Hygiene and Technology of Fish and Seafood products

Introduction

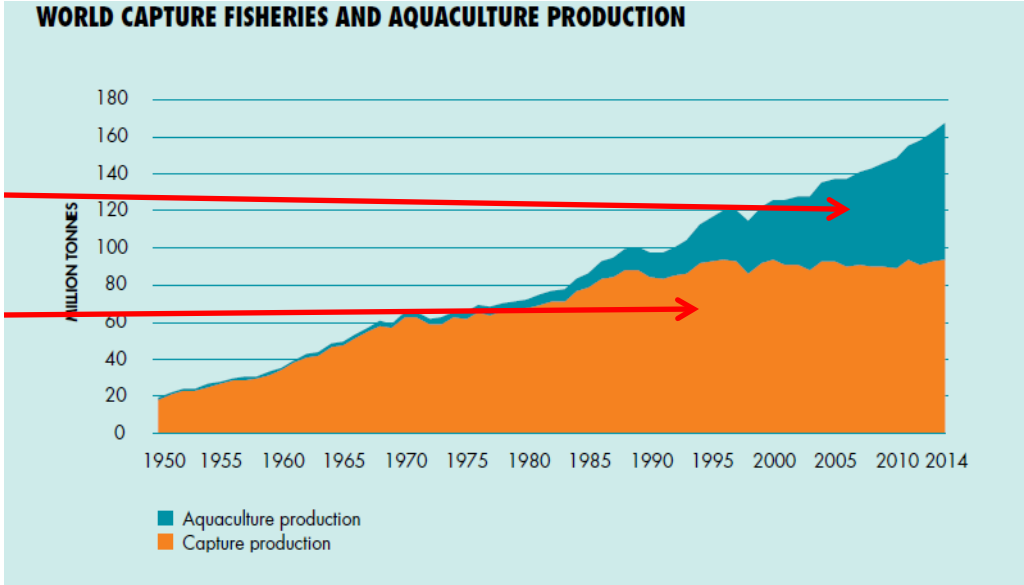
- **FOOD COMMODITY "FISH":**
- **Farmed in aquaculture systems or obtained by hunting as the wild species living in land waters or in an open waters of world seas and oceans.**
- **Term diadromous indicates all fish which migrate between the sea and fresh water.**
- **Anadromous fish are ones which migrate from the sea into fresh water to spawn.**
- **Adult salmons return to river of their birth to spawn after a few years at sea and usually die when spawning is over.**
- **Catadromous fish are ones which migrate from fresh water into the sea to spawn.**
- **Adult eels leave fresh water and swim to tropical seas (Sargasso sea) and die after spawning.**

Aquaculture

Fishing

World fisheries harvest, wild capture versus aquaculture production, in million tons from 1950 to 2010.

- **If we compare the production of wild fish to fish farming, production of fish from aquacultures has grown faster. In the last years production of wild fish has stagnated or has increased only very slightly.**



https://www.youtube.com/watch?v=kEAnkY-WBFg

World fisheries and aquaculture production (2009 – 2014)

WORLD FISHERIES AND AQUACULTURE PRODUCTION AND UTILIZATION

	2009	2010	2011	2012	2013	2014
			(Million tonnes)			
PRODUCTION						
Capture						
Inland	10.5	11.3	11.1	11.6	11.7	11.9
Marine	79.7	77.9	82.6	79.7	81.0	81.5
Total capture	**90.2**	**89.1**	**93.7**	**91.3**	**92.7**	**93.4**
Aquaculture						
Inland	34.3	36.9	38.6	42.0	44.8	47.1
Marine	21.4	22.1	23.2	24.4	25.5	26.7
Total aquaculture	**55.7**	**59.0**	**61.8**	**66.5**	**70.3**	**73.8**
TOTAL	**145.9**	**148.1**	**155.5**	**157.8**	**162.9**	**167.2**
UTILIZATION[1]						
Human consumption	123.8	128.1	130.8	136.9	141.5	146.3
Non-food uses	22.0	20.0	24.7	20.9	21.4	20.9
Population (*billions*)	6.8	6.9	7.0	7.1	7.2	7.3
Per capita food fish supply (*kg*)	18.1	18.5	18.6	19.3	19.7	20.1

Note: Excluding aquatic plants. Totals may not match due to rounding.
[1] Data in this section for 2014 are provisional estimates.

Why it is healthy to eat fish?

- helps to maintain cardiovascular health by playing a role in the regulation of blood clotting, prevent vessel constriction leading to reduced blood pressure
- can play a beneficial role in cardiac arrhythmia (irregular heartbeat) and reduce the risk of sudden death, heart attack, and strokes
- can support healthy brain function and nerves during pregnancy
- It is important for prenatal and postnatal neurological development of infants
- can reduce tissue inflammation and reduce the risk of arthritis or alleviate the symptoms of rheumatoid arthritis
- can decrease the risk of some diseases: depressions, Alzheimer's disease, diabetes, and development of dementia in older people

The nutritive value

- **There are six major classes of nutrients: water, proteins, fats, saccharides, minerals and vitamins.**
- **These nutrient classes can be categorized as either macronutrients (needed in relatively large amounts) or micronutrients (needed in smaller quantities).**
- **The macronutrients include water, proteins and fats.**
- **The micronutrients are saccharides, minerals and vitamins.**
- **The macronutrients provide structural material:**
- **amino acids from which proteins are built, and**
- **fatty acids from which cell membranes (phosfolipids) are built.**
- **Lipids in form of the esters of three fatty acids and glycerol (triacylglycerols) are the main components of depot lipids and the main sources of energy.**
- **Some amino acids and fatty acids, but not all, are essential in the diet: they cannot be synthesized in our body.**

Water

- **The main component of fish flesh is water.**
- **The water in fresh fish muscle is tightly bound to the proteins.**
- **The average water content in fatty fish is about 70 %, in lean fish is about 80 % of the weight samples of fresh fish meat.**
- **The water content is inversely proportional to the content of fat. High content of water in the flesh is connected with very law fat content.**

Species	Water content	Fat content
cod	78 – 83 %	< 1%
mackerel	60 – 74 %	> 15 %

- **Laboratory analysis**
- **The water content (moisture content) in fish is determined gravimetrically by drying the sample with sand up to constant weight at temperature +103 ± 2 °C.**

Proteins

- **The average total protein content in fresh fish is usually between 15 and 20 %.**
- **The proteins in fish muscle tissue can be divided into three groups:**
- **Structural proteins (actin, myosin) which constitute 70-80 % of the total protein content. These proteins are responsible for muscle movement.**
- **Sarcoplasmic proteins (myoglobin, haemoglobin). This fraction constitutes 25-30 % of the protein. These proteins are responsible for cell metabolism.**
- **Connective tissue proteins (collagen) constitute approximately 1-3 % of the protein. Collagen forms a different connective tissues such as skin, swim bladder and the collagen fibrils in muscle. The varying amounts and varying types of collagen in different fish also have an influence on the textural properties of fish muscle.**
- **All proteins are chains of chemical units called amino acids, they are characterized by inclusion of nitrogen in these units.**
- **some amino acids are essential - we cannot produce them in our body and therefore must be supplied from the diet, and**
- **some are non-essential - we can produce them in our body from other nitrogen-containing compounds.**

Proteins

- **Fish proteins contain all the essential amino-acids and, like milk, eggs and meat proteins, have a very high biological value.**

	Essential amino-acids in mg/100 g of proteins								
	Lysine	Tryptophan	Histidine	Phenylalanine	Leucine	Isoleucine	Threonine	Methionine	Valine
fish	8.8	1.0	2.0	3.9	8.4	6.0	4.6	4.0	6.0
egg	6.8	1.9	2.2	5.4	8.4	7.1	5.5	3.3	8.1

- **Two essential amino acids called lysine and methionine are generally found in high concentrations in fish proteins, in contrast to cereal proteins for example. Thus fish and cereal protein can supplement each other in the diet.**

- **Laboratory analysis**
- **The protein content is determined as an amount of organically bound nitrogen by Kjeldahl method (recalculating coefficient $f_1 = 6.25$).**

Note

- **Proteins of fish contain a parvalbumin – protein with low molecular weight.**
- **It is a calcium-binding albumin that has been identified as an food allergen causing allergic diseases of human.**
- **Processing procedures of fish like drying, salting, boiling, smoking, marinating or sterilization and digestion with proteolytic enzymes or extreme low pH value in human stomach do not affect allergenicity of fish allergens.**
- **Allergy to fish is manifested in different ways - from the reaction of the skin (pimples, swelling, hives), through digestive problems (diarrhea or vomiting) to respiratory problems.**

https://www.youtube.com/watch?v=sGWZFcsyMgA

Lipids, Fats

- **“Lipid” is synonymous with “fat”.**

- **Lipids are among the most variable in fish. Their contents and compositions in the body may be influenced by muscle tissue components and by other factors (species, health status, motoric activity, age, sexual cycle stage, type of diet and its composition, feeding intensity)**

- **Fish naturally accumulate fat under the skin, among the internal organs or in the muscles. Fish can be divided into three groups according to lipid content:**

1. **Lean fish have a fat content lower than 2 % (cod, hake)**

2. **Medium fat fish have a fat content between 2 % and 10 % (salmon, common carp)**

3. **Fat fish have a fat content higher than 10 % (mackerel, silver carp)**

- **The lipids present in fish species may be divided into two major groups: the phospholipids and triglycerides.**

- **The phospholipids make up the structure of the unit membranes in the cells.**

- **The triglycerides are lipids used for energy storage in fats, they are often termed depot fat.**

- **A few fish (from family *Gempylidae*, oilfish – escolar) have wax esters as specific part of their depot fats. These substances are indigestible and can cause various diseases of the gastrointestinal characters (pain, diarrhea).**

- **Laboratory analysis**
- **The lipid content is determined quantitatively by extraction in hot solvents by Soxhlet method.**

- **Fatty acids (FA) can be either saturated (without double bonds in chain SFA) or unsaturated (with double or more bonds UFA).**

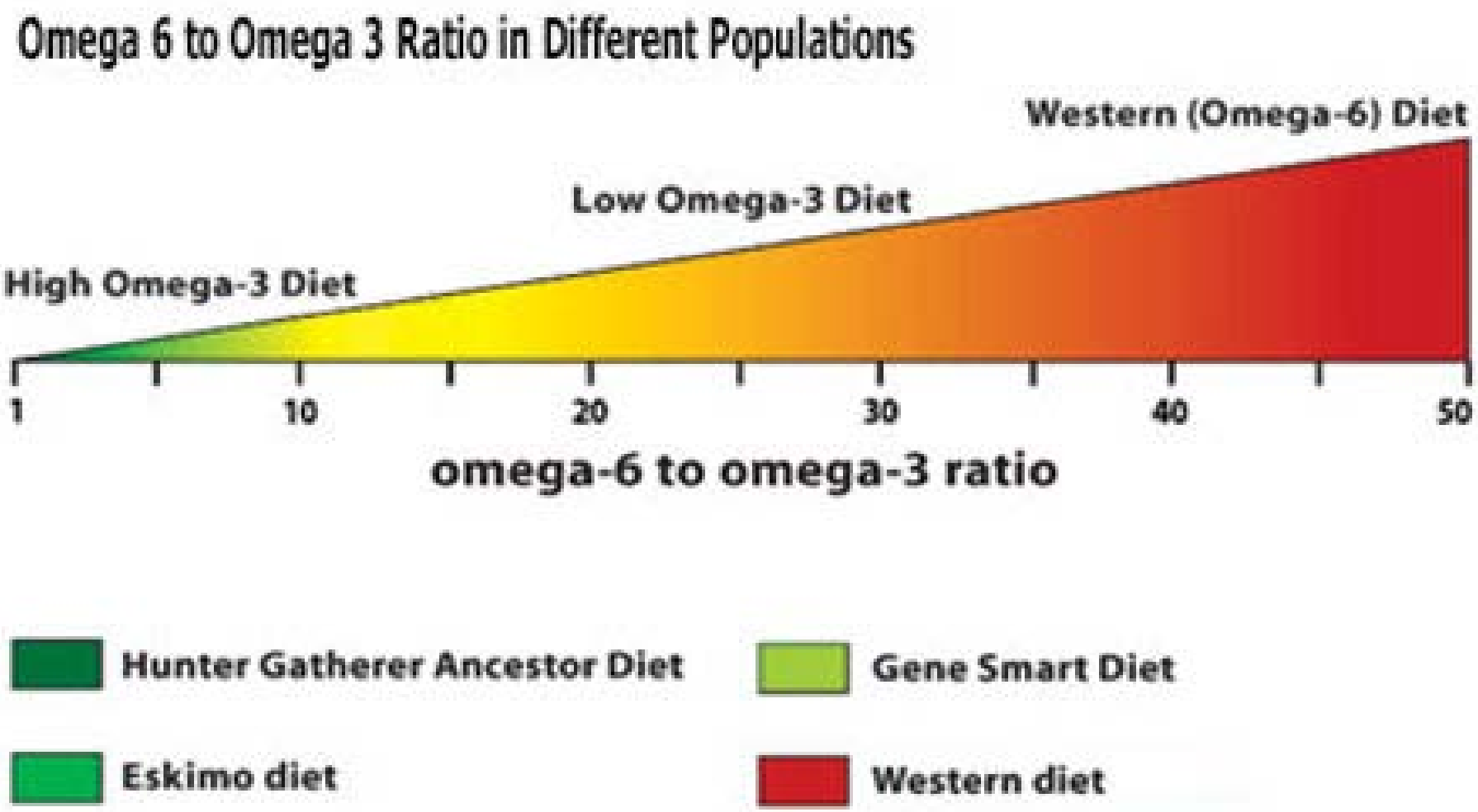
- **An unsaturated UFA are synthesized from a saturated FA, introducing double bonds through elongation and desaturation of carbon (C) chain by enzymes called elongases and desaturases.**

- **Fatty acids with one double bonds in chain are called MUFA monounsaturated fatty acids.**

- **Fatty acids with more than one double bonds in chain are called PUFA polyunsaturated fatty acids.**

- **Term HUFA (highly polyunsaturated fatty acids) designates a subsample of PUFA with twenty or more carbon (C) atoms in chain.**

- **PUFA are considered healthier in comparison with SFA.**



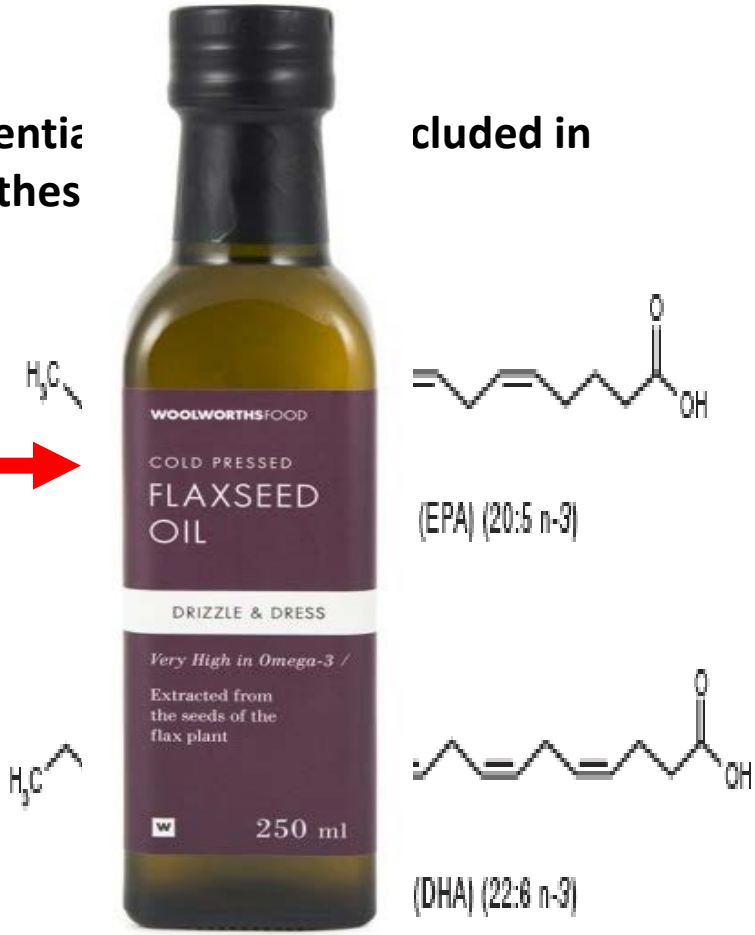
- **It is recommended that the PUFAs omega-6/omega-3 ratio should be ≤ 2**

- **or reverse ratio PUFAs omega-3/omega-6 should be for freshwater fish of 1 to 5 and for sea fish of 5 to 10.**

- **Most fatty acids are non-essential, meaning the body can produce them as needed, generally from other fatty acids.**

- **However, in humans, at least two PUFAs are essentia cluded in the diet because they are almost exclusively synthes**

- **Especially the presence of the essential PUFAs:**
  linoleic fatty acid (LA: C18:2omega-6)
  α-linolenic fatty acid (LNA: C18:3omega-3)
  have a significant physiological effect on human organism.



- **Two other PUFAs:**
  eicosapentaenic fatty acid (EPA: C20:5omega-3)
  docosahexaenic fatty acid (DHA: C22:6omega-3)
  are synthesized from the α-linolenic fatty acid (LNA: C18:3omega-3) introducing double bonds through elongation and desaturation of carbon (C) chain by enzymes, have a significant physiological effect on human organism and they are considered to be highly beneficial to human health.

Minerals

- Fish meat is valuable as a source of mineral substances. The amount of minerals in fish flesh is usually somewhere between 1 and 2 %.

- Laboratory analysis
- The ash content is determined gravimetrically by burning samples in a muffle furnace at temperature 550 °C until the disappearance of black carbon particles.

- Many elements are present in relative big quantity; they are usually called MACROMINERALS.

- Minerals such as calcium (Ca) and phosphorus (P) are located especially in bones.
- Small bones are usually softened during fish processing, and eaten together with the meat. Thus, fish bones present a very valuable source of these minerals.

MACROMINERALS	Average value in mg/100 g
calcium (Ca)	79 (1000 mg)
phosphorus (P)	190 (700 mg)
potassium (K)	278 (4700 mg)
sodium (Na)	72 (1.5 g)
sulfur (S)	191 (800 mg)

- Fish are considered a good source of potassium (K); sodium (Na) content is very low.

- Sulfur (S) is consumed in the form of sulfur-containing amino acids.

- Many elements such as manganese (Mn), copper (Cu), zinc (Zn), selenium (Se) are present in a very small amounts; they are usually called MICROMINERALS.

- Seafish are considered to be the best source of iodine (J) for human nutrition.
- The recommended daily intake of iodine for humans is 200 µg/per day.
- Iodine (J) is important for hormone development essential thyroid hormones.

- The thyroid is a gland that regulates many metabolic processes, such as growth and energy use. A lack of dietary iodine can cause an enlarged thyroid gland (goitre) or other iodine deficiency disorders including mental retardation in children.

MICROMINERALS	Average value in mg/100 g
manganese (Mn)	0.82 (2mg/day)
copper (Cu)	0.20 (1 mg/day)
zinc (Zn)	0.96 (10 mg/day)
selenium (Se)	0.025 (0.055 mg/day)
Iodine (J)	0.009 (0.15 mg/day)

Vitamins in fish

- **Vitamins can be divided into two groups, those that are SOLUBLE IN FAT, such as vitamins A (retinol) and D (cholecalciferol), and those that are SOLUBLE IN WATER, such as vitamins B_1 (thiamine), B_2 (riboflavin), niacin, B_6 (pyridoxin), B_{12} (cyanocobalamin), panthothenic acid and biotin.**

- **Vitamins C (ascorbic acid) and E (tocopherol) are present in fish only in very small quantities.**

- **The amounts of vitamins vary widely from species to species, and throughout the year.**
- **The vitamin content of individual fish of the same species, and even of different parts of the same fish, can also vary considerably.**

- **Vitamin A (retinol) is required for normal vision and helps eyes adjust between light and dark situations. Rich dietary sources of retinol include fish liver oils.**

- **Fish is one of the few natural dietary sources of vitamin D (cholecalciferol). Vitamin D aids in the absorption of calcium, helps in the prevention of osteoporosis. Rich dietary sources of cholecalciferol include fish liver oils.**

- **Water-soluble vitamins in fish are more uniformly distributed, and the flesh usually contains more than half the total amount present in the fish.**

Saccharides

- **The amount of saccharides in fish muscle is generally too small to be of any significance in the diet.**
- **In white fish the amount is usually less than 1 %, but in the dark muscle of some fatty species it may occasionally be up to 2 %.**

- **Saccharides content is usually determined mathematically.**

- **Saccharides in % = 100 – (moisture + protein + fat + ash content in %)**

Energetic value

- **Energetic value is usually determined mathematically:**

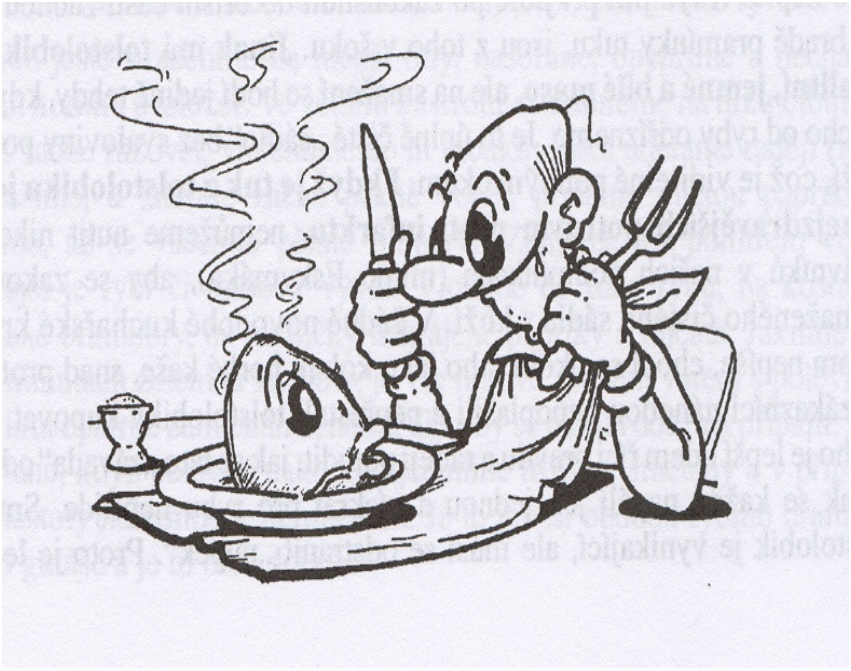
- **Energetic value in kJ/100 g = (protein + saccharides content) × 17 + fat content × 37**

- **Nutrition experts recommend eating of fish at least two times per week as part of a healthy diet. The weight of one portion should be about 150 to 200 grams. Only regular consumption of fish has a positive effect on human health.**

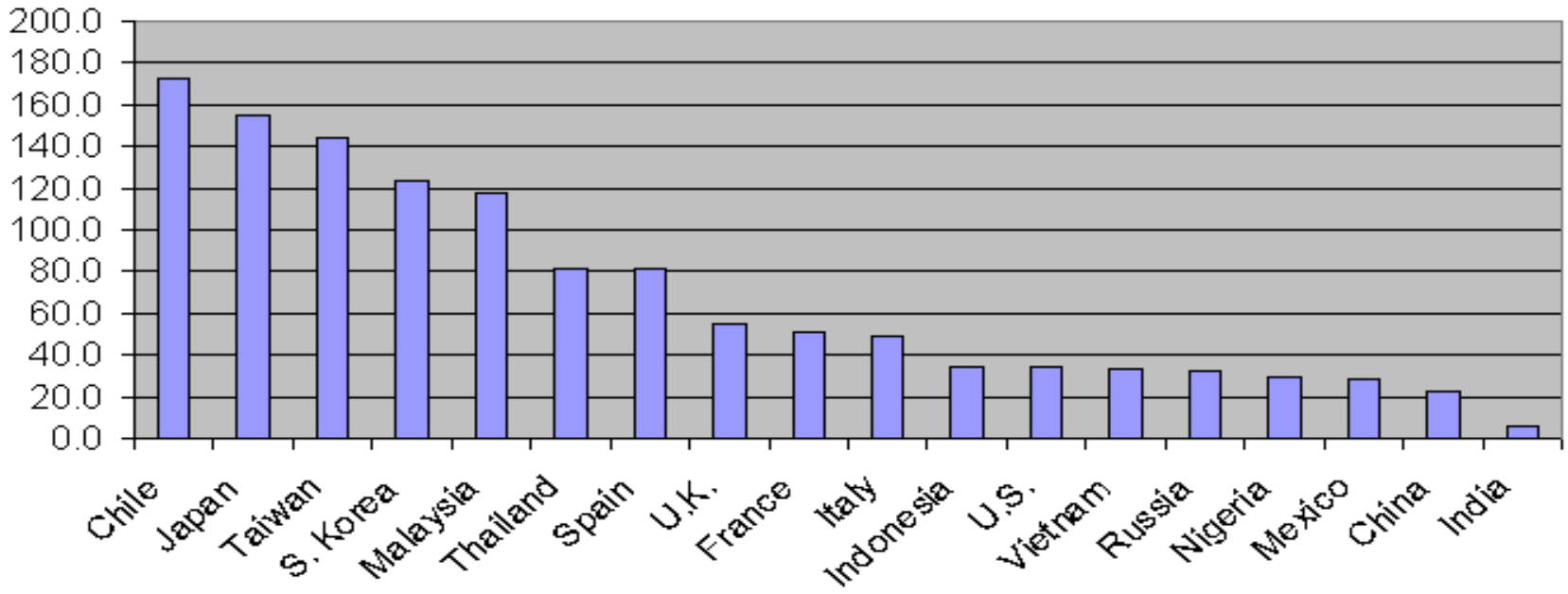
- **The world average of fish consumption and the number of consumers has constantly been increasing in the last years and amounts now to 18.8 kg/per year/per capita.**

- **In recent years, fish consumption is:**
- **lowest in Africa (9.1 kg per capita)**
- **highest in Asia (20.7 kg per capita)**

- **In the Czech Republic annual consumption of fish is very small and varies about 5.5 kg per capita; of which consumption of freshwater fish is only 1.4 kg.**



Annual Seafood Consumption by Country in Pounds Per Person



Sources: National Geographic Magazine, October, 2010.
Economist. *Pocket World in Figures* . 2010.

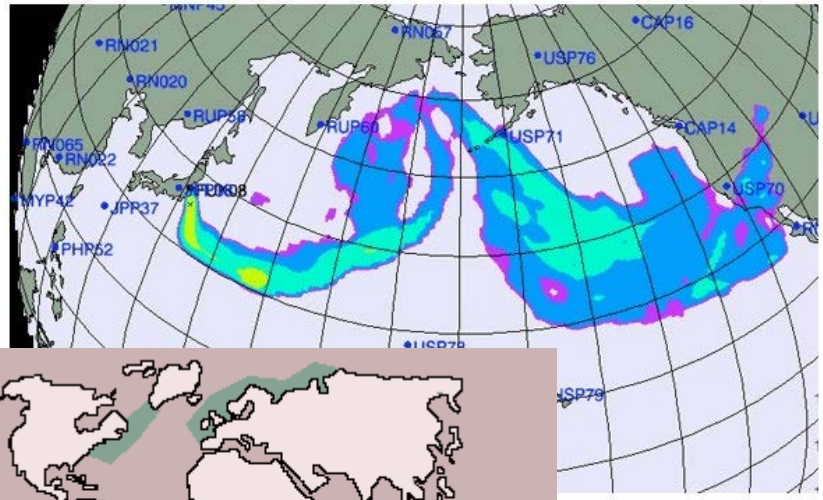
Marine fish
species important for human nutrition

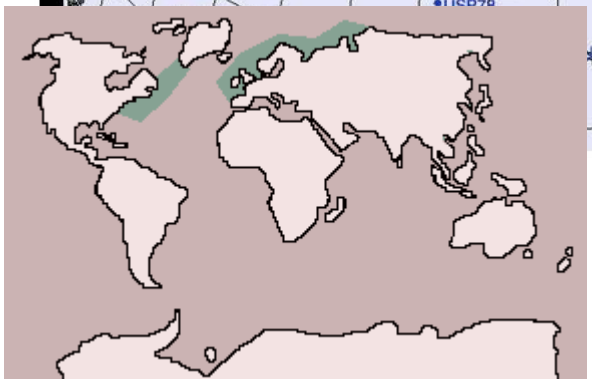
Salmons

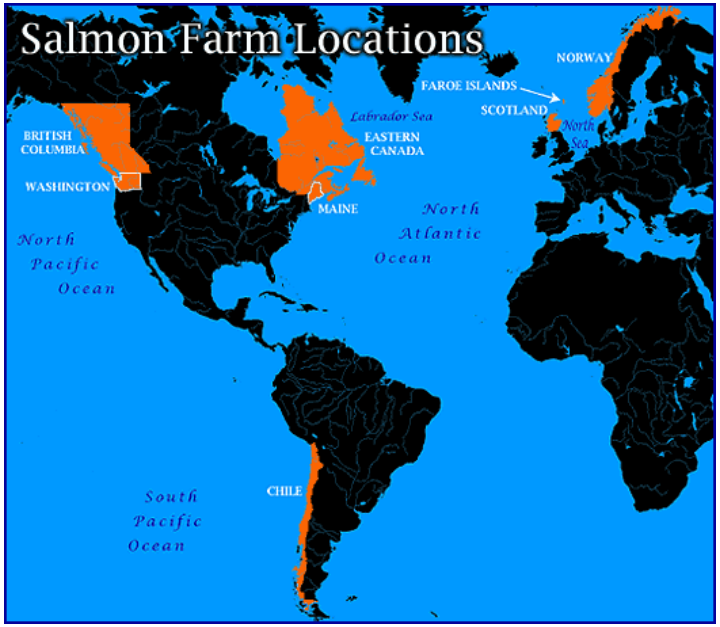
- Salmon is the common name for various species of fish in the family *Salmonidae*.

- Wild species of salmons like *Oncorhynchus gorbuscha* (Pink salmon), *Oncorhynchus keta* (Chum salmon), *Oncorhynchus nerka* (Sockeye salmon), *Oncorhynchus kisutch* (Coho salmon) or *Oncorhynchus tschawytscha* (Chinook salmon) live along the coasts of both the Pacific Ocean and the North Atlantic.

- Salmons are intensively produced in aquaculture. *Salmo salar* is one of the major species grown in aquaculture under controlled conditions in many parts of the world. Most of the world's farmed salmons come from Scotland, Norway and Chile.

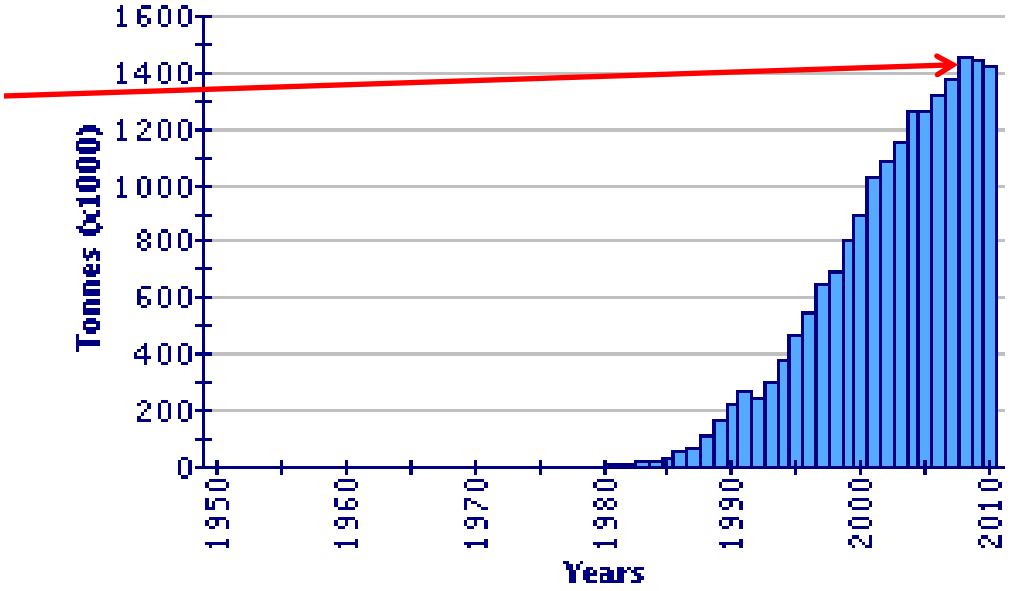




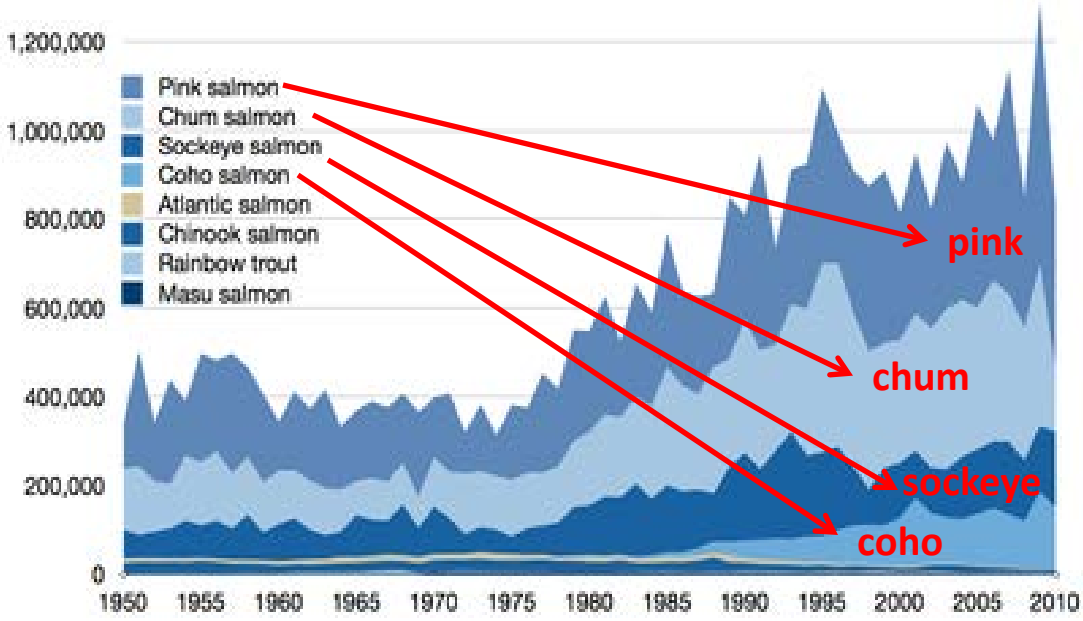


- In recent years, production of farmed *Salmo salar* was around 1.4 mil. tons.

- In year 2011 current worldwide production of farmed *Salmo salar* exceeds 1.72 mil. tons.



- In contrast, annual captures of various species of wild salmons are very different and within one species the volume of production varies from year to year.



Salmon Fillet Trim Guide

Available from http://www.fwbryce.com/Images/Trim_Guide.pdf

1. TRIM A

Removed

1) Backbone off
2) Belly bone off

4. TRIM D

..moreover removed

8) Tail piece off
9) Belly membrane off
10) Nape trimmed

3. TRIM C

..moreover removed

7) Pin bone out

2. TRIM B

..moreover removed

3) Back fin off
4) Collarbone off
5) Belly fat off
6) Belly fins off

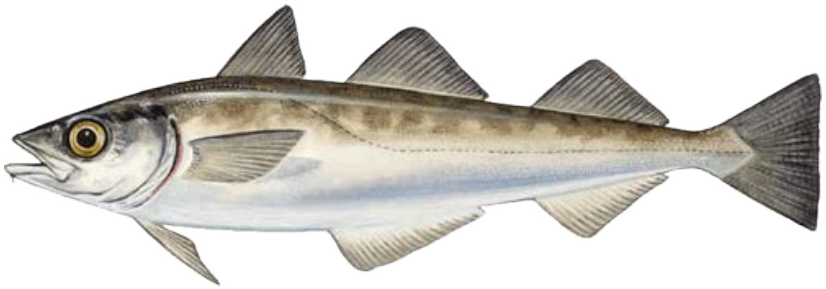
5. TRIM E

..moreover removed

11) Skin off

Theragra chalcogramma

Alaska pollock



- **Alaska pollock is species from the family *Gadidae*. In 2011, global capture production for Alaska pollock was 3 206 513 mil tons (FAO Fishery Statistic).**

- **Alaska pollock is a very tasty fish with soft texture. Boneless fillet are creamy in color. Cooked, the meat is white, firm, and flaky. Cod liver contains large amounts of fat; meat is high in protein and low in saccharides and fat.**

Merluccius merluccius

European hake

- **Species from the family Merluciidae, hakes, have softer flesh and are less flakey than other whitefish such as cod or pollock. Hake tastes mild and slightly sweet.**

Scomber scombrus

Atlantic mackerel

- **Atlantic mackerel is species from the family Scombridae. Mackerels have vertical stripes on their backs and deeply forked tails. Mackerel is intensively harvested by humans and it is popular worldwide.**

- **In 2011, global capture production for Atlantic mackerel was 944 748 tons (FAO Fishery Statistic).**

- **Mackerel has a rich flavor. When raw, the meat looks grayish and oily; when cooked, it is off-white to beige in color and soft, flaky, and moist in texture. Mackerel is considered one of the more healthful fish because it is rich in omega-3 fatty acids.**

Thunnus albacares

Yellowfin tuna

- **Yellowfin tuna has a mild, meaty flavor. The meat is bright red when raw but turns brown to gray when cooked. The meat is firm and moist, with large flakes.**
- **Yellowfin tuna can be found fresh, frozen, or canned. Yellowfin tuna is often served raw as sashimi and in sushi.**
- **In 2011, global capture production for Yellowfin tuna was 1 223 907 tons (FAO Fishery Statistic).**

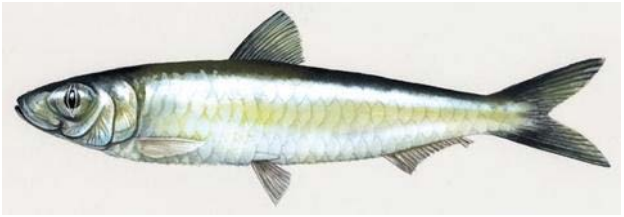
Katsuwonus pelamis

Skipjack tuna

- **Skipjack are primarily sold as “canned tuna” but are also sold fresh or frozen. When raw, good-quality skipjack meat is deep red. Smaller fish are lighter red. Cooked skipjack becomes light gray.**
- **Skipjack is an excellent source of protein.**
- **In 2011, global capture production for Skipjack tuna was 2 647 662 tons (FAO Fishery Statistic).**

Sarda sarda
Atlantic bonito

- **Bonito is a popular food fish in the Mediterranean; its flesh is similar to tuna and mackerel, and its size is intermediate between the two. The use of its meat is similar to the previous two species of tuna.**



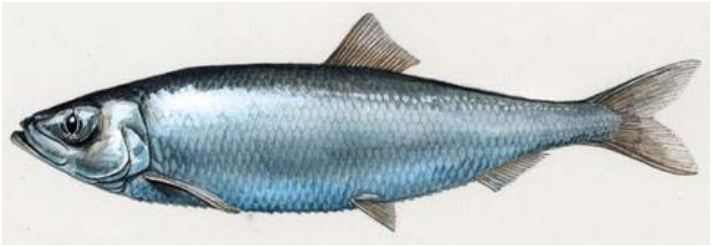
Sardina pilchardus
European sardine

- ***Sardina pilchardus* is an important fishery species from the family *Clupeidae*.**
- **In 2011, global capture production for *Sardina pilchardus* was 1 036 708 tons (FAO Fishery Statistic).**

- **Small sardines have a delicate flavor. Larger sardines have a fuller, oilier flavor. Sardines are very high in selenium, high in calcium and phosphorus and vitamin B12. They are a natural source of omega-3 fatty acids.**

- **Sardines are commonly canned. Fresh sardines are often grilled, pickled or smoked served in cans.**

Clupea harengus
Atlantic herring



- **Atlantic herring from the family *Clupeidae* is one of the most important fish species in the world.**

- **In 2011, global capture production for Atlantic herring was 1 778 488 tons (FAO Fishery Statistic).**

- **Fresh herring is delicious and versatile for various technologies of processing. The meat of fresh herring is off-white and soft. Small fresh herring have a more delicate flavor while larger herring have a fuller, oilier flavor. Otherwise, flavor and texture depend on how the herring has been prepared – whether pickled, smoked, or salted.**

- **Herrings are a great source of omega-3.**

Sprattus sprattus

Sprat

- **The European sprat is a species of small oily fish of the family *Clupeidae*. The fish is around 12% fat in its flesh and is a source of many vitamins. When used for food it can be canned, salted, fried, grilled, baked or marinated.**

- **In 2011, global capture production for *Sprattus sprattus* was 553 473 tonnes (FAO Fishery Statistic).**

Engraulis mordax

Anchovy

- **Anchovy from the family *Engraulidae* is harvested around the world. In 2011, global capture production for was 274 241 tonnes (FAO Fishery Statistic).**

- **Fresh anchovies have a rich taste and a soft texture. The meat of unprocessed anchovy is gray; it becomes off-white when cooked. The majority of the catch is canned, salted, turned into paste.**

- **Fishery products originating from member states of the European Community must be comply with the requirements laid down in:**

- **Regulation (EC) No 854/2004 laying down specific rules for the organization of official controls on products of animal origin intended for human consumption**

- **or, for example, in the case of their import from third countries with requirements that are equivalent to Community rules.**

- **Regulation (EC) No 178/2002 laying down the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety**
- **Regulation (EC) No 852/2004 on the hygiene of foodstuffs.**
- **Regulation (EC) No 853/2004 laying down specific hygiene rules for food of animal origin.**
- **Regulation (EC) No 2073/2005 on microbiological criteria for foodstuffs.**
- **Regulation (EC) No 2074/2005 laying down implementing measures for certain products under Regulations (EC) No 853/2004 and 854/2004.**
- **Regulation (EC) No 2406/1996 laying down common marketing standards for certain fishery products.**
- **Regulation (EC) No 1881/2006 setting maximum levels for certain contaminants in foodstuffs.**
- **Regulation (EC) No 37/2010 on pharmacologically active substances and their classification regarding maximum residue limits in foodstuffs of animal origin.**
- **Regulation (EC) No 1069/2009 laying down health rules as regards animal by-products and derived products not intended for human consumption.**
- **Regulation (EC) No 1169/2011 on the provision of food information to consumers.**

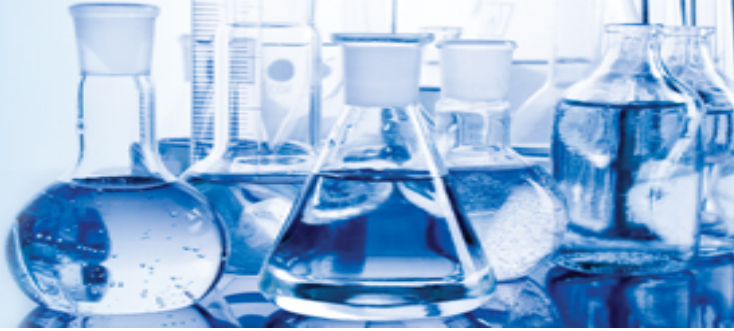
Official controls of fish and fishery products in the producing countries are to include, in particular:

(a) a regular check on the hygiene conditions of landing and first sale;

(b) inspections at regular intervals of vessels and establishments on land, including fish auctions and wholesale markets, to check, in particular:

(i) where appropriate, whether the conditions for approval are still fulfilled,
(ii) whether the fishery products are handled correctly,
(iii) for compliance with hygiene and temperature requirements, and
(iv) the cleanliness of establishments, including vessels, and their facilities and equipment, and staff hygiene; and

(c) checks on storage and transport conditions.



Organoleptic test
(EC 2406/1996)

Total volatile basic nitrogen (TVB-N)
CR 2074/2005

Represents degradation of proteins to ammonia.
In fresh fish only ammonia is present as TVB-N.
-25 mg of N/100g: *Sebastes spp., Helicolenus dactylopterus, Sebastichthys capensis*
-30 mg of N/100g: *Pleuronectidae*
-35 mg of N/100g: *Salmo salar, Merluccidae* family, *Gadidae* family

Trimethylamine (TMA)

Trimethylamine oxide (TMAO) by bacteria and enzymes is converted to TMA – fishy odor.

Histamine:
Formed out of histidine, regulated by EC 2073/2005

Poisonous fishery products
EC 2074/2005

Microbiological check
EC 2073/2005

Residues and contaminants
EC 854/2004

Parasites CR 1276/2011
-20ºC for at least 24 hours
-35ºC for at least 15 hours

DECISIONS AFTER OFFICIAL CONTROLS

Fishery products are to be declared unfit for human consumption if:

1. **organoleptic, chemical, physical or microbiological checks or checks for parasites have shown that they are not in compliance with the relevant Community legislation**

2. **they contain in their edible parts contaminants or residues in excesses of the limits laid down in Community legislation**

3. **they derive from poisonous fish or fishery products containing marine biotoxins in total quantities exceeding the limits referred to in Regulation (EC) 853/2004**

4. **the competent authority considers that they may constitute a risk to public or animal health or are for any other reason not suitable for human consumption.**

Regulation (EC) No 853/2004 of the European Parliament and of the Council laying down specific hygiene rules for food of animal origin

Requirements for all vessels

1. Vessels must be designed and constructed so as not to cause contamination of the products with bilge-water, sewage, smoke, fuel, oil, grease or other objectionable substances.

2. Surfaces with which fishery products come into contact must be of suitable corrosion-resistant material that is smooth and easy to clean. Surface coatings must be durable and non-toxic.

3. Equipment and material used for working on fishery products must be made of corrosion-resistant material that is easy to clean and disinfect.

4. When vessels have a water intake for water used with fishery products, it must be situated in a position that avoids contamination of the water supply.

- Clean water may be used with whole fishery products. Clean seawater may be used with live bivalve molluscs, echinoderms, tunicates and marine gastropods; clean water may also be used for external washing.

- Clean seawater means natural, artificial or purified seawater or brackish water that does not contain microorganisms, harmful substances or toxic marine plankton in quantities capable of directly or indirectly affecting the health quality of food. Clean water means water of a similar quality.

Requirements for vessels designed and equipped to preserve fresh fishery products

1. **These vessels must be equipped with tanks or containers for the storage of fishery products at the temperatures approaching that of melting ice (temperature ranges between -1 ^{o}C to +2 ^{o}C).**

2. **Tanks and containers used for the storage of fishery products must ensure their preservation under satisfactory conditions of hygiene and, where necessary, ensure that melt water does not remain in contact with the products.**

Requirements for freezer vessels

1. **Freezer vessels must have freezing equipment with sufficient capacity to lower the temperature rapidly so as to achieve a core temperature of not more than -18 ^{o}C;**

2. **and have refrigeration equipment with sufficient capacity to maintain fishery products in the storage holds at not more than -18 ^{o}C.**

3. **Storage holds must be equipped with a temperature-recording device in a place where it can be easily read. The temperature sensor of the reader must be situated in the area where the temperature in the hold is the highest.**

Requirements for factory vessels

Factory vessels must have at least:

(a) a receiving area reserved for taking fishery products on board, designed to allow each successive catch to be separated. This area must be easy to clean and designed so as to protect the products from the sun or the elements and from any source of contamination;

(b) a hygienic system for conveying fishery products from the receiving area to the work area;

(c) work areas that are large enough for the hygienic preparation and processing of fishery products, easy to clean and disinfect and designed and arranged in such a way as to prevent any contamination of the products;

(d) storage areas for the finished products that are large enough and designed so that they are easy to clean. If a waste-processing unit operates on board, a separate hold must be designed for the storage of such waste;

(e) a place for storing packaging materials that is separate from the product preparation and processing areas;

(f) special equipment for disposing waste or fishery products that are unfit for human consumption directly into the sea or, where circumstances so require, into a watertight tank reserved for that purpose.

(g) a water intake situated in a position that avoids contamination of the water supply; and

(h) hand-washing equipment for use by the staff engaged in handling exposed fishery products with taps designed to prevent the spread of contamination.

(in an adequate number and suitably located)
It has to be provided with hot and cold running
water, materials for cleaning hands (liquid soap, disinfectant) and for hygienic drying.

HYGIENE REQUIREMENTS

1. The parts of vessels or containers for the storage of fishery products must be kept clean and maintained in good repair and condition.

2. As soon as possible after they are taken on board, fishery products must be protected from contamination and from the effects of the sun or any other source of heat.

3. Fishery products must be handled and stored so as to prevent bruising.

4. Fishery products other than those kept alive must undergo chilling as soon as possible after loading.

5. Ice used to chill fishery products must be made from potable water or clean water.

6. Where fish are headed and/or gutted on board, such operations must be carried out hygienically as soon as possible after capture, and the products must be washed immediately with potable water or clean water.

7. Where freezing in brine (saturated solution of sodium chloride) of whole fish intended for canning is practised, a temperature of not more than -9 °C must be achieved for the product.

REQUIREMENTS DURING AND AFTER LANDING

- **Food business operators responsible for the unloading and landing of fishery products must:**

(a) ensure that unloading and landing equipment that comes into contact with fishery products is constructed of material that is easy to clean and disinfect and maintained in a good state of repair and cleanliness; and

(b) avoid contamination of fishery products during unloading and landing, in particular by:

- **carrying out unloading and landing operations rapidly;**

- **placing fishery products without delay in a protected environment at the temperature approaching that of melting ice (temperature ranges between -1 ^{o}C to +2 ^{o}C);**

REQUIREMENTS FOR FRESH FISHERY PRODUCTS

1. **Unpackaged chilled fishery products must be stored under ice in appropriate facilities. Re-icing must be carried out as often as necessary. Packaged fresh fishery products must be chilled to a temperature approaching that of melting ice.**

2. **Operations such as heading and gutting must be carried out hygienically. It must be carried out as quickly as possible after the products have been caught or landed. The products must be washed with potable water or, on board vessels, clean water immediately after these operations.**

3. **Operations such as filleting and cutting must be carried out so as to avoid contamination or spoilage of fillets and slices. Fillets and slices must not remain on the worktables beyond the time necessary for their preparation. Fillets and slices must be wrapped and chilled as quickly as possible after their preparation.**

Fresh fish

- may be offered for retail sale to the final consumer unless appropriate labeling indicates:

- the commercial designation of the species;

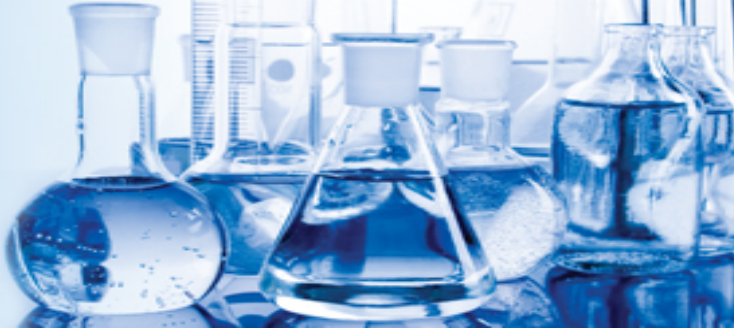
- the production method (caught at sea or in inland waters or farmed);
  '… caught …' or '… caught in freshwater …' or '… farmed …' or
  '… cultivated …'

- the catch area (FAO)

- the 'use by' date shall be indicated as follows:
- (a) it shall be preceded by the words 'use by …';
- (b) the words in point (a) shall be accompanied by:
- — either the date itself, or,
- — a reference to where the date is given on the labeling,
- (c) the date shall consist of the day, the month and, possibly, the year, in that order and in uncoded form;

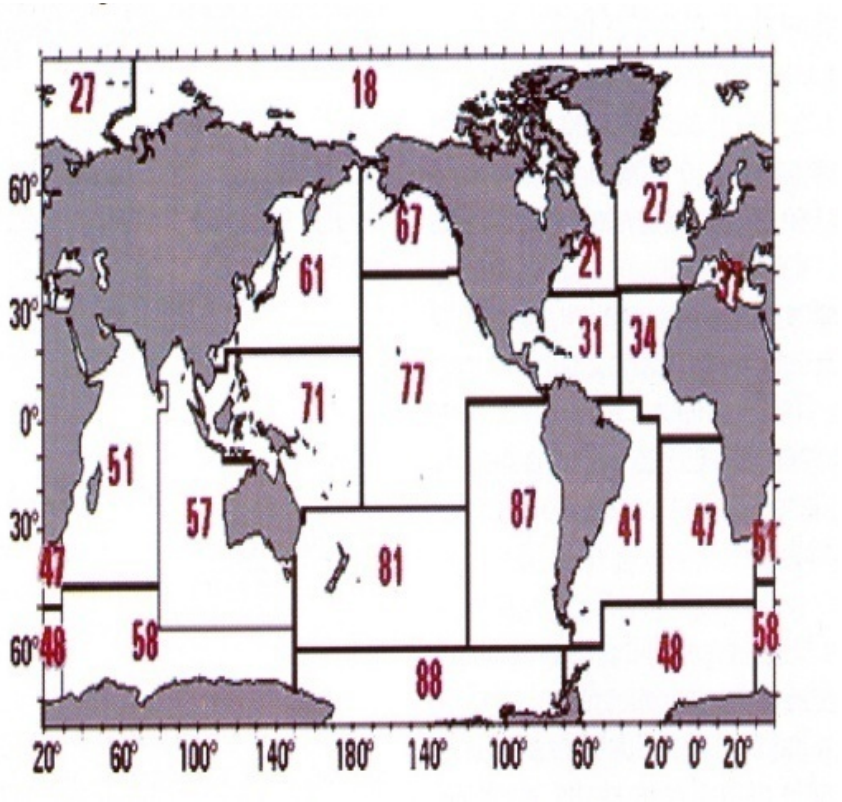
- and the storage conditions (0 - +2 ^{o}C)

Fish freshness indicators



- **Peroxide value** (early stages of oxidation, decrease after storage period)
- **Free fatty acids content** (hydroxylation of lipids)
- **pH** (5,4 – 7,2)
- **Total volatile basic nitrogen content (TVBN)** (30 – 35 mg TVB-N/100 g limit of acceptability)
- **Trimethylamine content** (10 – 15 mg TMA/100 g limit of acceptability)
- **Thiobarbituric acid assay** (10 µmol MDA-equiv per 1 kg fish)

Catch area	Identification of the area
North-West Atlantic	FAO area 21
North-East Atlantic	FAO area 27
Baltic Sea	FAO area 27.IIId
Central-Western Atlantic	FAO area 31
Central-Eastern Atlantic	FAO area 34
Souht-West Atlantic	FAO area 41
Souht-East Atlantic	FAO area 47
Mediterranean Sea	FAO areas 37.1, 37.2 and 37.3
Black Sea	FAO area 37.4
Indian Ocean	FAO areas 51 and 57
Pacific Ocean	FAO areas 61, 67, 71, 77, 81 and 87
Antarctic	FAO areas 48, 58 and 88



Position of areas is exact determined in degrees according to their geographical longitude and latitude.

REQUIREMENTS FOR FROZEN PRODUCTS

- **Establishments on land that freeze fishery products must have:**
- **freezing equipment with sufficient capacity to lower the temperature rapidly so as to achieve a core temperature of not more than -18 ^{o}C**
- **and must have refrigeration equipment with sufficient capacity to maintain fishery products in the storage holds at not more than -18 ^{o}C.**

Deep frozen fish

- must be labeled by:

- the date of freezing or the date of first freezing in cases where the product has been frozen more than once 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 date of minimum durability

- and the storage conditions

- **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,**

- **(b) the words referred to in point (a) shall be accompanied by:**
- **— either 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 possibly, the year, in that order and in uncoded form.**

- **However, in the case of foods:**

- **— which will not keep for more than 3 months, an indication of the day and the month shall be sufficient,**

- **— which will keep for more than 3 months but not more than 18 months, an indication of the month and year shall be sufficient,**

- **— which will keep for more than 18 months, an indication of the year shall be sufficient,**

REQUIREMENTS FOR THAWING

- **The thawing of foodstuffs is to be undertaken in such a way as to minimize the risk of growth of pathogenic microorganisms or the formation of toxins in the foods.**

- **During thawing, foods are to be subjected to temperatures that would not result in a risk to health.**

- **Where run-off liquid from the thawing process may present a risk to health it is to be adequately drained.**

- **Following thawing, food is to be handled in such a manner as to minimize the risk of growth of pathogenic microorganisms or the formation of toxins.**

TRANSPORT OF FISHERY PRODUCTS

1. **During transport, fishery products must be maintained at the required temperature. In particular:**

(a) fresh fishery products must be maintained at a temperature approaching that of melting ice (temperature ranges between -1 ^{o}C and +2 ^{o}C);

(b) frozen fishery products must be maintained at an even temperature of not more than -18 °C in all parts of the product, possibly with short upward fluctuations of not more than 3 °C (temperature must not be higher than -15 °C)

2. **If fishery products are kept under ice, melt water must not remain in contact with the products.**

REQUIREMENTS FOR MECHANICALLY SEPARATED FISHERY PRODUCTS

1. **The raw materials used must satisfy the following requirements.**

(a) **Only whole fish and bones after filleting may be used to produce mechanically separated fishery products;**

(b) **All raw materials must be free from guts.**

2. The manufacturing process must satisfy the following requirements:

(a) **Mechanical separation must take place without undue delay after filleting;**

(b) **If whole fish are used, they must be gutted and washed beforehand;**

(c) **After production, mechanically separated fishery products must be frozen as quickly as possible or incorporated in a product intended for freezing or a stabilising treatment.**

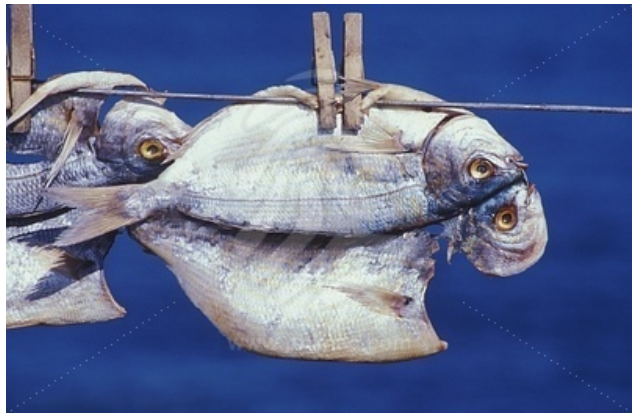
- **All types of fish products covered by the definition of mechanically separated meat shall bear the following indication from 'MECHANICALLY SEPARATED MEAT' and the name(s) of the fish species from which it comes.**

Processing technology of seafish

- Dried fish
- Salted fish
- Marinated fish
- Smoked fish
- Canned fish

Dried fish

- Fish are mainly dried in maritime countries, with the help of the sun and wind or in the special dryers.
- Preservation is achieved by the removal of water from fish. The average loss of weight ranges between 50 and 60 %.
- Dried fish are usually prepared from eviscerated fish, frequently combination of drying and salting is used.
- The temperature of drying air is about + 45 ^{o}C.
- Drying lasts for many days.
- After drying, water content in fish must be bellow 20 %.



Salted fish

- Salting of fish is one of the oldest and the most widely used method of fish preservation in maritime countries. Inland, the salting of fish is used mainly as a part of fish processing in fish plants.
- Most frequently, fat fish (especially herrings) are salted.
- Preservation is achieved by the removal of water from fish and restriction of microbial activity.
- The salting process consists of many physical, chemical and biological reactions due to the activity of enzymes and microorganisms.
- Diffusion of salt into the meat is finished within approximately two weeks after the fish is placed in the salt solution.
- Various concentrated pickling solutions of sodium chloride are used.

Marinated fish

- The process of fish marination occurs in two phases:

1. During the first phase, fish becomes digestible and is partially preserved.
2. During the second phase, products achieve their final form for distribution and are preserved from decomposition.

- There are 2 technological methods of fish marination:

- Cold marinades
- Warm marinades (cooked, roasted)

- Herrings are the basic raw material used for the production of marinades. They can be fresh-iced or salted. Frozen fish are required to be defrosted.
- Fish must be washed in potable water before processing.
- Fish must be decapitated, eviscerated, deboned , as well as cut for fillets.

Smoking using a cold smoke

- The fish (especially salmon) are immersed in a 10 – 14 % salt solution for 1-2 hours, and then shortly washed.

- The smoke temperature ranges between 17 and 25 ^{o}C.
- Smoking lasts for about 70 hours.
- Shelf life of the final product ranges between 14 days and 3 months.

- The final products must be kept in cold storage. The storage temperature should range between 1-8 ^{o}C.

Smoking using a hot smoke

- The raw fish are immersed in a 4 – 10 %
  salt solution for 1-2 hours, and then shortly washed .

- The smoking process can be divided into three phases:

1. Pre drying of fish at a temperature of 45 °C
2. Roasting of fish at a temperature of between 85 – 95 °C, resulting of meat softening. *The temperature inside the thickest part of the fish must be minimum 70 °C / 10 min*
3. Smoking at a temperature of between 60-80 °C accompanied by desirable changes in meat colour and flavour.

- The entire smoking process lasts for about 5 hours.

- After that the fish are cool by cold air and can be wrapped.

- The final products must be kept in cold storage. The storage temperature should range between 1-8 °C.

Canned fish

- The process of fish canning does not differ from the canning of red meat.
- Fat fish are usually canned (sardines, tuna, mackerel, herring).
- Lean fish are less frequently processed this way.

- The fish are sterilized in a hermetical packages at a temperature of +121 ^{o}C for 10 – 15 minutes.

- The final products must be kept in cold storage and must be protected from light.

COUNCIL REGULATION (EEC) No 2136/1989 laying down common marketing standards for preserved sardines and trade descriptions for preserved sardines and sardine-type products

1. **'preserved sardines' means products prepared from fish of the species *Sardina pilchardus***

2. **'preserved sardine-type products' means products marketed and presented in the same way as preserved sardines and prepared from fish of the following species:**

(a) ***Sardinops melanosticus, S. neopilchardus, S. ocellatus, S. sagax, S. caeryleus;***
(b) ***Sardinella aurita, S. brasiliensis, S. maderensis, S. longiceps, S. gibbosa;***
(c) ***Clupea harengus;***
(d) ***Sprattus sprattus;***
(e) ***Hyperlophus vittatus;***
(f) ***Nematalosa vlaminghi;***
(g) ***Etrumeus teres;***
(h) ***Ethmidium maculatum;***
(i) ***Engraulis anchoita, E. mordax, E. ringens;***
(j) ***Opisthonema oglinum;***
(k) ***Strangomera bentincki.***

Preserved sardines may be marketed in any of the following presentations:

1. sardines: the basic product, fish from which the head, gills, internal organs and caudal fin have been appropriately removed. The head must be removed by making a cut perpendicular to the backbone, close to the gills;

2. sardines without bones: as the basic product referred to in point 1, but with the additional removal of backbone;

3. sardines without skin or bones: as the basic product referred to in point 1, but with the additional removal of the backbone and skin;

4. sardine fillets: portions of flesh obtained by cuts parallel to the backbone, along the entire length of the fish, or a part thereof, after removal of the backbone, fins and edge of the stomach lining. Fillets may be presented with or without skin;

5. sardine trunks: sardine portions adjacent to the head, measuring at least 3 cm in length, obtained from the basic product referred to in point 1 by making transverse cuts across the backbone;

6. any other form of presentation, on condition that it is clearly distinguished from the presentations defined in points 1 to 5.

- **After sterilization, the products in the container must satisfy the following minimum criteria:**

- **The sardines or parts of sardine must:**

- **— be reasonably uniform in size and arranged in an orderly manner in the container,**
- **— be readily separable from each other,**
- **— present no significant breaks in the abdominal wall,**
- **— present no breaks or tears in the flesh,**
- **— present no yellowing of tissues, with the exception of slight traces,**
- **— comprise flesh of normal consistency. The flesh must not be excessively fibrous, soft or spongy,**
- **— comprise flesh of a light or pinkish colour, with no reddening round the backbone, with the exception of slight traces;**

- **the covering medium must have the colour and consistency characteristic of its description and the ingredients used.**

- **The ratio between the weight of sardines in the container after sterilization and the net weight, both expressed in grams, shall be not less than the following values:**

- **— 70 % for the covering media: olive oil; other refined vegetable oils, natural juice (liquid exuding from the fish during cooking), saline solution or water; marinade, with or without wine;**

- **— 65 % for the covering medium: tomato sauce;**

- **— 50 % for the any other covering medium**

https://www.youtube.com/watch?v=WPpFjl8qeM4

Production of fish in the Czech Republic
Processing technology of live common carp

- **In the Czech Republic there are two ways of fish production:**

- **Farming in aquaculture**
- **the production of freshwater fish in aquacultures (ponds) is approximately 20,000 tons of live fish (per year). The highest proportion (more than 86 %) on this production has common carp.**

- **Sport fishing (angling)**
- **Sport fishermen (line fishing tackle) catch approximately 4,000 tons of freshwater fish (per year).**

- **The traditional approach to freshwater fish rearing in the Czech Republic is based on foods naturally occurring in ponds (zooplankton, benthos). The energy-producing component of their diet is supplemented with untreated cereals (especially with wheat).**

Production of live freshwater fish in the Czech Republic

Year	Aquaculture production	Sport fishing, line fishing tackle	Total tons live weight
2000	19 475	4 654	24 129
2001	20 098	4 646	24 744
2002	19 210	4 983	24 193
2003	19 670	5 127	24 797
2004	19 384	4 528	23 912
2005	20 455	4 242	24 697
2006	20 431	4 646	25 077
2007	20 447	4 276	24 723
2008	20 395	4 164	24 559
2009	20 071	4 112	24 183
2010	20 420	3 990	24 410
2011	21 010	3 859	24 869
2012	20 763	3 910	24 673

Aquaculture production	20 763 tons/per year	
	tonnes	%
Common carp	17 972	86,6
Salmonid fish (rainbow trout)	738	3,6
Herbivorous fish (silver carp, grass carp)	1 071	5,2
Tench	241	1,2
Predatory fish (pike)	218	1,1
other species	406	2,0

Common carp (*Cyprinus carpio*)

- **In the Czech Republic, the common carp of the family *Cyprinidae* is considered the economically most important fresh-water fish species reared for commercial purposes. Typically extensive to semi-intensive in character, carp production is based on the farming of F1 generation fry obtained from controlled reproduction of sexually mature genetically specified generation carp. Market carp is fished by the age of three.**

- **It is possible to distinguish, by the appearance of the body and scales, three phenotypic groups of carp: scaly, mirror and leather carp, the difference among types is both genetic and visual:**

- **Scaly carp (the whole body is covered with scales)**
- **Mirror carp (a series of large scales is placed on the body along the lateral line)**
- **Leather carp (the dorsal row of scales is either absent or incomplete, a series of scales along the lateral line is missing)**

Scaly carp

Mirror carp

Leather carp

- **Two trademarks are registered in the Czech Republic.**

- **The CZECH CARP is registered as a trademark since 2001. The owner of this trademark is Fishermen's Association of the Czech Republic. The trademark Czech carp may use only members of this Association.**

- **The OMEGA3CARP® is high in omega-3 fatty acids and it is on sale in stores by the end of 2011.**
- **Omega3kapr® has a guaranteed content of healthy unsaturated fatty acids in the meat, which should contain at least 1 g omega-3 fatty acids per 1 serving (200 g meat), of which 300 mg of docosahexaenoic (DHA) and eicosapentaenoic (EPA) acids.**
- **This is achieved by feeding a mixture that has an original recipe that is used for rearing carp.**
- **The special composition of the mixture, created on vegetable oil-based (the rape pressings and extruded flax), is protected by utility model (No. 21926).**

rape

flax

- **Two trademarks are registered in the European Union.**

- **The POHORELICE CARP is registered in the EU as a Protected Designation of Origin since 2007.**

- **'DESIGNATION OF ORIGIN' is a name which identifies a product:**
- **(a) originating in a specific place, region or, in exceptional cases, a country;**
- **(b) whose quality or characteristics are essentially or exclusively due to a particular geographical environment with its inherent natural and human factors; and**
- **(c) the production steps of which all take place in the defined geographical area.**

- **The entire production process, from the spawning of the fish to the growth phase, including feeding and processing of the fish, is carried out exclusively within the defined geographical area.**

- The TREBON CARP is registered in the EU as a Protected Geographical Indication in 2007.

- 'GEOGRAPHICAL INDICATION' is a name which identifies a product:
- (a) originating in a specific place, region or country;
- (b) whose given quality, reputation or other characteristic is essentially attributable to its geographical origin; and
- (c) at least one of the production steps of which take place in the defined geographical area.

- Processing of the fish can be carried out also in the other geographical areas.

Sales of freshwater fish in the Czech Republic

About 46 % of freshwater living fish have usually been sold before Christmas and only 10 % have been processed in the fishery plants.

Export of live freshwater fish forms 45 % of the whole production volume. The live fish are exported especially to Germany, Slovakia, Austria as well as France, Hungary, Poland and Italy.

processed in fishery plants in Czech 10%

sold of live freshwater fish in EU 44,5%

sold of live freshwater fish in Czech 45,5%

- **As fish are poikilotherms and metabolism varies with temperature, withdrawal periods are set in "degree days". Degree days are calculated by multiplying the water temperature in degrees centigrade by the number of days following cessation of treatment.**

- **Freshwater fish which have been treated with some medicines (for instance antiparasitic, antifungal drugs) can be distributed after a certain withdrawal period. Where products are used outside the data sheet recommendations then the veterinary surgeon must set a withdrawal period not less than the minimum of 500 degree days.**

practical example			
	cold season		warm season
average daily temperature of water	5 °C		10 °C
withdrawal period is 500 °days calculation	500 : 5 =		500 : 10 =
withdrawal period	100 days		50 days
withdrawal period is 250 °days calculation	250 : 5 =		250 : 10 =
withdrawal period	50 days		25 days

FOOD CHAIN INFORMATION

- **The relevant food safety information are following data:**

- **the status of the holding**
- **the animals' health status;**
- **kind of veterinary medicinal products administered to the fish within a relevant period, together with their dates of administration and withdrawal periods;**
- **the occurrence of diseases that may affect the safety of meat;**
- **the results of all laboratory analysis, if they are relevant to the protection of public health or that may affect the safety of meat, including results of samples taken in the framework of the monitoring residues of xenobiotics and control of zoonoses;**
- **relevant reports about previous ante- and post-mortem inspections of fish from the same holding of provenance including reports from the official veterinarian;**
- **production data, when this might indicate the presence of disease; and**
- **the name and address of the private veterinarian normally attending the holding of provenance.**

VETERINARY EXAMINATION OF LIVE FRESHWATER FISH
ANTE MORTEM INSPECTION

- **Live fish are examined by external visual inspection.**
- **Fish are evaluated according to species, their health status, viability and welfare. Fish that died during transport must be disposed.**

- **Slaughter of the fish may not take place until the official veterinarian so permits.**

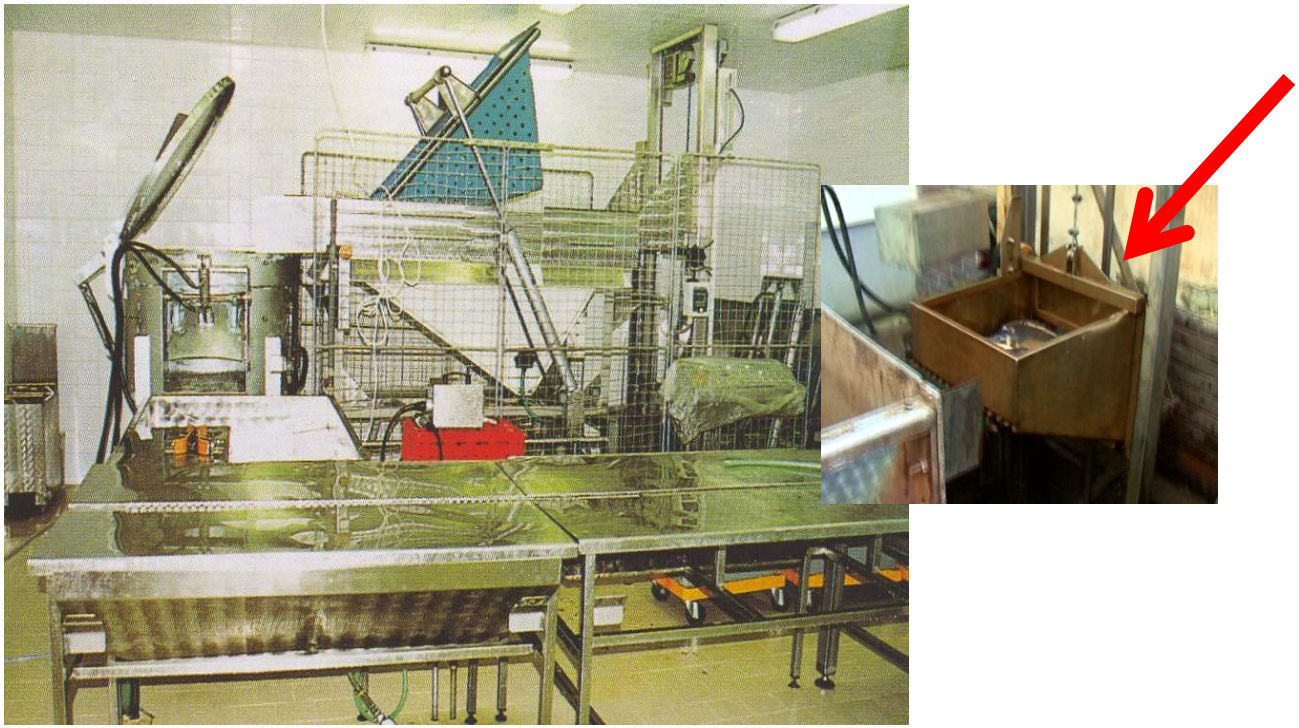
FRESHWATER FISH PROCESSING

- **Preliminary processing of freshwater fish usually consists of the following steps: stunning, scaling, evisceration, bleeding, beheading, cutting of fins, halving, filleting, skinning and different combinations of the above.**

Stunning of live fish

- **Stunning of live fish is best done with alternating electric current in water bath.**
- **Conditions of stunning:**
- **electric voltage: 230 volts, intensity of electric current: 2,2 – 6 amperes**

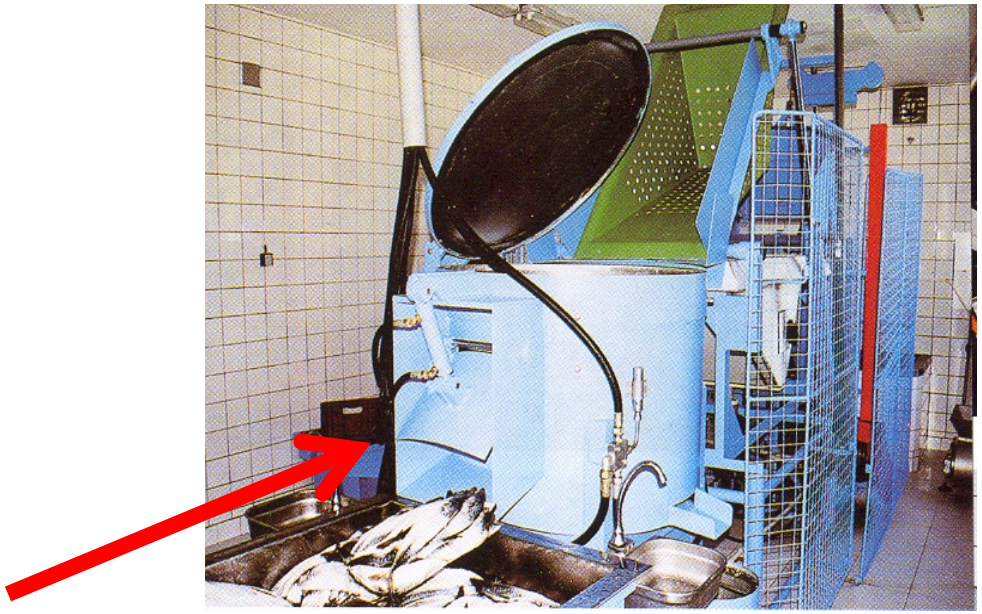
- **Fish must be kept alive as long as possible before stunning. Fish are placed in a stack. Stack with live fish is lifted up and fish are transported using the slip into a tank with drinking water. The electric current passed through the water and fish are stunned.**



- **No bleeding has to be performed in industrial processing of fish.**

Scaling

- Common carp, silver carp, grass carp are routinely scaled; this is extremely labour-intensive when done manually.
- Tools used for manual scaling are moved over the body of fish from tail fin towards the head, pulling out the scales.



- The vertical cylindrical scaler with rotating bottom and fixed side wall is widely used in small fish processing plants. Fish (the total weight is usually 50 kg) is loaded from the top and unloaded through the door in the side wall.

- The scales are removed from fish under a pressure of water stream while fish is placed inside the drum.

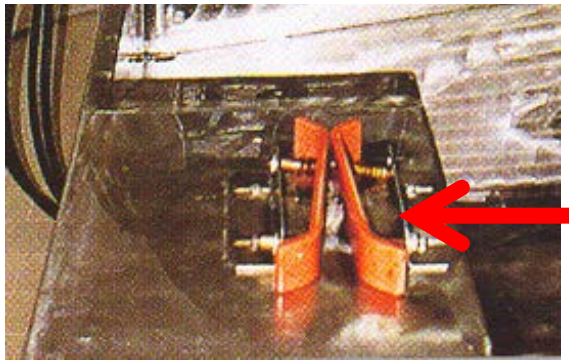
- **The drums are made of stainless mesh with rough edges.**
- **The processing time of a rotating scaler with the vertical rotation axis is from 2 to 7 minutes depending on the species and size of fish.**
- **The effectiveness of removing scales is 80-90 %.**

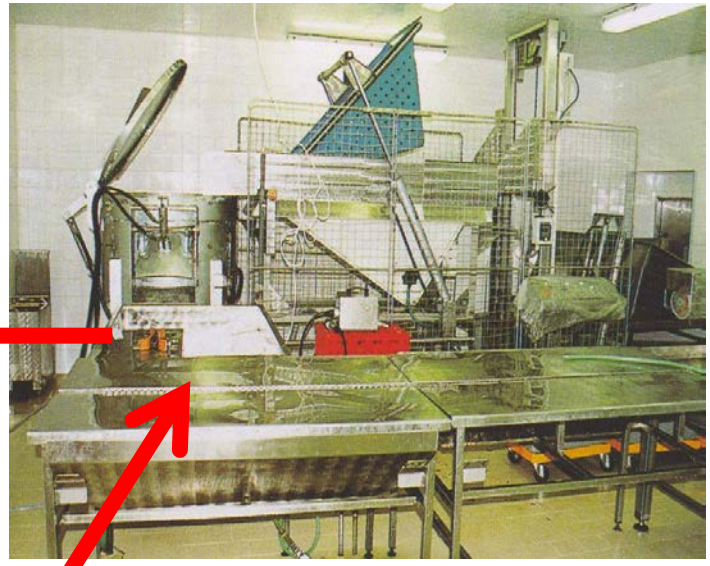
- **Electrical hand-held scalers simplify and speed up the scaling procedure.**
- **They are most commonly used for secondary scaling of fish which has left the automated scaling.**
- **Use of electrical hand-held scalers reduces labour intensity and assures complete elimination of scales.**

Gutting

- **Fish are cut longitudinally from the anal opening up to the heart region. Special care is taken to avoid cutting the gall bladder or intestinal tract.**

a circural saw





- **Evisceration is performed on a table made of special material which is hard, easy to wash and does not absorb fluids. The table surface should be frequently and periodically cleaned.**

- **Evisceration of freshwater fish is labour-intensive and usually performed by hand. The purpose of gutting is to remove internal organs including kidney and blood from body cavity.**

Cutting away fins, deheading

- **Cutting away unpair fins (dorsal, ventral and tail) is most frequently done after gutting. This operation is done manually, with a knife or a meat cleaver.**

- **Common carps are frequently deheaded manually, although many mechanized deheading machines had been developed for processing fish.**

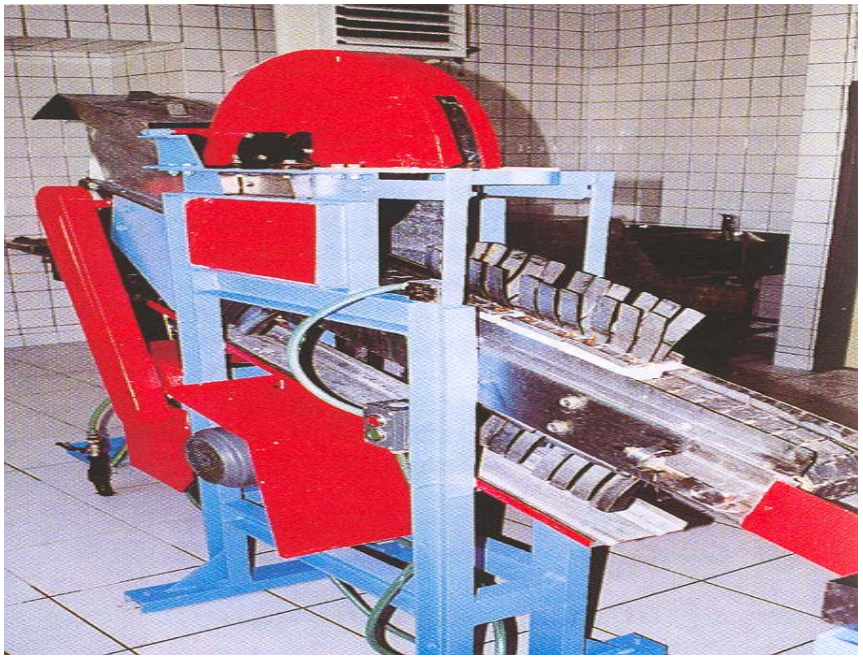
- **The cutting elements used in the deheading machines are guillotine cutters.**
- **The head constitutes 10 – 20 % of the total fish weight and it is cut off as an inedible part; only the heads of common carp are obtained for the purposes of human nutrition (fish soup).**

guillotine cutters

Slicing fish into steaks or two halves

- **Slicing of deheaded and gutted fish into steaks (horseshoe) by a cut perpendicular to the backbone is a very common fish processing method. The fish pieces obtained average 2.5 to 4.5 cm thick.**

- **The simplest type of carp processing is its cutting into two halves using a circular saw. Fish are divided into two halves by a longitudinal cut which is guided along the backbone or in the middle of the backbone.**



Washing

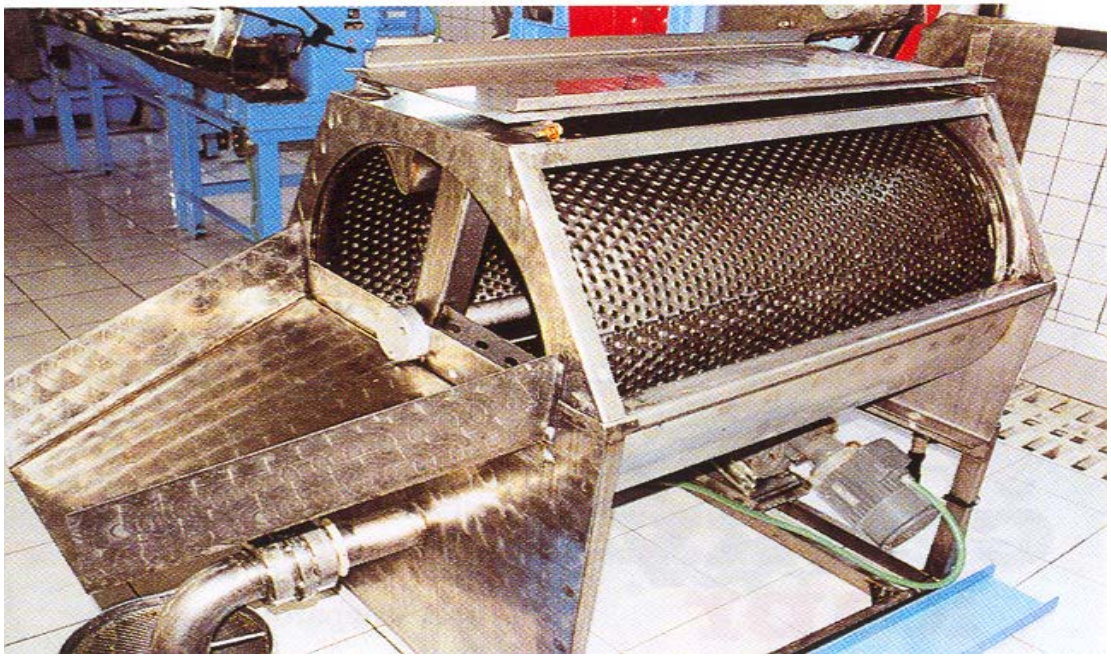
- **Washing must be done on termination of the processing operation of fish.**
- **Washing is intended primarily to clean the fish from the remnants of tissues, blood, scales, etc. and to remove accumulated bacterial contamination. The effectiveness of the washing procedure depends on the ratio of fish volume to water volume and on the water quality. Potable water to which is added flake ice is used for washing.**
- **Water volume ratio for achieving the desired level of cleanliness is 1:1, however, in practice more water is usually used (twice as much).**
- **To improve the effectiveness of the cleaning procedure, various mechanized washing devices are utilized which can remove up to 90% of the initial bacterial contamination.**
- **The following washers are commonly used: vertical or horizontal drums.**

- **The operation cycle for these machines is 1-2 minutes.**

- **The most common is the horizontal washing drum. A rotating perforated drum constitutes the main component of this device; the drum is usually 2 m long.**

- **Inside the drum there are rubber bars which facilitate mixing of fish.**

- **Washing is continuous and is accomplished by spraying water under pressure through the perforated pipe installed inside the drum.**



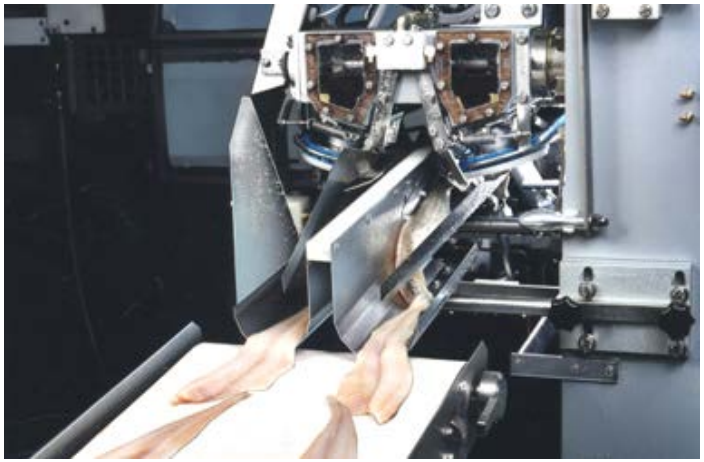
Filleting

- **A fillet (without skin or with skin) is a piece of meat consisting of the dorsal and abdominal muscles without backbone and rib bones.**

- **Filleting efficiency depends upon fish species, its sex, size and nutritional condition and the way of filleting.**

- **Manual filleting is very labour-intensive and largely depends on the skills of the workers.**
- **The yield of fillets with the skin varies between 41 - 49 %.**

- **Machines of different design are used for filleting of fish. The simplest filleting machine has two disc knives set from each other at a distance equal to the thickness of the fish's backbone. The quality of the final product is good, but the yield of fillets with skin is lower, around 33 %.**

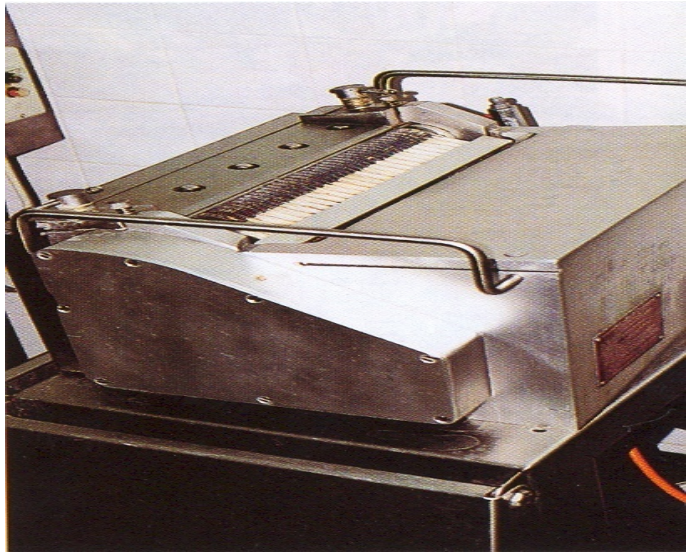


Skinning

- **Manual fillet skinning is labour-intensive and difficult operation; a sharp knife is needed. The fillet is placed on the board skin-down, the meat is grasped in the left hand and the knife is drawn between the skin and meat.**

- **Skinning machines are produced in many countries. Various fish species can be processed in this machine, including larger fish. Compared with manual operations, this machine facilitates and speeds up skinning.**

Manual fillet skinning



Skinning machine

Thank you for your attention!