Preventing losses and preserving quality in food cargoes

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When perishable foods are carried from producers to consumers, they are expected to withstand the vagaries of transport across considerable distances. Their journeys vary from simple one-mode carriage from farm to market, to complex moves involving lorries, storage warehouses, processors, refrigerated containers, feeder ships and carrier vessels, ending with handling by the consignees beyond the port. Yet, carriers, shippers and consignees and their insurers have all experienced the arrival at destination of perishable cargo that was not of the quality anticipated.

Perishable foods must withstand complex transport from producer to consumer - Les denrées périssables doivent supporter des modes de transport complexes du producteur au consommateur - Los alimentos perecederos deben resistir un transporte laborioso desde el punto de producción al de consumo

Preventing cargo biodegradation

Biodegradation of perishable foods takes place naturally unless some stratagem is adopted to prevent or delay this process, Perishable foods can, for example, be frozen, chilled, dried or placed in ambient - or controlled-atmosphere storage (see Table).

According to international agreements, frozen products should be held at temperatures lower than -12°C, at which significant biodegradation cannot take place (Economic Commission for Europe, 1991; Council of the European Communities, 1991), When product temperature rises above the -12°C threshold for carriage the risk of biodeterioration becomes greater, and at about -10°C actual biodeterioration can begin, with eventual detectable effects.

Many products are carried chilled (Economic Commission for Europe, 1991), The respiration of fruits and vegetables generates heat, uses oxygen and creates carbon dioxide and water vapor, and ethylene gas may be produced which accelerates ripening, Chilling slows these processes, The aim is to reduce the product's temperature and maintain it at the lowest possible value without causing damage.

Controlled-atmosphere carriage is used with respiring fruits, such as bananas, where both the temperature and the gas composition in contact with the product must be held very precisely to ensure that ripening does not occur in an uncontrolled way, Both chilling and atmosphere control are delicate procedures demanding fine control.

Dried products can remain stable, without significant biological activity, but they do deteriorate if they lack appropriate packaging to prevent them from absorbing or releasing water vapor, If bulk products, such as grain, that cannot be packaged readily are loaded at high ambient temperature, the water content should be reduced more than is necessary at lower temperatures to maintain product stability (Milton and Jarrett, 1970; Milton and Pawsey, 1988).

The stability of other products when stored under ambient conditions is largely determined by their prior processing and packaging, Sterile packaged products, such as canned foods, are stable over a wide temperature range.

Packaging and transportation needs

Some products, such as grains, may be transported dry in bulk, while others, for instance, fish, may be conveyed wet in bulk in the deep holds of sea-going vessels. Tuna frozen at sea may be stacked up fish on fish in the refrigerated hold of a mother vessel, unprotected from handling, the surrounding fish or the handlers. Other perishable cargoes are packaged in units in cartons, bags, boxes or polyethylene or may be palletized before loading. Many such cartoned products are then dispatched in 20 - or 40-foot containers.

To protect the food, packaging has to be suitable for the purpose, the duration and the complexity of the storage and journey. Suitable packaging is more likely if the selling and buying parties make a contract before the product is transported. Much produce, however, is sold after manufacture and packaging to buyers who do not specify how it is to be protected en route to destination. This oversight can result in disputes when the product arrives.

A 20 - or 40-foot container provides considerable advantages over bulk transportation since the control over the conditions for perishable products is potentially greater, raising the total product security. A refrigerated or controlled-atmosphere container can carry cargo under pre-set conditions, and if loss of control occurs it may be limited to one unit, However, one container load is not as valuable as a hold full of material, so insurers may have less incentive to investigate damage claims for a single unit.

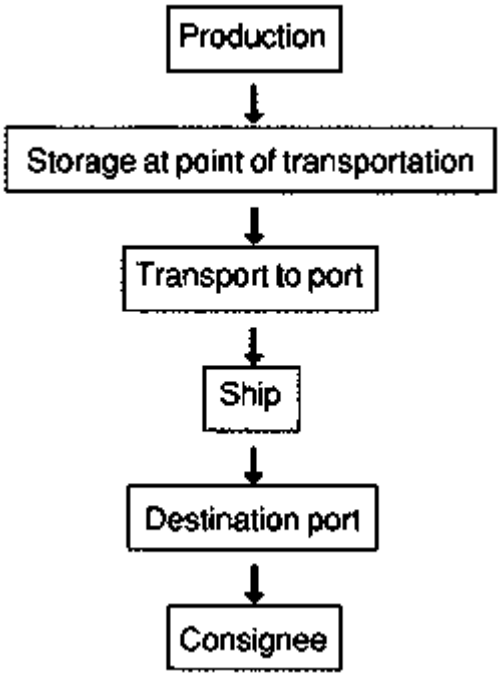
The duration of journeys can vary tremendously from a few days (as with a fresh chilled vegetable) to a period of months (as in the case of a block of frozen fish) (Figures 1 and 2). A perishable commodity may spend time at container terminals or in warehouses which may be owned and managed by different companies, each following instructions for carriage and passing the product to the next carrier or storage facility, Contractual and legal relationships determine the levels and limitations of responsibility for the commodity at any one time.

TABLE Examples of perishable cargoes

Frozen	Chilled	Controlled atmosphere	Dried	Ambient or air-conditioned storage
Fish and fish products: IQF[a] shrimps and prawns, surimi, farmed salmon, whole and fillets	Fish (on melting ice)	Fruit: bananas, avocados	Herbs	Chocolate
Meat	Meat	Some meats	Mushrooms	Processed products in cans: fish, meat, vegetables, fruit
Vegetables: IQF asparagus, mushrooms	Fruit: grapes, apples, pears, nectarines, plums		Beans	Wine
Fruit: IQF raspberries, blackberries	Fruit juices		Grains	Fish meal
Block frozen raspberries	Vegetables: asparagus, onions, garlic, salad crops, peas		Milk powders	Fermented fish and vegetables
	Flowers			

[a] IQF = individually quick-frozen.

Stages in a simple journey - Diverses étapes d'un trajet simple - Etapas de un viaje en un solo sentido



Quality

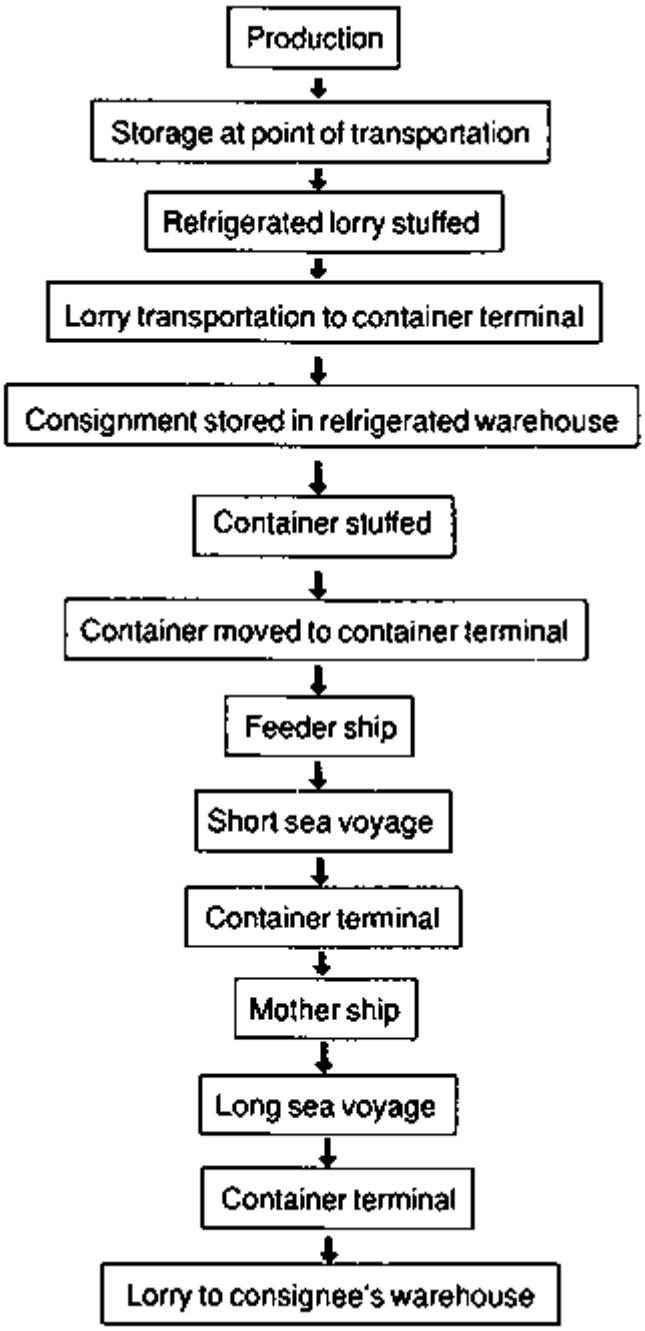
The overall quality of a product is judged by a number of parameters, Perishable products can be defined by their stable quality features and by those that change.

For instance, for fruit the parameters are size, ripeness and fullness. For salmon fillets, visible features such as the pinkness of the flesh, the absence of blood spots, the texture and the absence of gapping in the flesh are important, Other parameters can be considered; for example, the surface dryness of soft fruits can influence the probability of mould growth.

Defining information such as the weight of the unit and the number, size and grade of the items is stamped on the outer packing, and these features do not change. If the date of production is included on the packaging it implies that the goods are perishable and that some of the quality features change with time.

Good quality is judged by freshness, expected appearance, smell and texture. Since these features change with time, the maintenance of good quality depends on retarding this natural progression as much as possible. The range of changes varies among products: in fats unacceptable flavour changes occur because of oxidation; in fruits ripening causes changes in colour, texture and sweetness; in head-on, shell-on prawns blackening can occur; in meat the slow activity of enzymes causes texture changes; in produce held at temperatures above -10°C microorganisms can begin to grow and cause change and quality loss; in grains and other dry products absorbed moisture can allow mould to grow. Microorganisms affect many products and may cause soft rots. Fresh vegetables naturally dehydrate (wilt), and the loss of crispness is a loss of quality,

Stages in a complex journey - Diverses étapes d'un trajet complexe - Etapas de un viaje de ida y vuelta



Quality loss

Quality loss is judged in terms of demonstrable and inferred defects. Some faults are indisputable even to the untutored eye, By sorting, the proportion of food damaged can be assessed and the defective product may still be acceptable to a section of the market. Quality loss is also judged by interpretation of signs that indicate that the product was handled less than optimally, If the temperature recorder of the container of cargo shows deviations from the requested temperature it is inferred that the product is damaged, and the cargo is examined for visible defects.

Physical changes may indicate how the product was handled en route. For example, frozen products may show ice formation which indicates that temperature fluctuations in refrigerated storage have occurred, causing water to sublime from the product and then to recondense inside the packet, This leads to dehydration of the product,

known as freezer burn, Severe temperature abuse may be evident through signs of thawing and refreezing, seen when, for example, individually quick-frozen items stick together.

To avoid poor practices and give guidance for improvement, FAO and the World Health Organization (WHO) have developed a series of guidelines and codes of practice both to protect the quality of products and to ensure that temperature control can be maintained and appropriately monitored (Codex Alimentarius Commission, 1993,1994), The Codex Alimentarius Commission and the European Economic Community (EEC) (now the European Community (EC)) have published examples of the controls required and recommended sampling methods (Codex Alimentarius Commission, 1994; Commission of the European Communities, 1992a, 1992b).

When does quality loss arise?

Any perishable product has a finite life span under given conditions which is divisible into two stages (Figure 3), During the period of apparent quality stability, from X to A, the quality is in fact reduced to a point (A) where there are noticeable changes in one or more of the quality parameters. During the second stage, from A to B, the changes continue, eventually rendering the product unacceptable at B.

Real and apparent quality loss with time - Perte de qualité réelle et apparente au fil du temps - Pérdida de calidad real y aparente con el tiempo

Problems may arise under three circumstances:

- when the product is transported very near the end of period X-A;

- when the rate of quality loss is accelerated, that is the slope of X-A (which is primarily temperature dependent) is steepened and the product moves more rapidly from period X-A into period A-B;

- when a product is already in period A-B when the journey begins.

While quality loss occurs naturally, the time it takes for a perishable product to become unacceptable depends on handling, storage and temperature experience, Ideally a product should arrive and be distributed completely within period X-A, Even under optimal conditions, time is not on the side of perishable products, and they are more likely to arrive in an acceptable condition if only a short time within this period has elapsed prior to dispatch.

Need for quality definitions

In a contract between a seller and a buyer each has to know the quantity, price, availability and quality of the product that is changing hands, Does the supplier guarantee shipment of goods that leave the factory at a certain quality? Does the buyer expect that those goods will be identical in terms of quality on arrival? Does the buyer inform the seller of the acceptance criteria and build in some tolerance for quality loss with time? Does the carrier, working between the buyer and the seller, have an interest in knowing what the quality is?

In some countries the export quality of certain goods is controlled, particularly if the country wishes to emphasize an image of quality in selling, For some goods an

accompanying health certificate or phytosanitary certificate may be required to control the transmission of disease to human beings, animals or crops. Some countries have instituted systems of quality management in particular sectors of the food industry (Garrett and Hudak-Roos, 1992; White and Noseworthy, 1992; Lima dos Santos, 1992), generally drawing on internationally recognized standards of good management practice such as ISO 9002 (International Organization for Standardization, 1994), Such cross-industry systems are intended to raise and ensure the quality of the products.

Suppliers can often use quality control and quality assurance methods, such as those developed for seafoods by FAO (1994), to ensure that goods meet a definable standard, The factory should be able to certify the quality of each consignment; however, the terms may be limited, covering only certain parameters and omitting those that are perceived as crucial at the time of receipt.

Certainly the standards for all principal foods described in the Codex Alimentarius provide a fundamental basis for mutually understood product descriptions. The standards define limits for composition and contaminants and in some cases list the tolerances for defects (Codex Alimentarius Commission, 1990).

When the sellers and buyers are known and the goods travel familiar routes, the opaqueness of quality definition on paper may seem unimportant. However, with goods travelling greater distances and being bought by large, powerful, possibly multinational interests, the nature of trade is changing, The personal element may be diminishing, and the formal description of goods is becoming more essential. Many goods are sold through markets, and at the time of production the buyer may be unknown.

Where the goods to be purchased are of the highest quality and command the highest price, the seller and the buyer may work together (Spriegel, 1993). In fact, good manufacturing practice (GMP) would demand the development of a manual for use between them which would provide details of many features and which might use photographic data to define some parameters. However, if a declared definition of the product's quality is lacking, situations arise when the receiver's perception of tolerable quality loss differs from that of the sender.

Between the seller and the buyer is the carrier. Worldwide, the costs and availability of transportation as well as levels of assurance of quality maintenance vary (Gill and Phillips, 1993), Some but not all transporters develop considerable expertise in the carriage of products. If product quality loss occurs in consignments, determination of when loss has occurred is crucial in dispute settlement. Thus, expertise and good management practices at all stages are vital.

Dispute settlement

The companies that produce the perishable commodities are most familiar with them and are best able to define their qualities, The quality definition should be a confidential matter between the seller and the buyer; the properties need not be declared unless a dispute arises, The carriers should not need to know the condition of individual cargoes because the shipper should declare that the goods are fit for transportation under specific carriage conditions of certain limited duration. The willingness of a producer/shipper to declare fitness for carriage should be a strong indication of the level of confidence in the product and its quality, temperature and durability.

If a declaration of fitness for carriage is received, the carrier only needs to know whether the packaging is intact and appropriate for the anticipated handling and whether the product is received within previously agreed temperature tolerances. The carrier should discern whether the conditions requested are adequately described; if not, a risk is involved in the decision to accept the cargo. The carrier should know whether it can provide the conditions requested. Finally, the receiver should be able to demonstrate that the quality received does or does not match expectations.

Packaging should be suited to the purpose, duration and complexity of the storage and journey - Le conditionnement doit être adapté au but, a la durée et á la complexité de l'entreposage et du voyage - El envasado ha de ser adecuado a la finalidad, duración y complejidad del almacenamiento y el viaje

Relationships among interested parties - Relations entre les parties intéressées - Relaciones entre las partes interesadas

If a dispute about quality arises, the shipper should be able to demonstrate the validity of the claim of fitness for carriage; the carrier should be able to demonstrate adequately that it has provided the requested conditions of carriage; and the consignee should be able to demonstrate that the product has moved outside its acceptable quality range in relation to contractual description between shipper and consignee.

The settlement of responsibility for quality loss should depend on the documented evidence of quality control at all stages between production, transportation and receipt of goods (Figure 4), In other words, total quality management (TQM) is needed throughout the transportation chain and positive systems of control must be adopted.

Successful implementation of TQM systems requires effective training of key personnel within food and carrier companies and of quality standards enforcement officers, Furthermore, to ensure that products leave the hands of the producer in defined condition and pass to the carrier in the same defined condition also requires independent assessment by surveyors holding internationally recognized

qualifications, conversant in quality management techniques and capable of assessing the risk to products involved in individual operations, This observation is in line with the 1991 recommendations that FAO continue to develop procedures for inspection and sampling and help developing countries to improve import/export controls (Lupien, 1993). Independent assessors would verify the quantity, the condition and integrity of the packaging, the presence of any visible defects, the temperature conditions under which the product was loaded and the temperatures of the cargo itself.

Post-shipment surveys are commonplace, but pre-shipment surveys are less common, not least because of the cost. However, from the viewpoint of cargo interests and carriers' insurance interests, pre-shipment surveys under the conditions described would lead to greater levels of certainty that perishable commodities could be successfully carried, and would contribute greatly to the attribution of responsibility should disputes arise.

There is a need for specialist knowledge in the hands of independent assessors, who could also be surveyors, to pursue on behalf of insurers the validity of producers' records leading to the declaration of fitness for carriage, A successful assessment would require detailed specialist knowledge of the nature of food commodities and the hazards to which they are subject, and could lead to a new breed of independent professionals capable of investigating and protecting the interests of producers, carriers or consignees.

Loss prevention strategies

Globally, trade in foods takes place in the framework of broad national, trading block and international agreements such as the General Agreement on Tariffs and Trade (GATT). However, the national food safety laws of importing countries, which primarily have the role of protecting the safety of consumers, can act as non-tariff barriers to trade, This has long been recognized by the Codex Alimentarius Commission, which has been the main world body working for the technical harmonization of international trade agreements to ensure that their use is equitable and non-discriminatory (Lupien, 1993).

There is still much to be done in the area of avoidance or satisfactory settlement of disputes regarding quality of imported foods, The interested parties - the producer, the carrier and the receiver (consignee) - need to agree on the limits of their responsibility, yet each should be able to demonstrate due diligence in its execution. The implementation at points of production of systems of quality management compatible with the standards of the ISO 9000 series could be appropriate and should include control of product identification, product traceability and non-conforming products, The well-accepted Hazard Analysis and Critical Control Point (HACCP) system for food production is among the available tools. The ideas contained in this system could be extended to anticipated or imputed hazards in the chain of transportation of perishable foods (Pawsey, 1994,1995).

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