Opportunities into Extending the Shelf Life of Imported Pelagic Fish in Egypt: A Fact-Finding Study

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Acronyms

EFSA	European Food Safety Authority
EOS	Egyptian Organization for Standards & Quality
FFA	Free Fatty Acids
MTI	Ministry of Trade and Industry
NVWA	Netherlands Food and Consumer Product Safety Authority
p-AV	p-Anisidine Value
PUFAs	Polyunsaturated Fatty Acids
PV	Peroxide Value
RSW	Refrigerated Seawater
TBA	Thiobarbituric acid
TBARS	Thiobarbituric acid reactive substance
TVB-N	Total Volatile Basic Nitrogen

1 Introduction

This report is presented by consultants Megapesca Lda of Portugal, in response to a request by the Embassy of the Netherlands in Egypt for expert services in relation to a study on the export of frozen small pelagic fish from the Netherlands to Egypt. This trade flow delivers considerable benefits to Dutch fishery business operators. However, several operators also report difficulties in complying with Egyptian import standards, particularly in relation to shelf-life limitations.

The Embassy of the Netherlands in Egypt therefore requested expert services to undertake a comparative analysis of standards applied to international trade in such products, a review of their scientific basis and a mapping of options for improving value added without compromising product safety and quality. The study Terms of Reference and deliverables are shown in Annex 1.

2 Activities undertaken

The study commenced on 5th February 2024 and is to be completed by 15th April 2024.

Following initial consultations with the Embassy of the Kingdom of Netherlands in Cairo and Dutch fishery operators, the consultant undertook a short period of desk work at the home office to review relevant documentation and plan activities for the field mission.

A field mission to Egypt was undertaken from 9th February to 8th March 2024. During this period the consultant met with relevant fishery business operators engaged in import, processing, and marketing of small pelagic fish. In addition, relevant Egyptian institutions were visited to discuss issued related to the shelf life of imported fish, standards, and their implementation. The consultant coordinated the holding of a workshop for 25 persons held at the Netherlands Embassy on 7th March, with the objective of presenting the main findings and recommendations of the mission. This is described in more detail in Section 7. A full list of persons met during the mission and organisations visited is shown in Annex 2, along with participants in the workshop.

The consultant concluded the mission with the preparation of the final report at the home office between the dates of 11th to 19th March 2024.

3 Gap analysis

This describes the main features of the production of and trade in pelagic fish exported by European pelagic fishery operators to Egypt and explores in more detail some of the issues which give rise the constraints experienced.

3.1 Production of small pelagic fish by the Dutch fleet

The Netherlands operates a significant fleet of eight industrial mid-water pelagic freezer trawlers which fish in the international waters of the NE Atlantic, as well as the fishing zones

of the EU, Norway and Mauritania[1]. Key operators include Parleviet & Van der Plas, Cornelis Vrolik and W.van de Zwann. Some of these operators also have shareholdings in fishing companies operating pelagic freezers elsewhere in the EU (Poland, Germany, and Lithuania), and the Dutch interest in the Egyptian market is therefore much greater than represented only by those vessels flagged to the Netherlands.

All of the Dutch operators are members of the EU Pelagic Freezer Trawler Association, which is based in Zoetermeer, the Netherlands. These vessels operate in the EU, Norwegian waters, and international waters of the NE Atlantic and also fish in the waters of Mauritania under an EU Sustainable Partnership Agreement. The vessels have modern processing and storage facilities onboard, which include refrigerated seawater storage tanks (0°C to -1°C), plate freezing and cold storage (-18°C and below).

The Dutch pelagic catches are comprised of four main species: herring (*Clupea harengus*), mackerel (*Scomber scombrus*), horse mackerel (*Trachurus trachurus*) and blue whiting (*Micromesistius poutassou*). There are also catches of the silver smelt (also known as Argentine) (*Argentinua silus*). All of these are the species except blue whiting are of interest to the Egyptian market. The catches of these species over the period of years 2000 to 2022 are shown in Figure 1. In recent years annual catches have been in the region of 190,000 tonnes. In 2022 about 40% of the catch (by weight) was herring, and 14% was mackerel (Figure 2).

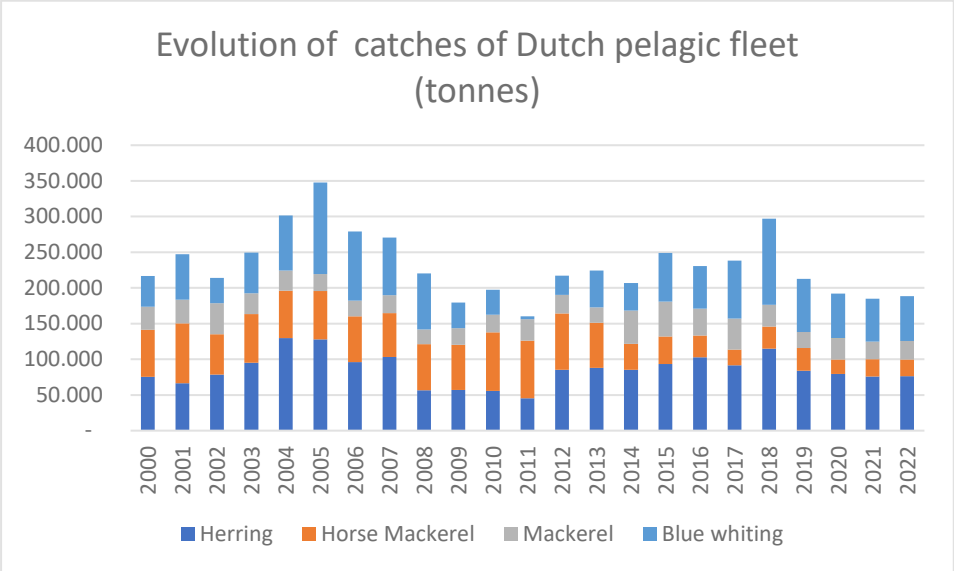

Figure 1: Catches of main species small pelagic fish by the Dutch fleet 2000-2022

Source: Eurostat Data Browser
https://ec.europa.eu/eurostat/databrowser/view/fish_ca_main/default/table?lang=en

[1] Scientific, Technical and Economic Committee for Fisheries (STECF) - The 2023 Annual Economic Report on the EU Fishing Fleet (STECF 23-07)

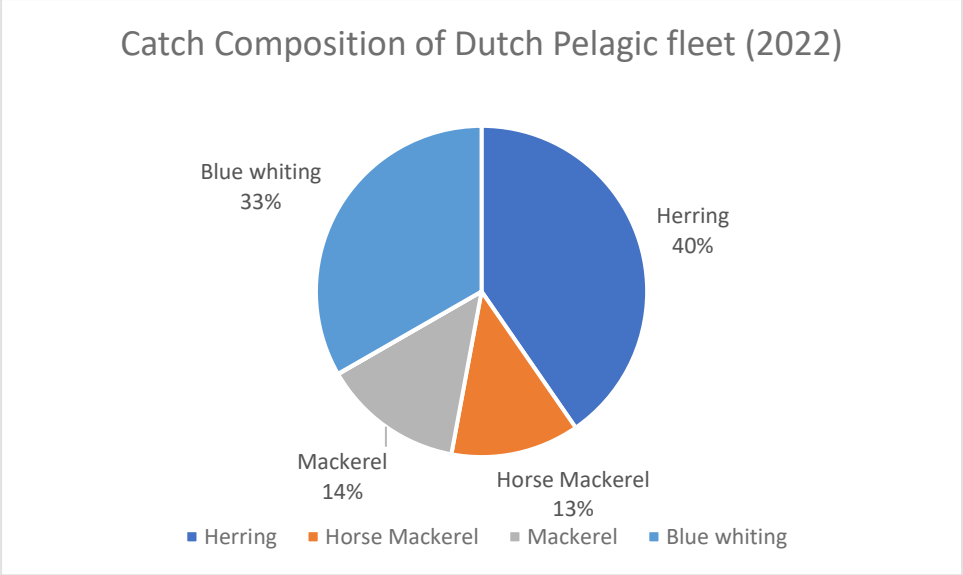

Figure 2: Composition of catches of small pelagic fish by the Dutch fleet 2022

Source: Eurostat Data Browser
https://ec.europa.eu/eurostat/databrowser/view/fish_ca_main/default/table?lang=en

3.2 Exports of fish from Netherlands

The Netherlands is a major fish exporter. In 2022 the Netherlands exported over 600,000 tonnes of frozen fish, worth EUR991 million. Most of this volume comprises small pelagic fish (including fish caught by other EU and UK flagged vessels, some of which have Dutch interests, landing in Dutch ports). About 53% of the exports are within the EU. Other than intra-EU trade, the major export destinations include Nigeria (about 20% by value), Egypt (8%) and China (3%). Egypt is therefore a strategically important market for Dutch frozen fish exporters, accounting for between 8 and 14% of the exports by volume and 6 and 11% by value of exports over the period 2019 to 2022.

According to EUROSTAT, between 2018 and 2022 the annual total EU exports of frozen fish to Egypt averaged EUR106 million, of which the Netherlands accounted for 62% (EUR68 million) as shown in Figure 3. This corresponds to an annual tonnage of 73,689 tonnes. Almost all of this (92%) comprises small pelagic fish, with herring being the most valuable product (57% by value), followed by horse mackerel (26%) and mackerel (19%). In fact, the Netherlands accounted for 97% of the herring and 51% of the mackerel supplied by the EU to Egypt during this period (Figure 3).

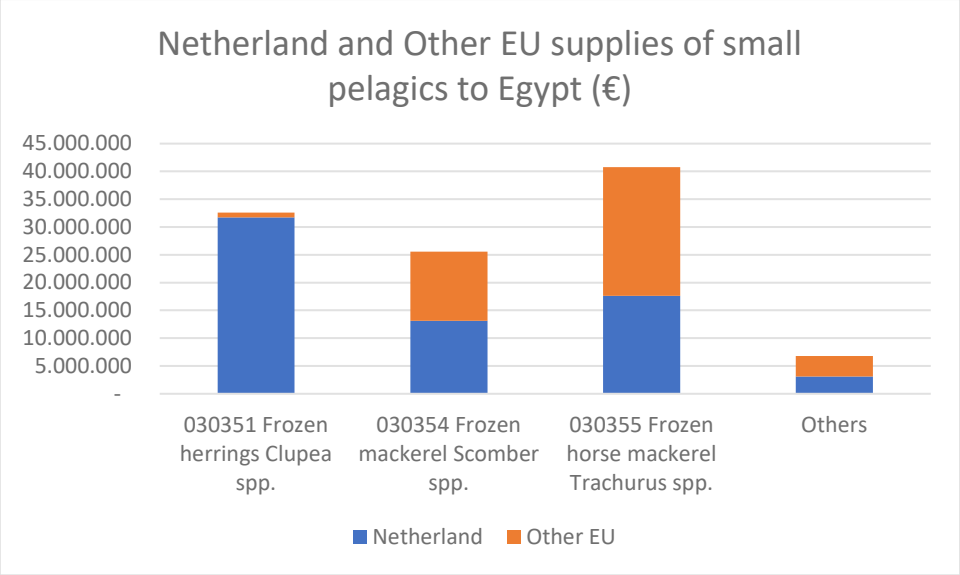

Figure 3: Netherland and Other EU annual supplies of small pelagic fish to Egypt 2018-2022

Source: EUROSTAT Database, 2024

3.3 Typical production and handling practices

The typical procedures for operation of mid-water pelagic freezer trawlers such as those operated by the Dutch fleet, reflect many years of development and investment in fish handling and processing technology to achieve optimal efficiency and quality.

On hauling the net, fish are discharged in bulk to **pre-chilled** tanks in which refrigerated seawater (RSW) is recirculated (at a temperature of 0-1°C). This rapidly reduces the temperature of the fish and provides a stable environment for holding the product pending freezing. Typically, the residence period in the RSW tank is short (e.g. 2-3 hours to chill, but it can be longer depending on catch rates). The fish is then transferred to the processing deck, where it is sorted into species and weight grades, before freezing (mostly) using vertical plate freezers. This method of freezing ensures effective heat transfer between hydraulically operated aluminium plates containing the refrigerant and the fish in contact with the plate. Glaze (fresh potable water) is not usually added unless there is a specific request from certain clients. Freezing is to a target of -18°C at the centre of the block, which usually takes 2 to 3 hours, after which the frozen block of fish is released from the plates before packing in polythene bags, sealing, and inserting into a carton. Block size is 20 or 24kg, depending on the vessel and freezers used. The cartons are labelled with a code identifying species, vessel and production date and transferred to a cold store on the vessel, which is held at a temperature of between -18°C to -23°C onboard until discharge. The whole process is highly automated and in normal operations the product is typically not touched by human hand. Vessel trips are usually 3 to 4 weeks, during which catches can be from 2,000 to 5,000 tonnes. The typical process flow is shown in Figure 4:

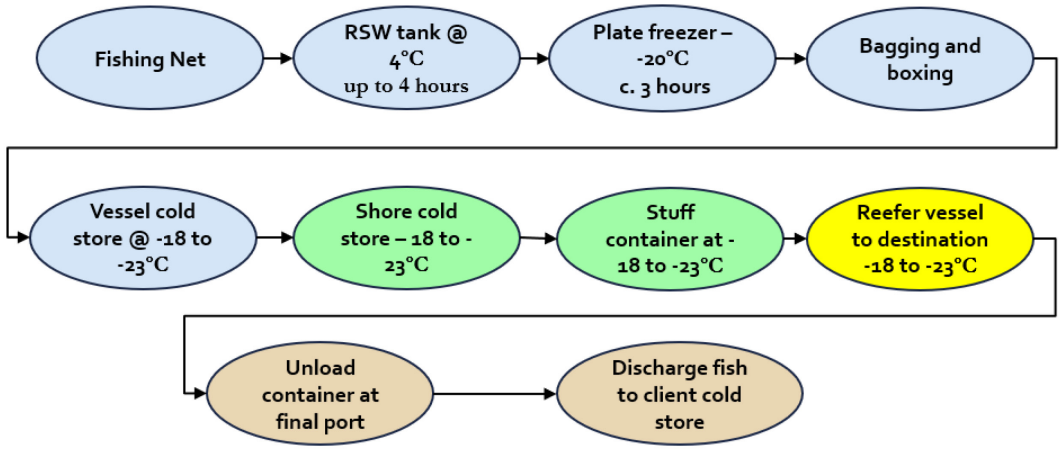

Figure 4: Typical process flow for production of frozen at sea small pelagic fish

Most of the landings (even of fish caught in distant waters) are made in the Netherlands (Ijmuiden or Scheveningen) where the cartons are discharged directly to cold storage. The products are held in cold storage until consigned to the clients. The temperature of the cold storage is in the range of -18°C to -23°C. It is important to note that products are standardised and supplied from cold storage. They are not caught and packed to order. The Dutch operator does not know the final destination of any batch of fish at the time of discharge to shore.

When an order is received, product is withdrawn from the cold store and prepared for transport. Historically bulk transport in reefer vessels was typical, but transport is now mostly containerised. Operators report that no bulk trade with Egypt has taken place since around the year 2000. Typically, containers operator at a set point of about -20 to -23°C depending on specifications. The typical journey time from Netherlands to Egypt is 3 weeks, depending on the route. The main ports of discharge are Alexandria and Port Said.

3.4 The Egyptian market for imported frozen fish

Egypt, with a population of over 100 million people is not self-sufficient in fish, relying on imports of frozen small pelagic fish for direct consumption, and of fishmeal to supply feed for the rapidly developing aquaculture sector. Traditionally, Egypt imports significant quantities of fish and fishery products (HS Code 03, including crustacea and molluscs). Table 1 shows that most of this is frozen within the category HS0303. Note that this Table excludes canned fishery products under HS codes 1604 (such as canned tuna and sardines) and 1605 (such as canned shellfish).

Table 1: Imports of fishery products under HS Code 03 by Egypt (2018 to 2022)

		US$ 1000				
Code	Product label	2018	2019	2020	2021	2022
'0301	Live fish	75	41	46	70	269
'0302	Fish, fresh or chilled (excl. fish fillets and other fish meat of heading 0304)	3,151	1,198	720	650	630
'0303	Frozen fish (excl. fish fillets and other fish meat of heading 0304)	517,620	583,319	487,808	339,210	324,079
'0304	Fish fillets and other fish meat, whether or not minced, fresh, chilled or frozen	32,735	37,195	22,345	27,938	40,094
'0305	Fish, fit for human consumption, dried, salted or in brine; smoked fish, fit for human consumption, ...	913	552	461	755	419
'0306	Crustaceans, whether in shell or not, live, fresh, chilled, frozen, dried, salted or in brine, ...	141,461	170,482	154,713	145,290	150,587
'0307	Molluscs, fit for human consumption, even smoked, whether in shell or not, live, fresh, chilled, ...	31,451	31,743	26,525	39,295	33,751
'0309	Flours, meals and pellets of fish, crustaceans, molluscs and other aquatic invertebrates, fit ...	-	-	-	-	5
	Total	727,406	824,530	692,618	553,208	549,834

Source: ITC Trade map database

A more detailed breakdown in Table 2 shows that most of this total (95-99%) is comprised of frozen fish and fishery products, with the majority in the form of frozen whole small pelagic fish, frozen fish fillets and frozen crustacea as shown in Table 2 below. In general terms, the imports of fishery products can be expressed as including 6 main groups: small pelagic fish (herring, mackerel, horse mackerel and sardines), crustacea (i.e. shrimp), white marine fish, catfish fillets, salmon, and cuttlefish/squid.

On average the small pelagics make up 45% and shrimp 23% (Figure 5). Small pelagic fish therefore form the majority of the import volume, and comprise Atlantic herring (which is typically salted and smoked whole by Egyptian operators), and mackerel/horse mackerel, mostly used either by the national processing industry (for canning or smoking) or for direct sale via fishmongers and Government cooperative stores (*gameyas*, for which the Government contracts via several national public or private sector suppliers who manage the import procedures).

Table 2: Egyptian imports of different frozen fishery products by value 2019 to 2022

	US$ 1,000				
Product label	**2018**	**2019**	**2020**	**2021**	**2022**
Small pelagics	312,564	347,601	344,747	235,638	218,318
Shrimp& other crustacea	140,154	168,727	154,009	143,149	149,317
Alaska pollack/Pacific cod & similar	164,994	193,228	73,182	70,110	66,366
Salmon	12,739	15,282	10,917	13,873	24,635
Catfish fillets	974	727	1,351	2,996	16,776
Cuttlefish and squid	3,956	25,904	24,928	35,976	21,202
Others	58,249	64,087	80,414	44,296	38,943
TOTAL	693,630	815,556	689,548	546,038	535,557

Source ITC TradeMap Database, 2024

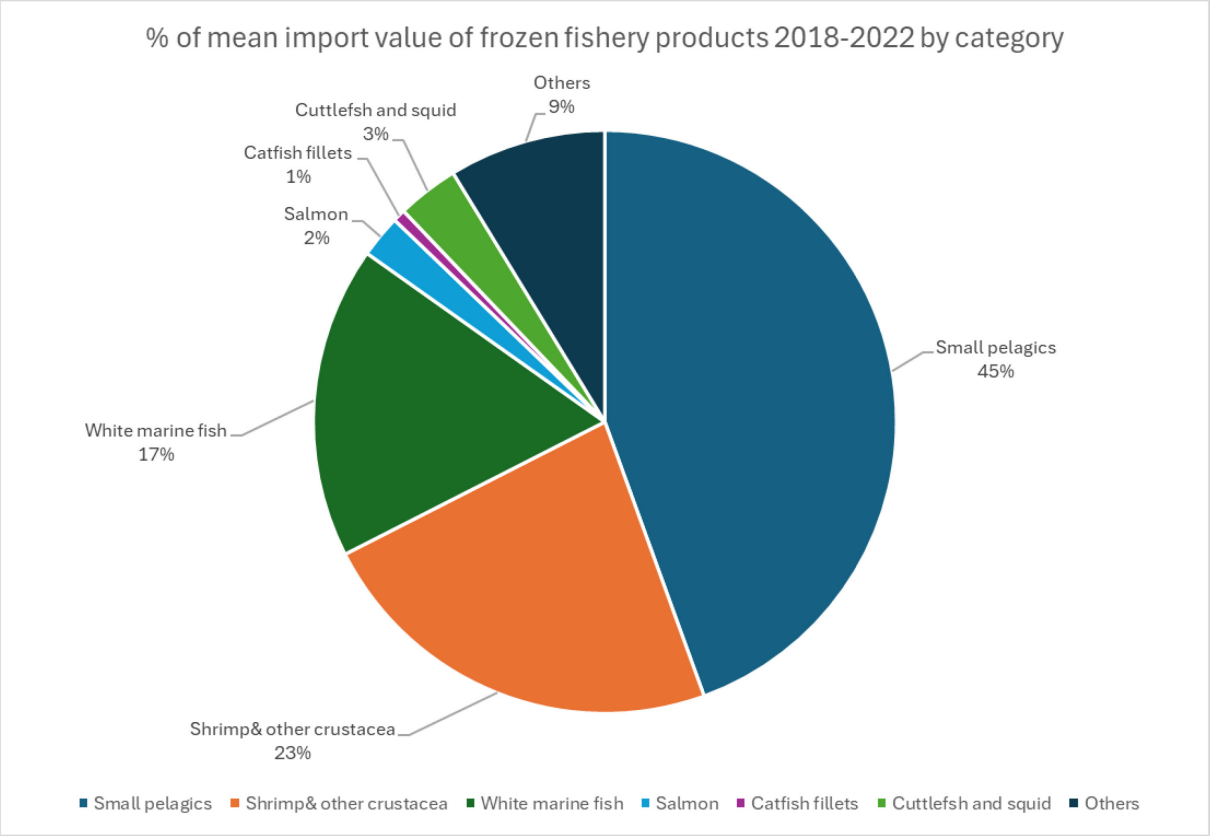

Figure 5: Average imports of frozen small pelagic fish by Egypt from EU/Netherlands (2018-2022)

Source: ITC TradeMap Database, 2024

3.5 Egyptian Standards for the importation of frozen fish

3.5.1 Egyptian standards

Egyptian standards are adopted by the **Egyptian Organization for Standards & Quality (EOS).** The standards are prepared by one of the Technical Committees. There are 29 committees in

the field of food industries, and 5 general committees for engineering, food products, textile, measurements, and chemical sectors. Standards for fish and fishery products are addressed by the Technical Committee for Fish & Fishery Products. However, shelf-life considerations for all foods are addressed by the General Committee for Food Packing, Packaging and Labelling Committee (which receives advice from the relevant commodity committee). The standards, as adopted by the EOS, are essentially voluntary in nature. However, they may be adopted, in whole or in part as regulatory measures, by Decree of the Ministry of Trade and Industry.

The applicable standards to the trade in whole frozen fish are:

- Standard No. 889-1 / 2009 Frozen Fish Part: 1 Whole Fish
- Standard No. 2613-2 / 2008 Shelf Life for Food Products Part: 2 Shelf Life

3.5.2 Standard No. 889-1 / 2009 Frozen Fish Part: 1 Whole Fish

The scope of Part 1 the standard, applicable to: *"Whole fish, gutted or headed which has been quick frozen to -18℃ in the least time possible, and packed in suitable packs to resist dehydration".* Part 2 of Standard ES 889 / 2009 addresses Fish Portions, which includes fillets.

This standard has been amended several times. A summary of the salient provisions of these standards is provided below.

Standard No. 889-1:

Scope/Definition: Whole fish, gutted or headed which has been quick frozen to -18℃ in the least time possible, and packed in suitable packs to resist dehydration

Water used for glazing or washing should be potable water or from clean seawater

Conditions for raw fish (fresh, not contaminated, single species within a pack), free of parasites (dead or alive)

Kept at <18℃
No roundworms in the head
Free of pathogenic microbes
Aerobic mesophilic bacteria < 1million/g
Coliform <100 CFU/g
S.aureus <1000/g
Free from *Salmonella, Shigella* in 25g
Free from:

- *Vibrio parahaemolyticus*
- *Cl.botulism*
- *Listeria*
- *E.coli*

Histamine <10mg/100g of fish muscle for listed fish families (none applicable to farmed species) (no sample >20mg/100g)

Total volatile nitrogen compounds:

- *Sebastes* spp 25mg/100
- *Salmo salar* and *Mugildae, Gadidae* 35mg
- Others 30 mg/100g

- Tri-amino nitrogen (10mg/100g)

- Thiobarbituric acid 4.5 mg malonaldehyde/kg (see below)*

- Residue of pesticides in line with Egyptian specification and Codex Alimentarius Commission
- Limits of heavy metals in line with ESI 2360 (heavy metals in food)
- Veterinary medicines in line with Egyptian specification and Codex Alimentarius Commission
- Radiation in accordance with regulations and Codex Alimentarius Commission
- No more than one defect under Specification 6188 (schemes and criteria for packaged food samples)

Additives shall be in accordance with regulations.
Product free of physical damage
Free of belly burst
Pollutant limits in the product should not exceed maximum limits
Homogeneity of size in the same pack
Free of:

- Dehydration
- Foreign bodies
- Changes in texture
- Parasites
- Abnormal smell and flavour

Labelling

- Suitable packaging
- Packs to be labelled
- In line with ESO 2613 regarding shelf life of food products and ESO concerning labelling of packed food stuffs. The label should state the following:
- Name, address
- Country of origin, importer
- Species name, family
- Type of fish (whole, gutted etc)
- Net weight
- Conditions of storage and handling
- Date of freezing (day/month)
- Expiry date and duration

Inspection and testing in-line with ESO2760 Natural and chemical methods for testing of fish and fish products, Part 1 Frozen Fish.

Microbiological tests should be in line with EOS approved methods

Of relevance, is the specification in the original standard that the maximum level of Thiobarbituric Acid Reactive Substances (TBA) should not exceed 4.5 mg malonaldehyde/kg. This was modified by Decree of the Minister of Trade and Industry and published in the Egyptian Gazette – Issue 26, February 2, 2021. The provision concerning TBA is deleted, and alternative measures of rancidity are specified as follows:

With regards to detecting rancidity in fish and its products, the numbers for peroxide and anisidine mentioned in the international Codex Standard No. 329/2017 are relied upon, regarding fish oils, which are as follows:

- Peroxide number limits are less than or equal to 5 mL active oxygen equivalent/kg of oil
- Anisidine value limits are less than or equal to 20

There is no rationale provided for this amendment. The referenced Codex Standard 329/2017 is applicable only to fish oils only, stating that "*For the purpose of this Standard, the term fish oils refers to oils derived from fish and shellfish".* The consultant considers that it is not valid to apply a Codex standard developed for fish oils to whole fish. This is because fish oils undergo an extraction process which involves heat and pressure and have very different quality characteristics to natural fish oils present in fish.

Whilst the previous rancidity indicator specified before the Standard was amended (Thiobarbituric Acid Reactive Substance -TBARS) is not a perfect indicator of rancidity in fish, neither is the Peroxide No. nor Anisidine Value. TBARS remains as the most commonly used indicator in research studies and the rationale for the 2021 proposal adopted by the Technical Committee to amend the Standard 889-1 is not clear.

Irrespective of the scientific justification for the revisions to the standard, all of these parameters are indicators of rancidity in frozen fish and are particularly relevant for oily fish such as small pelagic species. It is further clear (as shown in Section 5) that oxidative rancidity (however indicated) is, under normal circumstances (i.e. decent quality raw material, stored at a stable temperature $<18°C$) the limiting factor in the shelf life of frozen pelagic fish.

3.5.3 Standard No. 2613-2 / 2008 Shelf Life for Food Products Part: 2 Shelf Life

Standard No.2613 Part 1 sets the general approach of applying risk analysis to the issues of shelf life dating of foods. It states that:

- Food products classified as highly perishable and therefore high risk will be permitted entry to local commerce and (for the case of imports) entry to the country as per Part 2 of ES 2613 (time before expiration date).
- Expiration dates for food products **not** mentioned in Part 2 will be determined by the manufacturer and it shall bear the responsibility for its adequacy.

No.2613 Part 2 lists products considered to be "Highly perishable", to which the standard sets fixed "durability" dates and requirements concerning minimum unexpired shelf life.

Products not listed in Part 2 may bear an expiration date determined by the manufacturer have no minimum requirements concerning unexpired components of the shelf life. Part 2, which has also been amended several times, sets the following requirements for different fishery products:

Table 3: ES2613 Part 2: Durability of Highly Perishable Foods - Fishery Products

Product	STD#	Std. Title	Durability	Package	Remaining Shelf Life*
Frozen fish stored at -18°C					
Smoked fish / cold process	288 / 2005	Smoked fish	5 months	suitable	2.5 months
Smoked fish / hot process			3.5 months	suitable	2 months
Smoked fish / semi hot			3.5 months	suitable	2 months
Shrimp and Shellfish	516 / 1993	Frozen shrimps	8months	Plastic or carton	4 months
Frozen fish	**889-1/2005** **889-2/2005** **889-3/2007**	**Frozen fish**	**6months**	**PE in carton**	**3 months**
Frozen Calamari	2800 / 1995	Frozen Calamari	10 months	suitable	5 months
		Frozen Octopus	8 months	suitable	4 months
Chilled fish stored at 0 – 4 °C					
Salted fish	1725-1 / 2005 1725-2 / 2005 1725-3 / 2005	Salted fish	12 months	suitable	6 months
Caviar	3018 / 1996	Fish Roe and Caviar	6 months - past	suitable	3 months
Fish Roe	3018 / 1996	Fish Roe and Caviar	6 months - UV	suitable	3 months

* minimum unexpired shelf life at the date of import

Frozen fish should therefore have a labelled durability of 6 months from a declared date of production, and a remaining shelf life of minimum 3 months when placed on the market. The requirement in Standard 2613-2 for a remaining shelf life of 3 months is interpreted as applying at the date of import (taken as the date of arrival in an Egyptian port of the transporting vessel).

The consignment is considered to be unfit if these dates are not respected and should therefore in law be condemned and not used for human consumption. It is notable that the shelf-life limit is applicable to **all frozen fish** (which includes both whole fish, under HS code 0303 and portioned and filleted fish under HS Code 0304) even though, as we shall see in Section 5, they have very different shelf-life characteristics.

3.5.4 Application of Egyptian Standards

Egyptian Standards address numerous conditions regarding the quality and safety of different products. Normally, when adopted by the Egyptian Organisation of Standards and Quality, standards are voluntary standards. However, for regulatory controls (including imports), these

become mandatory when adopted through the issue of a Decree by Egypt's Ministry of Trade and Industry (MTI).

Both Standard 8891-1 and Standard 2613-2 have been given regulatory power by the adoption of the relevant decrees. They are therefore obligatory standards applicable to all products placed on the market, irrespective of origin. Standard 2613-2 is implemented by Ministerial Decree No. 385/2006 and Ministerial Decree No. 434/2008.

At the outset of the COVID19 pandemic there was a significant restriction of much economic activity including food distribution e.g. through restaurants and retail outlets. This disrupted the flow of products (particularly in relation to import of frozen beef liver and fish, being the major perishable products imported in frozen form). Many Egyptian business operators in these sectors found that frozen imported product in their cold stores was difficult to sell within the shelf-life periods specified in 2613-2. Following operator representations to the Ministry of Trade and Industry, and to avoid significant losses due to shelf-life expiration, the Ministry adopted Decree No. 209/2020 of April 2020. This Decree adjusted the regulatory expiration dates to 9 months in case of frozen fishery products and 10 months in the case of frozen beef livers. The period of the Decree was six months. Since that time the Decree has been renewed several times and is still in place. The latest extension was for one year, issued on 23 June 2023.

It is therefore important to note that the Standard has not changed, and the Decree extending shelf life was adopted as temporary measure.

Since the Ministerial Decree extending the mandatory shelf-life to 9 months is due to expire at the end of June, the Ministry of Trade and Industry and the EOS face an imminent decision as to whether to:

a) Do nothing, and allow the shelf-life to revert back to 6 months for frozen fish on expiry of the term of the Decree

b) Extend the Decree adjusting the shelf-life durability for another period (of 6 months, one year, or permanently)

c) Review and adjust the Egyptian standard (to accommodate an extension of the shelf-life limitations).

3.5.5 Application of standards in import procedures

Generally, import clearance on arrival in Egypt comprises checks on origins (EUR1) and the export veterinary certificate issued by the relevant food safety authority of the exporting country. In the case of the Netherlands this is the Netherlands Food and Consumer Product Safety Authority (NVWA). Sanitary clearance is conducted both by the General Organization for Import and Export Control, and the National Food Safety Authority.

4 Stakeholder engagement

The consultant engaged in meetings and correspondence with the key value chain operators, both in Netherlands and Egypt.

Consultations were held with the main exporters from the Netherlands (van der Zwan, Cornelis Vrolijk, Parleviet & Van der Plas), the Netherlands- based Pelagic Freezer Trawler Association (which represents wider sectoral interests in the EU) and five Egyptian importers, with a view

to identify the key issues and root causes leading to shelf-life constraints on their business activities. The key elements in the discussion are highlighted below.

4.1.1 Dutch pelagic fish sector

Catches are highly seasonal, and the target species have peak seasons at different times of year, which determine the location and timing of fishing campaigns. The main season for herring is during July/August/September, when the herring are in peak condition prior to spawning, and very little is caught outside this period. Mackerel has two peak seasons (January/March and October/November). Horse mackerel may be caught all year round, often mixed with other species. Silver smelt has a peak in April/May. Blue whiting, which is the biggest catch (with exports to the African market) is the main target in the third and fourth quarters of the year, with the vessels often exclusively focusing on this species for 3 or 4 months. The highly seasonal nature of the production cycle means that fish of a certain species, size grade and maturity (as demanded by the customer) cannot always be available freshly frozen. Product caught during one season must be stored for several months to be able to supply the market when there are no catches. To meet orders received throughout the year, there are no options other than to supply customers with product which might already have been in the cold store for several months.

Considering that one month of available shelf life is potentially spent on the fishing boat prior to landing, and one month is required for transport and import procedures, a short-mandatory shelf life can cause problems with the expiry date. This is especially the case with herring, with a relatively short, 3-month season. Orders received in May/June can only be filled with product caught the previous September (at the latest) at which point the fish may have been in cold storage for up to 8 months. The situation with Egypt is exacerbated since an important (and premium priced) part of the market demand is for large sized female herring with roe, with limited supplies. Mackerel, being the other main import, is less of a problem since it has two catching seasons.

For this reason, meeting the shelf-life specifications set by the Government of Egypt has always been a problem for the European suppliers of small pelagic fish to this market. The problem is not only reported by the Dutch operators, but also Norwegian and Irish suppliers also express concerns.

The problem was eased somewhat by the Ministerial Decree of 2020 extending the shelf life to 9 months. However, since that time the constraints of the COVID pandemic, although no longer evident, have been replaced by delays in access to foreign currency (see below). As a result, during 2023 and early 2024, product ordered and reserved by Egyptian clients could often remain in the Dutch cold store for up to two months, awaiting the issue of the Letter of Credit from the Bank of Egypt, before the container can be stuffed and consigned.

The Dutch operators (which may also sell catches from other EU vessels) export several hundred thousand tonnes of small pelagic fish to destinations in Africa, Europe, and the Middle East. They report that these importing countries have different requirements to those established by Egypt. These markets either do not apply mandatory shelf-life requirements (e.g. they may require “best before dates” applied by the operator, in which case 2 years is usually specified) or if they do apply a mandatory shelf life, this is set at 18 to 24 months, depending on the country. The operators therefore have a strong interest to have equivalent conditions applied to their trade with Egypt.

4.1.2 Egyptian Importers and Fish processors

Imported small pelagic fish is either sold a) directly to consumers in supermarkets, fishmongers of cooperative stores (*gaameyas*) as whole frozen or thawed product or b) it is processed into a range of products (typically smoked or salted) which are then sold into retail or catering distribution. Egyptian importers of fish from the Netherlands are therefore either large scale processors (who may also sell frozen fish to other traders or smaller processors) or dedicated traders selling into the same market.

When an order is placed, the operator will prepare the labels (in the Arabic language), specifying the date of freezing (based on information supplied by the exporter) and the date of expiry, according to the Egyptian standard (as amended). These are then sent by courier to the exporter to affix to the order. An example of typical label content is shown below:

Item Name: Frozen Whole Herring Fish
Production date: 6 November, 2023
Expiration date: 5 August, 2024
Net Weight: 23 kg
Gross Weight: 25kg
Country of origin: Netherlands (EU)
Exporting and producing company: XXXXXXXX
Stored at a temperature of 18 degrees Celsius below zero
Freezing method: quick freezing.
Importing company: XXXXXXXXXXXXXXX
Importer address: XXXXXXXXXXXXXXXX
Importer phone: XXXXXXXXXXXXXXXXX
Only the data and dates written in Arabic on the card are taken into account

Figure 6: Example of label applied to imported frozen fish

Where possible operators will seek to place regular orders throughout the year. Since all trade is now containerised, the dimensions of the order is easily scalable to ensure that supply meets demand. However, the buying departments in importing companies in Egypt are also conscious of the seasonal availability of certain species. They follow abundance of the species and catch rates closely to ensure that their needs are met whilst buying at the right time to obtain optimal prices. The demand for fish peaks in Egypt at around Sham el Nassim festival in late April/early May. In this case processors would typically seek to place orders from EU suppliers early in January, to provide enough time for import, clearance, processing, and distribution to the local market. However, quite often they need to buy well in advance to secure supplies (especially in the case of herring, as described above) and the fish may have to be purchased in larger quantities to ensure that all needs are covered until the next season's catch becomes available.

Since 2022 an additional constraint has arisen, in that access of importers to foreign currency has been further limited by a national balance of payments crisis. These external foreign currency constraints mean that it can take typically up to two months after deposit of funds in

Egyptian pounds for the issue of the Euro or US$ denominated letters of credit by the Central Bank of Egypt[2].

Added to the seasonal supply pattern, the need to purchase longer in advance due to limited catches (subject to quota restrictions), this additional delay means that even with the extended shelf life specified since 2020, importers experience difficulties in both a) ensuring that when product is imported it is within 6 months of the catch date, and b) that it is distributed to the final user (processor or consumer) within 9 months of the catch date. Importers report that when the imported products are approaching the expiry date, they are placed in a weak negotiating position by their customers, and often have to accept unfavourable prices. At best, careful management of the shelf-life constraint demands a lot of management time in ordering and stock management. At worst, product approaching its expiry date has to be sold quickly and at a discount to avoid expiry and total loss.

Exporters of whole frozen fish to Egypt, whilst appreciating the additional flexibility introduced by the extension of shelf-life period in 2020, consider that this measure is still too restrictive and are concerned that it remains only a temporary measure which could be revoked at any time. Processors and importers express a strong interest for **a permanent amendment to shelf-life specifications** for frozen fish, which either:

a) replaces the mandated shelf life with a "best before date" specified by the primary supplier; or,

b) if the regulatory concept of mandatory shelf-life specification is to be retained, extends this further to a period which provides greater flexibility, such as 15 to 18 months.

They note that option a) would align the Egyptian standard with the requirements of Codex Alimentarius Commission and other international best practices (see next section). The Egyptian operators consider that such a change would improve value added, reduce waste, and improve profitability without compromising the quality or safety of products which they deliver to Egyptian consumers.

5 Shelf-life regulations in other countries/regions

The consultant reviewed relevant international, regional, and national standards applicable to the issue of shelf-life and rancidity development in fish and fishery products.

5.1 Codex Alimentarius

The FAO/WHO Codex Alimentarius Commission publishes consensually agreed standards, adopted under WTO rules as reference standards in resolution of trade disputes. Several standards are applicable to the situation described in the study.

[2] The floating of the Egyptian Pound in early March 2024 is expected to ease this constraint

CODEX STANDARD FOR SALTED ATLANTIC HERRING AND SALTED SPRAT CXS 244-2004 Adopted in 2004. Amended in 2011, 2013, 2016, 2018. This sets the quality standard for herring. The only reference to non-compliance due to rancidity is defined in section 8.1.3:

Odour and flavour/taste: "Fish affected by persistent and distinct objectionable odours or flavours indicative of decomposition (such as sour, putrid, fishy, rancid, burning sensation, etc.) or contamination by foreign substances (such as fuel oil, cleaning compounds, etc.)"

CODEX STANDARD FOR QUICK FROZEN FINFISH, UNEVISCERATED AND EVISCERATED CXS 36-1981 Adopted in 1981. Revised in 1995, 2017. Amended in 2013. This sets the quality standard for all frozen fish. A sample is considered defective if "*affected by persistent and distinct objectionable odours or flavours indicative of decomposition or of feed"*.

CODEX GENERAL STANDARD FOR THE LABELING OF PREPACKAGED FOODS, CODEX STANDARD 1-1985 (REV. 1-1991). This sets the requirements for labelling of pre-packaged foods. It requires that labelling a food product with the date of minimum durability is required if the food is prepackaged. Codex also requires that the label also specifies special conditions for the storage of the food if the validity of the date depends thereon. The format for labelling the date of minimum durability in Codex is as follows:

Minimum durability	Labelling specification
Not more than three months	"Best before ..." day and the month
More than three months	Best before end month and the year

It requires that the day, month, and year shall be declared in un-coded numerical sequence except that the month may be indicated by letters in those countries where such use will not confuse the consumer. The standard contains no mention of restricting imports by their date of minimum durability. The Standard is silent on the issue of who determines the date of minimum durability.

The Codex Alimentarius Commission also publishes **"Principles and Guidelines for Risk-Based Inspection of Imported Food" (N06-2004**), which proposes a scientific and historical approach to inspection but presents no content relating to date of minimum durability.

5.2 European Union requirements

5.2.1 EU shelf-life requirements

Requirements for labelling of foods in the EU are set out in Regulation 1169/2011 on the provision of food information to consumers. There are no mandated shelf-life durations specified for different foods within this regulation.

Instead, it requires that, *"where their activities concern the provision of food information to consumers"* foods are labelled with relevant shelf-life information. This means that foods need only be labelled as specified where they are offered to the final consumer. Foods traded within the supply chain between business operators are not required to be labelled with shelf-life information.

The Regulation refers to shelf-life as the "*date of minimum durability*" and defines it as the date until which food retains its specific properties when properly stored. It differentiates between best-before and use-by dates and outlines some products, exempt from shelf-life labelling. Some of the main provisions are set out below:

SHELF LIFE LABELLING REQUIREMNETS SET OUT IN EU REGULATION 1169/2011 ON THE PROVISION OF FOOD INFORMATION TO CONSUMERS

Article 9: List of mandatory particulars: Requires that information such as *inter alia* the date of minimum durability or use-by-date should be provided in a conspicuous, legible and indelible format on product packaging.

……..

(f) the date of minimum durability or the 'use by' date;

(g) any special storage conditions and/or conditions of use

Article 24: In the case of foods which, from a microbiological point of view, are highly perishable and are therefore likely after a short period to constitute an immediate danger to human health, the date of minimum durability shall be replaced by the 'use by' date. After the 'use by' date a food shall be deemed to be unsafe in accordance with Article 14(2) to (5) of Regulation (EC) No 178/2002

Annex III: Additional Particulars for Specific Foods.

For frozen meat, meat preparations and unprocessed fishery products, the Regulation also requires an indication of the date of freezing or the date of first freezing in cases where the product has been frozen more than once e.g. when large pieces of meat/fish are cut into small portions for selling.

Annex X: Date Of Minimum Durability, 'Use By' Date And Date Of Freezing

The date of minimum durability shall be indicated as follows: (a) the date shall be preceded by the words: — 'Best before …' when the date includes an indication of the day, — 'Best before end …' in other cases.

Frozen fish should be labelled "Best before……"

The date of freezing or the date of first freezing shall be indicated as follows: (a) it shall be preceded by the words 'Frozen on …'; (b) the words referred to in point (a) shall be accompanied by: — the date itself, or, — a reference to where the date is given on the labelling, (c) the date shall consist of the day, the month and the year, in that order and in uncoded form.

The EU therefore discriminates between foods which are microbiologically unstable, which should be labelled with a "use by" date, and those which are stable under stated conditions of distribution and storage, in which case a "best before" must be expressed. For frozen fish (and some other foods), additionally the date of freezing should be specified.

5.2.2 Quality requirements

Specifications for the quality grading of fish are set out in Council Regulation (EC) No 2406/96 of 26 November 1996 laying down common marketing standards for different fishery products. This sets the fresh fish grading specifications according to organoleptic assessment of the grades: E (Extra), A, B and (C – not admitted). See Table 4 below. These standards are still in force but are currently subject to review. Rancid odours in the gills are specified as one of the criteria for consideration in quality grading. It notes that iced fish goes rancid before stale, whereas RSW/CSW fish goes stale before rancid.

5.3 Norwegian Requirements

Norway is the largest supplier of frozen fish to Egypt. The above EU legislation is applicable directly in Norway under the terms of the Treaty on the European Economic Area (EEA). In addition, the Directorate of Fisheries of Norway has adopted the "Quality Regulations Relating to Fish and Fishery Products 1999". The relevant provisions are specified in the box below. Again, the only mention of rancidity is in relation to abnormal sensory characteristics.

Norway: Relevant Provisions of

Quality Regulations Relating To Fish And Fishery Products 1999

Section 1-10: General requirements regarding fish and fishery products 1: It is not permitted to market for human consumption fish and fishery products that are not regarded as sound and wholesome (i.e. are spoilt or hazardous to health) or will not be sound and wholesome on arrival at their destination, or which show any of the following quality defects: A. be rancid or damaged by freezing or drying……

Section 5-2. Other purposes than stated in sections 5-1 and 5-3 1. The raw materials shall satisfy the following organoleptic and chemical requirements: A. The fish meat shall be firm and elastic (finger pressure does not leave a permanent mark). B. The odour and flavour shall be fresh and characteristic of the species, with no trace of abnormal odours or flavours (decomposition products, rancidity).

Section 5: Samples of meat from lean fish or herring and mackerel species shall not on average contain more than 3 mg, and no sample may contain more than 5 mg of trimethylamine Nitrogen per 100 g, determined according to the method specified by the Director General of Fisheries.

Table 4: EU Grading specifications for fresh fish

Applicable to: Albacore or long-finned tuna, bluefin tuna, bigeye tuna, blue whiting, herring, sardines, mackerel, horse mackerel, anchovy, and sprat

	Freshness category			Not admitted (1)
	Extra	A	B	
Skin (2)	Bright pigmentation, bright, shining iridescent colours; clear distinction between dorsal and central surfaces	Loss of lustre and shine; duller colours; less difference between dorsal and ventral surfaces	Dull, lustreless, insipid colours; skin creased when fish curved	Very dull pigmentation; skin coming away from flesh (3)
Skin mucus	Aqueous, transparent	Slightly cloudy	Milky	Yellowish grey, opaque mucus (3)
Consistency of flesh (2)	Very firm, rigid	Fairly rigid, firm	Slightly soft	Soft (flaccid) (3)
Gill covers	Silvery	Silvery, slightly red or brown	Brownish and extensive seepage of blood from vessels	Yellowish (3)
Eye	Convex, bulging; blue-black bright pupil, transparent 'eyelid'	Convex and slightly sunken; dark pupil; slightly opalescent cornea	Flat; blurred pupil; blood seepage around the eye	Concave in the centre; grey pupil; milky cornea (3)
Gills (2)	Uniformly dark red to purple. No mucus	Less bright colour, paler at edges. Transparent mucus	Becoming thick discoloured opaque mucus	Yellowish; milky mucus (3)

	Criteria			
	Freshness category			Not admitted (1)
	Extra	A	B	
Smell of gills	Fresh seaweed; pungent; iodine	No smell or seaweed. Neutral smell	Slightly sulphureous (4) fatty smell, rancid bacon cuttings or rotten fruit	Rotten sour (3)

(1) This column will apply only until a Commission Decision is taken establishing criteria for fish which is unfit for human consumption, pursuant to Council Directive 91/493/EEC.

(2) For herring and mackerel preserved in cool seawater (either chilled by ice (CSW) or refrigerated by mechanical means (RSW)) complying with the requirements laid down in Directive 92/48/EEC (OJ No L 187, 7. 7. 1992, p. 41) Annex II, point 8, the following freshness categories apply:

— criterion A applies for Extra and A categories.

(3) Or in a more advanced state of decay.

(4) Iced fish goes rancid before stale, CSW/RSW fish goes stale before rancid.

5.4 United States Requirements

Except for infant formula, product shelf-life dating is not universally required by US Federal regulations. Where dates are applied voluntarily, the measures applied depend on the kind of product and the agency under whose jurisdiction the product falls.

In the case of imported fish and fishery products, the products are subject to the jurisdiction of the US Food and Drug Administration and set out under Title 21 CFR Part 123 —Fish and Fishery Products. This is silent on the issue of labelling.

The Food Safety and Inspection Service (FSIS) of the USDA is responsible for meat, poultry, eggs and fish of the order Siluriform (catfish)[3] placed on the market. Under the Code of Federal Regulations 381.126 and 431.2 a "pack date" is required for thermally processed, commercially sterile meat and poultry products. For other products under FSIS jurisdiction, the Code of Federal Regulations CFR 317.8 states that a date may be voluntarily applied to products provided it is done so in a manner that is truthful and not misleading and in compliance with FSIS regulations. Section 32 of CFR 317.8 indicates that where a date label is applied it should express the month of the year and the day of the month and a phrase explaining the meaning of the date, in terms of "packing" date, "sell by" date, or "use before" date, with or without a further qualifying phrase, e.g., "For Maximum Freshness" or "For Best Quality."

5.5 Canadian requirements

In Canada under the Food and Drug Regulations (C.R.C., c. 870 Section B.01.350) date labelling requirements are applied to fishery products only when they fall into the category of prepackaged foods. This excludes shipping containers unless the containers and their contents are sold as a prepackaged product to a consumer at the retail level. For wholesale fishery products therefore no date labelling is required at the point of import.

Section B.01.007 of the Regulations further states that labelling in a retail setting is required only where a prepackaged product has a durable life of 90 days or less. Labelling of frozen foods with any form of expiry date is therefore considered voluntary.

Where expiry or shelf-life labelling is applied the label must state the durable life date, and instructions for the proper storage if it requires storage conditions that differ from normal room temperature. A packaging date is only required when the product is packed in a retail premises. The durable life date should be expressed as "best before" including year where appropriate.

[3] The mandate for inspection of these fish was transferred from the FDA to USDA in 2016

6 Literature review of quality and shelf life of frozen fish

6.1 Quality of frozen pelagic fish

6.1.1 Oxidation of fats

In a seminal technical paper, the Food and Agriculture Organization of the UN has indicated that fatty fish are particularly susceptible to lipid degradation which can create severe quality problems especially in frozen storage[4]. In general, the breakdown of oils in food to produce rancidity is a complex set of reactions between the fatty acids in a triglyceride molecule and oxygen, resulting in free fatty acids and other compounds. There are two distinct reactions in fish lipids which impact on quality deterioration, these being hydrolysis and oxidation. The former is a cleavage of fatty acids, often involving gut, cellular or bacterial enzymes. The latter is an enzymatic or a chemical reaction with atmospheric oxygen, which can be catalyzed by metal ions e.g. in blood. The outcome of these processes is production of a range of lower molecular weight substances (aldehydes, ketones, alcohols, organic acids, and alkanes) many of which some have the unpleasant taste and smell attributed to rancidity. For this reason, the development of rancidity is generally considered to be the limiting factor in the shelf life of frozen oily fish such as tuna, herring, salmon etc. Some breakdown products may also contribute to texture changes by binding to fish muscle proteins. The impact of these reactions depends on fish species and storage temperature and duration.

Fatty acid chains with a high proportion of unsaturation (double bonds in the chain, as found in polyunsaturated fatty acids, known as PUFAs) are much more susceptible to these breakdown processes. These are the components of fish oils which contribute to the important ω-3 and ω-6 fish oils which contribute to the high nutritional quality and proven health benefits of fish consumption.

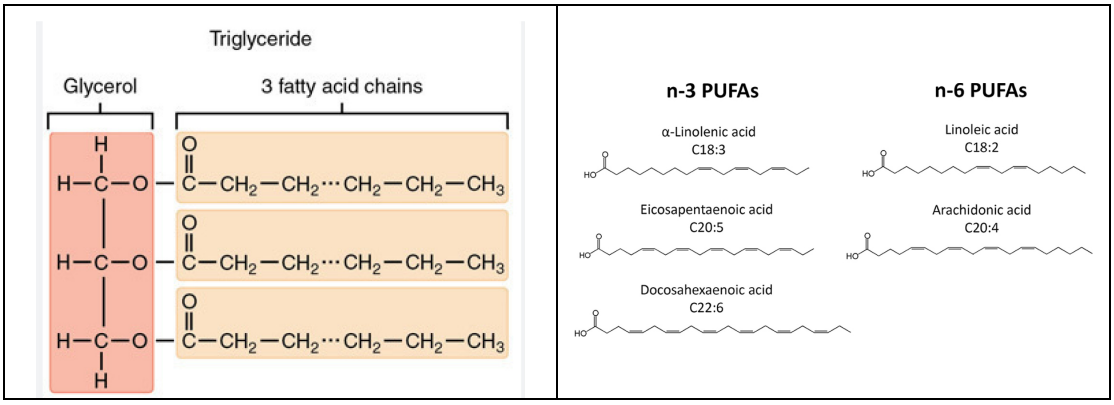

Figure 7: Composition of fats and oils and important ω-3 and ω-6 polyunsaturated fatty acids

The extent of oxidative rancidity during frozen storage depends on several factors such as oil content, temperature, presence of oxygen (glazing, packaging method), presence of iron

[4] Quality and quality changes in fresh fish, FAO FISHERIES TECHNICAL PAPER – 348, H. H. Huss, Technological Laboratory, Ministry of Agriculture and Fisheries, Denmark, FAO, Rome, 1995

(haem complex in blood & dark muscle) and other metals, light and the presence of antioxidants e.g. tocopherol (Vitamin E precursor naturally present in animal muscles).

6.1.2 Measurement of rancidity

There are several tests used for the measurement of rancidity. The most common ones are:

a) **Free Fatty Acids (FFA)**: estimates the amount of fatty acids that have been liberated from their triglyceride structure. A titration is performed directly on the extracted fat. Knowing what type of fat or fat containing product is being tested is important for this analysis to ensure that the appropriate factors are applied (the test does not differentiate between fatty acid types which affect the results).

b) **Peroxide Value (PV)**; estimates the amount of peroxides in the lipid portion of a sample. Peroxides are the initial indicators of lipid oxidation and react further to produce secondary products such as aldehydes. Because peroxide formation increases rapidly during the early stages of rancidification but subsequently diminishes over time, it is often paired with other indicators.

c) **p-Anisidine (p-AV)** value estimates the amount of reactive aldehydes and ketones in the lipid portion of a sample. Both compounds can produce strong objectionable flavours and odours detectable at relatively low levels. The compound used for this analysis (p-Anisidine) reacts readily with aldehydes and ketones. The reaction can also be measured using a colorimeter, so that it is a relatively simple measurement. However, the oil must be extracted from the sample first, making it a longer test to perform.

d) **Thiobaribituric Acid Reactive Substances (TBARS)** also measures aldehydes (primarily malondialdhyde and similar compounds) created during the oxidation of lipids. This analysis is useful for low-fat samples. The whole sample can be analysed, thus omitting the need for extraction of the lipids component.

e) **Sensory evaluation** by an expert taste panel measures directly the flavour and odour impacts of rancidity on the human palate. It is important that panel is selected for individuals with sensitive palates (using threshold tests) and that it is trained for accuracy using the full range of rancidity intensities. Panellists should be able to consistently identify and describe the nature of the rancid flavours, as well as their intensity using a rating scale. Taste panels are expensive and time consuming to set up, but once operating very cheap and quick to get valid results. They provide the only common test for rancidity (other than multi-component gas analysis) which can be considered 100% valid.

6.2 Review of literature on shelf life of frozen pelagic fish

6.2.1 Methodology

Using internet sources (Google Scholar) the consultant conducted a review of the scientific literature, with a view to identifying food safety hazards and quality parameters relevant to the species concerned, and factors during production and storage which affect the characteristics of the final frozen fish products in the scope of this study.

The search terms were selected to focus on the specific species concerned in the import of fish into Egypt (since these species, having a high oil content are especially susceptible to enzymic and oxidative rancidity in frozen storage which limits their shelf life). It is also noted that the small pelagic fish species concerned exhibit considerable variation in key quality

parameters (notably content and composition of fats and oils) which is dependent on season and catch location, and which impact directly on shelf life.

Therefore, the search terms employed were:

- Shelf-life of frozen herring/frozen mackerel/frozen horse mackerel
- Seasonality characteristics in composition of herring, mackerel, and horse mackerel

6.2.2 Main findings

key features of the studies and tabulated results are presented in Annex 3, along with the full detailed list of references identified in the review. Some of the most relevant findings from this review are as follows:

TBARS is the most common chemical indicator of rancidity

The most common indicator of rancidity used in shelf-life studies of these species is TBARS. Some studies also use peroxide value and anisidine tests. However, there are wide variations in the levels of TBARS considered to be acceptable:

- Ruiz-Capillas and Moral (2001): minimum value of TBA index detectable by panellists was 1.44 mg MDA/kg
- Huss (1995) and Boran et al, 2006: expressed and acceptable limit of 7–8 mg MDA/kg
- Connell (1995) suggests an acceptable limit 1–2 mg MDA/kg

Several authors observe only a weak (non-significant) correlation between TBARS value and sensory evaluation result, which is likely to be cause of the different expressions of acceptable limits.

Many shelf-life studies are conducted on fillets, not on whole fish

About half of the studies undertaken on shelf life of pelagic fish use fish fillets, rather than whole frozen fish. Studies on fillets are not directly applicable to the international trade in pelagic fish, since the primary product is whole frozen fish.

Shelf-life of whole pelagic fish is significantly longer than that of filleted fish

There is clear evidence from numerous studies that whole frozen herring, mackerel, and horse mackerel (the species imported into Egypt) have a significantly longer-shelf life than fillets of fish of these species. (see Figure 7 for example). Fillets have greater exposure of their lipids to atmospheric oxygen and pro-oxidant compounds such as the haem complex in blood. Several studies prove that the shelf life of fillets can be significantly extended by use of glazing, vacuum packaging and use of antioxidant treatments.

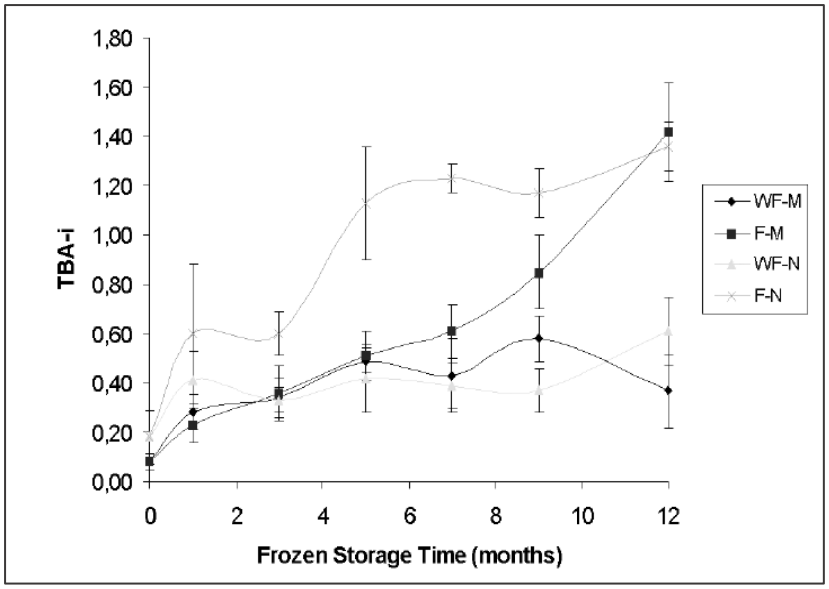

Figure 8: Thiobarbituric acid index (TBA-i) determination during frozen storage of mackerel

Units: mg malondialdehyde/kg). Key: WFM and F-M (whole fish and fillets, respectively, captured in May) and WF-N and F-N (whole fish and fillets, respectively, captured in November). Source: Aubourg, S. P., Rodríguez, A., & Gallardo, J. M. (2005). Rancidity development during frozen storage of mackerel (*Scomber scombrus*): effect of catching season and commercial presentation. European journal of lipid science and technology, 107(5), 316-323.

Few shelf-life studies consider other parameters

Only one study reports changes in microbiological conditions (showing a progressive decline in numbers of viable bacterial cells) and no studies consider histamine hazards during frozen storage. It is assumed that researchers considered both of these parameters to be stable during frozen storage. One study does consider changes in Total Volatile Basic Nitrogen (TVB-N) in of chub mackerel (Figure 8) showing that this parameter does develop during frozen storage over 10 months.

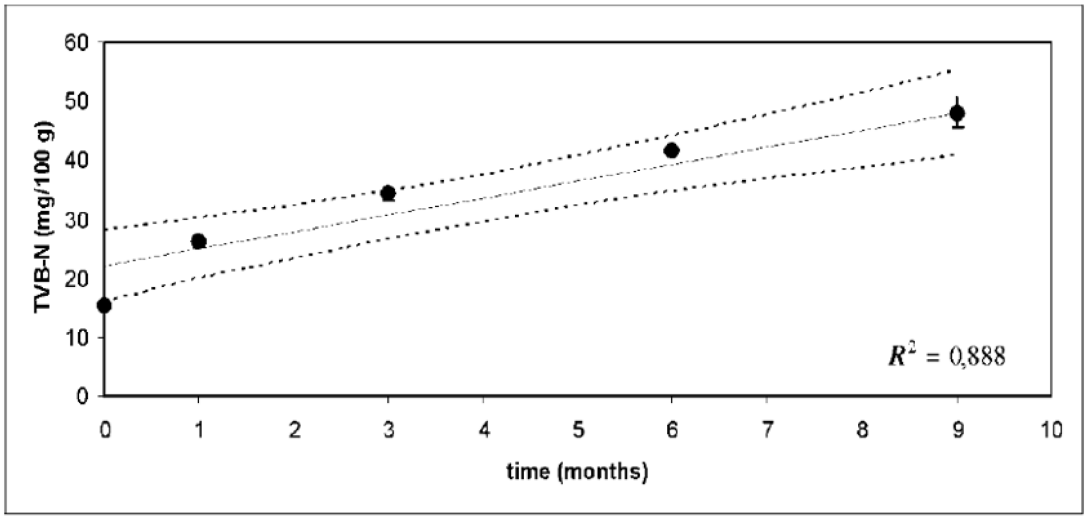

Figure 9: Changes in TVB-N values during frozen storage (-19°C) of chub mackerel.

Source: Agustinelli, S. P., & Yeannes, M. I. (2014). Effect of frozen storage on biochemical changes and fatty acid composition of mackerel (*Scomber japonicus*) muscle.

Studies do not use comparable conditions or measurement methods

Studies use different storage temperatures, analytical methods, and units for measuring rancidity indicators such as TBARS, making comparisons between them problematic.

Only four studies consider sensory evaluation of whole frozen fish

Only 9 out of 25 include sensory evaluation as a means of assessing quality and of these only four of these studied sensory changes in whole frozen fish. These four studies (all European) employed a panel of expert sensory evaluators, used as an analytical instrument to determine the presence and extent of off flavours. The results reported suggested that for European expert tasters, the limits of acceptability due to rancid flavours for frozen fillets were reached after about 3-4 months and after 6-7 months for whole frozen pelagic fish.

However, one can question the applicability of these findings to the Egyptian context. It is widely recognised that rancidity is essentially a quality parameter primarily concerning odour/flavour elements of consumer perceptions. Unlike food safety concerns where a quantitative risk of a particular health outcome for an average consumer can be calculated, quality parameters address the level of satisfaction of consumers, which is determined by many factors, including cultural values. Some consumers enjoy eating fishery products which others would consider to be spoilt (e.g. Swedish *Sürstromming* or Egyptian *feseikh*). In the context of shelf studies, acceptability can only be determined by studies which consult consumer opinions (i.e. consumer panels) rather than expert (trained) taste panels. No such studies are reported in the literature.

6.3 Nutritional quality

Fatty fish are excellent sources of micro-nutrients such as polyunsaturated fatty acids (PUFAs) and fat-soluble vitamins. Some studies found significant changes in the nutritional quality of the species concerned during frozen storage. Figure 9 shows that tocopherol (Vitamin E) falls to about half its fresh value after 12 months in frozen storage, and to about a third after 18 months. Another study (Table 4) showed that ω-3 and ω-6 PUFAs fell by about one quarter after 12 months frozen storage. However, it should be noted that primary determinant of nutritional quality related to consumption of oily fish is the highly variable fat content of the fish muscle. This is dependent on the dietary abundance and catching season and can vary in range from 1.3% to 25.7% (Nielsen et al, 2005[5]), a variation which can potentially mask relatively less significant changes which may occur during storage.

[5] Durita Nielsen, Grethe Hyldig, Jette Nielsen, Henrik Hauch Nielsen, Lipid content in herring (Clupea harengus L.)—influence of biological factors and comparison of different methods of analyses: solvent extraction, Fatmeter, NIR and NMR, LWT - Food Science and Technology, Volume 38, Issue 5, 2005, https://doi.org/10.1016/j.lwt.2004.07.010.

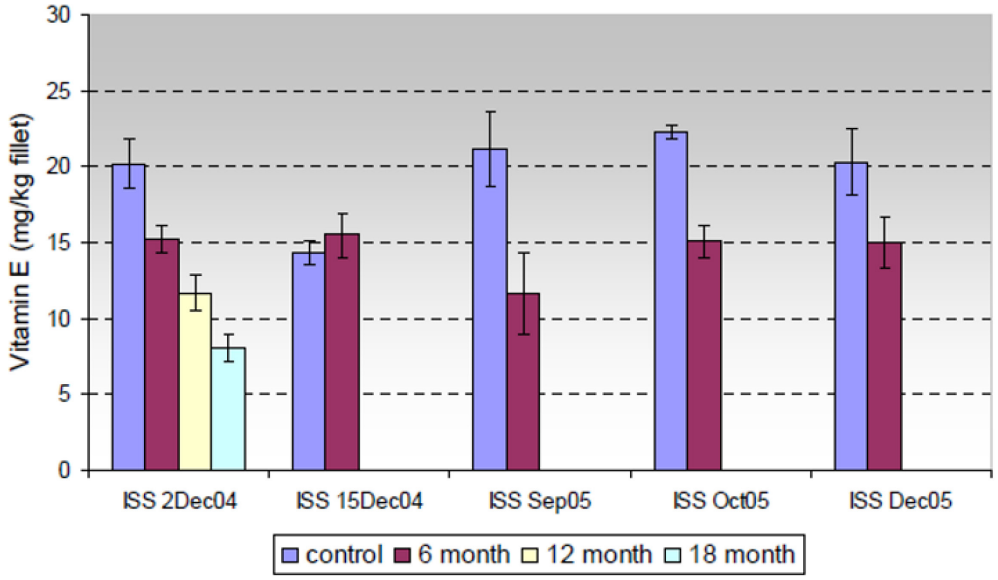

Figure 10: Content of tocopherol in Icelandic summer spawning herring

Source: Jónsson, Á. (2008). Improved quality of Herring for humans.

Table 5: Changes in polyunsaturated fatty acid composition of mackerel in frozen storage

	DARK MUSCLE				
Fatty acids (%)	**FROZEN STORAGE TIME (Months)**				
	1	**3**	**6**	**9**	**12**
∑ PUFA	32.08(1.25)	32.48(1.42)	31.01(0.24)	27.79(0.51)	24.51(1.48
∑ ω3	26.07(0.91)	26.75(1.21)	25.58(0.14)	21.81(0.87	18.97(1.87)
∑ ω6	1.92(0.91	1.56(0.21)	1.37(0.00)	1.35(0.14)	1.20(0.08)
∑ ω6/∑ ω3	0.07(0.03)	0.06(0.02)	0.053(0.01)	0.06(0.00)	0.06(0.03)

Source: Agustinelli, S. P., & Yeannes, M. I. (2015). Effect of frozen storage on biochemical changes and fatty acid composition of mackerel (*Scomber japonicus*) muscle. Journal of Food Research; Vol. 4, No. 1; 2015

6.4 Food safety considerations

In 2010 the European Food Safety Authority (EFSA) published a scientific opinion on consumption of *refined* fish oil for human consumption[6]. Refined fish oils are typically subject to extraction using heat up to 180°C and pressure. EFSA noted that whilst some oxidation

[6] EFSA Scientific Opinion on Fish Oil for Human Consumption. Food Hygiene, including Rancidity EFSA Panel on Biological Hazards (BIOHAZ)2, 3 European Food Safety Authority (EFSA), Parma, Italy, EFSA Journal 2010;8(10):1874

products in such fish oils may present a potential food safety hazard, present knowledge does not allow setting and recommending of maximum acceptable peroxide and anisidine values for the large variety of refined fish oils. The panel also indicated that information on the level of oxidation of fish oil (as measured by peroxide and anisidine values) and related toxicological effect in humans was lacking and information on toxicity of individual oxidation products of fish oil in humans was also lacking. It concluded that knowledge at that time does not allow setting and recommending of maximum acceptable peroxide and anisidine values for the large variety of refined fish oils.

A similar study conducted in 2011 by the Norwegian Scientific Committee for Food Safety (*Vitenskapskomiteen for Mattrygghet, VKM*) on risk assessment of decomposition substances and oxidation products in fish oils [7] also noted that there is very little or no information in the public domain with respect to composition of the oxidation products in food supplements of marine oil origin, as well as the related toxicological effects of oxidation products in humans. Experimental animal studies available at the time indicated that high doses of whole oxidised vegetable oils can affect health negatively. However, the data were not sufficient for risk assessment in fish oils. Based on the very limited information available, VKM concluded only that there is some concern related to regular consumption of oxidised marine oils.

However, as reported in section 2.5.3 Codex Standard 329/2017 did subsequently establish such limits in relation to refined fish oils for human consumption (of a peroxide number < 5 mL active oxygen equivalent/kg of oil and anisidine value < 20).

However. it is important to recognise that both of these risk assessment studies and Codex Standard consider only those risks associated with direct consumption of oxidised fish oils, in (for example) dietary supplements. Whilst risk assessors and the Codex Committee recognise that oxidation products may generally present a hazard, at present the state of knowledge is that there is no evidence that the presence of lipid oxidation products are harmful to health *per se* when present in oily fish subjected to extended frozen storage.

6.5 Quality of fish on the Egyptian market

6.5.1 Previous studies

During the literature survey, the consultant identified two reported academic studies which considered the quality and safety of imported frozen pelagic fish placed on the Egyptian market.

In a study of samples of frozen whole mackerel Dengawy et al (2017) found that the bacteriological counts met the relevant microbiological criteria set out in Egyptian Standards 889-1 at the start of the study and fell further during frozen storage to about half their initial

[7] Description of the processes in the value chain and risk assessment of decomposition substances and oxidation products in fish oils, Opinion of Steering Committee of the Norwegian Scientific Committee for Food Safety Date: 19.10.2011 Doc. no.: 08-504-4-final ISBN: 978-82-8259-035-8 Description of the processes in the value chain and risk assessment of decomposition substances and oxidation products in fish oils VKM Report 2011: 19, Norwegian Scientific Committee for Food Safety (Vitenskapskomiteen for Mattrygghet, VKM)

value after 4 months. This is considered to be a typical result, due to inactivation of bacterial cells (Table 5).

Table 6: Dorsal muscle bacteriological examination of frozen mackerel during storage

Storage Period (month) at -18°C ± 2°C	Dorsal muscle examination TBC (cfu×10^3/g)
1	6.15 ±0.042
2	6.00 ±0.052
3	4.35 ±0.055
4	3.30 ±0.078

Source: El-Dengawy, R. A., Sharaf, A. M., El-Kadi, S. M., Mahmoud, E. A., & Baidoon, E. S. (2017). Effect of Frozen Storage on the Chemical, Physical and Microbiological Quality of Imported Mackerel (*Scomber scombrus*). *Journal of Food and Dairy Sciences*, *8*(7), 287-293.

Another study reported on the quality frozen herring and smoked herring placed on the public market in Egypt in 2008 (see Table 7) the products met the Egyptian Standard in respect of the limits of the Thiobarbituric Acid Reactive Substances (TBARS) test at the time (of 4.5 mg MDA/kg as set by Egyptian Standard No. 889-1/2009).

Table 7: Fat quality indicators in herring fish and its products

(Mean ± Standard Error)

Samples	**Acid number** (mg KOH/g of fat)	**Free fatty acids** (ml/gm)	**Conjugated dienes** (n mole/mg)	**TBARS** (mg malonaldehyde/kg of sample)
Frozen	5.371 ±0.315	2.686 ±0.158	0.46 0±0.037	3.624 ±0.151
Smoked	8.785 ±0.230	4.393 ±0.115	0.63 ±0.022	4.378 ±0.076
Canned	1.167 ±0.102	0.584 ±0.051	0.15 ±0.037	2.391 ±0.176
Fillet	16.342 ±0.509	8.17 ±0.255	0.84 ±0.034	4.500 ±0.052

Source: Mervat Kamal Ibrahim Ragab (2008). Evaluation Of Nutritional And Hygienic Quality Of Herring Fish And Its Products. Assiut Veterinary Medical Journal, 54 (119),1-14.

Notable also is that in both studies the sensory quality of the products was also considered to be acceptable. The available evidence suggests that frozen whole mackerel and herring placed on the public market in Egypt (in 2008 and 2017) met the Egyptian standard in respect of the parameters relevant to this study.

6.5.2 Ongoing research

In 2022, despite the Ministerial Decree No. 209/2020 extending the mandatory shelf life of frozen fish and liver, importers continued to report difficulty in meeting the shelf-life specifications of the EOS standards 2613 Part 2/2008 in relation to these products. With a view to providing additional evidence of acceptable quality and safety, and compliance with the standard, the USAID project "*Transforming the Assessment and Inspection of Food Businesses*" (TAIB Project) supported a shelf life studies in collaboration with the NFSA and EOS. Two dedicated shelf-life studies aimed to further investigate the shelf-life characteristics of frozen

beef liver and frozen fish imported into Egypt. The studies were designed and implemented with technical assistance of NFSA, the Animal Health Research Institute (AHRI) under the Ministry of Agriculture and Land Reform, and international consultants. The studies were launched in 2023.

In the case of the study on frozen fish, this was conducted on samples of mackerel and horse mackerel collected from cold stores in Alexandria. The origins of the samples were Spain, Japan, UAE and Yemen. Fish were stored at a target temperature of -18 °C for 9 months, and samples drawn monthly for assessment. Whilst it was recognised that food safety parameters would not change during frozen storage, a decision was made to assess all of the relevant parameters set out in ES 889 Part 1. Analysis of samples was conducted at the AHRI and QCAP (the Central Laboratory for analysis of pesticide residues and heavy metals in food of the Egyptian Ministry of Agriculture).

The testing protocol included parasites and microbiology, (TVC, *E.coli*, Coagulase +ve *Staph.aureus, Samonella, Vibrio* spp. and histamine). Chemical parameters assessed were TVBN, diethyl and triethylamines, along with rancidity indicators (Peroxide Value and TBARS). Residues were also measured (cadmium, mercury, lead, and arsenic), along with the persistent organochlorines, PCBs, and dioxins. Finally sensory evaluation of thawed whole uncooked fish was conducted, with several visual, odour and physical parameters assessed, in most cases using a 3-point scale to establish a "quality index". However cooked fish odour, flavour or texture was not assessed.

The draft reports of the results and conclusions are expected to be available by the end of March 2024.

7 Workshop on shelf-life of imported of frozen fish

Following the data collection, literature search and stakeholder engagement presented above, the consultant identified the agenda and proposed participants for a one-day workshop hosted by the Embassy of the Netherlands in Egypt on the 7th March 2024.

7.1 Objectives

The objective of the workshop was to present and discuss the main findings of the study to all relevant stakeholders in the issue of the shelf life of frozen fish imported into Egypt. The workshop therefore sought to present the current situation, the issues and constraints faced by commercial operators as well as to consider the science and its interpretation in the context of risks and benefits of the import of frozen fish and in terms of food security and food safety for Egyptian consumers.

7.2 Programme

The programme for the workshop was follows:

Time	Title	Presenter
0930-1000	Registration	
1000-1005	Welcome and opening address	Mr. Peter Mollena, Ambassador of the Kingdom of the Netherlands to Egypt
1005-1015	Introductions	Mr. Tycho Vermeulen, Chair

		Agricultural, Counsellor to Egypt and Jordan, Embassy of the Kingdom of the Netherlands
1015-1035	1. Current Egyptian Standards for fish and fishery products and shelf-life specifications	Eng. Reda Mohamed Sayed, Food Standards Specialist Technical Secretariat of Shelf- life Committee and Fish and Fishery Products Committee, Egyptian Organization for Standardization and Quality (EOS)
1035-1100	2.Shelf life of fish - the Egyptian importers perspective	Mr. Samir Swailem, Chair of Meat and Fish Committee, Egyptian Chamber of Commerce
1100-1120	Coffee	
1120-1140	3.Shelf life of fish - the exporters perspective	Mr. Robert Ammeraal, Pelagic Sales Director, Cornelis Vrolijk, Netherlands
1140-1200	4.Considerations in the scientific case for shelf-life extension	Dr. Ian Goulding, Consultant to the Netherlands Embassy
1200-1300	Discussion and next steps	Mr. Tycho Vermeulen, Chair
1300	Closing remarks	Mr. Tycho Vermeulen, Chair

7.3 Participants

The workshop was attended by 25 representatives of all relevant stakeholders and organisations:

- Dutch fishing companies
- EU Pelagic Freezer Trawler Association
- Embassies of Netherlands, Ireland, Norway, and the USA
- Egyptian Chamber of Commerce in Alexandria
- Egyptian Small and Medium Industries Federation
- Egyptian Organisations for Standards and Quality
- National Food Safety Authority
- Egyptian Fish Importer and Processing companies
- Lakes and Fish Resources Protection and Development Agency
- Sustainable Hospitality Alliance

A full list of attendees is shown in Annex 2.

7.4 Content

Copies of the four presentations made are shown in Annex 4.

7.5 Workshop discussion

The key points arising from the discussion were as follows.

1. The problems and constraints concerning the shelf-life specifications identified by the study are confirmed by the European Exporters and the Egyptian importers and processors.
2. A number of technical clarifications regarding out-of-date content of translated content of the Standard 889 Part 1 and 2613 Part 2 were made, particularly in relation to rancidity indicators and parameters.

3. EOS (the responsible regulatory authority) and NFSA (being the inspection authority) of the Egyptian Government, are willing to consider changes to the shelf-life specifications for frozen fish as set out in Egyptian Standard 2613 Part 2. Standards have been revised several times in the past in response to changing circumstances and updated scientific opinion.
4. There is a good case for considering a separation of shelf-life specifications set out in Standard 2613 Part 2 to distinguish between frozen fish fillets and whole frozen fish. Options could also be considered for shelf-life specifications being set of different temperatures and/or packaging methods (e.g. -23°C and vacuum packaging)
5. However, all such proposals for amendment must follow the due processes for standard setting and be considered by the relevant Technical Committee for Fish and Fishery Products of the EOS. A clear evidential basis should therefore be presented for consideration. Any party is welcome to present evidence.
6. The evidential basis for selection of particular duration for the shelf life of frozen fish depends on data being presented concerning the compliance and acceptability of the imported products in the context of Egyptian situation. EOS has specified the conditions for the design of shelf-life studies if their evidence is to be accepted (set out in Annex 5).
7. Relevant new shelf life data from frozen fish of these species is expected to be supplied by the study undertaken by NFSA, AHRI and QCAP with support of the US TAIB project, with a report currently in the final stages of preparation.
8. No further work is advisable until the results of this study are available and have been considered by the Competent Authorities.
9. In the meanwhile, the current Ministerial Decree extending the shelf life to 9 months will expire at the end of June. In the short term, since there may be insufficient time to amend the Standard 2613 Part 2 before this deadline, and to avoid disruption to trade flows, the supply chain operators and their representatives may wish to request a further extension of the Decree from the Ministry of Trade and Industry.
10. Should the results of the current study fail to provide definitive data to allow the Fish and Fishery Products Committee of the EOS to make a decision on any shelf-life extension, then the supply chain operators and their representatives could consider supporting further primary research studies in line with the conditions set out in Annex 5.

8 Conclusions and recommendations

8.1 Conclusions

1. Compliance with the mandatory Egyptian standards for the shelf-life specifications for frozen fish as set out in Egyptian Standard 2613 Part 2 causes significant difficulties for European suppliers of small pelagic fish and their Egyptian customers due to the seasonal nature of the fishery and the specification of fixed time limits for shelf life. The difficulties impact on negatively profitability of Egyptian operators and ultimately, by disrupting import flows, have potential to reduce food security of Egyptian customers. However the adoption of an EOS specification of a fixed shelf-life (of 6 months) does not impact of food safety.
2. A 2020 extension of the mandatory shelf-life to 9 months due to COVID19 eased the situation, but a foreign currency crisis in 2023 and early 2024 has meant that constraints on supplies continue to be experienced.

3. The regulatory approach adopted by the Egyptian Organisation for Standards and Quality sets stricter requirements than specified in the standards set by the Codex Alimentarius Commission of the UN. The additional measures adopted are not risk assessed and could potentially be formally challenged under WTO rules.
4. There is a strong case for **removing all requirements in Egyptian food law for the fixed shelf-life for foods and replacing them with a labelling requirement consistent with Codex** and in line with the best international practices (as exemplified by EU, US, Canadian food legislation). For shelf-stable foods following the Codex approach in Egypt would require that for frozen products including fish, a best-before date be determined by the producer, and the product labelled accordingly.
5. Meanwhile, and pending such a policy decision, the EOS (the responsible regulatory authority) has indicated that it is willing to consider justified changes to the Standards. There is therefore potential to adjust the mandatory shelf-life specifications set out in Standard 2613 Part 2.
6. Whilst the application of a best before date of 6 months shelf life is entirely appropriate for the application to fish fillets, evidence from the reported literature suggests **that whole herring, mackerel and horse mackerel** can comply with Egyptian Standard ES 889 / 2009 for a substantially longer period. This provides an opportunity to distinguish in ES 2613 Part 2 between frozen fish fillets and whole frozen fish, and extend the shelf-life for frozen fish specified in the standard, without compromising the quality or safety of frozen fishery products delivered to the Egyptian consumer.
7. Relevant new shelf-life data from frozen fish of these species is expected to be generated in the short term from a study undertaken by NFSA, AHRI and QCAP with support of the US TAIB project. This new data may be used to support a short-term decision of the Technical Committee for Fish and Fishery Products of the EOS as to whether to retain or amend the mandatory shelf life of whole frozen fish.

8.2 Recommendations

The Government of Egypt is recommended to:

In the short term:

- extend the Ministerial Decree specifying the mandatory shelf-life 9 months for a further period beyond current the expiry date at the end of June, so as to avoid any disruption to trade and to give NFSA and EOS sufficient time to consider amendments to the standard.
- consider adjusting the mandatory shelf-life requirements, set out in ES 2613-2 / 2008 Shelf Life For Food Products Part: 2, by disaggregating the measure into two sections, with different shelf life requirements, addressing i) whole frozen fish (HS Code 0303) and ii) frozen fish portions (HS Code 0304), as set out in Table 8.

Table 8: Proposed amendments to Standard ES2613-2

Description	Durability at -18C	Packaging	Remaining shelf life**
Whole frozen whole fish under HS Code 0303	X months*	PE in carton	3 months
Frozen fish fillets and portions under HS Code 0304	6 months	PE in Carton	3 Months

*Period to be determined by the EOS Technical Committee for Fish and Fishery Products, based on data in this report and results of current research studies

**For imported products, this represents the minimum period from the date of import before the declared expiry date

In the longer term:

- consider aligning shelf-life labelling requirements with Codex Alimentarius Standards and best practices employed elsewhere, by replacing mandatory shelf-life specifications for frozen fishery products (and potentially other shelf-stable foods) with "best-before" date labelling.

Supply chain fishery business operators (Dutch and Egyptian) and their representatives are recommended to:

- submit a request a further extension of the Decree from the Ministry of Trade and Industry, to thus avoid disruption to trade flows, pending the results of the ongoing research study and technical deliberations of the EOS
- consider supporting further primary research studies in the case that the results of the current study fail to provide definitive data to allow the Fish and Fishery Products Committee of the EOS to make a decision on any amendment to the Standard 2613 Part 2 on shelf-life of frozen fish.
- ensure that any future shelf life study be conducted in line with the EOS stability study specifications, set out in Annex 5, and include sensory evaluation of samples by consumers to determine limits of acceptability.

Annex 1. Terms of Reference

Kingdom of the Netherlands

Organization	Netherlands Embassy in Cairo
Assignment	Consultancy Assignment – Opportunities into Extending the Shelf Life of Imported Pelagic Fish in Egypt: A Fact-Finding Study
Department	LAN (Netherlands Agricultural Network)
Location	Home Based, Cairo
Duration	15th Jan 2024 – 15th of April 2024

Consultancy Proposal should be sent via email to KAI-LNV@minbuza.nl no later than 12th December, 2023 (08:00 AM Cairo local Time) clearly stating the title of consultancy applied for. Any proposals received after this date/time will not be accepted. Any request for clarification must be sent by electronic communication to KAI-LNV@Minbuza.nl. **Failure to submit your application on time will be considered incomplete and therefore application will not be considered.**

1. **Background and Project Description**

Egypt is an important strategic partner of Netherlands and continues to engage with Egypt to advance mutually shared interests, including strong commercial ties. With a population of over 101 million and a GDP of $362 billion, there are solid opportunities for Netherlands in the medium-to-long term. Egypt's strategic location offers companies a platform for their commercial and agriculture activities into the Middle East and Africa.

Egypt's economy is diverse and agriculture sector is playing a big part of the economy. Egyptian market is a unique gateway to Africa as it is part of COMESA. Agriculture accounts for 40 percent of employment and 14 percent of GDP. Egypt relies heavily on imported agricultural products like frozen fish and other much of which is sourced from Netherlands. The Netherlands is a key partner for Egypt in trading agri-food technology. Egypt heavily relies on importation of pelagic fish, with the Netherlands being a major exporter. However, the current economic situation has resulted in extended delays for shipments to stay in port for longer periods. In April 2020, Egypt's Ministry of Trade and Industry (MTI) issued Decree No. 209/2020. The decree extends the shelf-life validity period for imported frozen fish from six- to nine-months. Due to the current situation, such period limit the opportunity for fish exporters to continue exporting to Egypt. There is a common practice between most of frozen pelagic fish exporters that shelf life life could reach to 2 years. To address this challenge, a fact finding study needed to find evidence allowing extending the current shelf-life of 9 months. Based on expert-judgement a shelf-life of 2 years is acceptable. Extending this shelf-life would greatly reduce waste and optimize the import process.

Objectives

The primary objective of this project is a literature study to the current international food-safety (and quality) regulation and standards (of USA, EU, UK and Norway) as well as possible literature on shelf-life and food safety of pelagic fish. A secondary objective is to understand the quality-factors relevant for shelf-life of pelagic fish and possible aspects to test these factors in a practical study-setup.

3. Scope of Work

The consultant will be responsible for conducting a comprehensive fact finding study, employing the following actions:

a) Gap Analysis:

i. Identify and assess relevant national and international regulations (USA, EU, UK and Norway), standards, and guidelines affecting the importation, storage, and transportation of pelagic fish.

b) Literature Review:

i. identify and assess relevant aspects the would affect shelf life of pelagic fish and advise on a practical study-setup to test for these aspects. (temperature setpoints that minimize quality-degradation and biological contamination, etc.)

ii. Conduct an extensive review of scientific literature, research papers, technical reports, and case studies on methods and technologies used to extend the shelf life of pelagic fish during importation and storage.

iii. Identify successful practices and interventions utilized in similar contexts or industries worldwide.

c) Stakeholder Engagement:

i. Identify and engage relevant stakeholders, such as importers, exporters, port authorities, regulatory bodies, and scientific institutions.

ii. Conduct interviews and surveys to gather insights and perspectives on the challenges, opportunities, and requirements for extending the shelf life of imported pelagic fish.

iii. Facilitate hyprid workshop to foster collaboration, share knowledge, and brainstorm potential solutions.

D) Best Practices and Recommendations:

i. Develop a comprehensive inventory of best practices and interventions that can potentially extend the shelf life of pelagic fish.

ii. Prioritize and recommend the most suitable interventions based on their feasibility, cost-effectiveness, and potential impact.

iii. Provide guidelines and technical recommendations for implementing recommended interventions in the Egyptian context.

4. Deliverables

The consultant is expected to deliver the following outputs:

a) Gap analysis report identifying challenges and opportunities related to extending the shelf life of imported pelagic fish.

b) Literature review report summarizing the findings from the scientific and technical literature.

c) Stakeholder engagement report, including insights, perspectives, and recommendations gathered from relevant stakeholders.

d) Best practices inventory with detailed descriptions of interventions to extend the shelf life of pelagic fish.

e) Final report integrating all findings, prioritized recommendations, guidelines, and technical specifications for implementation.

5. Timeline and Budget

The fact finding study is expected to be completed within 3 months, at an estimated budget of 15.000 EUR.

6. Confidentiality

The consultant is expected to maintain strict confidentiality regarding all proprietary information obtained during the study.

7. Reporting and Communication

The consultant shall provide regular progress updates to the stakeholders and submit all required reports outlined in section 4.

8. Evaluation Criteria

The consultant will be evaluated based on their experience in conducting similar studies, their proposed methodology, work plan, expertise in the subject matter, and their ability to deliver high-quality and actionable recommendations.

9. Ethical Considerations

The consultant is expected to adhere to ethical guidelines, ensuring integrity, impartiality, and respect towards all stakeholders involved in the study.

10. Ownership of Outputs

All outputs and deliverables resulting from this fact finding study will be the property of the client and may be used for further research or policy development.

2. Expected Outputs

1- A draft mapping scan (report) includes:

- **Chapter 1**
  Introduction A. Background of the study
  Overview of the pelagic fish industry in Egypt
- **Chapter 2**
  Current food safety and -quality standards and legal criteria for pelagic fish.
- **Chapter 3**
  Aspects that affect food safety and – quality and how these can be monitored in a study.
- **Chapter 4**
  - Short map summering the main challenges and opportunities for extending shelf life of pelagic frozen fish in Egypt.
  - How to unlock such bottleneck challenges and create enabling environment for Dutch companies

2- Hyprid workshop will be organized, bringing together key actors from the Dutch and Egyptian private sectors, government, and research institutes, in order to discuss the results of the study and share lessons learned.

The study needs to be concise reflecting and clarify the main challenges that might facing Dutch companies and investors to do business.

3. Consultant profile

The consultant(s) need(s) to have the following knowledge and experience:

- Demonstrated experience (10 years) developing more than one market analysis report, trade and food safety regulations report.
- Demonstrated experience in client-facing research advisory roles.
- Demonstrated knowledge and skills in methodology development and data analysis.
- Strong understanding of agri-food trade process, imports and exports procedures.
- Have experience working in importing food products and Agriculture inputs.
- Have an experience working with international companies or organizations.

The consultant(s) need(s) to have the following skills:

- Good interpersonal and communication skills.
- Solid skills in research and methodology design.
- Solid English language writing skills.
- Advanced strategic thinking and analytical skills.

The consultant(s) need(s) to have the following characteristics:

- Be able to accommodate short turnaround time (varies depends on the nature of the assignment, typically between 1-4 weeks).
- Be able to persuade and convince stakeholders.

Annex 2: List of persons met

Name	Organisation / Company	Email	Mobile Phone	Workshop 7th March 2024
Dr. Khaled Sofi	Chairman, Egyptian Organisation for Standards and Quality	khaledhsoufi@gmail.com		
Prof. Salah El-Din Moselhy Aly	Chairman, Lakes and Fish Resources Protection and Development Agency	Gafrd_eg@hotmail.com		
Dr. Tareq el Houby	Chairman, National Food Safety Authority of Egypt	Tareq.elhouby@nfsa.gov.eg	01149993336	
Dr. Ahmed Nasr-Allah	Country Director | Egypt WorldFish	a.allah@cgiar.org	+2010 20043	
Dr. Amany Ahmed	General Manager of General Administration of Veterinary Affairs (GAVA) at Lakes and Fish Resources Protection and Development Agency (LFRPDA)		0110 316 5075	
Dr. Eng: Khaled Hasan Soufi	Chairman. Egyptian Organisation for Standardisation and Quality. Ministry of Trade and Industry	Khaledsoufi@eos.org.eg	+2 0100 159 3066	X
Dr. Hanan Fouad	Egyptian Organisation for Standards and Quality	Hananfouad86@hotmail.com	+20 122 805 6795	
Dr. Hanan Seafawy	National Food Safety Authority of Egypt	hanan.seafawy.nafsa@gmail.com	01001927267	X
Eng. Ali El-Haddad	Chairman, Fish Basket	ahaddad@medfood.co	+201001314455	X
Eng. Reda Mohamed	Egyptian Organisation for Standards	Reda.mohamedsayed@yahoo.com	01005774607	X
Eng. Yasser Zaazou	CEO, Fish Basket	Yasser.zaazou @medfood.co	012 222 80498	
Mrs. Mai Siam	National Food Safety Authority of Egypt	Mai-siam@nfsa.gov.eg	01022204384	

Mr Robert Ammeraal	Pelagic Sales Director, Cornelis Vrolijk, Netherlands	Robert.Ammeraal@cornelisvrolijk.eu	+31 6 5119 3518	X
Mr. Alaa Allam	CM Seafood factory	Alaa.allam@seafoodfactory.com	01555225553	X
Mr. Arild Oksnevad	Royal Norwegian Embassy	ARILD.OKSNEVAD@MFA.NO	+201224183163	X
Mr. Elsayed Hussein	President, Port Said Star, El Nasser Company	sayed@el-nasser.net	+20 12222 83200	X
Dr. Esraa Mousa	National Food Safety Authority of Egypt	Esra.mousa@ nfsa.gov.eg	01112938894	
Mr. John O'Connell	Director of Strategic Growth and Partnerships. Land O'Lakes Venture37	joconnell@landolakes.com	+1651 249 4395	
Mr. Kamal Nabil Ibrahim	Trade and Economic Adviser. Royal Norwegian Embassy	Kamal.Ibrahim@mfa.no	+201 288 734 016	X
Mr. Mohamed Mohamady	Technical Director, Transforming the Assessment and Inspection of Food Businesses (TAIB) Program	mmohamady@landolakes.com	+20 1068839936	
Mr. Mohamed Mustafa	Embassy of Ireland, Egypt	Mohamed.Mustafa@dfa.ie	+202 2 728 7119	X
Mr. Naim Gayed	El Nasser Star for Trading & Import	naim@el-nasser.net	01000028300	X
Mr. Omar Abdellatif	Embassy of the Netherlands in Egypt			X
Mr. Samir Swailem	Chairmen of Fish and Meat Committee of Chamber of Commerce, Alexandria	Samara007@icloud.com	+20 122 3104 754	X
Mr. Samuel Karnis	Programme Director. Land O'Lakes Venture37	STKarnis@landolakes.com	+1320 420 4678	
Mr. Soliman Gamal	General Manager. El Nasser Group	solmangamal@portsaid-star.com	+20127 2222 577	
Mr. Tycho Vermeulen	Embassy of the Netherlands in Egypt	tycho.vermeulen@minbuza.nl	+20 2 273 5528	X

Ms. Walaa Dahab	Agricultural Officer to Egypt & Jordan. Embassy of the Kingdom of the Netherlands in Egypt	walaa.dahab@minbuza.nl	+202-2739 5586	
Mr. Willem Van Beelen	PP Group	WILLEMVANBEELEN@Hotmail.com	0036 50614886	X
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Ms. Fatma El-Haddad	Sakr	Fatma.Elhaddad@sakrgroup.net	+2 01 001 786 206	X
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Ms. Heba Hammad Radi Hammad	General Manager of Standards, Egyptian Standards Organisation	Eng.hebahammad@hotmail.com	+201 221344092	
Ms. Iman Rifaat	Under Secretary, Head of Central Department of World Trade Organisation of Affairs and Trade Agreements Sector, Ministry of Trade and Industry	i.abdelsatar@tas.gov.eg	+20 100 341 4516	
Dr. Marwa Lotfy	NFSA	Marwa.lotfy@nfsa.gov.eg	+20100985995	
Dr. Salma Mohamed	Aquaculture Engineer. Aquaculture Consultant Office	Salmamohamedmunir@gmail.com	01288480592	
Ms. Samar Assem	Community Manager, Sustainable Hospitality Alliance	Samar.assem@SustainableHospitalityAlliance.org	01201 904 699	X
Ms. Sylvia Edwars	Logistics Manager, Marine Foods.	sylvia@marinefoodseg.com	01220307828	
Prof. Hani Al-Minshawy	Head of the Fish Division at the Federation of Egyptian Industries	Summermoon333@gmail.com	03 462 3222	X

VIDEO CONFERENCE				**Workshop 7th March 2024**
Mr. Arnout Langerat	Managing Director, Cornelis Vrolijk, Netherlands	Arnout.Langerat @cornelisvrolijk.eu	+31 255 5325 24	X
Mr. Tim Heddema	President, Pelagic Freezer Trawler Association (PFA), Netherlands	theddema@pelagicfish.eu	+31 625 045 602	X
Mr. Wim van der Zwan	Managing Director, W. van der Zwan & Zn BV.	W.vanderzwan@wvanderzwan.nl		x

Annex 3: List of references reviewed and main findings on rancidity

Summary of findings

Species	Form	Period	Period unit	Temperature C	TBARS values	TBARS unit	Sensory	Reference	Notes
Atlantic mackerel	Whole	1	month	-20	0.2-0.3	mg/kg	A	Auborg 2005	
Atlantic mackerel	Whole	3	month	-20	0.35	mg/kg	B	Auborg 2005	
Atlantic mackerel	Whole	5	month	-20	0.4-0.5	mg/kg	B	Auborg 2005	
Atlantic mackerel	Whole	7	month	-20	0.35-0.4	mg/kg	C (unacceptable odour)	Auborg 2005	
Atlantic mackerel	Whole	9	month	-20	0.5-0.7	mg/kg	C (unacceptable odour)	Auborg 2005	
Atlantic mackerel	Whole	12	month	-20	0.35-0.5	mg/kg	C (unacceptable odour)	Auborg 2005	
Atlantic mackerel	Whole	6	month	-18	0.7	µmol/g		Romotowska et al 2016 (a)	
Atlantic mackerel	Whole	9	month	-18	0.6	µmol/g		Romotowska et al 2016 (a)	
Atlantic mackerel	Whole	12	month	-18	1.4	µmol/g		Romotowska et al 2016 (a)	
Atlantic mackerel	Whole	3	month	-18	0.7 to 0.9	µmol/g		Romotowska et al 2016 (b)	

Atlantic mackerel	Whole	6	month	-18	0.9-1.3	µmol/g		Romotowska et al 2016 (b)	
Atlantic mackerel	Whole	9	month	-18	0.8-1.2	µmol/g		Romotowska et al 2016 (b)	
Atlantic mackerel	Whole	12	month	-18	0.8-1.1	µmol/g		Romotowska et al 2016 (b)	
Atlantic mackerel	H&G	5	month	-18	n/a	n/a	Rancidity =3/5	Kolakowska and Deutry 1983	Commercial temperatures (-18 assumed).
Atlantic mackerel	fillet	5.5	month	-18	n/a	n/a	Rancidity =2/5	Kolakowska and Deutry 1983	Commercial temperatures (-18 assumed).
Atlantic mackerel	fillet	2	month	-18	n/a	n/a	Rancidity =0/5	Kolakowska and Deutry 1983	Commercial temperatures (-18 assumed).
Atlantic mackerel	mince	12	month	-30	38	µmol/g		Robles-Martinez et al 1982	
Atlantic mackerel	mince	2	month	-15	29	µmol/g		Robles-Martinez et al 1982	
Atlantic mackerel	whole	2.5	month	-25	0.29	µmol/g	rancidity flavour 19.6/100	Sveinsdottir et al 2020	
Atlantic mackerel	whole	4	month	-25	0.25	µmol/g	rancidity flavour 8.1/100	Sveinsdottir et al 2020	

Atlantic mackerel	whole	8	month	-25	0.15	µmol/g	rancidity flavour 6.1/100	Sveinsdottir et al 2020	
Atlantic mackerel	whole	10	month	-25	0.1	µmol/g	rancidity flavour 10.6/100	Sveinsdottir et al 2020	
Atlantic mackerel	whole	12	month	-25	0.22	µmol/g	rancidity flavour 19.4/100	Sveinsdottir et al 2020	
Atlantic mackerel	whole	15	month	-15	0.1	µmol/g	rancidity flavour 16.9/100	Sveinsdottir et al 2020	
Atlantic mackerel	fillet	3	month	-20	0.65	µg/g		Saeed and Howell 2002	
Atlantic mackerel	fillet	6	month	-20	1.2	µg/g		Saeed and Howell 2002	
Atlantic mackerel	fillet	12	month	-20	1.3	µg/g		Saeed and Howell 2002	
Atlantic mackerel	fillet	18	month	-20	1.4	µg/g		Saeed and Howell 2002	
Atlantic mackerel	fillet	24	month	-20	1.7	µg/g		Saeed and Howell 2002	
Atlantic mackerel	fillet	1	month	-27	0.6	mmol/kg		Standal et al 2018	
Atlantic mackerel	fillet	7	month	-27	0.45	mmol/kg		Standal et al 2018	
Atlantic mackerel	fillet	12	month	-27	0.2	mmol/kg		Standal et al 2018	
Atlantic mackerel	fillet	1	month	-27	14-30	µmol/kg		Thorleifsson 2015	

Atlantic mackerel	fillet	4	month	-27	40-66	µmol/kg		Thorleifsson 2015	
Atlantic mackerel	Whole	5	day	-20	0.05	nmol/mg protein	Zhou et al 2022	Plate frozen	
Atlantic mackerel	Whole	30	day	-20	0.08	nmol/mg protein	Zhou et al 2022	Plate frozen	
Atlantic mackerel	Whole	60	day	-20	0.13	nmol/mg protein	Zhou et al 2022	Plate frozen	
Atlantic mackerel	Whole	90	day	0.2	0.16	nmol/mg protein	Zhou et al 2022	Plate frozen	
Chub mackerel	fillets	2	month	-20	11.6	mg/kg	7.5 (very good)	Erkan and Bilen 2010	
Chub mackerel	fillets	4	month	-20	14	mg/kg	6.33 (good)	Erkan and Bilen 2010	
Chub mackerel	fillets	6	month	-20	14.2	mg/kg	4.5 (unacceptable)	Erkan and Bilen 2010	
Chub mackerel	fillets	9	month	-20	7.7	mg/kg	2.2 (unacceptable)	Erkan and Bilen 2010	
Chub mackerel	fillets	11	month	-20	7	mg/kg	1 (unacceptable)	Erkan and Bilen 2010	
Atlantic mackerel	fillets (Vacuum)	1	month	-27	3	mg/kg		Mozuraityte et al 2021	
Atlantic mackerel	fillets (Vacuum)	8	month	-27	5.4	mg/kg		Mozuraityte et al 2021	
Atlantic mackerel	fillets (Vacuum)	12	month	-27	6.5	mg/kg		Mozuraityte et al 2021	

Chub mackerel	fillets	1	month	-19	5	mg/kg		Agustinelli and Yeannes 2015	
Chub mackerel	fillets	3	month	-19	9	mg/kg		Agustinelli and Yeannes 2015	
Chub mackerel	fillets	6	month	-19	14.5	mg/kg		Agustinelli and Yeannes 2015	
Chub mackerel	fillets	9	month	-19	11	mg/kg		Agustinelli and Yeannes 2015	
Chub mackerel	fillets	12	month	-19	11	mg/kg		Agustinelli and Yeannes 2015	
Chub mackerel	fillets	1	month	-18	0.75	mg/kg		Park el 2021	
Chub mackerel	fillets	3	month	-18	0.9	mg/kg		Park el 2021	
Chub mackerel	fillets	5	month	-18	1.2	mg/kg		Park el 2021	
Chub mackerel	fillets	6	month	-18	1.5	mg/kg		Park el 2021	
Herring	Fillet	200	day	-25	3.8	mg/kg		Indergård et al 2014	
Herring	Fillet	375	day	-25	5.9	mg/kg		Indergård et al 2014	
Herring	Fillet	6	month	-20	18-90	µmol/g	rancid both in odour and flavour, discoloured, off-flavours	Jónsson et al (2008)	

Herring	Fillet	9	month	-20	40-58	µmol/g	rancid both in odour and flavour, discoloured, off-flavours	Jónsson et al (2008)	Investigated different stocks and seasons
Herring	Fillet	12	month	-20	56-80	µmol/g	rancid both in odour and flavour, discoloured, off-flavours	Jónsson et al (2008)	
Herring	Fillet	18	month	-20	57-70	µmol/g		Jónsson et al (2008)	
Herring	Smoked	3	month	-18	6.27	mg/kg		Abdel-Naeem et al 2021	
Herring	Smoked	0	month	-18	4	mg/kg		Abdel-Naeem et al 2021	
Herring	Fillet (white muscle)	14	month	-20	0.06	µmol/g		Dang et al 2017	
Herring	Fillet (dark muscle)	14	month	-20	3.5	µmol/g		Dang et al 2017	
Baltic herring	Whole	0	month	-18	n/a	n/a	Rancidity =0/5	Kolakowska and Deutry 1983	Commercial temperatures (-18 assumed).
Baltic herring	Whole	3	month	-18	n/a	n/a	Rancidity =2.5/5	Kolakowska and Deutry 1983	Commercial temperatures (-18 assumed).
Baltic herring	Whole	4	month	-18	n/a	n/a	Rancidity= 1/5	Kolakowska and Deutry 1983	Commercial temperatures

									(-18 assumed).
Horse mackerel	Whole	9	month	-20	0.68	mg/kg		Auborg and Ugliano 2021	
Horse mackerel	H&G	4	month	-18	n/a	n/a	Rancidity =1/5	Kolakowska and Deutry 1983	Commercial temperatures (-18 assumed).
Horse mackerel	H&G	6	month	-18	n/a	n/a	Rancidity =3/5	Kolakowska and Deutry 1983	Commercial temperatures (-18 assumed).
Horse mackerel	Whole	1	month	-20	0.26	mg/kg	Grade A	Auborg et al 2004 (a)	
Horse mackerel	Whole	3	month	-20	0.41	mg/kg	Grade B	Auborg et al 2004 (a)	
Horse mackerel	Whole	5	month	-20	0.85	mg/kg	Grade B	Auborg et al 2004 (a)	
Horse mackerel	Whole	7	month	-20	0.45	mg/kg	Grade C (unacceptable)	Auborg et al 2004 (a)	
Horse mackerel	Whole	9	month	-20	0.41	mg/kg	Grade C (unacceptable)	Auborg et al 2004 (a)	
Horse mackerel	Whole	12	month	-20	0.75	mg/kg	Grade C (unacceptable)	Auborg et al 2004 (a)	
Horse mackerel	Whole	1	month	-20	0.23	mg/kg		Auborg et al 2004 (b)	
Horse mackerel	Whole	3	month	-20	0.37	mg/kg		Auborg et al 2004 (b)	

Horse mackerel	Whole	6	month	-20	0.47	mg/kg		Auborg et al 2004 (b)	
Horse mackerel	Whole	9	month	-20	0.49	mg/kg		Auborg et al 2004 (b)	

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Annex 4: Presentations at Workshop: Thursday 07 March, 2024

Download these from:

1. Current Egyptian Standards for fish and fishery products and shelf-life specifications

https://onedrive.live.com/view.aspx?resid=307BCF07413CB784!180010&cid=307bcf07413cb784&authkey=!ADx3oe1pl9_m1AQ&CT=1710521714781&OR=ItemsView

2. Shelf life of fish - the Egyptian importers perspective

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3. Shelf life of fish - the exporters perspective

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https://onedrive.live.com/?authkey=%21ADx3oe1pl9%5Fm1AQ&cid=307BCF07413CB784&id=307BCF07413CB784%21180008&parId=307BCF07413CB784%21180006&o=OneUp

4. Considerations in the scientific case for shelf-life extension

https://onedrive.live.com/view.aspx?resid=307BCF07413CB784!180086&cid=307bcf07413cb784&authkey=!ADx3oe1pl9_m1AQ&CT=1710521855847&OR=ItemsView

Annex 5: EoS Guidelines for Stability Studies for Food

The stability study protocol, agreed upon by the competent committee, shall include the following points:

1. The name of the item and the standard specification that applies to it, if any.

2. Description of the item: The product is defined in terms of manufacturing processes and the type of packaging used.

3. Storage and handling conditions - data card and instructions for use, storage, and handling

4. Product characteristics: The applicant must adhere to the basic requirements of the standard specifications of the product mentioned in the study, such as (Aw, PH... etc.).

The competent committee evaluating the study may request inclusion of some additional characteristics in light of the justifications provided by the committee and available international, regional, or local references in order to verify the stability of the product during the proposed shelf life, and to conduct tests on it, including the results of natural, chemical, and microbiological tests in accordance with the specification of each product, and reference of these methods, in addition to providing a report on the evaluation of a period study

5. For assessment of the proposed validity period, the submitted report should include the following:

- the number of samples and their testing, and that the samples be representative in terms of manufacturing and installation conditions.
- The nature of the product should determine the duration of the test
- Study conditions are determined according to the nature of the item, such as temperature, storage, and relative humidity
- Testing periodicity
- Choosing a laboratory: It is preferable that the laboratories have the latest version of ISO No 17025 in the required tests
- Evaluating the results of additional characteristics in terms of acceptance, rejection, and batch numbers for samples
- Scientific references, and may include any statistical analyses used or data evaluation methods to determine the shelf life of the product

6. A pledge will be provided to show that the product will be produced and stored under the same conditions stated in the stability study and using the same containers and the same raw materials