible packaging, which comprises plastics, plastic-based laminates and films, also getting additional discussion. Also discussed below in detail because of its increasing importance in Europe, North America and globally, is the issue of biodegradability of packing, mainly of plastics and composites. Issues such as ensuring food safety in the manufacture of packaging, in general, using flexible packaging as an example

is explored. For ease of reference and the purposes of the rest of this chapter, non-rigid plastic packaging and films will be referred to as flexible packaging.

Secondary functions of packaging

The secondary functions of packaging include playing a critical role in the marketing of the product, providing appropriate portion control for buyers, traceability of the product through the coding on the packaging and providing security for the food contained within it. In this regard, the presence of tamper evident components of the package has attained a level of importance on par with the physical ability of the package to protect and secure the food. Another very important secondary function of packaging is in shelf life extension. This is particularly so as the packaging itself and any accompanying technology associated with it play a central role in shelf life determination, a topic to be discussed in more detail below.

Among the secondary functions of packaging, the ability of the package to secure the product from intentional tampering is important as there have been several prominent cases where intentional contamination of packaging occurred. Consequently, the tertiary and secondary packaging should secure the product from the factory, farm or production site, during transportation or shipping through to arrival at the point of sale where these are likely to be opened so that the product could be displayed in its primary packaging. As such, the nature, design, strength and integrity of any seals included with the secondary or tertiary packaging, including shrink-wrapping, are critical considerations for the functionality and security of the product/packaging combination that is taken to comprise the product as a whole. Of equal, if not more commercial importance is the packaging's role in the marketing of the product. Very attractive packaging such as is shown in Fig. 7.1



FIGURE 7.1 Attractive packaging play an important role in helping to market products. Source: André Gordon, 2019.

serve to attract customers to more closely examine the product, if they are not familiar with it and, oftentimes to buy and try the product to see whether it meets their needs. A range of options in convenience, shapes and portion control as is evident in the range of aseptic packaged product (Fig. 7.1B) also helps to encourage the consumer to purchase the product. With a significantly extended shelf life vs. traditionally packaged product, aseptic packaged product such as those from the Middle East shown here (Fig. 7.1B), the major proponents of which are Tetra Pak and Combibloc, have shown significant growth, particularly in Asia/Pacific, Africa and the Middle East and also in South and Central America, including the Caribbean region.

Another increasingly important role that packaging is playing is delivering the kind of portion control that consumers are looking for. This is being achieved through more flexibility and versatility being provided with multiple options for consumers in the sizes in which products that they like are available. By offering different portion sizes, the package allows consumers to purchase in accordance with their needs and circumstance: single use packaging and multiple sub-packages, as appropriate provide size control, facilitate inventory control and convenience. This helps to build demand and loyalty among consumers who want products such as those being offered in the packaging that is being sold. When combined with the informational component of the role of packaging (conveying information about the contents), as well as facilitating proper inventory management, traceability and, if required, effective recall, the secondary roles of packaging add significantly to the merchantability of the product being offered for sale.

A critical role that packaging plays in the marketing and commercial success of many products is in shelf life extension. In addition to the composition and critical factors for the specific product, which are themselves major determinants of the stability of the product, its shelf life and its ability to meet the consumers' unmet needs, packaging greatly influences the overall shelf life of the product. A low acid food such as milk has a completely different shelf life when packaged aseptically after Ultra High Temperature (UHT) processing versus being packaged in a gable top paperboard laminate box which has to be kept refrigerated. The UHT product is shelf stable at room temperature while the milk packed in the box will not last for more than a few days if left at room temperature. Similarly, meat (e.g. frankfurters) will keep for well over a year if packed under a hermetic seal in a can, as against being presented in a vacuum sealed laminate package, even when refrigerated. In developing countries where producers typically market their foods first on the domestic market before getting into exports, the choice of packaging and packaging technology will significantly influence the shelf life, and therefore the commercial opportunities for the product in the export market.

Developing country exporters have begun to utilize a much wider range of packaging options as they gain an increasingly greater share of the markets in developed countries where expectations for the presentation, utility, performance, safety and informational content of packaging may vary significantly from their home market. While it is not always the case, legislation in many developing countries as regards labeling, consumer protection and food safety, particularly the latter (Stier et al., 2002), tends to lag significantly behind their developed country counterparts, thereby oftentimes requiring a completely different approach to the packaging and labeling of products destined for export markets. This, along with the established and developing trends in metropolitan

markets, often leads to changes in the packaging technology employed for developing country products being exported to these markets and also benefit the domestic markets as firms produce for all markets using the same technology.

Trends in food packaging for exporters

Consumers in the major metropolitan markets into which developing country exports are going in greater numbers have growing expectations that the food that they consume and the packaging in which it is conveyed will reflect their changing tastes, needs and values. This has continued to drive the changes in consumer preferences, expectations and purchasing patterns, all of which favor those producers who understand and cater for the needs of these consumers. As has been emerging over the last 5 years or so, consumers in Japan, the United Kingdom, Mainland Europe, Australia, New Zealand, Canada and, more latterly, the USA have continued on a path where choices have been driven by the following factors:

- The environment
- Logistics
- Product protection
- Health
- Utility/Usability
- Economy

among others. This has resulted in their expectations of their food and its packaging being colored by specific considerations. In terms of *the environment*, more and more developed country consumers are expecting that their packaging will be made with a minimal use of resources from the environment, that they will be easy to empty and use and that they will be easy to dispose of in a manner that is respectful of the environment when they are finished with them. They expect their packaging to be *utilitarian* and therefore easy to open, hold and close with easy to understand and complete information about the product contained in it. *Logistically*, they expect that the packaging will be easy to handle, transport and store, it will be *economical* in terms of cost, will provide adequate protection from contamination and will preserve the healthy nature of the food it contains. Consequently, this means that food and beverage manufacturers and producers trading in the global market, will have to ensure that the food products that they are offering for sale and the packaging in which it is contained are:

- effective in delivering the taste, freshness and nutrition expected by the consumer
- aligned with their expectations for “clean” ingredients delivering more healthful food
- packaged responsibly, with minimal waste and
- delivered in a manner that shares their values.

Among the key drivers for the growing trend in food packaging options is the “Evolving Consumer”. Today’s consumers are liberated, confident and assertive in seeking the value propositions they want and are also self-expressive. With the change in attitude

TABLE 7.1 Changes in packaging preferences by consumers over the last 30 yrs^a.

Product	Conventional	Current
Milk	Glass, metal	Film, Pouches
Beverage	Glass	PET
Pharmaceuticals	Paper & glass	PVC, HDPE, PP, Glass
Toothpaste Tubes	Metal	HDPE, LLDPE
Soaps	Paper	Polyester Film, PVC
Fertilizer	Jute	PP woven sacs
Retail Carrier Bas	Paper, jute bags	LDPE, HM HDPE

^aDefinitions: PET – polyethylene terephthalate; PVC – polyvinylidene chloride; LLDPE – Linear low-density polyethylene; LDPE – low density polyethylene; HDPE high density polyethylene; HM HDPE – high molecular weight high density polyethylene; PP – polypropylene.

and increase in the number of working women, there has been a shift in the trends for the packaging of food in the last three decades. This is summarized below.

It is clear from Table 7.1 that the trend for packaging materials has changed from rigid to flexible and from heavy to light and elegant. From the manufacturers' and producers' perspective, satisfying these needs requires greater flexibility of equipment and the ability to scale rapidly if the growth in number of stock keeping units (SKUs) and in each SKU explodes as a result of increased demand. They will also need to have a greater understanding of their products, their processes, the regulatory requirements of the market and the trends driving them. These are among the major changes over the last few years as reflected in the findings of industry specific and other research which has shown both a growing and coalescing of trends across several markets. This can drive significantly greater value to food industry practitioners if they understand them and satisfy the needs of consumers. These and other emerging trends are discussed below.

Making a statement

Consumers in Europe have long used their purchasing power to strongly support causes to which they were partial such as fair trading practices, sustainable fishing and farming practices and waste reduction, among others. North American consumers have now begun more and more to buy products that say what they believe in and stand for. More than 70% of Americans are now more loyal to purpose-driven brands and are willing to defend them (Scroggins, 2019). For an increasing number of consumers, it is no longer acceptable for companies to simply make money with just under 80% expecting firms to positively impact society as well. Further, more than 60% of American consumers today would change brands better aligned to their issues and more than 55% are willing to pay more for products made by these companies (Scroggins, 2019). Globally, therefore for the foreseeable future, the opportunity exists for products from developing countries, properly marketed and packaged,

to reach consumers willing to pay better prices for them if the story of their production and the value chain involved aligns with the beliefs and values of the consumers.

Sustainability

Consumers are pushing hard for their governments, retailers and the food industry in general to take urgent and sustained steps to employ sustainable production practices that minimize or eliminate negative impacts on the environment. The North American industry is beginning to follow Europe's lead with the retail trade taking greater responsibility for the management of recycling of packaging and products as well as insisting on smaller package sizes ([Evergreen Packaging, 2018; Scroggins, 2019](#)). Governments will also move more and more to impose punitive taxation on packaging that is not easily re-usable or recyclable.

Telling a story/sharing values

Consumers are now making choices based on the corporate social responsibility of producers or the perceived environmental impact of the production, handling and distribution process for the products being bought. European consumers led the trend of modifying purchasing decisions to favor firms and products that could demonstrate environmental responsibility through a limited carbon footprint and the employment of sustainable production practices. [Wiley \(2018\)](#) reported that 67% of grocery shoppers surveyed agreed that retailers should choose products to be stocked based on the environmental friendliness of both the product and its packaging. Further, more than 50% of consumers avoid purchasing products of producers that were not socially responsible or who did not have environmentally responsible practices ([Evergreen Packaging, 2018; Wiley, 2018](#)). By these means, consumers in the foreseeable future in North America and Europe will live their stories through their purchases and seek to align with firms and products that share their values.

Convenience

A major driver now and in the foreseeable future for consumers in more developed markets is convenience. This includes portability, being able to have food on the go, have smaller and more convenient portion sizes, and be able to transport, store and handle food in a manner compatible with their lifestyle. These properties of the food are mediated mainly by the packaging and delivering these features should therefore be a major focus of the industry value chain.

Healthier packaging & cleaner labels

As consumers focus more on eating healthier, more natural foods, they are demanding packaging that is better aligned with the ingredients of the product which it contains ([Evergreen Packaging, 2018; Wiley, 2018](#)). Consumers who want healthier ingredients also want healthier packaging. A survey found that 71% of grocery shoppers agree that

healthier foods and beverages should use healthier packaging materials ([Evergreen Packaging, 2018](#)), including 61% of who want to see greater use of recyclable packaging. Further, 65% expect organic products and healthy beverage brands to offer more and better alternatives to non-biodegradable plastic packaging ([Wiley, 2018](#)).

The rise of private labels

One of the trends that has emerged is a rise in opportunities for the manufacturing of a range of food products for principals under their own private labels ([LaCroix, 2017; Scroggins, 2019](#)). Distributors such as Carrefour (France), Albert Heijn (The Netherlands), ASDA, Sainsbury, Tesco and Marks and Spencer (the United Kingdom), Loblaws (Canada) and Walmart, Publix, Whole Foods and Trader Joe's (the United States of America) all significantly expanded the shelf facing taken by their own house and other private brands. Contract packing opportunities currently abound if the producer can meet the Food Safety and Quality Systems (FSQS) requirements stipulated by the principals for whom the contract packaging is to be done. This is a major opportunity for the agribusiness sector in developing countries.

Vintage packaging

Investigators have seen an increasing trend towards consumer preference of packaging that has a vintage look and feel, inclusive of graphic elements reminiscent of the past but with a modern twist. This trend is particularly important for artisanal products or products that have a homemade quality and appeal. Products packaged such as this convey a sense of authenticity (another trend for food) and exclusivity, all of which consumers are willing to pay higher prices for. All of this augurs well for authentic, traditional flavorful products from developing countries that are packaged in a manner that meets these articulated needs of these discerning consumers.

Responsible packaging

The nature and amount of packaging that are part of products being offered for sale has become one of the driving factors in consumer purchasing decisions in North America, this is finally beginning to catch up with a long existing trend in the EU. Consumers indicate that they are now both choosing what they buy and changing buying decisions based on the type and amount of packaging involved with the product ([Wiley 2018](#)). Consumers are paying attention to the quantity and recyclability of the packaging used, whether it uses renewable material, inclusive of plant-based material such as bio-based, biodegradable packaging ([Evergreen Packaging, 2018](#)), the demand for which is an accelerating trend.

Incorporation of technology into packaging

In an effort to meet the requirements for traceability, better management of product handling, documentation of product history, easier provision of information to the



FIGURE 7.2 Transparent and see-through packaging on display at IFT 2019. Source: Innova Market Insights.

consumer and increasing regulatory requirements for labeling, producers have been making increased use of technology incorporated into packaging (LaCroix, 2017). This includes radio frequency identification (RFID), printed quick response (QR) codes that take the consumer to a video/website providing information about the product, company, country, its cause, etc. and time/temperature (TT) sensors, among others. Some of these are discussed further under the section on innovations in packaging (later on in this chapter).

Transparent packaging

Consumers want to see what they are buying or at least get a sneak peak of the product. This is driving a trend towards transparent packaging. This is evident in an increasing range of products, building on a trend which counts Sonoco's TruVue among its pioneers. This trend continues to grow and the range of packaging options satisfying it also continues to expand (Fig. 7.2).

Stricter labeling regulations

As consumers demand to know more about the foods they are eating and governments increase the requirements for declarations and disclosures for foods products globally, stricter laws governing labeling are being enacted. All major markets have had upgrades to their labeling regulations within the last three (3) years, with the attendant implications for the food industry. One consequence of this is that exporters now need to develop separate labels for Canada, the UK/EU and the US as a single label can no longer suffice for more than one market. This will be discussed further in the section on labeling below.

Hollowing of the middle class

A major emerging trend globally, and one which is accelerating more rapidly in the United States of America is the decline of the middle class (LaCroix, 2017). This transition in the socio-economic structure of consumers is creating a scenario in which packaging will need to be differentiated such that one variant of the product being offered is affordable (for the working class), while the other is packaged to be sold to the super affluent.

Container closure evaluation

As indicated in Chapter 6, container closure evaluation is an area that is critical, particularly for producers in developing countries seeking to export products packaged in glass, metal or composite containers and selected flexible packaging who must comply with the same requirements as domestic producers. There are several developing countries in which local regulations do not require any assessment of packaging containers and in which there is no training available or skilled personnel to undertake the assessments. It is therefore important that producers from these countries are able to understand what the regulations are, where to find the requisite information and how to undertake the evaluations required by the importing country food laws and regulations. The United States FDA regulations (Food and Drug Administration, 1998) and the Canadian Food Inspection Agency (CFIA) under the Safe Food for Canadians Regulations (SFCR) (Canadian Food Inspection Agency CFIA, 2019a,b,c) require the development of a scheduled process for thermally processed food as well as the accompanying container closure evaluations required to verify that commercial sterility is continuously being attained by said process. Consequently, provided below are more details in a summarized form of how selected container closure evaluation and examination of defects which comply with the requirements can be done. For more details, the Grocery Manufacturers Association's Science Education Foundations' (GMA-SEF) Better Process Control School (BPCS)¹ manual (Black and Barach, 2015) is an excellent reference. Likewise, the FDAs website (Food and Drug Administration, 1998) and CFIA's SFCR webpages (Canadian Food Inspection Agency CFIA, 2019c) also provide excellent guidance, further information and clarifications on this.

Can seam evaluation for metal and semi-rigid containers

The approach to the overall evaluation is described in a point-wise manner in the sections below.

Preliminary examination

- Remove labels and before removing any product sample, perform complete external can examination, observing such defects as evidence of leakage, pinholes or rusting, dents, buckling, and general exterior conditions.

¹ Dr. André Gordon has been a lecturer on this program for over 22 years.

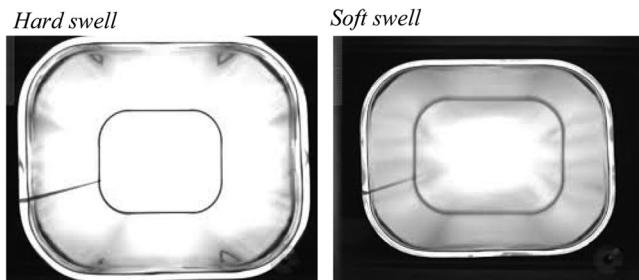


FIGURE 7.3 Hard and soft swells in metal cans. Source: GMA Science and Education Foundation.

- Classify each can as (a) flat, (b) flipper, (c) springer, (d) soft swell, or (e) hard swell (Fig. 7.3) according to established criteria.
- Use your hand as well as eye to evaluate the cans that present with either a hard or soft swell or which appear to be normal from a lot in which hard or soft swells have been recovered. A magnifying glass with proper illumination is helpful.
- Run your thumb and forefinger around seam on inside and outside of seam to locate any roughness, unevenness, or sharpness. Examine by sight and touch for the defects listed below that may result in leakage of the can through a faulty seam.

Visual examination

As a part of the container evaluation process, visual assessments are to be made during which the absence or presence of the features listed below should be noted and recorded. The definitions of these defects are also provided below.

- sharp seam
- cutovers or cut-throughs
- false seam (although some false seams may not be detected by external examination)
- dents
- deadheads (incomplete seam)
- excessive droop
- jump over
- excessive scuffing in chuck wall area
- knocked-down flange
- cable cuts on double seam
- excess solder

The can is then opened as per the procedure (see [Canadian Food Inspection Agency CFIA, 2019c](#)), the contents of the cans should then be emptied, following which the cans should be washed and dried, and tested can for leakage. The end is then removed, beginning at cutout strip closest to side seam, moving clockwise until entire cover hook is removed. If rocker-like motion does not work, pull out and away. Take care to prevent any injury or cut. Partially remove coded end with bacteriological can opener. The tools required to do a tear down evaluation were shown in Chapter 6 and are available on the CFIA or FDA websites ([Canadian Food Inspection Agency CFIA, 2019c](#); [Food and Drug Administration, 1998](#)).

TABLE 7.2 Measurement required on metal cans during can seam evaluation.

Required	Optional
Cover Hook (CH)	Overlap (by calculation)
Body Hook (BH)	Countersink
Width (length, height)	
Tightness (observation for wrinkle)	
Thickness	

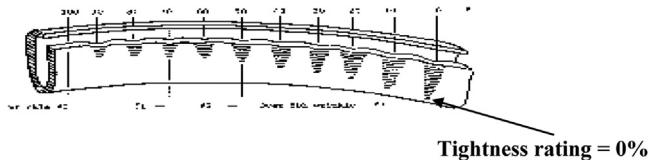


FIGURE 7.4 Tightness rating assessment for can double seams. Source: GMA Science and Education Foundation.

The measurements to be taken during can seam teardown and evaluation are outlined in Table 7.2.

The tightness rating is a measure of the extent of pressure delivered during the double seam formation and is an index of the safety of the seam. It is measured by estimating the extent of wrinkling on the cover hook as indicated by the length of the wrinkles present. A tightness rating close to 0 indicates a well-formed double seam (Fig. 7.4). For a definition of tightness rating see below. For a fuller treatment and description of this and other measurements see Black and Barach (2015) or Food and Drug Administration (1998).

Can seam defects (definitions)

Definitions of selected defects include:

- Cutover – A cutover is a sharp seam that has fractured and is considered a serious seam defect. A sharp seam is considered a minor seam defect. Cutovers are best detected by running a finger around the inside of the seam.
- Droop – a smooth projection of the end hook of the double seam below the bottom of the normal seam.
- False Seam – A false seam is considered a serious seam defect due to the absence of overlap. A defect where a portion of the body flange is bent back against the body, without being engaged with the end hook, but does not protrude below the bottom of the end hook radius.
- Insufficient overlap – Any portion of the double seam having an optical overlap of less than 25% of the internal seam length is considered to contain a serious double seam defect.
- A knocked-down curl is considered a serious double seam defect due to the absence of overlap.

Can seam defects (visual examination and testing)

The suitability of the particular food to be preserved also affects the performance of the container. Some of the instances in which can defects are observed include:

- Hydrogen swells and sulfide stains caused by chemical corrosion sometimes occur.
- In addition, prolonged storage of cans at elevated temperatures promotes corrosion and may result in perforation.
- Improper retorting operations, such as rapid pressure changes, may cause can deformation and damage seam integrity.
- Post-process contamination by non-chlorinated cooling water or excessive buildup of bacteria in can-handling equipment may also cause spoilage, and abusive handling of containers may result in leaker spoilage.
- Container examinations associated with food spoilage are usually accompanied by pH determination of the product, gas analysis of can headspace, and microbiological testing of the product.
- Spoilage within the can may be caused by leakage, under-processing, or elevated storage temperatures.
- Leaker spoilage occurs mainly from seam defects and mechanical damage.
- Improper pressure control during retorting and cooling operations may stress the seam, resulting in poor seam integrity and, possibly, subsequent leaker spoilage.

Figs. 7.5–7.7 show some of the more common can seam defects that may occur occasionally.

Packaging considerations for food safety and quality

Food/packaging interactions

The quality of a packaged food is directly related to the characteristics of the food and packaging material. When manufacturers are selecting the types of packaging suitable for the food product, it is important to consider the characteristics of the product and the possible



FIGURE 7.5 False seam or knocked down flange. Source: GMA Science and Education Foundation.



FIGURE 7.6 Buckling of a metal can.
Source: GMA Science and Education Foundation.



FIGURE 7.7 Paneling of a metal can.
Source: GMA Science and Education Foundation.

interactions that may occur in the packaging. The quality of a packaged food is directly related to the characteristics of the food and packaging material and any interactions that may take place. Some of the possible food-package interactions include *adsorption*, *absorption*, *migration* and *permeation of volatile compounds*. Each of these can play a role in the translocation of material associated with the packaging into the food which it contains.

In terms of transfer of components from one area of a flexible, printed package to another each of the above processes can play a role. *Adsorption* is the process by which components of one phase are extracted and concentrated at the surface of another phase of

TABLE 7.3 Types of migration across packaging films.

Types of migration		
Diffusion migration	Set off migration	Migration due to heating
Migration of substances through the walls of the packaging into the food <i>E.g. Soapy flavors into a drink in a PET bottle through the walls of the bottle.</i>	Migration from the printed to the unprinted side of a flexible package laminate due to both sides coming into contact with each other. <i>E.g. where packaging film is stacked one on top of the other during storage.</i>	Migration of gaseous substances or vapors into the food during heating. <i>E.g. vapors entering a flexibly packaged product during microwaving when the pores of the package open up.</i>

the packaging material. This may happen where a package is immersed in a liquid or a gaseous environment and a component of the liquid or gas adsorbs and concentrates on the exterior of the packaging film. *Absorption*, on the other hand is where the soluble component goes across the surface and enters into the other phase. An example of this would be the passage of a gas from the external environment into a package through the film surrounding the package or the loss of carbon dioxide (CO_2) from a carbonated beverage as it escapes from the PET bottle to the atmosphere over time. While absorption directly results in phase transfer and entry of the component into the package, entry of the adsorbed component requires the additional processes of either migration or permeation for entry of the component into the product. **Table 7.3** shows the three mechanisms by which migration can occur.

As indicated in **Table 7.3**, because many packaging materials are permeable to varying degrees, small molecules like gases, water vapor, organic vapors and other compounds may pass through the packaging and mix with and into the contents. Alternatively, this may only happen momentarily during a particular phase of the process (e.g. heat sealing, microwaving, pressure processing), but may be enough to ensure that a component become a part of the food being consumed that was not expected to be present. For this reason, it is critically important that producers understand the components that comprise the packaging being used, as well as the label applied and any inks or other material used to complete the design, comply with labeling requirements or simply color the packaging. While this is a consideration for all packaging, for glass and metal containers which are more inert and have low permeability, it is less of a concern. For paper and paperboard packaging, wood and composites, it is more so, while for flexible (plastic) packaging, including semi-rigid containers, it is often a major concern. It is in this context that there is now a focus on food safety of primary, secondary and tertiary packaging, including the handling, storage and transportation practices.

Important considerations for flexible packaging for exports

As has been seen, the demand for flexible packaging is increasing significantly as it gives the producers and marketers of foods a wide range of options in the marketplace. Flexible

packaging, however, also has an impact on the safety of the foods being displayed and sold and this has come under greater scrutiny as food safety systems have been extended to include packaging suppliers who must now meet the same requirements as suppliers of other inputs. For flexible packaging, issues such as the composition of the films, resins and processing aids used, food/packaging interaction and food safety of package components are considered. Other important considerations are the handling of primary food contact film during production and post-production handling. This should be done so as to protect the primary food contact surface from contamination with potential pathogen and/or harmful chemicals. Critical considerations include the environment in which the packaging is made (Fig. 7.8) and how it is handled and stored, post production (Fig. 7.9).

The composition of the ink or dyes used to print the labels or information directly on the non-food contact surface of the packaging film is also important. While there are many printing options available to the manufacturers of the various different kinds of flexible packaging, in all instances they will need to have a function in which the design to be printed on the package is typeset and the specific colors to be used are prepared, stored and dispatched to the production line as required. The nature of the inks used, their management, storage, handling and traceability should there be a problem are an important, if subsidiary aspect of the production of film or laminate to be used as an important part of a final package (Fig. 7.10). Important characteristics of other components of the laminated films that comprise many flexible packaging solutions include the nature of the resin/plastic used, the overall barrier properties of the film, including oxygen transmission rates (OTR) and permeability to moisture (moisture transition rates (MTR)). For the ink, the questions that arise include: What is its composition? Is it food safe? Does it transit the film and enter the product being packaged (i.e. film/product interactions) through the film by any of the means discussed previously?



FIGURE 7.8 Production area for packaging film in a packaging plant. Source: A. Gordon (2019).



FIGURE 7.9 Storage of packaging film post production in a packaging plant. Source: A. Gordon (2019).



FIGURE 7.10 Handling of inks, dyes and colors used for printing in a packaging plant. Source: A. Gordon (2019).

These are among the considerations that producers in developing countries need to be cognizant of as they continue to upgrade their technology in keeping with the trends required by their export market. Whether the flexible packaging being used is basic, relatively simple single or multilayer films or more complex composite materials to be used

for more robust processing (including thermal processing), the same issues arise as regards food safety, traceability and ensuring high quality packaging inputs to a high quality, safe food product that meets all of the requirements in its target markets.

Wood packaging: considerations

Wood is used as packaging material for foods in a variety of ways. As was noted in Chapter 6, wood can be used for primary packaging, but this is typically limited to a select group of products. When used as a primary packaging material, the wood is typically heated or otherwise treated to eliminate any risk of direct contamination with pests, chemicals or undesirable microorganisms. As such, the items that wood is used to package are often those that benefit directly from the properties of the wood itself, such as the tannins or other organics that impart flavor and/or color to beverages stored or aged in them such as rums (Fig. 7.11), wines, whiskey and selected other alcoholic, natural and specialty beverages. In these instances, the treatment used for the wood would typically be heat treatment (International Plant Protection Convention IPPC, 2016), as the use of chemical treatment would likely compromise the safety and organoleptic profile of the products being held, conveyed, stored or aged in the wooden containers. It may also be interesting to note that among other products that are held and aged in wooden barrels are pepper sauces, such as A. Smith Bowman Distillery's hot sauce and Jamaica's Pickapeppa Sauce, as well as teas, vinegar, mustard, maple syrup, vanilla and pickles (Covington, 2014). These are, however, not sold in the wooden barrels, as are some bulk wines, whiskeys and rum, among other spirits.



FIGURE 7.11 Wooden drums used for aging and displaying Guyana's award-winning El Dorado Rum.
Source: A. Gordon (2019).

Regulation of the export of wooden packaging materials

Developing countries exporting a range of food products into Europe, North America, Japan, the Middle East, China and the more developed countries of the Pacific Rim, need to be aware that the use of wooden packaging material in the form of boxes and related packaging, as well as pallets is prohibited unless these products meet new regulatory requirements formally adopted in 2013. These products are governed by the International Plant Protection Convention (IPPC) of the United Nations Food and Agriculture Organization (FAO) which adopted new regulations for the use of wood in international trade, International Standard for Phytosanitary Measures (ISPM) 15. This was adopted in 2013, having been implemented in most countries by the mid-2000s. The standard requires that all wood-based products must be demonstrably free of targeted pests to be approved for use in international trade.

The most common use of wood in packaging is for the making and repair of wooden pallets or crates that may be used to convey foods items. Pallets are widely used throughout the developing world because of their cost (relatively inexpensive), the ability to produce them locally and, where necessary, repair and reuse them, thereby also saving on costs. In some instances, wood is used as a container for products such as where some produce, fruits and vegetables may be packed and shipped in wooden crates which are more sturdy and protect them against damage. These crates, however, are typically made of manufactured wood such as plywood, particle board, oriented strand board or thin wood that would have been created by a process involving heat, or pressure or a combination of both and therefore are typically fully compliant. The pallets, on the other hand would not be compliant with ISPM 15 unless they are treated in accordance with its requirements. The phytosanitary treatment methods approved and described in the standards are heat treatment or the application of methyl bromide (MB) as per the guidelines, manufacturing for selected wood products and marking as per the standard. Of the treatments allowed, MB treatment is the least preferred as its use is being phased out. The heat treatments allowed involve the use of a conventional steam or dry kiln heat chamber or dielectric heating. All three treatments have their own designation (mark) that must be imprinted on each piece of wood that is treated. These are HT for conventional or dry kiln heating, DH for dielectric heating and MB for methyl bromide treatment ([Health Canada, 2016](#)).

Each type of heat treatment must meet specific requirements with conventional heat chamber technology (HT) requiring the attainment of 56 °C in the core of the wood for at least 30 minutes while dielectric heating requires 60 °C for one (1) continuous minute, the temperature to be reached within 30 minutes of commencement. Wood that is not treated in either of these ways or treated with MB, cannot be marked as fit for use in international trade and could face rejection at port of entry in major export markets. In countries where wooden packaging may be re-used, repaired and/or re-manufactured, re-use of previously treated and marked wood is allowed as long as it has not been repaired or remanufactured. In these cases, the wood may/will need to be retreated and re-marked, the mark as always only being applied after treatment is complete to prevent accidental by-pass of treatment and thus reduce/limit the risk of untreated wood getting into international commerce.

Other wooden packaging materials are exempt because they have been shown to be at low risk for contamination with the pests that are being targeted. These include wood

packaging material made entirely from thin wood (6 mm or less in thickness), wood packaging made wholly of processed wood material (e.g. plywood, particle board or oriented strand board) that has been made using glue, heat, pressure, or a combination of heat and pressure. Other exempt wood products are barrels for wine and spirit that have been heated during manufacture and gift boxes for wine or other food products that are made from wood that has been processed and/or manufactured in such a way that it is rendered free of pests. In meeting the demands of their customers for innovative or natural packaging, developing country food producers and exporters must be cognizant of ISPM 15.

Impact of packaging on shelf life

Extending shelf life

Packaging plays an important role in determining the shelf life of the products they contain. Traditional packaging such as glass bottles and cans were, and remain, widely used because they are able to not only maintain a hermetic seal, thereby excluding micro-organisms and extending the shelf life of products, they also exclude gases and, in the case of cans, exclude light. Light and the presence or absence of moisture and selected gases impact the quality and therefore the shelf life of a wide range of products, including fruits and vegetables, beverages, dairy products, meats, snacks, among others. Other types of packaging, such as paper in the form of paperboard packaging (Fig. 7.12) and corrugated cardboard, wood and some flexible packaging including metallized pouches and



FIGURE 7.12 Examples of paperboard packaging presented by Innova market insights. Source: Innova Market Insights.

other composite packaging which has a component with specific barrier properties, such as laminates with an opacity agent (paper, titanium dioxide, others), also help to extend shelf life. Consequently, all aspects of the production and delivery of foods from manufacturing, through storing, handling, transporting and displaying for retail need to be considered in the selection of packaging for optimal shelf life.

The need for greater convenience has fueled a growing demand for flexible packaging, particularly plastics with high barrier properties for various applications in the food industry. These plastics are used to protect the contents of the packaging against deterioration caused by contamination by microorganisms or occasioned by the entry of air (more specifically oxygen) or water vapor into the product, or loss of the gases used to create an inert environment (i.e. by gas flushing) through the packaging. Flexible packages are also required to protect the product against the loss of specific characteristics of its ingredients (e.g. flavors, color), while protecting its integrity. In addition to the demand for high-barrier films, there is also an increasing demand for biodegradable packaging, aspects of the biodegradability of packaging being discussed later on in this chapter. This is driving demand for alternative materials, including "green" polymers. These varied needs have seen the food industry experiencing an increase in the availability of flexible film-based packaging that offers a rapidly expanding array of properties, providing greater choice for the consumer and enhancing the options available to the producer in meeting their needs. Producers in developing countries need to be cognizant of these options when developing products for these markets or seeking to enhance the market opportunities for existing products.

All foods lose quality and other attributes over their shelf life during distribution by virtue of microbiological growth, enzymatic activity, physical damage and biochemical reactions. Some of this loss is due to product interaction with oxygen in the air and also oxygen dissolved and/or entrained in the product. Microbiological deterioration is best prevented by product formulation and processing but is often heavily influenced by storage, handling and, critically, the type and expected role of the packaging material used. Effective vacuum packaging, for example, reduces oxygen and eliminates or significantly reduces the growth of microorganisms that need oxygen to grow. Physical damage can only be averted or reduced by proper handling and the use of effective primary, secondary and tertiary packaging options. Enzymatic activity and biochemical reactions can be minimized by product design, formulation and processing. It can also be controlled by the exclusion of oxygen, reducing its availability to facilitate unwanted changes such as the enzymatic browning of products, among others.

Controlling moisture

Moisture (water vapor) migration into or out of the packaged product can also have a deleterious impact on shelf life. This is because of the following effects of the migration:

- a. Migration in: increased oxidation, other biochemical reactions, browning, wetness, agglomeration of product (hardening, "staleness"), etc.
- b. Migration out: hardening, staleness, loss of texture, flavor modification, etc.

Ensuring that the packaging chosen has the required barrier properties to moisture (expressed as its moisture transmission rate – MTR) is therefore important in assuring optimal shelf life for susceptible products. A thorough discussion of the role of moisture in the deterioration of foods can be found in [Labuza \(1982\)](#).

Controlling oxygen

Oxygen in the package headspace, oxygen entrained or dissolved in the food, and that which migrates from package exterior to the inside through the package as described above ([Table 7.3](#)) are the principal sources of oxygen in packaged foods. As with unwanted water vapor, oxygen can have negative consequences on the shelf life of products. Because of this, several methods have been developed to reduce oxygen in foods, including the use of oxygen scavengers, vacuum packaging, the use of high oxygen-barrier packaging and flushing with inert gasses (such as nitrogen), among others. Current processing and packaging technologies are capable of decreasing oxygen concentration in products to as low as 0.01%, significantly enhancing shelf life in susceptible products. Packaging that offer an effective oxygen barrier reduces:

- fat oxidation – this is accomplished by controlling or reducing environmental oxygen which causes deterioration (including rancidity) of lipids;
- nutrient loss – oxidative reactions cause nutrient loss in some foods (e.g. loss of vitamin E);
- color loss/changes – oxidation causes the loss of color or *browning* reactions in fruits, some vegetables, some juices and seafood.

Effective control of the presence and availability of oxygen in packaged foods will enhance the shelf life of products and should be among the options considered when seeking to market products in more competitive markets.

In summary, producers seeking to attain optimal shelf life performance from their products must consider the various modes by which product deterioration can occur and, in addition to the application of effective processing technology, seek to use available packaging technology to extend shelf life. These technologies include those which exclude or prevent the entry into products of water vapor and oxygen, allow for the creation of an environment in the package or container post-processing which is supportive of extended shelf life or which facilitate the application of processing technology that produce extended shelf life products. Whatever the means by which these desirable objectives are achieved, food industry participants should be cognizant and make full use of packaging technology to help drive value for their products through extended shelf life.

Packaging innovations driving changes in food safety, marketing and distribution

As consumers become more demanding, producers and retailers have had to respond to the demands and developing trends by developing or employing packaging innovations

that can help them to meet the needs as articulated. This has resulted in a number of innovations as food industry participants seek to satisfy, and also to capitalize on, consumer demands and the changing tastes and needs of different segments of the market. In addition to the trends already mentioned, the packaging industry has responded to other existing and developing consumer needs. These have included greater *environmental awareness* among consumers (as previously mentioned) which has driven the trend towards the use of *alternative materials*, including biodegradable packaging, and other materials with much lower carbon footprints, including those that *result in a reduction in packaging volume/weight*. Recycleable and renewable (reusable) packaging such as those being used by Elopak®, a liquid food package producer, and Sabic®, a manufacturer, who collaborated on the development of a “virtually 100% renewable” polyethylene carton are also in vogue (Elopak and Sabic, 2019), particularly in European countries where reduction in packaging waste is a major trend and also a part of EU regulations (The European Parliament and the Council of the European Union, 2018).

Packaging manufacturers are also responding to the ongoing demand for greater *food safety* as well as increasing demand for Ready-to-Cook (RTC) and Ready-to-Eat (RTE) meals. Meals-on-the-go, home meal delivery, smaller portion sizes, products that are easy to open and re-seal when used are among the industry's response to the need to deliver more convenient food choices, all while ensuing greater safety of the foods with various tamper-evident closures. These include innovations such as Ziploc® bags for storing foods, a range of flexible packaging based on re-sealable slide or press-to-close zipper closure technology, and resealable spouts on flexible packaging pouches (Fig. 7.13). Other more convenient food options are made possible by innovations in packaging technologies that have produced packaging with easy peel and easy open closures, resealable packaging, and a range of other



FIGURE 7.13 Resealable spouts on flexible Pouches. Source: A. Gordon (2018).

TABLE 7.4 Types of active and intelligent packaging.

Active	Intelligent
Oxygen scavenging	Time-temperature history
Ethylene scavenging	Light protection (photochromic)
Odor and flavor absorbing/releasing	Leakage, microbial spoilage indicating
Moisture absorbing	Physical shock indicators
Anti-microbial	Microbial growth indicators
Heating/cooling	Hot/cold indicators

technological responses to meet consumer needs. Other major technological advances in the RTE category are the development of *alufoil* for use in microwaveable, foil packed meals and technology-intensive active and intelligent (or smart) packaging.

Active and intelligent packaging

Active packaging is packaging that plays other roles and functions beyond the basic passive containment and protection of the product. Intelligent (smart) packaging is that which has been designed to sense or measure one or more attributes of the product, the internal environment of the package or the external environment. Active and intelligent packaging are innovations that help to extend the shelf life of the packaged product. Active packaging actively eliminates one or more of the conditions that cause spoilage or loss of quality. Basic examples of these would be packaging that includes a desiccant to absorb excess moisture and keep the food dry or those using oxygen scavengers. In both cases, the shelf life of the product would be extended. On the other hand, intelligent packaging monitors and indicates specific internal conditions which affect the product. An example of this would be the use of thermochromic ink as part of Time Temperature Indicator (TTI) technology that can be used to reveal the condition of the food since preparation. The latter depends on the reversible or irreversible (depending on the nature of product and the product handling system along the value chain) change in color of special ink depending on its exposure to predetermined temperatures or specific time/temperature combinations. In the case of irreversible thermochromic ink, once the set temperature or time/temperature combination has been reached, the color of the package (or a part thereof) will change to indicate the temperature history of the product. Examples of active and intelligent packaging are shown in [Table 7.4](#), with typical characteristics outlined below.

Active packaging

This consists of a matrix polymer, such as polyethylene terephthalate (PET), an oxygen scavenging/absorbing component and a catalyst. There are also active food packaging systems that use oxygen scavenging and anti-microbial technologies. These provide significant extensions to shelf life, improved quality throughout the distribution chain and greater convenience to the consumer.

Intelligent packaging

Intelligent packaging has functionality which switches on and off in response to changing external/internal conditions and can include a communication to the customer or end user as to the status of the product. A simple definition of intelligent packaging is 'packaging that senses and informs' (Day, 2008).

Edible packaging

With the potential to reduce or replace conventional packaging, much interesting research is being done on the development and use of edible packaging (Wang and Kerry, 2018). Edible packaging is intended to be eaten as a part of the product and as such is inherently biodegradable (Janjarasskul and Krochta, 2010). Edible packaging generally takes the form of films, sheets, coatings or pouches, with the major forms being coatings and films, the latter having an average thickness of less than 254 µm (Cerdeira et al., 2016a,b) and the sheets having thickness greater than 254 µm. The films and sheets are usually applied to the food product or components while coatings on the other hand are thin layers of edible materials formed directly on the surface of the food products (Janjarasskul and Krochta, 2010). Among the factors that determine the applicability of edible packaging are gas migration through the packaging, relative humidity, pH and the mechanical property of the packaging as well as other factors such their relative strength and durability during handling when compared to conventional packaging. While edible packaging has many potential applications and is likely to experience continued growth in its use, the opportunities which exist will be tempered by the challenges which arise, particularly with handling, shelf life, gas permeability and other considerations. More details on edible packaging is available in Cerdeira et al. (2016a).

Sustainable (biodegradable) packaging

A major driver of innovation in the packaging industry is the imperative for the food industry to significantly reduce the use of one-way, non-recyclable, non-reusable packaging. Efforts to develop biodegradable packaging were prompted by several factors, including the accumulation of plastic in the environment, the regulatory changes mentioned, evidence of the release of hazardous gases during incineration and greater consumer activism. More than ten (10) countries in Africa, France, India and Mongolia are among the countries banning the use of single-use plastic bags (McCarthy, 2018). Columbia, Jamaica and St. Vincent and the Grenadines in the Americas, and Papua New Guinea in Asia-Pacific have also instituted a ban, with others set to follow. Several states in the United States, EU member states and others have legislated the reduction, reuse or recycling of all packaging or have imposed taxes on packaging. These trends have made the environmental conservation and hence the biodegradability of packaging a major driver of changes in the packaging industry. It is therefore evident that as "great importance is given to products from renewable sources, for their positive impact on nature" (Ivanković et al, 2017), this drive for packaging biodegradability will continue for the foreseeable future.

There are different forms of bio-packaging adapted to the varying requirements for the packaging and storage of different types of products. They can exist as biodegradable gels,

bags, films, fruit/vegetable trays and boxes with lids (Ivanković et al., 2017), among others. Many are composed of biopolymers which may be made of 100% biodegradable materials (biomaterials) or combinations of biomaterials and synthetic materials. The increasing importance of biodegradable packaging, the range, nature and speed with which research and development in this area is proceeding, as well as the differing and sometimes involved nature of the regulatory requirements demand further attention of producers, exporters and food industry practitioners. Further discussion on biodegradable packaging is therefore presented below, with extensive treatment on the subject covered in Ramos et al. (2018).

Personalization and digital printing

Another new and interesting innovation is the development of personalized and interactive packaging driven by advances in digital printing and compatible technologies, including mobile phones. In 2015, a Belgian brewer printed interactive characters on beer bottles (News Desk, 2015). The characters on the beer bottles are brought to life using a smart phone app through which the characters deliver special performances. If two bottles are brought close to each other, the app creates a dialog between the two characters, providing entertainment for consumers of the product. This kind of innovation where food becomes a part of actively providing entertainment may be of interest to exporters seeking a unique selling proposition for their product in highly competitive developed markets.

Biodegradable packaging

The trend in recent years towards the use of polymeric materials for food packaging has seen them increasingly being used to replace glass, metal and paperboard-based products. This is because of the lower cost of polymers, their light weight and ease of use in fabricating packaging units, resilience, ease of coloring, inertness, and consumer demand, among other considerations. However, polymeric materials are generally slow to biodegrade, except those made from plant, animal or microbial sources, or those that have been deliberately altered chemically. Recent legislative actions by several countries around the world are now requiring food processors who use polymeric packaging to select those that are biodegradable, compostable, reusable or which can be recycled. This has helped to continue driving the trend that has seen the global biodegradable packaging industry being projected to reach US\$21.6 billion by 2026, with Europe being the largest market, followed by North America and the Asia Pacific region (Kenneth Research, 2019). The industry is divided in polymeric plastic and paper packaging, with plastics holding the largest market share. Plastics include bacterial cellulose and cellulose esters, poly(hydroxylalkonates) (PHA), poly(hydroxybutyrate) (PHB), polylactic acid (PLA), protein-based plastics and starch-based plastics (Ramos et al., 2018) which have different applications depending on their specific properties and can also incorporate a range of bioactive compounds, extending the shelf life and improving the quality of food products (Robertson, 2012). The availability of these forms of packaging has facilitated the accelerating move towards biodegradable packaging.

The European Union has been leading the trend towards biodegradable packaging and in Europe, companies using polymeric materials are often required to prove that the material meets established standards and are compliant with EU directives. One such standard is Directive 94/62/EC of 20 December 1994 on packaging and packaging waste ([The European Parliament and the Council of the European Union, 1994](#)). This standard seeks to encourage recycling, reuse and a general reduction in waste materials from reaching city and municipal landfills. The EU standard EN 13432 ([Deutsches Intitut für Normung DIN, 2000](#)) outlines the test methods and the assessment criteria to be used to establish if a package meets the minimum compostable threshold. The key requirements of the EN 13432 Standard are:

1. Minimum concentration limits for volatile compounds, fluorine, and heavy metals such as copper, zinc, nickel, cadmium, lead, mercury, chromium, selenium, arsenic and molybdenum in recycled packaging.
2. At least 90% of the packaging materials must be broken down into carbon dioxide and water by biological action within 6 months.
3. After 12 weeks of composting, at least 90% of the packaging material should disintegrate into pieces that are small enough to pass through a 2×2 mm mesh.
4. The quality of the compost should not decline because of the added packaging material. An ecotoxicity test should be used to determine if the germination and biomass production of plants are not adversely affected by the influence of the composted packaging.

The EN 13432 Standard specifies that packaging may be deemed to be compostable only if all the constituents and components of the packaging are compostable. During the certification procedure, an assessment is made not only of the basic materials, but also of the various additives and other product properties incorporated into the package. Biodegradability of packaging is also addressed by ISO 14855-1:2012, ISO 15270:2008 and ASTM D6400-04. These criteria can be used to determine the most appropriate materials when an assessment as to which packaging is biodegradable is to be done.

Selection of biodegradable packaging

Product development, manufacturing and marketing are among the departments within a company that have to consider various aspects of packaging material when new or existing product packaging is being reviewed. While each function will have its own specific considerations, the package selected must be compliant with the regulations in the destination market. Because the area of biodegradable packaging and the regulations governing them are so dynamic, many jurisdictions do not have settled criteria or regulations in place. This makes the selection and use of appropriate packaging that meets all of the various functional, esthetic, handling and regulatory requirements quite involved.

Biodegradable packaging can be made from 100% natural compounds, including cellulose, natural materials derived from animal or plant sources such as pulp (made of sugar cane bagasse, bamboo and other natural fibers) and cotton and wood, or from additives incorporated into a range of other films, such as low-density polyethylene (LDPE) or linear low density polyethylene (LLDPE). In the case where the firm makes its own LDPE or LLDPE packaging or has this packaging made for them, then the additive that the supplier proposes to be used should be evaluated against the same criteria for packaging

being bought directly from a supplier. The data should show that the additive(s) imparted acceptable biodegradability to packaging materials made with it, that it met the required strength and other performance criteria, and also that these packages met the requirements for being non-toxic. There are approaches and specific considerations that can make selecting the right packaging options more manageable for non-packaging specialists and these are discussed below, as well as considerations that should also advise the choices made.

In selecting between packaging options for biodegradability and functionality, and compliance with regulations, the following approach may be useful:

- Undertake research of the area to get an understanding of the requirements of the specific market and the technical specifications and performance criteria of various packaging options
- Review the technical material presented by the potential suppliers of various packaging options for the specific products to be packaged
- Review the relevant standards which should be referenced in the technical documents presented by the supplier
- Review reports on the performance of the packaging and, where the offer is for an additive to be used, of packaging made with the additives
- Where required, source additional materials to verify the information being provided by the potential suppliers
- On the basis of the review undertaken, select the most suitable packaging or packaging ingredient/additive supplier.

The documentation to be provided by the potential supplier should include test reports and studies that show that their packaging meets the required technical standards mandated by the markets in which the product is to be sold. Studies presented should include the details of test methods and results for tests done on the packaging/films, as well as the controls, to determine if the films met the standard for biodegradability as required by the EN13432 standard. They should also include a series of reports on biodegradability and related tests carried out on packaging material made specifically for the firm.

Assessment and testing of biodegradable packaging

Among the tests directly required by the EN 13432 Standard for biodegradable packaging made from polyolefin polymers (including LDPE and LLDPE) are the following:

1. *Plant seedling emergence and seedling growth test using the OECD² 207 and 208 Guidelines.* This test is used to determine if the addition of an additive to the polyolefin samples that would degrade in landfills will have an adverse effect on the growth of vegetation. The seedlings used in studies such as these include wheatgrass and onions.

² Composite packaging is made from combining the full surface of at least two different materials. It has also been defined as an outer packaging and inner receptacle combined so that they form an integral unit. Essentially it is multi-layer packaging with at least one inner and one outer layer such that each layer provides different functionalities that imbue the package with properties not obtainable from one type of flexible packaging layer alone.

2. *Biodegradation testing of the polyolefins.* This is accomplished by one of three methods or combinations of them. These are: 1) abiotic oxidative breakdown of the material; 2) microbial digestion of the materials themselves; or 3) microbial digestion of fragments of the materials. For #1 above, the test method used is typically ASTM 6954-04 Tier 1. In the case of #3, initial breakdown of the materials could be from oxidative breakdown, as an example. The degradation testing can be done according to the ASTM D-6954 and D-5510 standard test methods or to the ASTM D-6954 and D-5208 standard test methods. During the testing, the materials are expected to degrade into carbon dioxide, water and biomass. Organizations such as the Swedish National Testing and Research Institute, the Swiss Federal Laboratories for Material Science and Technology, and the National Centre for the Evaluation of Photoprotection, Clermont-Ferrand, France, among others, have expertise in these kinds of tests.
3. *Analysis of the materials for the presence of heavy metals.* This can be done according to the ASTM D1976-01 method using inductive coupled argon plasma spectroscopy.

The packaging film should also be assessed for shelf life stability, thermal degradation, degradation in the presence of ultraviolet light, thickness determination, as well as being examined by X-ray fluorescence (XRF) spectroscopy, and Fourier-transform Infra Red (FTIR) spectroscopy. Additional mechanical tests should be performed on the materials to investigate the influence on the film's properties from the incorporation of recycled virgin polyolefins blended with and without the additive being assessed. These mechanical tests include tensile, elongation and tear resistance of the materials before and after the addition of the additive. These evaluations should be done by testing the mechanical properties of the samples according to ASTM D882-09 for tensile, ASTM D1922-09 for elongation, and ASTM D1922-09 for tear strength (puncture and tear resistance), respectively. The intent of this second set of testing is to determine if the materials would be susceptible to a loss of mechanical properties after blending virgin, with recycled polyolefins containing the additive. An outline of these tests are below.

Stability testing

This test is designed to determine the ability of the material to maintain its inherent properties after exposure to a given quantum of sunlight and heat, not exceeding 30 °C, for a maximum of 700 hours. Degradation occurring within the material was estimated by measuring the concentration of carbonyl compounds such as aldehydes, ketones and carboxylic acids that developed in the material during the time of exposure at the testing conditions. These compounds are known to develop during the oxidative breakdown of polymers such as LDPE. Thus, the absence of carbonyl compounds in the sample is viewed as a sign of material stability. This test is done under accelerated conditions. This test method is designed to shorten the testing time by speeding up the rate of degradation. It is a well-accepted way of reducing the duration of this test while still being able to produce accurate results.

Thermal degradation testing

This test measures the rate at which the polymer degrades in conditions of high temperature that simulate exposure to the sunlight. This test is done in the presence and absence

of UV light. Thus, it simulates exposure to heat in the presence and absence of direct sunlight. The control samples, without the additive, should show no increase in carbonyl concentration during the test.

Testing for the presence of metal ions

This test is done using energy-dispersive x-ray fluorescence spectroscopy. This is a non-destructive method that will assay for the presence of, and quantify, metal ions in polymeric samples such as the LDPE films. The intent of this test is to determine the presence and concentration of the additive compound in the films and its absence in the control.

Thickness testing

The thicknesses of all sample materials should be measured before the ageing tests are done.

Conclusion

As the importance of providing packaging options demanded by the market continues to increase, professionals along the food value chain, including producers and exporters from developing countries, as well as the professionals that support them, will need to avail themselves of packaging that meets market requirements. This will mean the introduction of increasing amounts of biodegradable packaging as an important component of the final packaged product delivered to the market. This brief summary of some of the key considerations should allow food industry professionals to have a good grasp of the issues that will need to be addressed, as well as well as the criteria that the packaging will have to meet to comply with regulatory and market requirements.

Additional sources of information on biodegradable plastics include the Oxo-biodegradable Plastics Association, American Society for Testing and Materials (ASTM) standards, the EU Directives, major packaging companies such as Kruger Inc., the Mondi Group, Amcor, BASF SE and Reynolds Group, among others. Smaller, specialist manufacturing entities which provide additives to first generation packaging companies making traditional LDPE packaging, including Symphony Environmental Technologies (with their *d₂w* packaging additive) and Eco Poly Solutions Inc. (with their *Oxo Elite* packaging additive) also provide detailed information on their products. These, along with the information provided in this section, should allow decision-makers to have the tools needed to effectively engage with the opportunities presented by employing the right packaging technologies to get food products from developing countries in the hands of the consumers in all selected markets.

The importance of labeling for exporting products from developing countries to selected developed country markets

Introduction

Many of the products produced in developing are destined for the United States of America (USA), Canada and European Union (EU), the major export markets for these

products. Each of these markets have their own regulatory infrastructure and their own requirements for labeling for products being sold in their countries. As is the case for packaging, the food industry in each jurisdiction, including exporters wishing to have their products sold there, must meet all of the legal requirements to be able to retail their products in the market. In addition, where there are recommendations, traditional practices or new trends occasioned by changing consumer demands or the major firms within the country, it is the norm that products being offered for sale also seek to comply with these as well.

In the recent past it used to be possible to do a label that had compliant information on it for more than one major destination market. That has changed with the updating of their labeling requirements by the USA, Canada and the EU such that now each market requires specific declarations that are not in keeping with the regulations in other jurisdictions. For example, it was possible to prepare a label for a product being exported to Canada and also have it comply with the requirements in the USA. However, changes due to the Safe Food for Canadians Act as well as changes to the US labeling requirements regarding consumption sizes and the attendant declarations, when combined with the requirement for multi-lingual labels in Canada make it virtually impossible for one label to comply in both markets. The same applies to Canada and the EU and the USA and the EU. Consequently, and very importantly, companies offering products for sale in any of the major markets need to have an understanding of the current status of the regulations regarding labeling in each and also to keep abreast of the changes and the attendant implementation dates, where relevant. If not, they will be unable to avoid having their products be found to be non-compliant in the respective markets and therefore at risk of being barred at port of entry or withdrawn from the shelves, if they managed to enter the territory and get displayed in the market.

Labeling basics

The regulatory bodies that monitor label compliance are FDA and Canadian Food Inspection Agency (CFIA) in the US and Canada respectively and the Food Standards Agency (FSA) and European Food Safety Authority (EFSA) in the United Kingdom (UK) and the EU, respectively. While the EUs regulations would (and still do) normally apply in the UK, impending changes in the relationship may mean changes in regulatory compliance as regards foods being sold. It is germane, therefore, to consider EU and UK requirement differences, if any, if a firm intends to trade in both, in the same way as they are now impelled to if they trade in the US and Canada. Each territory has specific information that is required to be on the label of packaged food entering and produced there. Generally, the information presented on package labels should include:

- The name of the product and, if relevant, a statement of identity
- Net contents
- The name and address of the manufacturer/distributor/importer
- Directions for safe use of the product (including storage and preparation)
- The list of ingredients
- Any warning statement(s) that may be required

These are among the basic components of the information that must be present on the label or packaging for each product. In addition to this, each market also has specific requirements for advising consumers about the contents of the package and composition of the product, including its nutritional content. As such, “Nutrition Facts” labeling is a very important tool for providing information to the consumers on the packaged item. With the prevalence of lifestyle diseases, including diabetes and hypertension on the rise, both linked to obesity, regulatory bodies across the world, including the US FDA, CFIA, FSA and EFSA require that food manufacturers present detailed information on the composition of their food products by way of a Nutrition Facts Label. Additionally, the significant increase in allergen-related foodborne illnesses has resulted in regulators also requiring that food products are specifically labeled as to the potential allergens it may contain. These requirements apply to packaged foods produced domestically with the US, Canadian, UK or EU markets, as well as those imported from other countries, the compliance of which is routinely checked on randomly select food samples in the marketplace. These sampled products are checked for compliance to several compulsory regulatory requirements, including nutrition analyzes. This chapter will seek to bridge the divide between producers and exporters from developing countries and the requirements of importing countries that has seen a significant increase in rejections at port of entry over the last several years ([Gordon, 2016](#)), a trend which has continued.

Labeling requirements for export to the UK and EU

The labeling requirements in the EU, as with other markets, have been undergoing change over the last several years. The EU’s “Food Information to Consumers (FIC)” Regulation 1169/2011 became applicable on December 13, 2014 and presented new obligations and changes to the previously existing rules ([United States Department of Agriculture, 2019](#)). Nutrition labeling, for example, became mandatory in the EU on December 13, 2016. Despite this single European-wide approach to labeling, it is important for exporters to be aware that there may be some variation among the different Member States in implementing the harmonized EU legislation and they should ensure that there are not additional requirements in the specific market in which they seek to trade. In such a case where harmonization is not yet finalized, it is the importer’s responsibility to ensure that the existing requirements in that Member State are met.

In the EU, the terminology used have differences in meaning and understanding these is important in navigating the requirements and ensuring compliance. Specific EU terms are used in the EU legislative framework and will be mentioned frequently in this section of the chapter. The terms and their meanings are outlined below:

“An EU *Directive* is a form of legislation that is **“directed” at the Member States**. It will set out the objective or policy which needs to be attained. The Member States must then pass the relevant domestic legislation to give effect to the terms of the Directive within a time frame set in the directive, usually two years” ([Europa EU, 2019](#)). As this direct quote indicates, Directives define the results that must be achieved by the application of

a particular legislative requirement in each Member State but leaves each Member State with choices as to how to translate the directives into their national laws.

"Regulations", on the other hand, are binding and once they come into force on a specific date, all member states are required to implement them in their entirety ([Europa EU, 2019](#)). There is no leeway for interpretation for inclusion in the domestic law of each Member State as the Regulation has to be implemented as documented, without exception or modification.

A "Decision" is only applicable to those to whom it is specifically addressed (e.g. individuals or a country) but is binding on them.

A "Recommendation" is not binding and has no legal consequence. It allows institutions to make their views known and suggest an approach towards implementation but does not impose a legal obligation on them to implement it.

All of the above relate to all categories of food produced or sold in the EU. There are some types of food, however, that have specific additional labeling requirements which are handled and published separately. These include beef, cocoa and chocolate products, coffee and chicory extracts, fortified foods, fruit jams, jellies and marmalades, fruit juice, GMO products, honey, organic products, sugars, wine, wholly dehydrated preserved milk, dietetic or special use foods and foods labeled with nutrition and health claims. The discussion in this section will deal with all relevant categories of food and expand on the general requirements.

Food information to consumers

Packaged food sold in the EU must provide consumers with enough information for them to be able to make informed choices. This is captured in Regulation (EU) No. 1169/2011 (the FIC Regulation). In addition to the basic information indicated above, the label for food and beverages must also provide:

- Allergen highlighted in the list of ingredients (not in a "contains" box on the label)
- Quantitative Ingredient Declaration (QUID) for certain ingredients or category of ingredients
- Nutrition declaration
- Appropriate durability indication (shelf life/best before date)
- Indication of alcoholic strength per volume, if appropriate
- Country of Origin Labeling (COOL), if required
- Contact information for the manufacturer, packer or seller

The FIC regulation established new horizontal labeling requirements and repealed labeling Directive 2000/13/EC, as well as nutrition labeling Directive 90/496/EEC and warning labels Directive 2008/5/EC. Article 13 of the FIC regulation requires the mandatory information to be easily visible, indelible and clearly legible without being obscured by written or pictorial material. The size of the font should be greater than or equal to 1.2 mm as determined by the height of the letter 'x'. When the packages are smaller than 80 square centimetres (cm²), the minimum font size should be 0.9 mm. Nutrition labeling is not required for packages with a surface area less than 25 cm² and packages smaller than 10 cm² are not required to bear nutrition labeling nor a list of ingredients.

It is important to note that the mandatory information should be presented in a language easily understood by the consumers of the Member State where the food is to be marketed, i.e. for France the required language is French while for the Netherlands it is Dutch, etc. Member States may specify which information is required to be present in one or more official languages. To avoid non-compliance, translations of the mandatory information must be accurate. The ingredients should be listed in descending order of weight. However, in the EU, substances or products causing allergies must be indicated in the list of ingredients with the source of the allergen as listed in Annex II of Article 21 of the FIC Regulation. The name of the allergen should be highlighted by using a typeset that clearly distinguished it from the remainder of ingredients (Fig. 7.14), for example “*tofu (soya)*” and “*whey (milk)*”. Bold type or a background color can be used. Below is the list of allergens that should be declared when present in food and beverage, including alcoholic beverages:

- Cereals containing gluten
- Crustaceans
- Eggs
- Fish
- Peanuts
- Soybeans
- Milk
- Nuts
- Celery
- Mustard
- Sesame seeds
- Sulfur dioxide and sulfites at concentrations of more than 10 mg/kg
- Lupine
- Molluscs

The allergenic ingredients should be listed in the ingredients list as required. The voluntary use of warning boxes or statements such as “contains X” to repeat the presence of allergenic ingredients is not permitted. Only in the absence of an ingredients list (as in the case of small packages mentioned above) can the presence of allergens be indicated using the word “contains” followed by the name of the substance or product. Allergen advice may be included to direct the attention of the consumer to the highlighted allergens in the ingredients list as seen in Fig. 7.14.

The EU has a requirement for information about the quantity of the major or characteristic ingredient in the product, the Quantitative Ingredient Declaration (QUID), to be indicated as required for the following cases:

- It is highlighted on the label, emphasized in words (e.g. *made with butter*) or by the use of pictures and graphics
- Mentioned in the name of the product e.g. “*15% Strawberries*” on strawberry ice cream
- The ingredient is essential to characterize the product and to distinguish it from other products

The QUID declaration should be expressed as a percentage (%) and must appear in or immediately next to the name of the food or in the list of ingredients (EUR-Lex, 2017).

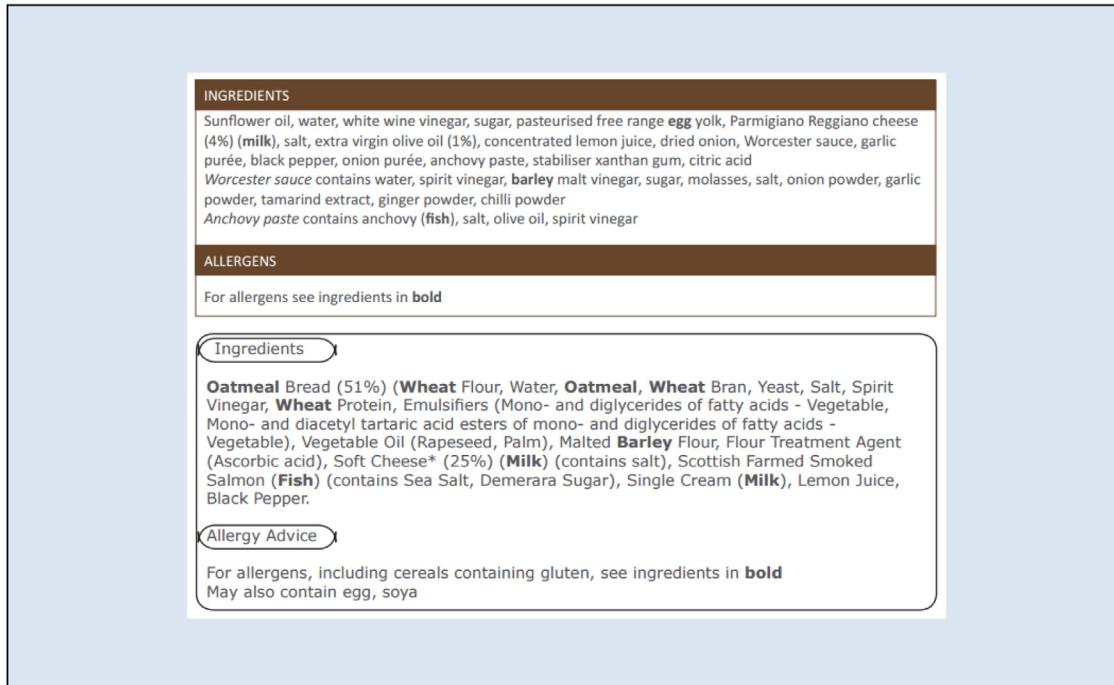


FIGURE 7.14 Examples of ingredient list with allergens highlighted and allergen advice. *Source: British Retail Consortium.*

If ingredients are natural constituents of the food (as caffeine is in coffee), the QUID requirement does not apply. The QUID is not required in certain cases such as where an ingredient is used in small quantities for flavoring purposes.

Nutrition labeling

All the elements mandatory for nutrition declaration should be presented in the same field of vision on the food label or packaging. Nutrition declarations are to be done on a “per 100 g or per 100 milliliters” basis, however per portion or per consumption units can be presented in addition to the declaration per 100 g or milliliters provided that the number of portions or consumption units is clearly specified on the package. The energy value should be expressed in kilojoules (kJ) and kilocalories (kcal). The declaration must list the constituents in this particular order:

- Amount of energy
- amounts of fat
- saturates (*i.e. saturated fats*)
- carbohydrate
- sugars
- protein
- salt

Constituents should be expressed in grams (g), milligrams (mg) or micrograms (μg) per 100 g or per 100 milliliters, as appropriate. Voluntary declarations can be made as well to supplement the mandatory information by including values for monounsaturates, polyunsaturates, polyols, starch, fiber, the vitamins and minerals listed in Part A of Annex XIII of the FIC regulation ([European Commission, 2019](#)).

For voluntary declarations of vitamins and minerals, the nutrient should be present in significant amounts. Declarations should be presented as percentage *nutrient reference values* (NRV) or *reference intakes* (RI) based on an average sized adult doing average amounts of physical activity³. Significant amounts are defined as follows:

- for products other than beverages, 15% of the nutrient reference values per 100 g or 100 ml
- for beverages, 7.5% of the nutrient reference values per 100 ml
- for single portion packages, 15% per portion.

Once information on % RIs per 100 g or per 100 ml is provided, it is a requirement that the additional statement “*Reference intake of an average adult (8400 kJ/2000 kcal)*” be presented in close proximity to the information on reference intakes ([Fig. 7.15](#)). On the other hand, the additional statement is not required if the information provided is on % RIs *per portion* and/or *per consumption unit* only basis.

³ *Nutrient reference values* are defined as a set of recommended daily nutrient targets based on current available scientific knowledge; *reference intake* is defined as a means of communicating maximum recommended nutrient intake to the public.

Nutrition Information		
	Per 100 g	
Energy	485 kJ / 117 kcal	
Fat	8 g	
Of which Saturates	3,7 g	
Carbohydrate	9 g	
Of which Sugars	8 g	
Protein	1,4 g	
Salt	0,02 g	
Vitamin C	14,81 mg	19% RI*

Salt content is exclusively due to the presence of naturally occurring sodium.

*Reference intake of an average adult (8 400 kJ / 2 000 kcal)

INGREDIENTS:Mandarin Oranges (37.9%), Light Whipping Cream (Milk), Pears (12.4%), Peaches (7.7%), Thompson Seedless Grapes (7.6%), Apple (7.5%), Banana (5.9%), English Walnuts (Tree Nuts)

Nutrition Information		
	Per 100 g	%Reference Intake RI
Energy	485 kJ / 117 kcal	6% RI
Fat	8 g	11% RI
Of which Saturates	3,7 g	19% RI
Carbohydrate	9 g	3% RI
Of which Sugars	8 g	9% RI
Protein	1,4 g	3% RI
Salt	0,02 g	0% RI
Vitamin C	14,81 mg	19% RI

Salt content is exclusively due to the presence of naturally occurring sodium.

Reference intake of an average adult (8 400 kJ / 2 000 kcal)

INGREDIENTS:Mandarin Oranges (37.9%), Light Whipping Cream (Milk), Pears (12.4%), Peaches (7.7%), Thompson Seedless Grapes (7.6%), Apple (7.5%), Banana (5.9%), English Walnuts (Tree Nuts)

	Per 100 g	Per portion of 249 g
	%Reference Intake RI	%Reference Intake RI
Energy	485 kJ / 117 kcal	6% RI
Fat	8 g	11% RI
Of which Saturates	3,7 g	19% RI
Carbohydrate	9 g	3% RI
Of which Sugars	8 g	9% RI
Protein	1,4 g	3% RI
Salt	0,02 g	0% RI
Vitamin C	14,81 mg	19% RI

Salt content is exclusively due to the presence of naturally occurring sodium.

Reference intake of an average adult (8 400 kJ / 2 000 kcal)

INGREDIENTS:Mandarin Oranges (37.9%), Light Whipping Cream (Milk), Pears (12.4%), Peaches (7.7%), Thompson Seedless Grapes (7.6%), Apple (7.5%), Banana (5.9%), English Walnuts (Tree Nuts)

FIGURE 7.15 Examples of nutrition declaration in different formats. *Source:* <https://www.esha.com/products/gensis-rd-food-labeling-software/labels-and-labeling/european-union-nutrition-facts-label/>.

TABLE 7.5 Limits and suggested declarations for negligible nutrients.

Nutrient	Negligible amount	Nutrition declaration
Fat		
Carbohydrate	No detectable amount present ≤ 0.5 g per 100 ml or 100 g	"0 g" "≤ 0.5 g"
Sugars		
Protein		
Saturates	No detectable amount present ≤ 0.1 g per 100 ml or 100 g	"0 g" "≤ 0.1 g"
Salt	No detectable amount present ≤ 0.0125 g per 100 ml or 100 g	"0 g" "≤ 0.5 g"

Previously, most nutrition declarations were provided on the back of packages. However, this is not required and manufacturers can place the declaration on any surface of the package provided that the font size requirements are adhered to. Once space permits, the declaration should be done in a tabular form. Otherwise, the declaration must appear in the linear format.

For the EU, instead of sodium the declaration of *salt* content is used so that this is clear to consumers at the point of purchase. Salt content is based on the total amount of sodium in the packaged product (both added and natural) and is calculated by multiplying the sodium content by 2.5. When salt is not added to the product, this can be indicated as seen in Table 7.5. If the presence of salt in the product is due exclusively to the natural occurring sodium, statements like "This product contains no added salt" or "Salt content is due to naturally occurring sodium" may be used.

Front of pack labeling

Front of pack (FoP) labeling allows for the voluntary repeat of mandatory information for pre-packaged food ([Department of Health, UK, 2016a](#)). Elements that are allowed on FoP are:

- Energy value (kJ/kcal)
- Energy value plus the amount in grams of *fat*, *saturates*, *sugars* and *salt*. These are commonly referred to as "*energy + 4*".

Foods offered for sale to the final consumer or mass caterers without pre-packaging, foods packed on sales premises at the consumers' request and foods packaged for direct sales are considered non-pre-packaged food. There are no requirements for nutrition information to be presented on these items but the information can be provided on a voluntary basis ([Department of Health, UK, 2016b](#)). When this is done, the full mandatory nutrition declaration, the energy value only or "*energy + 4*" should be provided. The declaration cannot omit any of the 4 nutrients in *energy + 4* if that format is used. Strict adherence to any of the three formats must be followed.

TABLE 7.6 Representation of minimum durability.

Food type	Acceptable format
Foods that will keep for longer than 3 months	Best Before followed by Day and Month
Foods that will keep for longer than 3 mo but less than 18 months	Best Before End followed by Month and Year
Foods that will keep longer than 18 months	Best Before End followed by Year only or Month and Year

Appropriate durability indication

The labels of pre-packaged food also require an indication of the minimum durability (commonly known as the *shelf life*) of the product. There are different formats required depending on the nature of the product. Minimum durability is referred to as the date until which the product will retain its specific qualities when properly stored. Two ways to indicate this date is by using "*best before*" when date includes an indication of the day and "*best before end*" in all other cases. Examples of appropriate declarations are given in [Table 7.6](#).

The term "*Use by*" is another means of indicating the minimum durability, however this is specifically for foods considered perishable and the food is deemed unsafe for consumption after the date indicated. Whenever there are individual pre-packaged portions each should bear the use by date on the package. Food that is sold frozen should bear information on the date it was frozen indicating the day, month and year preceded by the term "frozen on".

Warning on labels

The FIC regulation *Food Additives Regulation 1333/2008* presents a list of products that are required to bear a warning label. These include the following:

- foods when the durability has been extended by use of packaging gases
- foods which contain sweeteners
- foods which contain added sugar and sweeteners
- foods which contain aspartame
- foods which contain more than 10% added polyols
- confectionery and beverages which contain liquorice (glycyrrhizinic acid or its ammonium salt)
- beverages which contain more than 150 mg/l of caffeine and foods with added caffeine
- foods or food ingredients with added phytosterols, phytosterol esters, phytostanols or phytostanol esters
- foods that have been irradiated
- foods that contain genetically modified ingredients, unless their presence is accidental and $\leq 0.9\%$
- foods that contain sulfur dioxide in levels above 10 mg/l.

Additionally, it is important for manufacturers to investigate the additives that are permitted for use in the destination market to avoid the risk of noncompliance and possible

destruction or return of non-compliant products. There are six color additives, according to Annex V to *Food Additives Regulation 1333/2008* ([EUR-Lex, 2019a](#)), that when used in the manufacturing of a product would be accompanied by the statement "may have an adverse effect on activity and attention in children". They are sunset yellow (E110), quinoline yellow (E104), carnosine (E122), allura red (E129), tartrazine (E102) and ponceau 4 R (E124). The numbers in brackets are "E numbers" which are specific codes for substances allowable for use as food additives in the EU. All additives used in food products must be declared and indicated by its assigned E number on the package.

Alcoholic beverages must have a warning on their label indicating the alcohol content when the content is above 1.2%. The alcoholic strength is required to be indicated by a figure with maximum one decimal place followed by the symbol "% vol.." This information should be presented in the same field of vision as the product name and net quantity. Allergen labeling is also mandatory on all alcoholic beverages, EU FIC exempts alcoholic beverages with >1.2% alcohol content from mandatory nutrition labeling ([Department of Health, UK, 2017](#)). There are established standards for wine and guidelines available for the labeling of these products as EU and non-EU wines may be labeled differently.

Country of origin labeling (COOL)

Country of Origin Labeling (COOL) is primarily required in the EU for specific products and in specific instances. Mandatory COOL applies:

- whenever failure to indicate the country of origin might mislead the consumer
- to honey, fruit and vegetables, olive oil, fishery and aquaculture products and beef

Mandatory COOL has also been extended to *fresh, chilled and frozen pork, sheep and goat meat and poultry* in addition to the products for which COOL was already mandatory. Further, it is expected that COOL will also be required when the country of origin is given voluntarily but the origin of the primary ingredient in the product is different from that of the food product.

Organic food labels

The use of the EU organic logo became mandatory on all pre-packaged organic products produced in the EU since July 1, 2012. Organic products imported from outside EU may carry the EU organic logo if they comply with the EU production rules and the indication of the place of farming becomes mandatory. "Organic" and all its derivate terms or diminutives such as "bio" and "eco" may be used only to label products that comply with EU organic production rules and if at least 95% of the ingredients of agricultural origin are organic. Products containing less than 95% organic ingredients should indicate and make reference to the individual organic ingredients in the list of ingredients. The total percentage of organic ingredients must be indicated when reference is made to the organic production method in the ingredients list.

Using the e mark

Packages meeting the requirements of the Packaged Goods Regulations and are between 5 g and 10 kg for food and 5 ml – 10 L for beverages can bear the **e mark**. When used, manufacturers are declaring their compliance with the requirements of the “average system” under European Union Directive 76/211/EEC ([EUR-Lex, 2019b](#)). The mark is a metrological passport to trade allowing free access within European Economic Area (EEA) and respective markets including France, Netherlands and the UK. The products bearing the mark are not subjected to further weight and measurements regulation. Its use is optional, however packages that do not display the **e mark** must meet the regulations of the destination country.

Signposting

Traffic light food labels, more formerly called “signposting”, was first introduced in the United Kingdom with the intent to provide consumers with a clearer indication of the amount of salt, sugar or fat the products have. Like traffic light, the colors used in signposting are red, amber and green and are based on the quantity of the nutrients in the product. It was found that consumers were able to more easily decide on the products to be bought based on their content when signposting was used ([Michalopoulos, 2017](#)). In 2011, however, the traffic light system for food labeling was rejected at EU level

TABLE 7.7 Traffic light signposting criteria for 100 g of food.

Text	LOW ^a	MEDIUM	HIGH	
			Red	
Colour code	Green	Amber	>25% of RIs	>30% of RIs
Fat	≤ 3.0g/100g	> 3.0g to ≤ 17.5g/100g	> 17.5g/100g	> 21g/portion
Saturates	≤ 1.5g/100g	> 1.5g to ≤ 5.0g/100g	> 5.0g/100g	> 6.0g/portion
(Total) Sugars	≤ 5.0g/100g	> 5.0g to ≤ 22.5g /100g	> 22.5g/100g	> 27g/portion
Salt	≤ 0.3g/100g	> 0.3g to ≤ 1.5g/100g	>1.5g/100g	>1.8g/portion

Note: Portion size criteria apply to portions/serving sizes greater than 100 g.

Source: https://www.food.gov.uk/sites/default/files/media/document/fop-guidance_0.pdf.

TABLE 7.8 Traffic light signposting criteria for 100 ml of drink.

Text	LOW ^a	MEDIUM	HIGH	
	Colour code	Green	Amber	Red
				>12.5% of RIs
Fat	≤ 1.5g/100ml	> 1.5g to ≤ 8.75g/100ml	> 8.75g/100ml	> 10.5g/portion
Saturates	≤ 0.75g/100ml	> 0.75g to ≤ 2.5g/100ml	> 2.5g/100ml	> 3g/portion
(Total) Sugars	≤ 2.5g/100ml	> 2.5g to ≤ 11.25g/100ml	> 11.25g/100ml	> 13.5g/portion
Salt	≤ 0.3g/100ml	> 0.3g to ≤ 0.75g/100ml	> 0.75g/100ml	> 0.9g/portion

Note: portion size criteria apply to portions/serving sizes greater than 150 ml.

Source: https://www.food.gov.uk/sites/default/files/media/document/fop-guidance_0.pdf.

as part of negotiations on the food information to consumer regulation. It remains a voluntary front of pack labeling element based on realistic size portions of the food or beverage.

The traffic light signposting requires a definition for the colors ([Department of Health, UK, 2016a,b](#)) and the criteria are set out in [Table 7.7](#) for food and [Table 7.8](#) for beverages. In both tables, low cut off is based on the “low” nutrition claim for fat, saturates, total sugars and salt in the EU Nutrition & Health Claims Regulation (EC) 1924/2006.

Labeling requirements for export to the United States of America

In the United States of America (USA), the regulations indicate that packages have two main types of panels on which specific information should be presented. The front area of the package that will most likely be seen by the consumer is called the Principal Display Panel (PDP). To the right of the PDP is the Information Panel – IP ([Fig. 7.16](#)). The PDP should contain the statement of identity or the name of the product as well as the net contents of the package, while the IP should contain information that should not be interrupted by intervening material but instead be placed together such as the:

1. name and address of the manufacturer, packer or distributor
2. ingredients list
3. nutrition labeling
4. allergen labeling

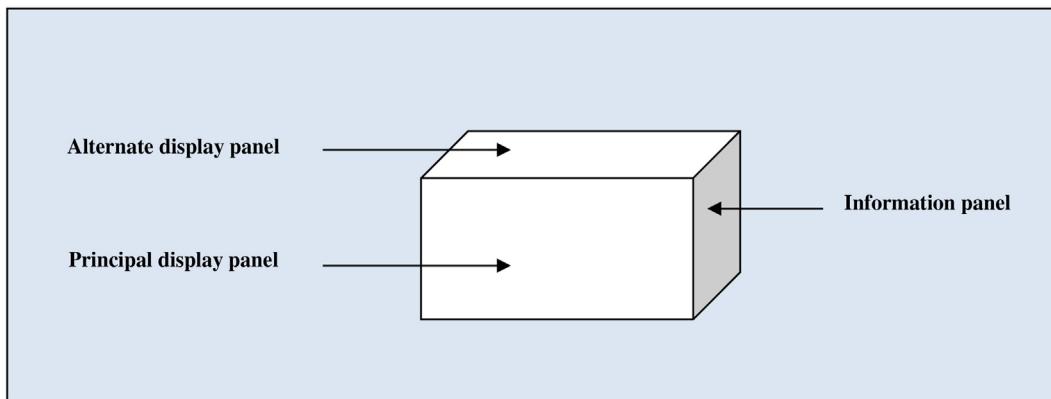


FIGURE 7.16 Principal display and information panels for US labels.

The print size and type should make the information be easy to read, conspicuous and adequately contrasted with the background of the packaging, especially on the information panel which houses the information that many consumers use to determine whether to consume the food, particularly those who may have allergies or be on restrictive diets. There are also specific requirements for the font sizes for the statement of identity and net contents of the product on the PDP.

The statement of identity should be prominent and in **bold type** and should be presented as the common/usual name of the food. The net quantity should be located within the bottom third of the PDP, have sufficient contrast and be expressed as weight for solid foods, volume measure for liquids and numeric counts for small individual units, for example cookies or cherries.

The ingredients should be listed in descending order of predominance, before or after the nutrition label and contact information for the manufacturer, packer or distributor, with a type size no less than 1/16th inch in height as measured by the lower case letter "o". It should be prominent and easy to read, with the common names of the ingredients being used unless a different term is provided by the regulations. Major food allergens should be declared as well as any additives or colors (both certified and non-certified) used during the processing or production of the packaged items.

Food allergens

In order to make it easier for consumers with food allergies and their caregivers to identify and avoid foods that contain major food allergens, the Food Allergen Labeling and Consumer Protection Act (FALCPA) was passed by the US Congress in 2004. It requires that the label of a food that contains an ingredient belonging to the identified group of food allergens or which contains protein from a "major food allergen" declare the presence of the allergen in the manner described by the law. It became effective on January 1, 2006 and all labels for foods to be consumed in the US can be assessed for their compliance with the regulations. Even though there are more than 160 foods components that have been identified as causes

Option 1

Contains Wheat, Milk, Egg, and Soy

Option 2

Ingredients: Enriched flour (**wheat** flour, malted barley, niacin, reduced iron, thiamin mononitrate, riboflavin, folic acid), sugar, partially hydrogenated soybean oil, and/or cottonseed oil, high fructose corn syrup, whey (**milk**), **eggs**, vanilla, natural and artificial flavoring) salt, leavening (sodium acid pyrophosphate, monocalcium phosphate), lecithin (**soy**), mono-and diglycerides (**emulsifier**)

FIGURE 7.17 Options for declaring the major food allergens on packaged food labels.

of food allergies in sensitive individuals, only 8 have been defined as major food allergens. They are so characterized because they account for greater than 90% of all documented food allergies in the US which have been shown to have severe or life-threatening consequences.

FALCPA describes the major food allergens as ingredients that contain one of the following or proteins from of the following:

- Milk
- Wheat
- Fish (e.g. salmon, flounder)
- Peanuts
- Tree nuts (e.g. walnuts, pecans, almonds)
- Soybeans
- Egg
- Crustacean Shellfish (e.g. lobster, crabs, crayfish)

There are two options for declaring the allergens in a product. The first is to place the word "contains" followed by the name of the food source from which the major allergen is derived. This should be placed in the vicinity of (i.e. immediately after or adjacent to) the ingredients list *in a font size no less than the ingredients list*. Alternatively, the allergens may be included in the ingredients list as the name of the food ingredient which is the source of the allergen followed by the common or usual name of the allergen (in brackets). Examples are shown in Fig. 7.17 below which was adopted from the FDAs website.

Upon entry to the United States of America, imported food packages may be assessed at port of entry for their compliance with Nutrition Labeling and Education Act (NLEA) of 1990, which provides FDA with specific authority to require nutrition labeling of foods regulated by the agency. It also requires that all nutrient contents claims and health claims on the labels should be consistent with the regulations. There may be flexibility for "small packages" and/or exemptions for small businesses⁴.

⁴ Small businesses are defined by the regulations as businesses that had gross food sales or \$50,000 or less and those who have total annual gross sales (food and non-food) of \$500,000 or less.

TABLE 7.9 List of information required in the nutrition label in the United States of America (USA) prior to the release of updated regulations in May 2016.

Mandatory	Voluntary
Total Calories	Calories from saturated fat
Calories from fat	Polyunsaturated fat
Total fat	Monounsaturated fat
Saturated fat	Potassium
<i>Trans</i> fat	Percent of vitamin A present as beta-carotene
Cholesterol	Soluble fiber
Sodium	Insoluble fiber
Total carbohydrate	Sugar alcohol
Dietary fiber	Other carbohydrates
Sugars	Other essential vitamins and minerals
Protein	
Vitamin A	
Vitamin C	
Calcium	
Iron	

The regulations require that the nutritional information must be set off in a box with the heading “Nutrition Facts” stretched across the width of the box. The label may be oriented perpendicularly or parallel to fit the design of the packaging, however, FDA urges manufacturers to strive for consistency of presentation of nutrition information in the market and to place the Nutrition Facts label so that it is readily observable and legible to the consumer at the point of purchase.

There are some nutrients (vitamins and minerals) and other information that must be included in the nutrition labeling (Table 7.9). This list was updated in 2016, when the FDA released the new labeling requirements on May 20. The appearance of the label required has also been redefined in order to make it easier for consumers to find the information they need when purchasing/consuming a product.

Once a nutrient claim that characterizes the level of a nutrient directly or by implication is made, the nutrient should be included in the list whether it falls in the list of mandatory or voluntary nutrients. Any voluntary information included should be placed immediately following the mandatory nutrient, maintaining the grouping of carbohydrates, minerals and vitamins i.e. voluntary minerals should be placed following mandatory minerals. There are 5 nutrients that should appear in bold type on the label: total fat, cholesterol, sodium, total carbohydrate and protein. The information presented in bold in Table 7.9 should also be presented in bold font in the nutrition facts panel (NFP).



FIGURE 7.18 Current and new US label layout for packaged food respectively. Source: The FDA website – www.fda.gov

There are specific rounding rules for listing the calories defined within the regulations. Disclosure statements are required for nutrients that may increase the risk of disease or health related conditions i.e. where the nutrient exceeded the prescribed level as defined by the Daily Values (DV) (determined by the Reference Daily Intakes for vitamins and minerals and the Daily Reference Values for the other nutrients).

As previously indicated, changes will be made to what is required in the nutrition labels starting in January 2020. The changes required (shown in Fig. 7.18) will include the following:

- *The inclusion of “added sugars”.* Many experts recommend consuming fewer calories from added sugar because this may decrease the intake of nutrient-rich foods while increasing overall caloric intake. It is recommended that the daily intake of calories from added sugars not exceed 10% of total calories.
- *Updated daily values for nutrients like sodium, dietary fiber and Vitamin D which are used to calculate the percentage daily values (DV) on the labels.* This helps the consumer to understand the nutrition information in the context of a total daily diet.
- *The declaration of the amount of potassium and Vitamin D on the label, because they are new “nutrients of public health significance”.* Calcium and iron are still required, but Vitamins A and C will not be but could be included on a voluntary basis.

- *The continued requirement for "Total Fat," "Saturated Fat," and "Trans Fat" on the label, however "calories from fat" will no longer be required because research shows the type of fat is more important than the amount.*
- Calories is required to be in bold as per current regulations however, the font size should be bigger and more prominent than the remainder of the information in the nutrition facts box.
- Updated Serving Size Requirements Package Sizes which would better reflect how people eat and drink today, which has changed since serving sizes were first established 20 years ago. By law, **the label information on serving sizes must be based on what people actually eat, not on what they "should" be eating.** This requirement should be present in bold and font size bigger than for the current requirement, but not as big as the calories declaration.
- *Any packaged foods, including drinks, that are typically eaten in one sitting will be required to be labeled as a single serving* and that calorie and nutrient information declared for the entire package. For example, a 20-ounce bottle of soda that is typically consumed in a single sitting should be labeled as one serving rather than as more than one serving.
- *Any package that is larger and could be consumed in one sitting or multiple sittings, should bear "dual column" labels to indicate both "per serving" and "per package" calories and nutrient information.* Examples are 24-ounce bottles of soda or a pint of ice cream. Consumers are will be better able to understand how many calories and nutrients they are getting if they eat or drink the entire package at one time.
- *Updated footnote to help consumers understand the percent daily value concept.* The statement on the labels (of food intended for adults and children over the age of 4) would be shorter than the current footnote to allow for more space on the label, stating:
*The percent daily value (%DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2000 calories a day is used for general nutrition advice. For children 1 – 3 years of age:
*The percent daily value (%DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 1000 calories a day is used for general nutrition advice.
- *A Refreshed Design*

Labeling requirements for export to the Canada

The Canadian Food Inspection Agency (CFIA) is the major federal agency that has jurisdiction over foods offered for sale in Canada, whether produced domestically or imported. All foods in Canada need to have labels that comply with the Consumer Packaging and Labeling Act (CPLA), the Food and Drug Act (FDA) and the Food and Drug Regulations (FDR). The official languages of Canada, English and French, must be present on all labels except where exemptions are permitted by law. The information in French may appear on a separate panel than the information in English or may be on the same panel but must meet the minimum height requirement for the text (type) printed on the label.

As with the labels on packaged foods destined for consumption in the US, certain information is mandatory, including the name of the product or the "common name". Both French and English common names should be on the principal display panel and should be no less than 1.6 mm based on the lower case letter "o". The English common name should appear in boldface type. Consistency in type height is encouraged for both

languages. Certain voluntary information, if included on the labels or advertisement on packages, is subjected to other requirements and must be presented bilingually although voluntary information is not generally subject to bilingual requirements at the federal level. Some of the information required to be present bilingually are:

- Organic Claims
- Nutrient Content Claims
- Additional Nutritional Information
- Health Claims

Another mandatory element that should be present on all labels is the *net quantity declarations* which also must be bilingual. When words are used instead of the SI symbols in net quantity declarations, they must appear in both official languages. A list of ingredients should be presented on all pre-packaged foods with more than one ingredient and the ingredients should be declared in descending order of their proportion by weight as determined before they are combined to make the food.

Allergen labeling for Canada

If any allergens are present in the pre-packaged food, they must be declared. In Canada, the list of allergens of concern/ingredients causing adverse health reactions (collectively referred to as "allergens" in the Canadian scenario) is longer than in the US and includes:

- tree nuts (almonds, Brazil nuts, cashews, hazelnuts, macadamia nuts, pecans, pine nuts, pistachios or walnuts)
- peanuts
- sesame seeds
- wheat (gluten)
- eggs
- milk
- soybeans
- crustaceans
- shellfish
- fish
- mustard seeds
- sulfites

It is mandatory that all food allergens must be declared in the list of ingredients or in a "contains" statement. When using the ingredients list format, the prescribed source name of the food allergen should be shown in parentheses, as follows:

Ingredient List: flour (wheat), liquid albumin (egg), vegetable oil, sugar, flavor.

Other labeling requirements

The Food and Drug Regulations (FDR) requires that food additives are declared in the list of ingredients of pre-packaged foods when added to a food, whether alone or with natural flavoring agents. The word "artificial" or "imitation" must be included as an integral

TABLE 7.10 List of month abbreviations for the Canadian labels.

Month	Abbreviation	Month	Abbreviation
January	JA	July	JL
February	FE	August	AU
March	MR	September	SE
April	AL	October	OC
May	MA	November	NO
June	JN	December	DE

part of the flavoring preparation name and the declaration should be in the same type size and style as the flavoring preparation name. The identity and principal place of business of the manufacturer or the business for which the food has been manufactured or produced for sale or resale should be declared in both official languages and meet the type height requirements of 1.6 mm or greater. It is important to note that websites, telephone numbers, and virtual addresses do not fit the criteria for “principal place of business” declarations since they are not physical locations. Food exported for consumption in Canada should include “imported by/for” (importé par/pour) or the country of origin as part of the identity and principal place of business declaration whether they are labeled or relabeled in Canada or elsewhere, including bulk imports.

The date format applicable for products sold in Canada is different to that used elsewhere ([Canadian Food Inspection Agency CFIA, 2019d](#)). The abbreviations are shown in [Table 7.10](#) (above). The format requires that the year should be listed first, followed by the month (bilingual or abbreviated), followed by the day of the month as seen in [Fig. 7.19](#). Date markings/Best Before dates are required when the packaged food has a shelf life less than 90 days. In these cases, the date marking should be preceded by “Best Before”. Food with shelf life greater than 90 days (e.g. cereals) are not required to be labeled with a “Best Before” date. However, a “Best Before” may be declared on foods with a shelf life greater than 90 days, depending on the purveyor. The “Best Before” date may appear anywhere on the package. If it is placed on the bottom, a clear indication of its location must be shown elsewhere on the label. It must be present in both English and French or indicated by using specified bilingual abbreviations ([Canadian Food Inspection Agency CFIA, 2019e](#)). In addition, foods requiring date marks should bear storage instructions once storage conditions differ from normal room/ambient temperature. Examples include “keep refrigerated” and “store in a cool, dry place”.

Labeling of irradiated foods

Federal controls are applicable to the safety and labeling of foods that have been irradiated. There are certain irradiated foods that can be sold in Canada. Some of these are potatoes, wheat, flour, whole wheat flour, onions, whole or ground spices and dehydrated seasoning preparations. Labeling regulations for irradiated food are enforced by CFIA and are detailed in the Food and Drug Regulations (B.01.035) which require the identification

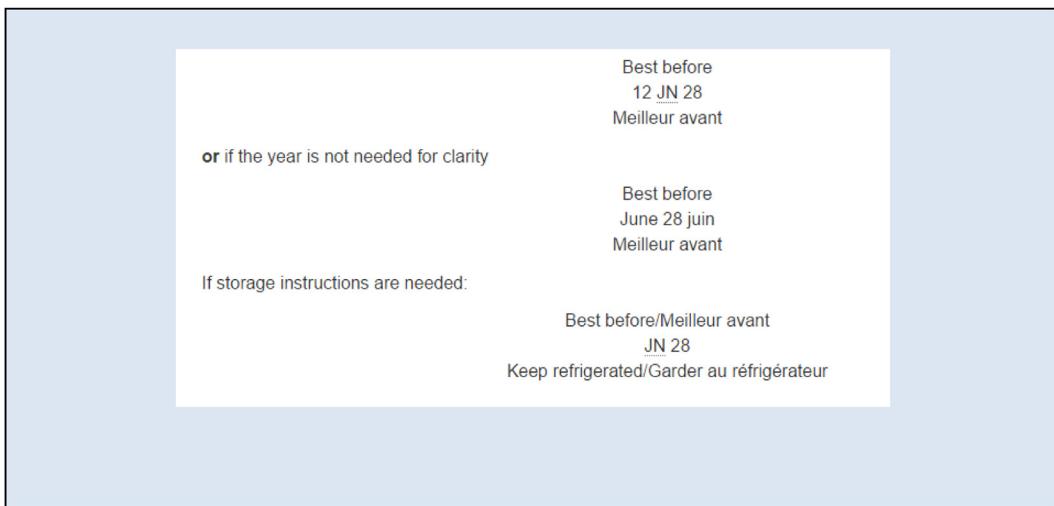


FIGURE 7.19 Examples of acceptable durability declarations for foods exported to Canada. Source: <http://www.inspection.gc.ca/food/requirements/labeling/industry/date-markings-and-storageinstructions/eng/1328032988308/1328034259857?chap=2>.

FIGURE 7.20 The symbol for irradiated products.



of wholly irradiated foods with both a written statement such as “irradiated” or “treated with radiation” or “treated by irradiation” and the international symbol shown in Fig. 7.20 on the PDP at the correct size as specified by the regulations. When there are irradiated ingredients accounting for 10% or more in the final product, they must be identified in the list of ingredients as irradiated (Canadian Food Inspection Agency CFIA, 2019f).

The labeling of irradiated food is not limited to the package but should extend to the shipping containers housing the products en route to the final destination for sale to consumers. These are also required to bear the identification of wholly irradiated foods with a written statement such as “irradiated” or “treated with radiation” or “treated by irradiation” but are not required to bear the international symbol.

Nutrition labeling

The Nutrition Facts table (NFT) must be located on one continuous surface, generally understood to be a flat surface or a slightly curved surface that is unbroken or

uninterrupted by defined edges, etc. The table is not allowed to continue over edges and corners onto a second surface or panel and must have the same orientation as the other information on the label when there is sufficient space ([Canadian Food Inspection Agency CFIA, 2019g](#)). It may however be oriented in another manner when there is otherwise insufficient space available, provided that the product will not leak out or be damaged when the package is turned to view the table. The NFt should be visible under regular conditions of sale, i.e. the outer package should not have to be manipulated in order to view the table.

The format and presentation of the NFt are specifically prescribed ([Canadian Food Inspection Agency CFIA, 2019h](#)) and there is no provision for the use of languages other than the official languages (French and English) within the table. The NFt must list the required information in the correct order, using approved nomenclature, units, rounding rules and the appropriate format. The table should provide information on the energy (caloric) content and twelve (12) nutrients, in a specific amount of the product. There is also a prescribed way for presenting the nutrition facts table, but each format should allow for comparison among packaged foods at the point of purchase. Certain foods are exempt from nutrition labeling but may voluntarily display the Nutrition Facts table which should be compliant with the requirements of the regulations. [Fig. 7.21](#) shows the mandatory

Nutrition Facts	
Valeur nutritive	
Per 1 cup (250 ml) pour 1 tasse (250 ml)	
Calories 110	% Daily Value* % valeur quotidienne*
Fat / Lipides 0 g	0 %
Saturated / saturés 0 g	0 %
+ Trans / trans 0 g	
Carbohydrate / Glucides 26 g	
Fibre / Fibres 0 g	0 %
Sugars / Sucres 22 g	22 %
Protein / Protéines 2 g	
Cholesterol / Cholestérol 0 mg	
Sodium 0 mg	0 %
Potassium 450 mg	10 %
Calcium 30 mg	2 %
Iron / Fer 0 mg	0 %

*5% or less is a little, 15% or more is a lot
*5% ou moins c'est peu, 15% ou plus c'est beaucoup

FIGURE 7.21 Canadian bilingual label standard format nutrition facts table. Source: CFIA, <http://www.inspection.gc.ca/food/requirements/labeling/industry/nutritionlabeling/nutrition-facts-table/eng/1389198568400/1389198597278?chap=1>.

TABLE 7.11 Point size measures for the wording on Canadian labels.

Type size	Leading size	Rule	Indents/spacing
6 point = 2.12 mm	9 point = 3.17 mm	0.5 point = 0.18 mm	3 point = 1.06 mm
8 point = 2.82 mm	12 point = 4.23 mm	1 point = 0.35 mm	5 point = 1.76 mm
13 point = 4.59 mm	14.5 point = 5.12 mm	2.5 point = 0.88 mm	6 point = 2.12 mm

information which must always be present in the NFT and the order in which it should appear. Generally, any voluntary information declared maybe presented within or outside of the table. Additional information may be declared and is especially required once a claim is made about the nutrient mentioned.

As required by the regulations, the characters within the nutrition facts table should not be decorative and should be presented in single standard sans serif font, an example of which is Helvetica. The characters must be displayed such that they never touch each other or the rules – the horizontal and vertical lines of the table. The requirements for font size and width are set out in the regulations for all formats of the NFT ([Canadian Food Inspection Agency CFIA, 2019h](#)). The table below indicates common point size measures in the standard formats of the NFT ([Table 7.11](#)).

There are three basic formats for the presentation of the nutrition facts table: basic, horizontal and linear. There are also specialized formats used in special cases, including:

- Simplified formats
- Dual formats for
 - Food requiring preparation
 - Different amount of food
- Aggregate formats
 - Different kinds of food (for each food in an assortment)
 - Different amounts of food

The main differences in the labels compliant with US regulations versus those compliant with Canadian regulation include but are not limited to the following.

- Even though the quantity of *trans fat* is required on both labels, a reference standard was not developed for the sum of saturated and trans fat and, as a result, no percentage daily value (DV) is required ([Canadian Food Inspection Agency CFIA, 2019i](#)).
- Although required by both countries, percent DVs for mandatory vitamins and minerals are based on Reference Daily Intakes/Reference Amounts Customarily Consumed (RACC) in the US and Recommended Daily Intakes for Canadians ([Health Canada, 2006, 2016](#)).
- The rounding rules for certain components of the foods that should be included in the nutrition table are different between countries.
- Servings per container may be expressed as “per”, “serving” or “serving size” (in addition to the French equivalent). Household measures should be declared with metric values in brackets using the bilingual abbreviations (e.g. mg, g, mL).

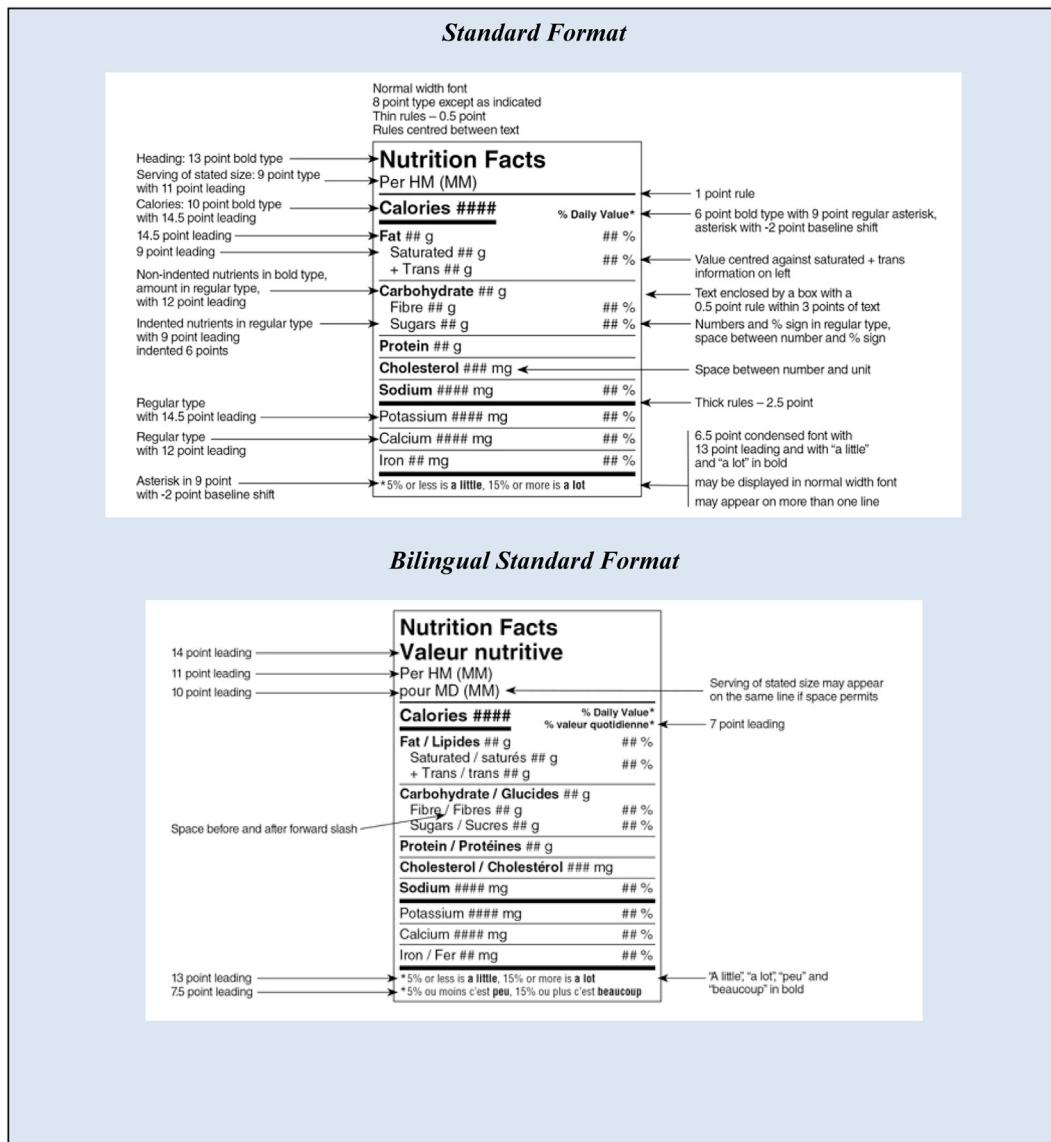


FIGURE 7.22 Standard & bilingual standard format for the nutrition facts table showing the mandatory elements and required presentation. Source: <https://www.canada.ca/en/health-canada/services/technical-documents-labeling-requirements/directory-nutrition-facts-table-formats.html>.

The Food and Drug Regulations (FDR) defines the manner in which energy content and nutrient values should be declared. It is important to note that the requirements are different for different categories of products such as simplified formats, pre-packaged foods for children under two years of age, pre-packaged foods for use in manufacturing other foods,

foods for commercial and industrial enterprises or institutions, as well as small packages (< 100 cm²). The manufacturer should ensure that they are familiar with the requirements applicable to their product. Generally, the information required for the standard and the bilingual standard format of the Nutrition Facts table are indicated in Fig. 7.22. The bilingual format uses the same specifications as for the standard format except as otherwise indicated. The order of languages may be reversed from the order shown in Fig. 7.22.

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