FST 3316 – 8

Meat Science & Technology

FISH AND FISHERY PRODUCTS

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1. Chemical composition & Nutritive value of fish

The chemical composition of fish varies considerably from a species and an individual to an other according to age, the sex, the environment and the season. The following table presents a comparison of the global composition of the fish and the one of the beef. The peak values and minimal indicated are rather extreme and rarely achieved.

Table 8 –1 Main component of muscles of fish and beef

COMPONENTS	*FISH*			*BEEF*
	Minimum	*Normal interval*	*Maximum*	
Proteins (%)	*6*	*16-21*	*28*	*20*
Lipids (%)	*0,1*	*0,2-25*	*67*	*3*
Carbohydrates (%)		*<0,5*		*1*
Ash (%)	*0,4*	*1,2-1,5*	*1,5*	*1*
Water (%)	*28*	*66-81*	*96*	*75*

Table 8 –2 Chemical composition of the fillets of various species of fish

Scientific name	*Water (%)*	*Lipids (%)*	*Proteins (%)*	*Energetic value (KJ/100g)*
Micromesistius poutassou	*79-80*	*1,9-3,0*	*13,8-15,9*	
Gadus morhua	*78-83*	*0,1-0,9*	*15,0-19,0*	*314-388*
Anguilla anguilla	*60-71*	*8,0-31,0*	*14,4*	*295-332*
Clupea harengus	*60-80*	*0,4-22,0*	*16,0-19,0*	
Pleuronectes platessa	*81*	*1,1-3,6*	*15,7-17,8*	*332-452*
Salmo salar	*67-77*	*0,3-14,0*	*21,5*	
Salmo trutta	*70-79*	*1,2-10,8*	*18,8-19,1*	
Thunnus sp	*71*	*4,1*	*25,2*	*581*
Nephrops norvegicus	*77*	*0,6-2,0*	*19,5*	*369*
Basilichthys bornariensis	*80*	*0,7-3,6*	*17,3-17,9*	
Cyprinus carpio	*81,6*	*2,1*	*16,0*	
Prochylodus platensis	*67,0*	*4,3*	*23,4*	
Colossoma macropomum	*67,1*	*18,0*	*14,1*	
Colossoma brachypomum	*69,3*	*15,6*	*15,8*	
Pseudoplatystoma tigrinum	*70,8*	*8,9*	*15,8*	
Plagioscion squamosissimus	*67,9*	*5,9*	*21,7*	
Ageneiosus spp.	*79,0*	*3,7*	*14,8*	

2. Preparation of fish

2.1. Catching and preparation of fresh fish

As fish spoils very quickly, measures must be already be taken on board the fishing boat to limit spoilage. First off all, the fish must immediately be kept out of the salt water so that the fish does not get contaminated by bacteria in the salt water.

Apart from preventing contamination, one should also remove bacteria which are already present. It would be best to remove the intestines and gills of the fish on board the fishing boat. After that the fish must be washed with clean water to rinse off any blood or other remains. It would next be best to transport the fish on ice to shore. However cleaning and transporting the fish on ice is often difficult and expensive to realize.

All that can be done then is to transport the fish as quickly and carefully as possible to the shore. To avoid having bacteria from the intestines, liver, gills and on the skin of fish increase, the fish must be kept in a clean boat and in the shade.

2.2. Cleaning fish

To clean fish, first of all one needs good and clean tools. Personal hygiene is also important. It is important that the fish is not cleaned on the ground but on a clean table or bench. The table should be at working height and can be made of wood, metal or concrete. The surface of the table must be smooth and easy to clean. It is also handy to clean the fish on a cutting board so that the table is not damaged.

Knives are the most important tools for cleaning fish. Short knives are used for small kinds of fish, long flexible knives to fillet larger kinds of fish and a thick, strong knife to cut open large fish. The knives must be sharp. The method used to clean fish depends primarily on the size and kind of fish.

1. With very small kind of fish, such as anchovies, sardines and other kinds of fish which are smaller than 10 cm, usually only the intestines are removed. Whether or not this is done depends on local customs and the purpose for which the fish is to be used. For some fermentation processes the intestines are not removed.
2. Fish which are larger than 15 cm, apart from being cleaned, are also cut crosswise so that the surface area of the fish is increased and the flesh becomes less thick. Preservation methods work faster with a larger surface area of the flesh.
3. With fish which are larger than 25 cm, apart from cleaning and splitting them, one also makes extra cuts in the fresh. Some times the fish are cut into chunks or completely filleted.

The way in which the fish are cleaned depends not only o the size of the fish but also on the wishes of the consumer. Some consumers, for example, want the fish with its head intact while others especially want it cut off. An other element to be discussed is a brief description of how to gut, split and fillet fish.

2.3. Gutting and Scaling

1. Place the fish on a clean board and hold it by its head. Scrape the scales off starting at the tail and working towards the head. Try not to damage the skin of the fish while doing so.
2. Wash the fish in clean (drinking) water and remove all loose scales
3. Lay the fish on its side on a clean board and cut into the fish along its gills with a sharp knife. Do the same on the other side but do not cut the head off.
4. Cut the gills free by cutting the ends free from the head and body with the point of the knife.
5. Slit the abdominal wall open from the anal opening towards the head of the fish. Cut deep enough but try not to damage the intestines of fish.
6. When the fish has been opened up, the gills and intestines can be removed by placing one finger under the gills and pulling everything out.
7. Scrape any remaining blood out with the knife.
8. Clean the abdominal wall with clean (drinking) water

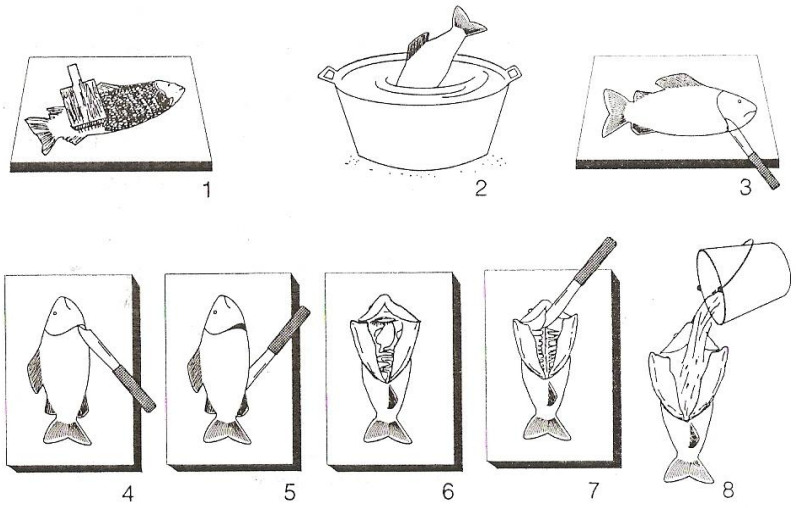

Figure 8 –1 Gutting and Scaling of fish

2.4. Splitting

The splitting methods vary with the size of fish.

2.4.1. Small and medium sized fish

1. Place the fish on a clean board with its back facing you and its heaadd to the right if you are right-handed. Slit the fish open down the middle from the head to the tail, along the middle fish bone, but do not cut into the underbelly.
2. Open the fish and remove the intestines and gills. Wash the fish thoroughly with clean (drink) water.

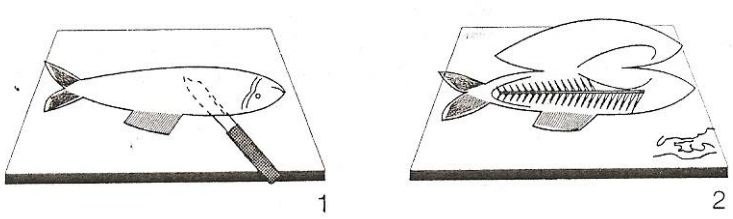

Figure 8 –2 splitting of small fish

2.4.2. Large fish

Extra cuts are made in the flesh of large fish to increase the surface area and to decrease the thickness of the fish.

1. Place the fish on a clean board with the abdominal side facing you and the head to the right if you are right-handed. Make a cut in the fish from the gill arch to the tail so that a strip of fish-flesh is left.
2. Turn the fish over and open it up. The strip of flesh must remain attached at the back.
3. Place the fish with its head to the right and the abdominal side facing you. Split the head open and cut towards the tail so that a second strip of flesh is formed. In doing so, the abdomen is also open.
4. Open the fish and remove its intestines and gills. Then wash with clean (drinking) water

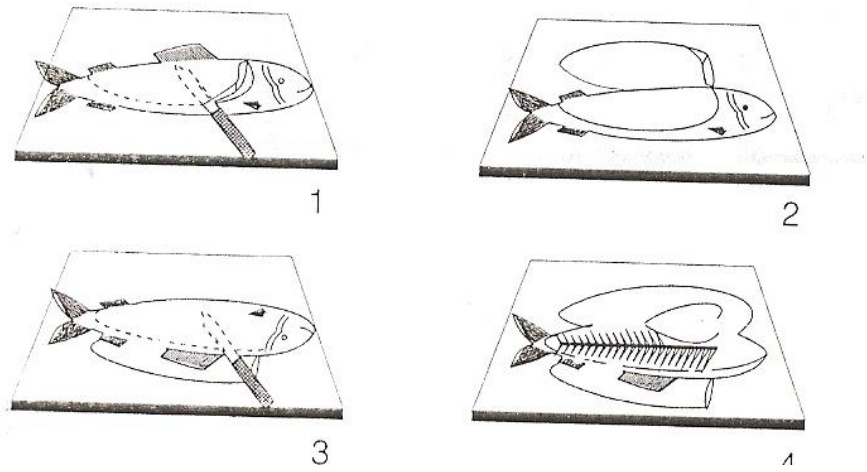

Figure 8 –3 Splitting of large fish

2.5. Filleting

The filleting methods vary with the size of fish.

2.5.1. Small fish.

One can use a fish which has not been cleaned for this.

1. Place the fish on a clean board with its back facing you. Place the head on the left if you are right-handed. Cut along the contours of the gill arches until you hit the backbone.
2. With one slice, cut the fillet loose from the backbone from the head to the tail. In doing so, the abdomen is cut open.
3. When the fillet is loose, you can see the intestines and other organs.
4. Turn the fish over so its abdominal side faces you.
5. Repeat steps 1, 2 and 3.
6. If necessary, cut the fins from the fillets. Then wash the fillets with clean (drinking) water.

2.5.2. Large fish

1. Place the fish on a clean board with the stomach facing up. For the handed people the head must be on the right. Cut along the contours of the gill arches.
2. Remove the head and intestines.
3. Place the fish on its side. For the first fillet, start at the head end and cut the fish in the direction of the tail to halfway along the backbone. Cut as close to the backbone as possible.
4. Also cat the other side of the fillet loose.
5. Turn the fish so its tail is to the right.
6. Remove the other fillet from the backbone. If necessary, remove the fins from the fish. Wash the fillets with clean water.

With all preservation methods it is important to use fish of the same size within one batch so that a uniform final product is made.

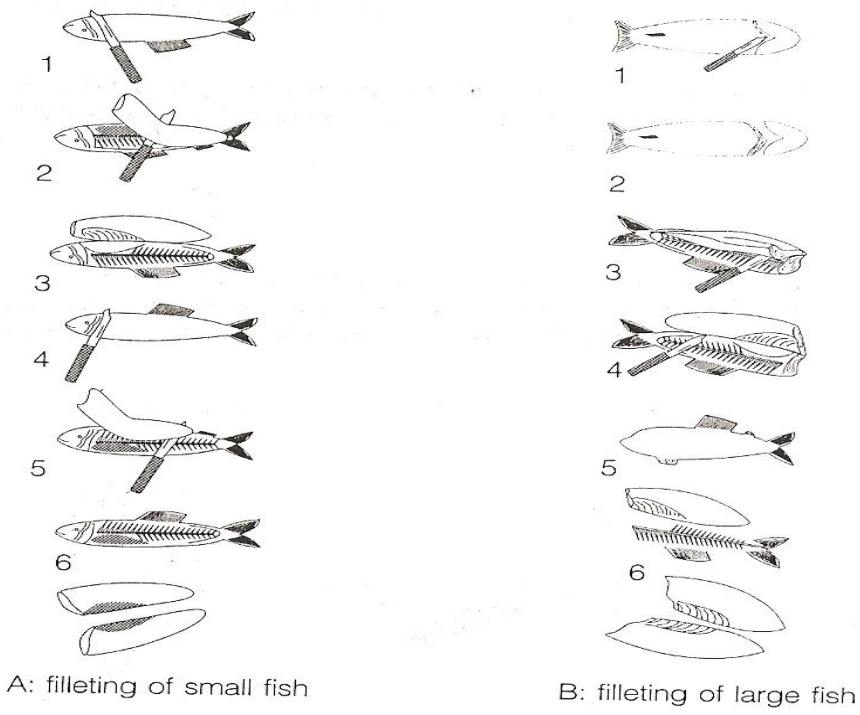

Figure 8 –3 Filleting of fish

2. Fish Quality evaluation

Different methods have been developed to value the quality of fish. One distinguishes the sensory methods, microbiological methods and chemical methods.

2.1. Sensory methods

The Method of Quality index is founded on the meaningful sensory parameters for the raw fish when one uses many parameters and a system of quotation of defects of 0 to 4.

It uses a system of quotation in which fish is classified and the points corresponding to the defects are recorded. The notes of all features are added then to give a general sensory quotation that one calls the ***quality index***. The note 0 is assigned to the very fresh fish. This one increases as fish deteriorates.

2.2. Microbiological methods

The goal of the microbiological exams of the sea products is to value the possible presence of bacteria or organisms capable to have some consequences on the public health and to give an idea of the hygienic quality of fish including the rupture of the cold chain and hygiene during the handling and the treatment.

The microbiological data don't provide any information in general on the freshness. However, the number of specific bacteria of change is in relation with the remaining shelf life and this one can be predicted from such values.

The traditional bacteriological exams are complex, long, expensive and require expertise for their execution and the interpretation of the results. It is recommended to limit these analyses in number and in extent.

2.3. Chemical methods

The chemical methods for the quality assessment of the sea products present the interest to be able to establish quantitative norms. Naturally, in most cases, the sensory methods are useful to identify the good or bad quality of the products. It is why the chemical methods can be used better to solve the problems about products of doubtful quality.

2.3.1. Total Basic Volatile Nitrogen

The Total Basic Volatile Nitrogen is a dosage extensively used to value the quality of the sea products. It is a general term that consists of the determination of the ***trimethylamine*** (produced by the spoilage bacteria), the ***dimethylamine*** (produced by the autolytical enzymes during the storage of the frozen fish), ***ammonia*** (produced by the deamination of the amino acids and catabolites of nucleotides) and other nitrogenous volatile basic compounds associated to the deterioration of the sea products.

Although the analysis of TBVN are relatively simple to do, they especially reflect the last stages of the deterioration and are not considered generally reliable to measure the deterioration during the first ten days of storage of the frozen fish.

2.3.2. Ammonia

Ammonia is formed by the bacterial deterioration or deamination of proteins, peptide and amino acids. It is also produced during the autolytical deterioration of the adenosine monophosphate (AMP).

Although ammonia has been detected like volatile component in altered many fish, little study quantified it, because it was impossible to determine its relative contribution to the general growth of the total volatile bases.

The molar reduction of NH_3 in fish gives one mole of glutamic acid and NAD that can be followed by spectrophotometry to 340 nm.

2.3.3. Trimethylamine (TMA)

The trimethylamine is an amino volatile associated to the "doubtful" typical odor of deteriorated sea product. Its presence in fish under deterioration is due to the bacterial reduction of the trimethylamine oxide (TMAO) that is naturally present in the living tissue of several marine fish species.

Although one thinks that the TMA is produced by the action of the spoilage bacteria, the interrelationship with the bacterial numberings is not often very good. One now thinks that this phenomenon is due to the presence of a number reduces "*specific spoilage bacteria* " which don't always represent a big proportion of the total bacterial flora but that can produce big quantities of compounds bound to the deterioration as the TMA.

One of these specific spoilage organisms, *Photobacterium phosphoreum* generates about 10 to 100 times more TMA than the specific spoilage bacteria widely-known *Shewanella putrefaciens.*

Appendix – 01

Diagram of the quality assessment used to note the quality index by a scale of shortcomings.

PARAMÈTRES DE QUALITÉ	***CARACTÈRE***	***POINTS (GLACE/EAU DE MER)***
ASPECT GÉNÉRAL	*Peau*	*0 Brillant luisant* *1 Brillant* *2 Terne*
	Tâches de sang sur les ouïes	*0 Sans* *1 Petit 10-30%* *2 Gros 30/50%* *3 Très important / 50-100%*
	Rigidité	*0 Raide en rigor mortis* *1 Elastique* *2 Ferme* *3 Mou*
	Ventre	*0 Ferme* *1 Mou* *2 Eclaté*
	Odeur	*0 Fraîche, algue/métallique* *1 Neutre* *2 Moisi/aigre* *3 Viande pas fraîche/rance*
YEUX	*Clarté*	*0 Claires* *2 Brumeux*
	Forme	*0 Normaux* *1 Plats* *2 Concaves*
BRANCHIES	*Couleur*	*0 Caractéristique, rouge* *1 Pâle, décolorée*
	Odeur	*0 Fraîche, algue/métallique* *1 Neutre* *2 Douceâtre/légèrement rance* *3 Aigre puante, pas fraîche/rance*
Total des points		*(min. 0 et max. 20)*