# Fish and seafood in Portugal -

# - a review of its availability and consumption

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**Report for the IJUP 2012-2013 Project (PP_IJUP2011_235)**

**Impact Evaluation of the consumption of Fish and Seafood in Portugal**

(Avaliação Ambiental do Consumo de Pescado em Portugal)

**Novembro 2013**

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# 1. Introduction

As an important health and environmental determinant that is subject to change, the characterization and monitoring of dietary habits are of paramount importance.

Following the general objective of evaluating the environmental impact of fish and seafood consumption in Portugal, the aim of the present report is to review and compile the published data that would allow the characterization of the Portuguese consumption of this particular food group.

Although dietary habits are not easy to capture, to identify and to follow up its trends from a given population it is essential to have updated, reliable and comparable data.

As illustrated by Figure 1 [(1)] dietary consumption measurements might be performed at three main levels: the national supply (levels I and II), the household availability (levels III and IV) and the individual consumption (level V).

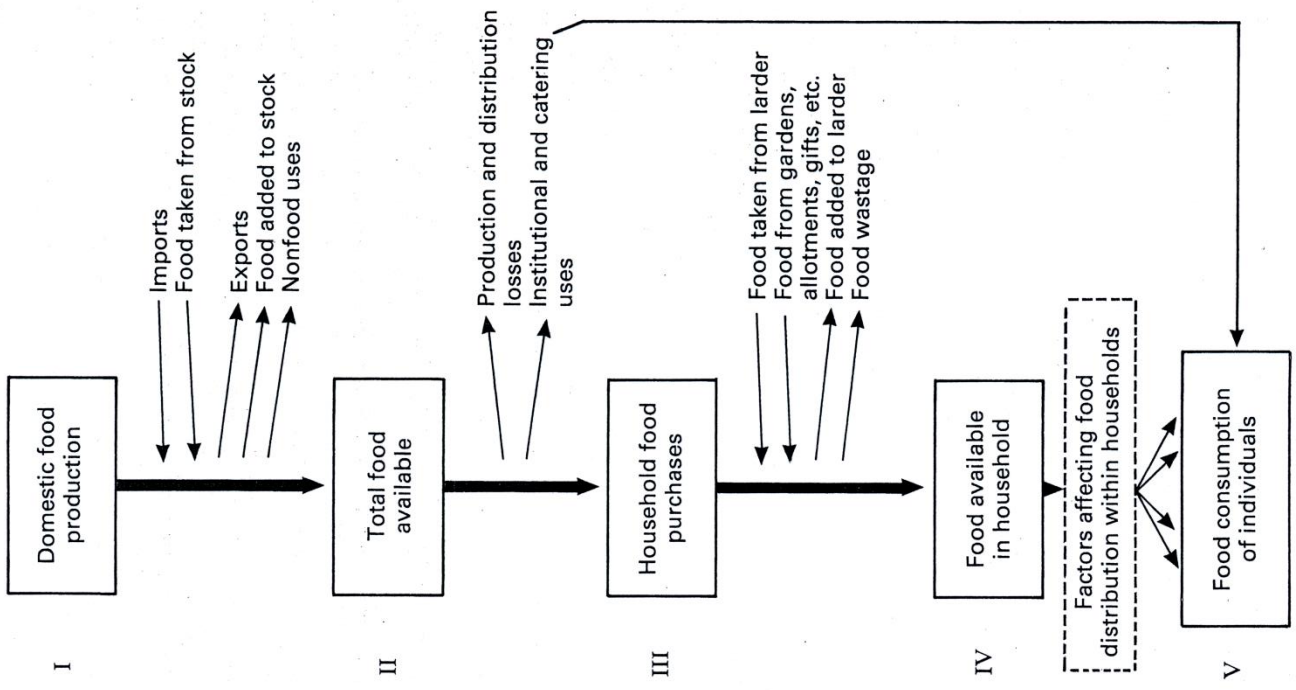



**Figure 1 - Different levels of food consumption measurement [(1)]**

Following the food consumption measurement levels, this report is structured in three main chapters focusing on data from the national supply, the household availability and the individual consumption. Some other different information sources that were considered relevant are also included. At the end, a chapter with general comments and conclusions is presented.

# 2. National Supply

## a) Context

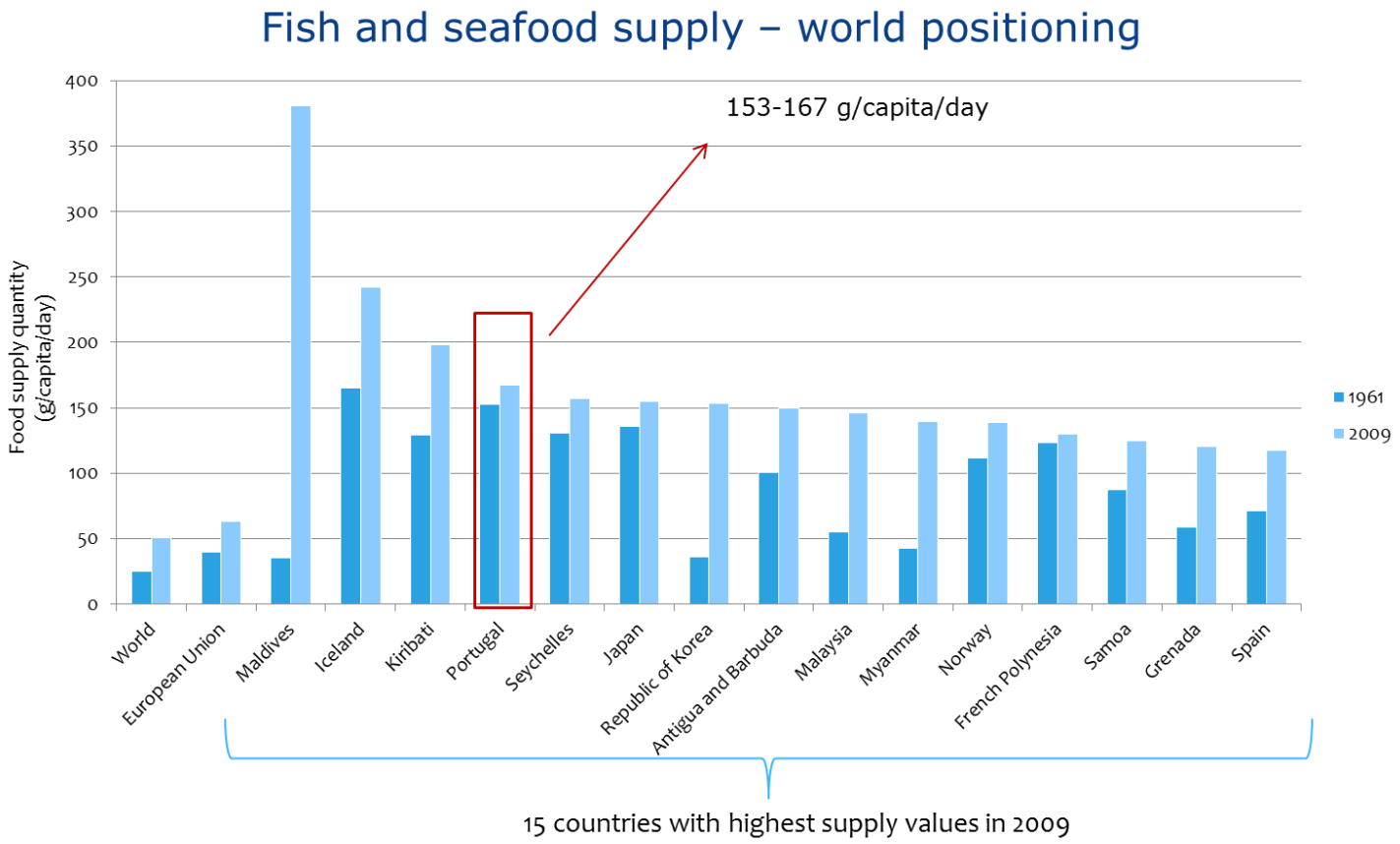
The national food supply estimates were obtained from the Food and Agriculture Organization (FAO) food balance sheets (FBS) [(2)]. In order to know the historical trends, data were collected from 1961 to 2009 (the oldest available and the most recent). Comparison of Portuguese national availability values with those from the world and other countries, as well as values for production, imports and exports are presented.

FBS, which are usually compiled by the national statistics institutes, rely on countries' governmental and other administrative statistic sources and are computed in a regular basis referring to one year periods. FBS data relate not only to the quantities available for consumption in private households but also in the non-household sector, i.e. catering establishments, boarding schools, hospitals, prisons, armed forces bases and other communities. Non-commercial or subsistence-level productions are not included because they are not officially registered. All processed food items (ex: bread) are converted back into their primary form (ex: such as wheat). The data is expressed in mean *per capita* food supply (through the division by the country's population in the middle of the corresponding year) but it is worth noting that tourists and illegal immigrants are not considered in this estimations.

## b) Food Balance Sheets

### 2b.1) Supply - world positioning

In 2009, Portugal was the 4th country in the world with the higher fish and seafood supply. The average values in the world and in the European Union increased from 1961 up to 2009. (Graph 1)



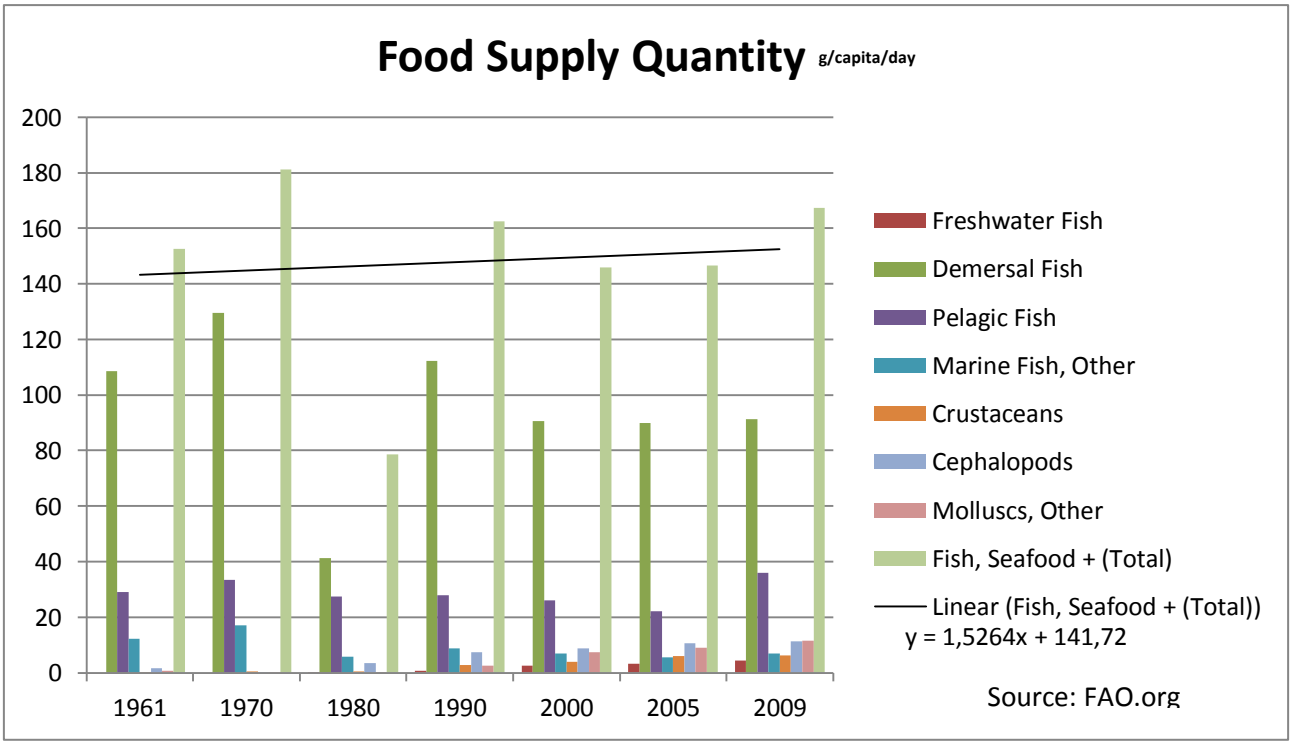

**Graph 1 - Fish and seafood supply quantity (values relate to the years 1961 and 2009), the world positioning of Portugal and other countries, including the mean of the World and the European Union. FAO [2]**

### 2b.2) Supply by fish and seafood groups

FAO aggregates the data from fish and seafood supply by groups (for detailed information see appendix). (Table 1 and Graph 2)

**Table 1 - Portuguese food supply quantity by groups, 1961 to 2009.** FAO [2]

| Food supply quantity \| 1961 to 2009 | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Years** | **1961** | | **1970** | | **1980** | | **1990** | | **2000** | | **2005** | | **2009** | |
| **Items** | **g/capita/d** | **t/yr** | **g/capita/d** | **t/yr** | **g/capita/d** | **t/yr** | **g/capita/d** | **t/yr** | **g/capita/d** | **t/yr** | **g/capita/d** | **t/yr** | **g/capita/d** | **t/yr** |
| Freshwater Fish | 0 | 0 | 0 | 0 | 0,27 | 964,41 | 0,82 | 2970,55 | 2,47 | 9318,42 | 3,29 | 12661,76 | 4,38 | 17037,35 |
| Demersal Fish | 108,49 | 352746,56 | 129,59 | 410756,24 | 41,37 | 147769,09 | 112,33 | 406929,47 | 90,68 | 342103,00 | 89,86 | 345831,6 | 91,23 | 354866,91 |
| Pelagic Fish | 29,04 | 94421,24 | 33,42 | 105930,04 | 27,4 | 97869,79 | 27,95 | 101252,37 | 26,03 | 98201,82 | 22,19 | 85399,55 | 35,89 | 139605,10 |
| Marine Fish, Other | 12,33 | 40090,01 | 16,99 | 53852,52 | 5,75 | 20538,37 | 8,77 | 31770,42 | 6,85 | 25842,58 | 5,48 | 21090,11 | 6,85 | 26645,16 |
| Crustaceans | 0,27 | 877,88 | 0,55 | 1743,31 | 0,55 | 1964,54 | 2,74 | 9925,99 | 3,84 | 14486,94 | 6,03 | 23206,82 | 6,3 | 24505,77 |
| Cephalopods | 1,64 | 5332,33 | 0,27 | 855,81 | 3,56 | 12715,93 | 7,4 | 26807,43 | 8,77 | 33086,05 | 10,68 | 41102,62 | 11,23 | 43682,51 |
| Molluscs, Other | 0,82 | 2666,16 | 0,27 | 855,81 | 0,27 | 964,41 | 2,47 | 8947,88 | 7,4 | 27917,54 | 9,04 | 34790,98 | 11,51 | 44771,66 |
| Fish, Seafood + (Total) | 152,60 | 496166,69 | 181,1 | 574025,43 | 78,63 | 280857,71 | 162,47 | 588567,88 | 146,03 | 550918,62 | 146,58 | 564121,9 | 167,4 | 651153,36 |
| Portugal Population | 8.908.000 | | 8.684.000 | | 9.786.000 | | 9.925.000 | | 10.336.000 | | 10.544.000 | | 10.657.000 | |



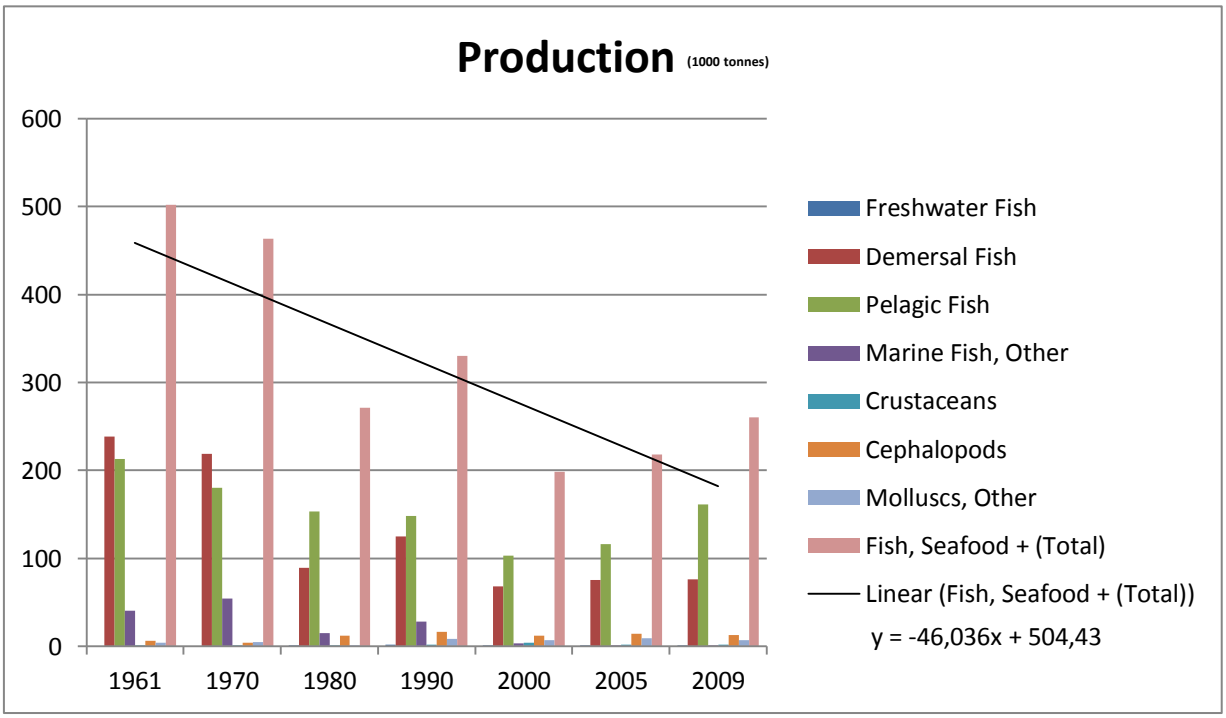

**Graph 2 - Fish and seafood supply quantity, total and by groups. FAO [2]**

## 2b.3) Production

In accordance to FAO, production data relates to the farm level for primary crops (i.e. excluding harvesting losses for crops) and livestock items and in terms of live weight (i.e. the actual ex-water weight of the catch at the time of capture) for primary fish items. As production data describes, the slope of linear regression indicates that the total production quantity has declined over the years. (Table 2 and Graph 3)

**Table 2 - Fish and seafood production quantity in Portugal, 1961 to 2009. FAO [2]**

| Production (1000 tonnes) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Fish groups \ Year | 1961 | 1970 | 1980 | 1990 | 2000 | 2005 | 2009 |
| Freshwater Fish | 0 | 0 | 1 | 2 | 1 | 1 | 1 |
| Demersal Fish | 238 | 219 | 89 | 125 | 68 | 75 | 76 |
| Pelagic Fish | 213 | 180 | 153 | 148 | 103 | 116 | 161 |
| Marine Fish, Other | 40 | 54 | 15 | 28 | 3 | 1 | 1 |
| Crustaceans | 1 | 1 | 1 | 2 | 4 | 2 | 2 |
| Cephalopods | 6 | 4 | 12 | 16 | 12 | 14 | 13 |
| Molluscs, Other | 4 | 5 | 1 | 8 | 7 | 9 | 7 |
| Fish, Seafood + (Total) | 502 | 463 | 271 | 330 | 198 | 218 | 260 |



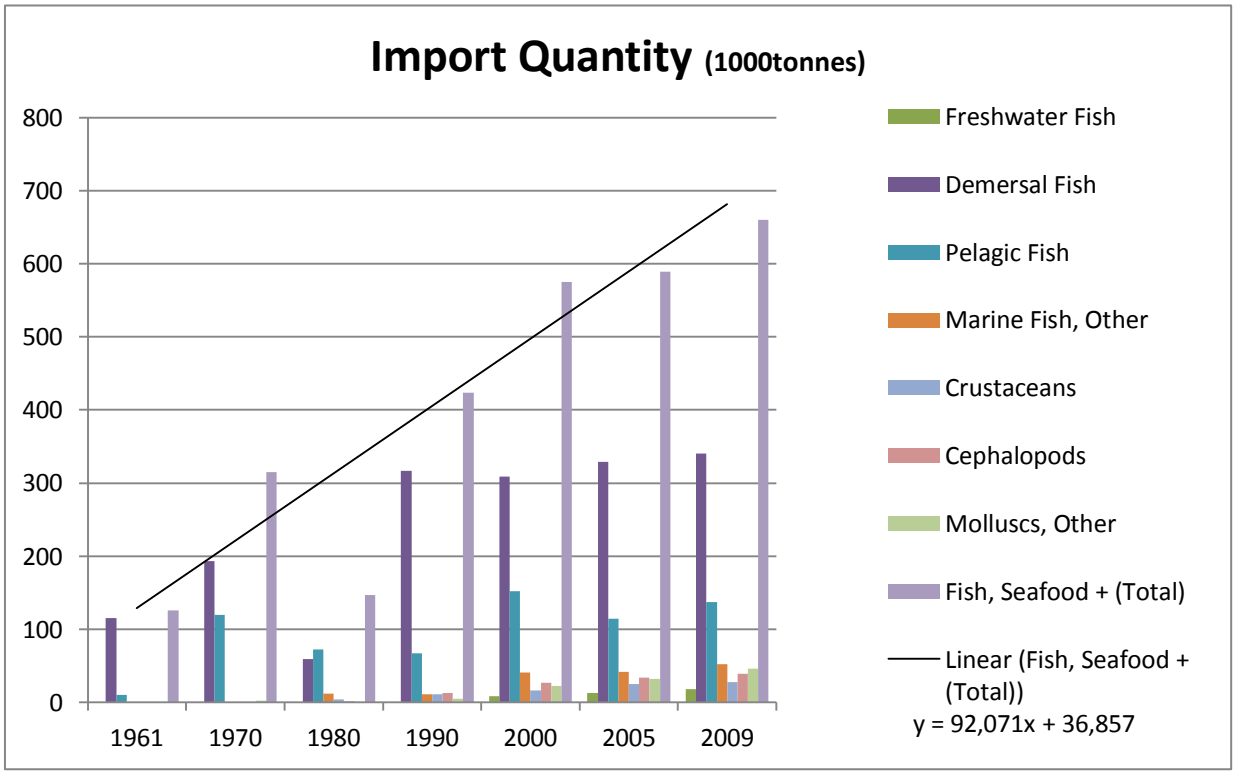

**Graph 3 - Fish and seafood production quantity in Portugal, 1961 to 2009. A linear regression equation was applied to see the slope. FAO [2]**

## 2b.4) Import

In Portugal, import quantities of fish and seafood have been increasing overtime. (Table 3 and Graph 4)

**Table 3 - Fish and seafood import quantity in Portugal, 1961 to 2009. FAO [2]**

| Import Quantity (1000tonnes) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Fish groups \ years** | **1961** | **1970** | **1980** | **1990** | **2000** | **2005** | **2009** |
| Freshwater Fish | 0 | 0 | 0 | 0 | 8 | 13 | 18 |
| Demersal Fish | 115 | 193 | 59 | 317 | 309 | 329 | 340 |
| Pelagic Fish | 10 | 120 | 72 | 67 | 152 | 114 | 137 |
| Marine Fish, Other | 0 | 0 | 12 | 11 | 41 | 42 | 52 |
| Crustaceans | 0 | 0 | 4 | 11 | 16 | 25 | 28 |
| Cephalopods | 0 | 0 | 1 | 13 | 27 | 34 | 39 |
| Molluscs, Other | 0 | 2 | 0 | 5 | 22 | 32 | 46 |
| Fish, Seafood + (Total) | 126 | 315 | 147 | 424 | 575 | 589 | 660 |



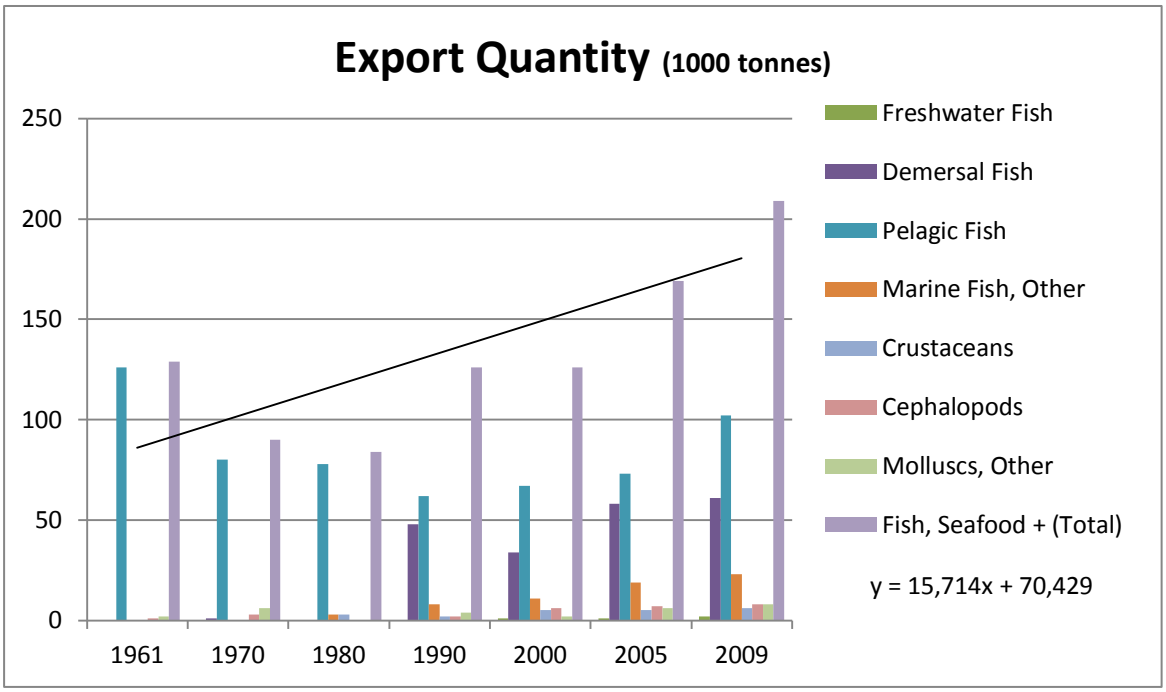

**Graph 4 - Fish and seafood import quantity in Portugal, 1961 to 2009. A linear regression equation was applied in order to calculate the slope. FAO [2]**

## 2b.5) Export

Together with import quantities, Portugal has also increased its export quantities of fish and seafood. (Table 4 and Graph 5)

**Table 4 - Fish and seafood export quantity in Portugal, 1961 to 2009. FAO [2]**

| Export Quantity (1000 tonnes) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Groups \ Years** | **1961** | **1970** | **1980** | **1990** | **2000** | **2005** | **2009** |
| Freshwater Fish | 0 | 0 | 0 | 0 | 1 | 1 | 2 |
| Demersal Fish | 0 | 1 | 0 | 48 | 34 | 58 | 61 |
| Pelagic Fish | 126 | 80 | 78 | 62 | 67 | 73 | 102 |
| Marine Fish, Other | 0 | 0 | 3 | 8 | 11 | 19 | 23 |
| Crustaceans | 0 | 0 | 3 | 2 | 5 | 5 | 6 |
| Cephalopods | 1 | 3 | 0 | 2 | 6 | 7 | 8 |
| Molluscs, Other | 2 | 6 | 0 | 4 | 2 | 6 | 8 |
| Fish, Seafood + (Total) | 129 | 90 | 84 | 126 | 126 | 169 | 209 |




**Graph 5 - Fish and seafood export quantity in Portugal, 1961 to 2009. A linear regression equation was applied in order to calculate the slope. FAO [2]**

## 2b.6) Stock variation

The definition of stock variation presented in the FAO glossary describes that this term comprises changes in stocks occurring during the reference period at all levels between the production and the retail levels, i.e. it comprises changes in government stocks, in stocks with manufacturers, importers, exporters, other wholesale and retail merchants, transport and storage enterprises and in stocks on farms. In the absence of information on opening and closing stocks, changes in stocks are also used for shifting production from the calendar year in which it is harvested to the year in which it is consumed. Net increases in stocks (add to stock) are generally indicated by the sign "-". No sign denotes net decreases (from stock). (Table 5)

**Table 5 - Fish and seafood stock variation quantity in Portugal, 1961 to 2009. FAO [2]**

| Stock Variation (1000 tonnes) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Groups \ Years** | **1961** | **1970** | **1980** | **1990** | **2000** | **2005** | **2009** |
| Freshwater Fish | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Demersal Fish | 0 | 0 | 0 | 12 | 0 | 0 | 0 |
| Pelagic Fish | -2 | 0 | 0 | 0 | 0 | 0 | 0 |
| Marine Fish, Other | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Crustaceans | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Cephalopods | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Molluscs, Other | - | - | - | - | - | - | - |
| Fish, Seafood + (Total) | -2 | 0 | 0 | 13 | 0 | 0 | 0 |

## 2b.7) Self-sufficiency

The self-sufficiency ratio (SSR) is defined as: SSR = production*100/(production + imports – exports). The SSR can be calculated for individual commodities, groups of commodities of similar nutritional values and, after appropriate conversion of the commodity equations, also for the aggregate of all commodities. In the context of food security, the SSR is often taken to indicate the extent to which a country relies on its own production resources, i.e. the higher the ratio the greater the self-sufficiency.

In 1961 the SSR for fish and seafood in Portugal was around 1, which indicates the independence of the country in this group of products. Along time SRR has been decreasing and the most recent data presents a ratio of 0.37, meaning a decrease in production and a large increase in the imports. (Table 6)

**Table 6 - Fish and seafood self-sufficiency ratio [SSR = production*100/(production + imports – exports)] in Portugal, 1961 to 2009. FAO [2]**

| Self-Sufficiency Ratio (SRR) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Group \ Years** | **1961** | **1970** | **1980** | **1990** | **2000** | **2005** | **2009** |
| Fish, Seafood + (Total) | 1,01 | 0,67 | 0,81 | 0,53 | 0,31 | 0,34 | 0,37 |

# 3. Household Availability

## 3a) Context

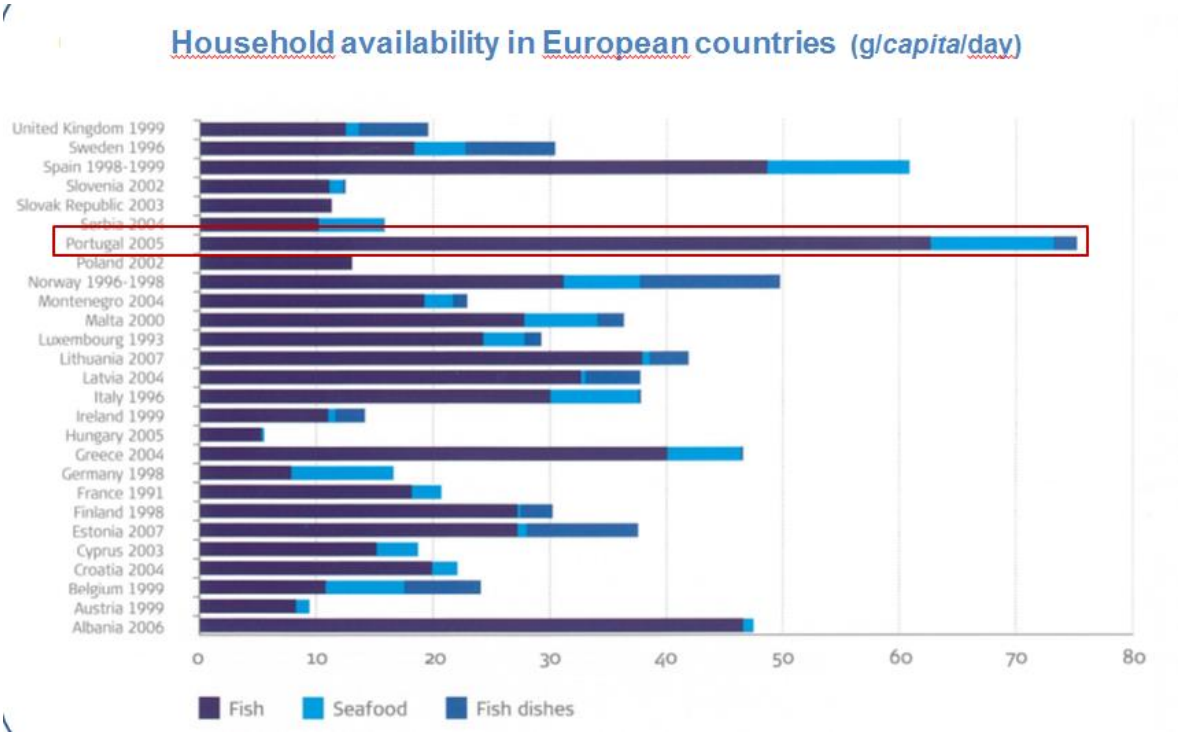
The program DAFNE-ANEMOSSoft [(3)], that compiles data collected through the Household Budget Surveys (HBS), was used to get information for household availability. The data available for Portugal refers to the years 1990, 1995, 2000 and 2005.

Conducted regularly by the national statistic institutes for economic purposes, HBS data collecting techniques are based on a self-recorded diary of cash inputs and outputs completed by each member of the household. In order to capture seasonal variability data collection within the whole country is distributed along one year period. The sample unit is the household and thus institutions or communities are excluded. Food acquisitions (including not only purchases but also contributions from the household's own production and food items received as gifts) are recorded in quantities during a period of time, from one week to one month. Food purchased for consumption outside the home is usually only registered in price value but not fully recorded in kind or weight. The food and beverages registered are subsequently grouped and made available in a list of predefined codes. The mean *per capita* daily availability is generally estimated through a division of the household daily availability by the number of household members, without considering outside the house food consumption, food wasted, spoiled, or fed to pets. Usually inedible weight factors are applied but no assumption regarding food waste is considered.

## 3b) Household Budget Surveys

### 3b.1) Total household availability

Portugal was the European country with the highest household availability of fish and seafood. The major contributor for this availability was the fish group. It is also important to note that the availability of fish dishes was smaller in Portugal than in the other European countries. (Graph 6 and Table 7)




**Graph 6 - Fish and seafood household availability in Europe. The listed years are the most recent available for each country. DAFNE-ANEMOSSoft [3]**

**Table 7 - Fish and Seafood household availability in Portugal, 1990 to 2005. DAFNE-ANEMOSSoft [3]**

| Fish and seafood household availability in Portugal (g/capita/day) | | | | |
|---|---|---|---|---|
| **Groups \ Years** | **1990** | **1995** | **2000** | **2005** |
| Fish | 68,00 | 77,00 | 71,00 | 63,00 |
| Seafood | 5,77 | 6,47 | 9,41 | 9,67 |
| Fish Dishes | 1,01 | 2,04 | 2,06 | 2,81 |
| Total | 74,78 | 85,51 | 82,47 | 75,48 |

## 3b.2) Household availability by disaggregated species in 2005

Although apparently available in the DAFNE-ANEMOSSoft, such information was not shown accurately (many items had no attributed values and legends were difficult to interpret). In the absence of sound published data disaggregated by species and processing methods, data was retrieved from the original database of the ANEMOS project (including Portuguese household budget survey data) by one of the authors (personal data not published). (Tables 8, 9 and 10).

**Table 8 - Household availability disaggregated by fish species. All values refer to 2005 and are ordered from the highest to the lowest value. ANEMOS project (data not published)**

| Fish | |
|---|---|
| **Fish** | **Mean (g/person/day)** |
| Jack-Fish, horse mackerel | 8.4 |
| Sardines | 6.61 |
| Other Fish (Fresh or refirgerated) | 6.27 |
| Hake - frozen | 5.95 |
| Salty and dried cod fish - Grown up | 5.18 |
| Salty and dried cod fish - average | 4.56 |
| Canned Tuna Fish | 2.98 |
| Salty and dried cod fish - big | 2.68 |
| Hake | 2.22 |
| other frozen fishes | 2.1 |
| Hake fillets - frozen | 1.87 |
| Sword fish | 1.81 |
| Red Fish - Frozen | 1.27 |
| Big Jack-Fish | 1.17 |
| Whiting, bib, pout | 0.9 |
| Red snapper | 0.87 |
| Other Parts of salty and dried cod fish (heads | 0.74 |
| Salty and dried cod fish - special | 0.74 |
| Maruca | 0.7 |
| Other fish fillets - frozen | 0.68 |
| Spanish mackerel | 0.54 |
| Canned Sardines | 0.41 |
| Sardines - Frozen | 0.39 |
| Meagre, sea bass | 0.36 |
| Sole like fishes | 0.36 |
| Red Fish | 0.35 |
| Conger eel | 0.29 |
| Hake (small) | 0.27 |
| Wreckfish, grouper | 0.27 |
| Tuna Fish | 0.25 |
| Fork-beard - frozen | 0.23 |
| Jack-Fish, horse mackerel - frozen | 0.22 |
| Salty and dried cod fish - in pieces | 0.15 |
| Blacksnot sea bream | 0.14 |
| Mackerel | 0.13 |
| Fork-beard | 0.11 |
| Other Canned fishes | 0.09 |
| Pomfret | 0.05 |
| Sea bream | 0.05 |
| Smoked Salmon | 0.05 |
| Other salty, dried or smoked fishes | 0.04 |
| Snaper | 0.04 |
| Black Snapper | 0.03 |
| John Dory, moonfish | 0.03 |
| Red snapper - frozen | 0.03 |
| Bogue | 0.01 |
| Sea bream - frozen | 0.01 |
| Alfonsino, Imperador, Red Bream | 0 |
| Snapper - Frozen | 0 |

**Table 9 - Household availability Quantity disaggregated in fish dish items. All values refer to 2005 and are ordered from the highest to the lowest value. ANEMOS project (data not published)**

| Fish Dishes | |
|---|---|
| **Fish Dish** | **Mean (g/person/day)** |
| Fish or Seafood cakes and croquettes | 1.07 |
| other convenience products based on fish, | 0.68 |
| Immitation seafood sticks | 0.39 |
| Boiled shrimps and prawns | 0.28 |
| Ready to eat pasta with fish and seafood | 0.22 |
| Fish or seafood patie | 0.1 |
| Cooked rice with fish | 0.03 |
| Other boiled crustaceans and molluscs n.d. | 0.03 |

**Table 10 - Household availability Quantity disaggregated in seafood items. All values refer to 2005 and are ordered from the highest to the lowest value. ANEMOS project (data not published)**

| Seafood | |
|---|---|
| **Item** | **Mean (g/person/day)** |
| Octopus, fresh, refrigerated | 1.61 |
| Octopus, frozen | 1.32 |
| Squids, frozen | 1.23 |
| Other frozen crustacean, molluscs | 1.17 |
| Shrimps and prawns, frozen | 1.04 |
| Squids, fresh, refrigerated | 0.85 |
| Cuttlefish, fresh, refrigerated | 0.62 |
| cuttlefish, frozen | 0.49 |
| Shrimps and prawns, fresh, refrigerated | 0.33 |
| Mussels, fresh, refrigerated | 0.26 |
| Fish liver, roes - frozen | 0.21 |
| Other fresh, crustacean, molluscs | 0.15 |
| Spider crabs, fresh, refrigerated | 0.11 |
| cockles, fresh, refrigerated | 0.1 |
| Snails, fresh, refrigerated | 0.1 |
| canned crustaceans, molluscs | 0.04 |
| cockles, frozen | 0.03 |
| Fish liver, roes - fresh | 0.02 |
| Crabs, fresh, refrigerated | 0 |
| Lavagante fresh, refrigerated | 0 |

## 3b.3) Household availability by Portuguese regions

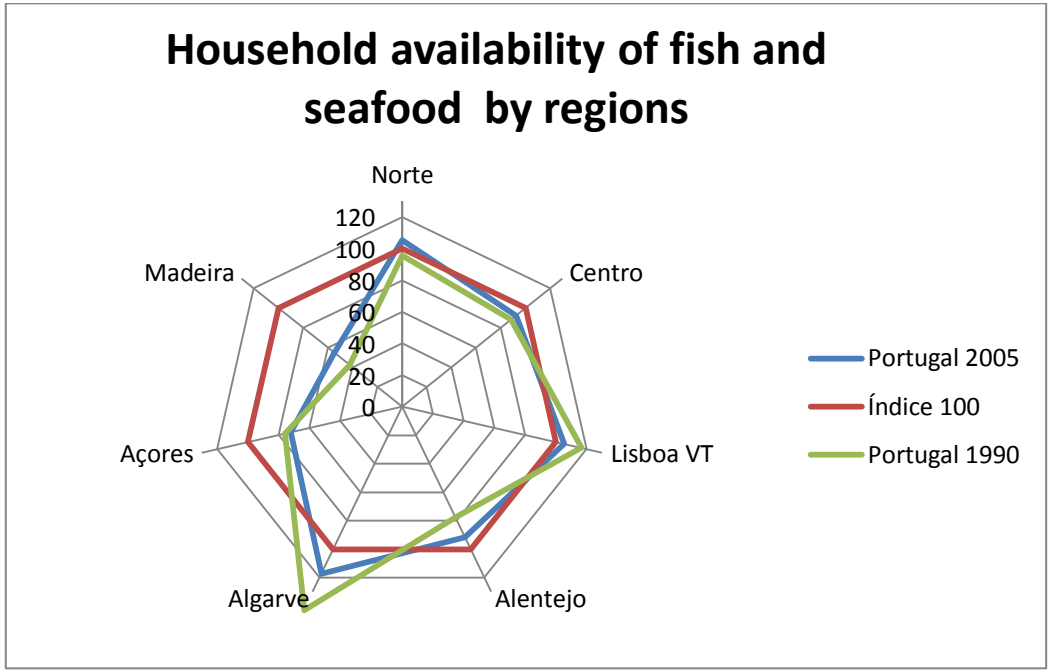
Algarve was the region presenting the highest availability, while Azores and Madeira presented the lowest values. (Tables 11.1 and 11.2 and Graph 7)

**Table 11.1 - Household availability in Portugal – Mainland regions, 1990 to 2005.** [4]

| (g/capita/d) | *North* | | | | *Centre* | | | | *Lisbon area* | | | | *Alentejo* | | | | *Algarve* | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1990 | 1995 | 2000 | 2005 | 1990 | 1995 | 2000 | 2005 | 1990 | 1995 | 2000 | 2005 | 1990 | 1995 | 2000 | 2005 | 1990 | 1995 | 2000 | 2005 |
| **Total** | **71,11** | **82,5** | **77,61** | **79,14** | **65,83** | **76,27** | **74,99** | **69,29** | **86,84** | **96,6** | **94,73** | **79,15** | **57,94** | **65,92** | **76,03** | **68,98** | **106,94** | **117,96** | **104,84** | **88,22** |
| Fresh/frozen fish | 42,14 | 46,67 | 42,4 | 67,62 | 39,01 | 45,2 | 42,19 | 59,68 | 56,75 | 63,98 | 60,45 | 62,05 | 38,72 | 43,37 | 49,64 | 57,48 | 77,79 | 90,98 | 79,93 | 70,87 |
| Salted/canned fish | 22,88 | 27,46 | 24,09 | | 22,87 | 26,04 | 24,52 | | 20,53 | 21,39 | 19,85 | | 13,76 | 15,85 | 15,55 | | 16,97 | 14,19 | 11,77 | |
| Seafood | 5,47 | 6,17 | 9,24 | 9,06 | 3,21 | 4,06 | 6,53 | 7,68 | 7,97 | 8,47 | 11,91 | 13,03 | 3,72 | 5,39 | 8,61 | 8,34 | 11,09 | 10,96 | 11,06 | 13,72 |
| Fish dishes | 0,61 | 2,2 | 1,88 | 2,46 | 0,74 | 0,96 | 1,75 | 1,92 | 1,59 | 2,76 | 2,52 | 4,07 | 1,74 | 1,32 | 2,24 | 3,16 | 1,08 | 1,82 | 2,06 | 3,63 |

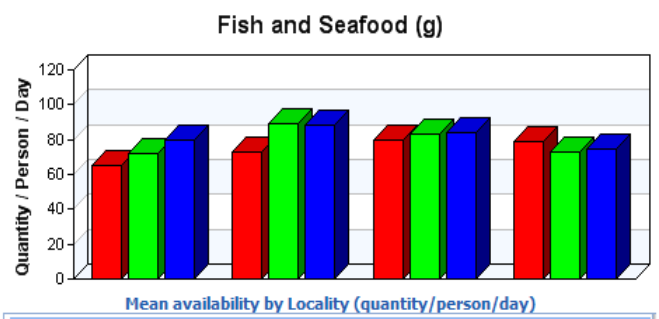
**Table 11.2 - Household availability in Portugal and its Autonomous regions, 1990 to 2005.** [4, 5]

| (g/capita/day) | *Azores* | | | | *Madeira* | | | | **Portugal** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1990 | 1995 | 2000 | 2005 | 1990 | 1995 | 2000 | 2005 | 1990 | 1995 | 2000 | 2005 |
| **Total** | **56,40** | **85,93** | **66,74** | **54,02** | **31,39** | **46,36** | **40,13** | **41,21** | **74,51** | **85,63** | **82,68** | **75,09** |
| Fresh/frozen fish | 44,61 | 67,58 | 44,25 | 47,77 | 28,51 | 39,61 | 31,33 | 37,46 | 47,18 | 53,89 | 49,95 | 62,61 |
| Salted/canned fish | 9,76 | 14,01 | 15,29 | | 2,78 | 6,09 | 7,46 | | 20,54 | 23,23 | 21,25 | |
| Seafood | 1,73 | 3,11 | 5,44 | 4,15 | 0,09 | 0,35 | 0,91 | 2,92 | 5,77 | 6,47 | 9,41 | 9,67 |
| Fish dishes | 0,3 | 1,23 | 1,76 | 2,11 | 0,01 | 0,31 | 0,43 | 0,83 | 1,01 | 2,04 | 2,06 | 2,81 |



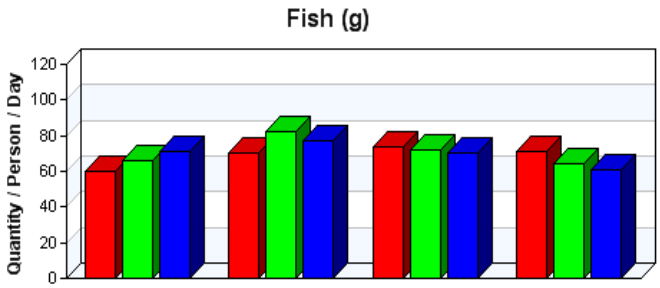

**Graph 7 - Household availability of fish and seafood by Portuguese regions, 1990 and 2005.** [4, 5]

## 3b.4) Household availability by locality urbanization degree



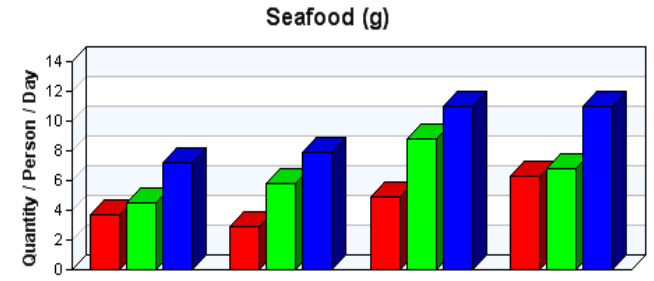

Mean availability by Locality (quantity/person/day)

| | Rural | SemiUrban | Urban |
|---|---|---|---|
| Portugal 1990 | 65 | 72 | 80 |
| Portugal 1995 | 73 | 89 | 88 |
| Portugal 2000 | 80 | 83 | 84 |
| Portugal 2005 | 79 | 73 | 75 |



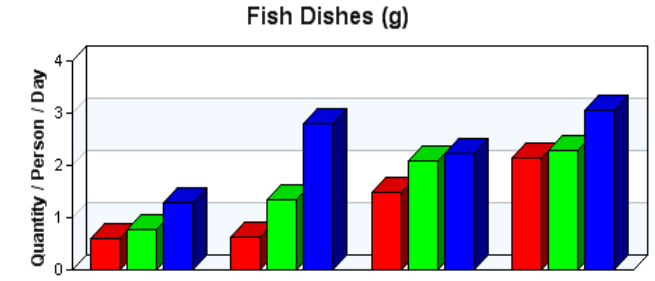

Mean availability by Locality (quantity/person/day)

| | Rural | SemiUrban | Urban |
|---|---|---|---|
| Portugal 1990 | 60 | 66 | 71 |
| Portugal 1995 | 70 | 82 | 77 |
| Portugal 2000 | 74 | 72 | 70 |
| Portugal 2005 | 71 | 64 | 61 |




Mean availability by Locality (quantity/person/day)

| | Rural | SemiUrban | Urban |
|---|---|---|---|
| Portugal 1990 | 3,72 | 4,53 | 7,16 |
| Portugal 1995 | 2,91 | 5,77 | 7,89 |
| Portugal 2000 | 4,95 | 8,77 | 11 |
| Portugal 2005 | 6,31 | 6,82 | 11 |

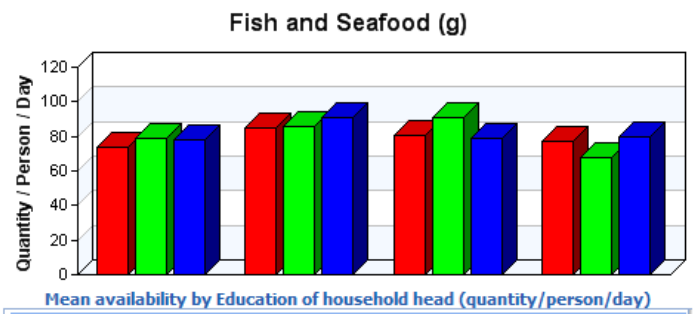



Mean availability by Locality (quantity/person/day)

| | Rural | SemiUrban | Urban |
|---|---|---|---|
| Portugal 1990 | 0,60 | 0,78 | 1,29 |
| Portugal 1995 | 0,62 | 1,35 | 2,81 |
| Portugal 2000 | 1,48 | 2,08 | 2,23 |
| Portugal 2005 | 2,15 | 2,29 | 3,05 |

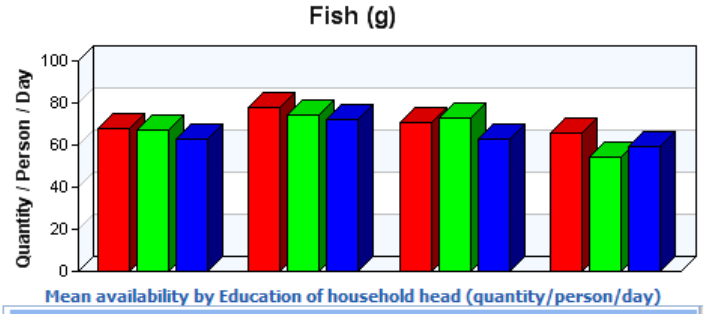
**Figure 2 – Household availability of fish and seafood by locality urbanization degree in Portugal, 1990 to 2005. (although designated only by fish and seafood, this category also includes fish dishes). DAFNE-ANEMOSSoft [3]**

## 3b.5) Household availability by education level of the household head



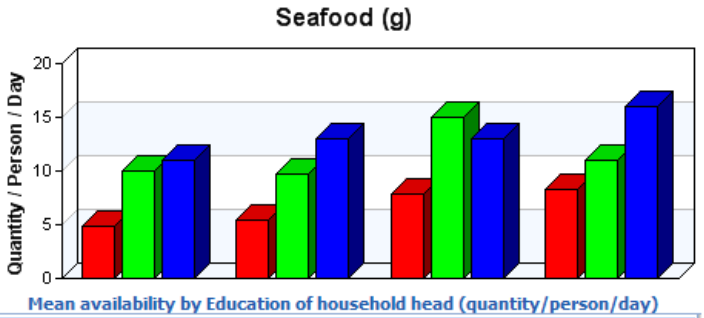

Mean availability by Education of household head (quantity/person/day)

| | Elementary | Secondary | Higher |
|---|---|---|---|
| Portugal 1990 | 74 | 79 | 78 |
| Portugal 1995 | 85 | 86 | 91 |
| Portugal 2000 | 81 | 91 | 79 |
| Portugal 2005 | 77 | 68 | 80 |



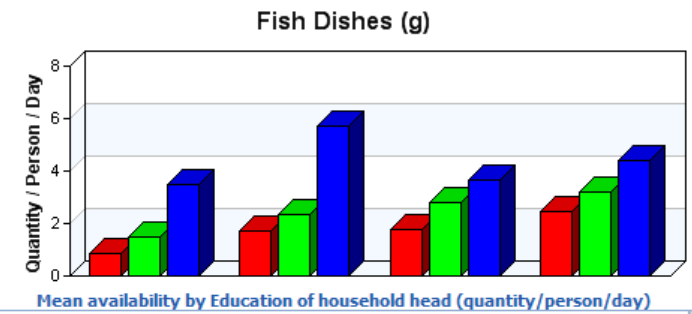

Mean availability by Education of household head (quantity/person/day)

| | Elementary | Secondary | Higher |
|---|---|---|---|
| Portugal 1990 | 68 | 67 | 63 |
| Portugal 1995 | 78 | 74 | 72 |
| Portugal 2000 | 71 | 73 | 63 |
| Portugal 2005 | 66 | 54 | 59 |




Mean availability by Education of household head (quantity/person/day)

| | Elementary | Secondary | Higher |
|---|---|---|---|
| Portugal 1990 | 4,85 | 10 | 11 |
| Portugal 1995 | 5,43 | 9,66 | 13 |
| Portugal 2000 | 7,91 | 15 | 13 |
| Portugal 2005 | 8,31 | 11 | 16 |

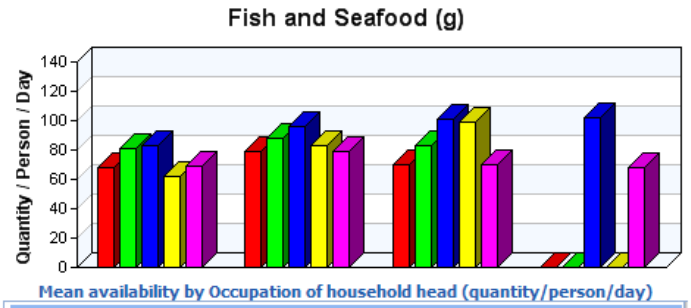



Mean availability by Education of household head (quantity/person/day)

| | Elementary | Secondary | Higher |
|---|---|---|---|
| Portugal 1990 | 0,83 | 1,49 | 3,46 |
| Portugal 1995 | 1,73 | 2,36 | 5,70 |
| Portugal 2000 | 1,79 | 2,78 | 3,66 |
| Portugal 2005 | 2,46 | 3,18 | 4,40 |

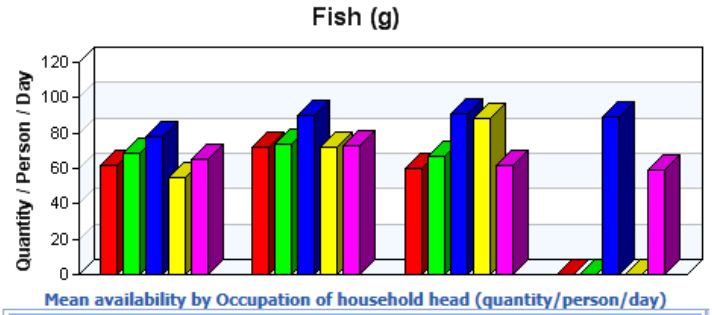
**Figure 3 Household availability of fish and seafood by education of household head (Elementary, Secondary and Higher)in Portugal, 1990 to 2005. (although designated only by fish and seafood, this category also includes fish dishes). DAFNE-ANEMOSSoft [3]**

## 3b.6) Household availability by occupation of household head



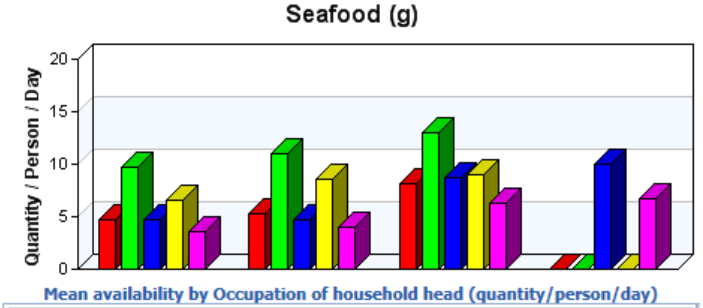

Mean availability by Occupation of household head (quantity/person/day)

| | Manual | Non Manual | Retired | Unemployed | Others |
|---|---|---|---|---|---|
| Portugal 1990 | 68 | 81 | 83 | 62 | 69 |
| Portugal 1995 | 79 | 88 | 96 | 83 | 79 |
| Portugal 2000 | 70 | 83 | 101 | 99 | 70 |
| Portugal 2005 | N/A | N/A | 102 | N/A | 68 |



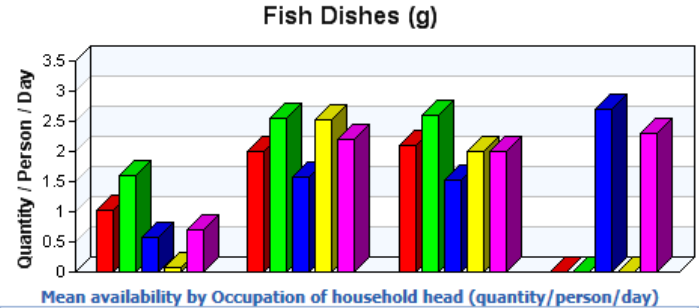

Mean availability by Occupation of household head (quantity/person/day)

| | Manual | Non Manual | Retired | Unemployed | Others |
|---|---|---|---|---|---|
| Portugal 1990 | 62 | 69 | 78 | 55 | 65 |
| Portugal 1995 | 72 | 74 | 90 | 72 | 73 |
| Portugal 2000 | 60 | 67 | 91 | 88 | 62 |
| Portugal 2005 | N/A | N/A | 89 | N/A | 59 |




Mean availability by Occupation of household head (quantity/person/day)

| | Manual | Non Manual | Retired | Unemployed | Others |
|---|---|---|---|---|---|
| Portugal 1990 | 4,73 | 9,74 | 4,67 | 6,63 | 3,52 |
| Portugal 1995 | 5,33 | 11 | 4,75 | 8,58 | 4,01 |
| Portugal 2000 | 8,10 | 13 | 8,66 | 9,01 | 6,25 |
| Portugal 2005 | N/A | N/A | 10 | N/A | 6,76 |

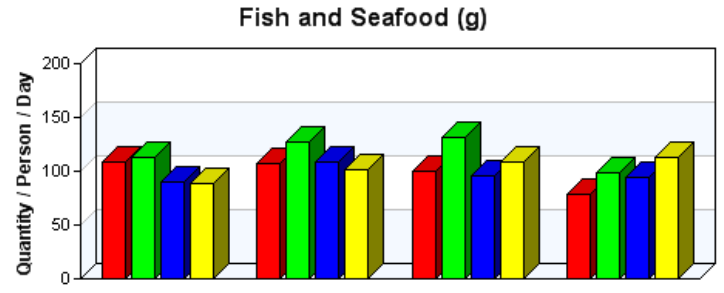



Mean availability by Occupation of household head (quantity/person/day)

| | Manual | Non Manual | Retired | Unemployed | Others |
|---|---|---|---|---|---|
| Portugal 1990 | 1,03 | 1,59 | 0,58 | 0,08 | 0,71 |
| Portugal 1995 | 1,99 | 2,55 | 1,57 | 2,53 | 2,19 |
| Portugal 2000 | 2,11 | 2,60 | 1,53 | 2,01 | 2,00 |
| Portugal 2005 | N/A | N/A | 2,71 | N/A | 2,30 |

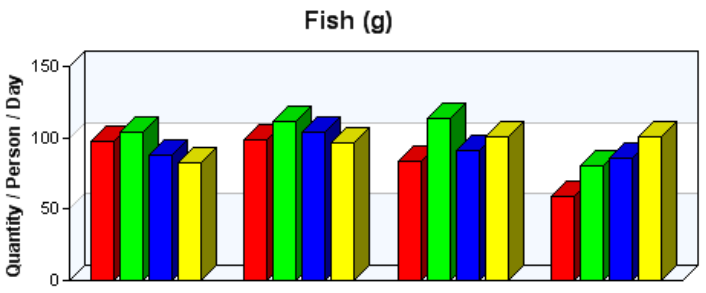
**Figure 4 – Household availability of fish and seafood by occupation of household head (Manual, Non Manual, Retired and Unemployed) in Portugal, 1990 to 2005. (although designated only by fish and seafood, this category also includes fish dishes). DAFNE-ANEMOSSoft [3]**

## 3b.7) Household availability by household composition



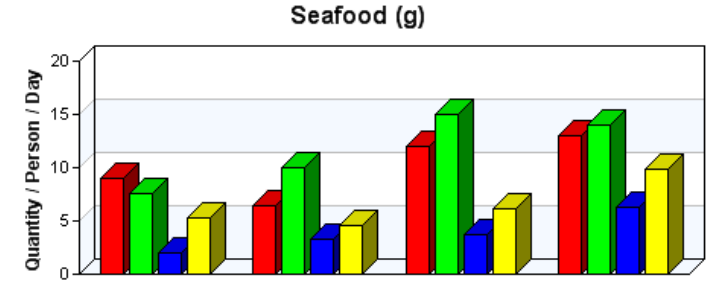

Mean availability by Household Composition (quantity/person/day)

| | Adult Single | Adult 2 Members | Elderly Single | Elderly 2 Members |
|---|---|---|---|---|
| Portugal 1990 | 108 | 113 | 90 | 88 |
| Portugal 1995 | 107 | 127 | 109 | 102 |
| Portugal 2000 | 100 | 131 | 96 | 108 |
| Portugal 2005 | 79 | 98 | 95 | 113 |



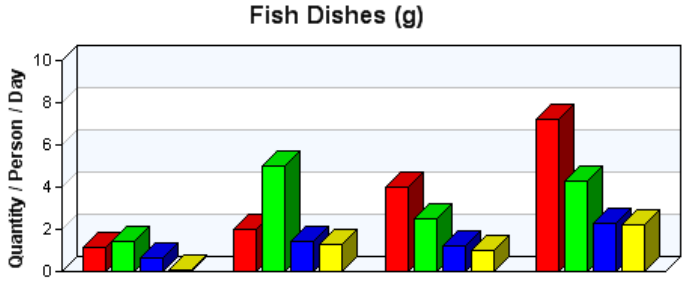

Mean availability by Household Composition (quantity/person/day)

| | Adult Single | Adult 2 Members | Elderly Single | Elderly 2 Members |
|---|---|---|---|---|
| Portugal 1990 | 98 | 104 | 88 | 83 |
| Portugal 1995 | 99 | 111 | 104 | 96 |
| Portugal 2000 | 84 | 114 | 91 | 101 |
| Portugal 2005 | 59 | 80 | 86 | 101 |




Mean availability by Household Composition (quantity/person/day)

| | Adult Single | Adult 2 Members | Elderly Single | Elderly 2 Members |
|---|---|---|---|---|
| Portugal 1990 | 9,03 | 7,54 | 1,93 | 5,33 |
| Portugal 1995 | 6,48 | 10 | 3,29 | 4,56 |
| Portugal 2000 | 12 | 15 | 3,65 | 6,21 |
| Portugal 2005 | 13 | 14 | 6,26 | 9,88 |




Mean availability by Household Composition (quantity/person/day)

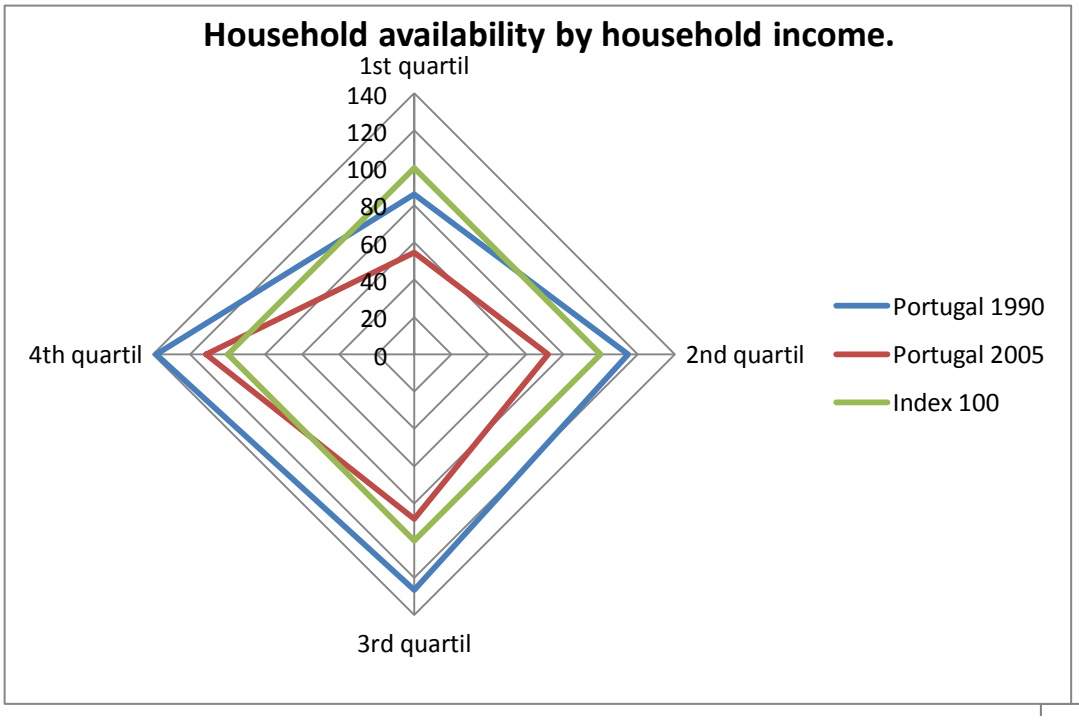
| | Adult Single | Adult 2 Members | Elderly Single | Elderly 2 Members |
|---|---|---|---|---|
| Portugal 1990 | 1,16 | 1,46 | 0,66 | 0,08 |
| Portugal 1995 | 2,00 | 4,97 | 1,41 | 1,29 |
| Portugal 2000 | 4,00 | 2,49 | 1,25 | 1,01 |
| Portugal 2005 | 7,19 | 4,28 | 2,31 | 2,22 |

**Figure 5 –Household availability of fish and seafood by household composition (adult single, 2 adult members, elderly single and 2 elderly members) in Portugal, 1990 to 2005. (although designated only by fish and seafood, this category also includes fish dishes). DAFNE-ANEMOSSoft [3]**

## 3b.8) Household availability by household income

**Table 12 - Household availability by household income quartiles in Portugal, 1990 to 2005. (N.a – data not available). (data not published)**

| Group / Survey year | Income (euro/capita) | Total (g/capita/day) | Fish (g/capita/day) | Fresh and frozen fish (g/capita/day) | Salty and dried fish (g/capita/day) | Smoked and canned fish (g/capita/day) | Seafood (g/capita/day) | Fish dishes (g/capita/day) |
|---|---|---|---|---|---|---|---|---|
| 1990 | 1st quartil | 64.06 | 59.57 | 41.64 | 16.59 | 1.32 | 3.84 | 0.65 |
| | 2nd quartil | 85.94 | 77.85 | 53.79 | 22.26 | 1.79 | 6.70 | 1.38 |
| | 3rd quartil | 94.50 | 81.12 | 57.06 | 22.77 | 1.27 | 11.97 | 1.41 |
| | 4th quartil | 103.57 | 86.36 | 59.71 | 24.61 | 2.03 | 13.91 | 3.29 |
| 1995 | 1st quartil | 65.93 | 62.16 | 45.48 | 14.68 | 2.00 | 3.12 | 0.64 |
| | 2nd quartil | 78.91 | 73.20 | 50.30 | 20.54 | 2.35 | 4.43 | 1.27 |
| | 3rd quartil | 96.29 | 85.83 | 58.52 | 24.69 | 2.61 | 7.58 | 2.87 |
| | 4th quartil | 97.07 | 82.85 | 59.83 | 20.43 | 2.58 | 10.99 | 3.22 |
| 2000 | 1st quartil | 59.70 | 53.80 | 37.52 | 14.51 | 1.77 | 4.69 | 1.20 |
| | 2nd quartil | 71.54 | 63.25 | 43.76 | 16.88 | 2.60 | 6.73 | 1.55 |
| | 3rd quartil | 82.17 | 70.94 | 48.83 | 19.52 | 2.59 | 9.03 | 2.19 |
| | 4th quartil | 104.67 | 87.21 | 63.09 | 20.77 | 3.34 | 14.68 | 2.77 |
| 2005 | 1st quartil | 41.13 | 37.12 | *n.a.* | *n.a.* | *n.a.* | 3.49 | 0.50 |
| | 2nd quartil | 54.33 | 49.14 | *n.a.* | *n.a.* | *n.a.* | 3.76 | 1.42 |
| | 3rd quartil | 66.71 | 57.64 | *n.a.* | *n.a.* | *n.a.* | 6.93 | 2.13 |
| | 4th quartil | 84.10 | 68.33 | *n.a.* | *n.a.* | *n.a.* | 12.28 | 3.47 |




**Graph 8 - Household availability of fish and seafood by household income quartiles in Portugal, 1990 and 2005. (data not published)**

# 4. Consumption

## 4a) Context

Consumption data refers to individual intake information. In the absence of a regularly collected national dietary survey (the first and only one was carried out in 1980), the food and nutrient consumption data was retrieved from four different sources.

## 4b) National Health Surveys

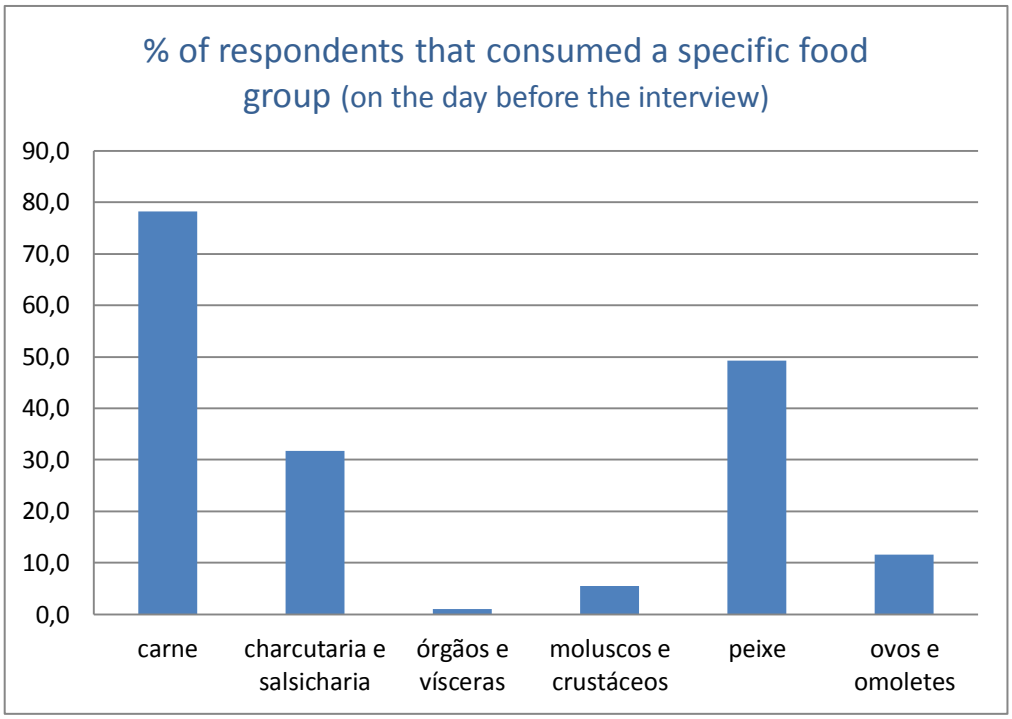
The individual-based National Health Survey provides qualitative information on national food habits. However, this source of information is also very limited as food groups are simply reported as eaten or not in the previous day and only quantitative data on consumption of milk and alcoholic beverages are available [6, 7, 8]. (Table 13)

**Table 13 – Percentage of respondents from the Portuguese National Health Surveys [6, 7, 8] who ate fish or seafood in a main meal the day before. The first three surveys were applied only in the mainland.**

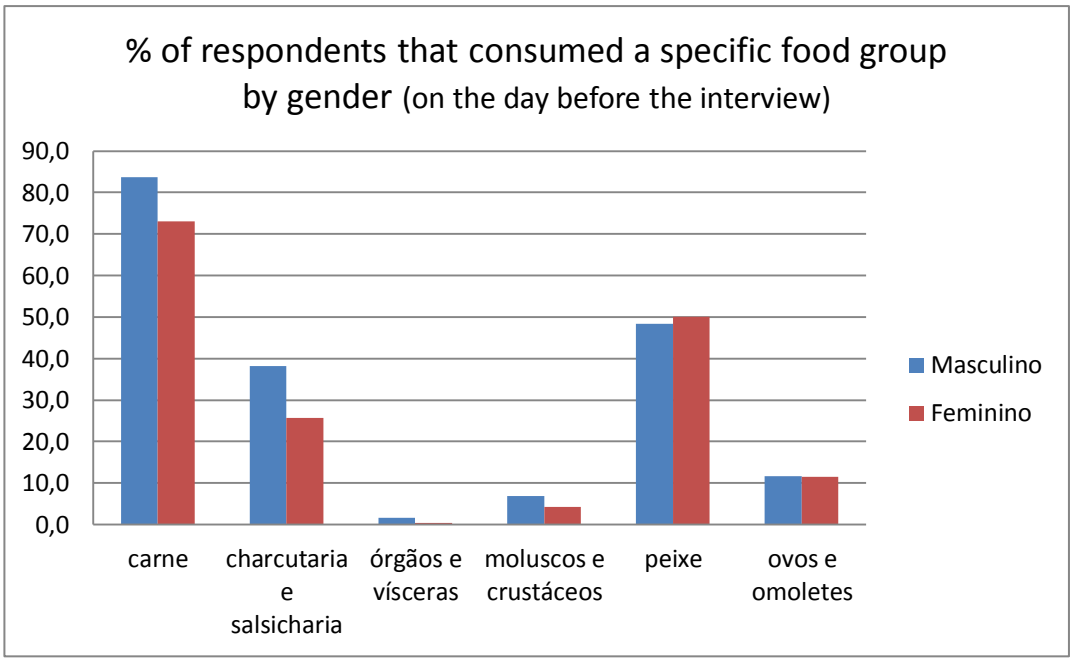
| National Health Survey | | 1st | 2nd | 3rd | 4th |
|---|---|---|---|---|---|
| | | 1987 | 1995/1996 | 1998/1999 | 2005/2006 |
| Portugal | Mainland | 56% | 55% | 53% | 49% |
| | Madeira | *Not considered* | | | 45% |
| | Azores | | | | 41% |

## 4c) SPCNA/Nestlé study

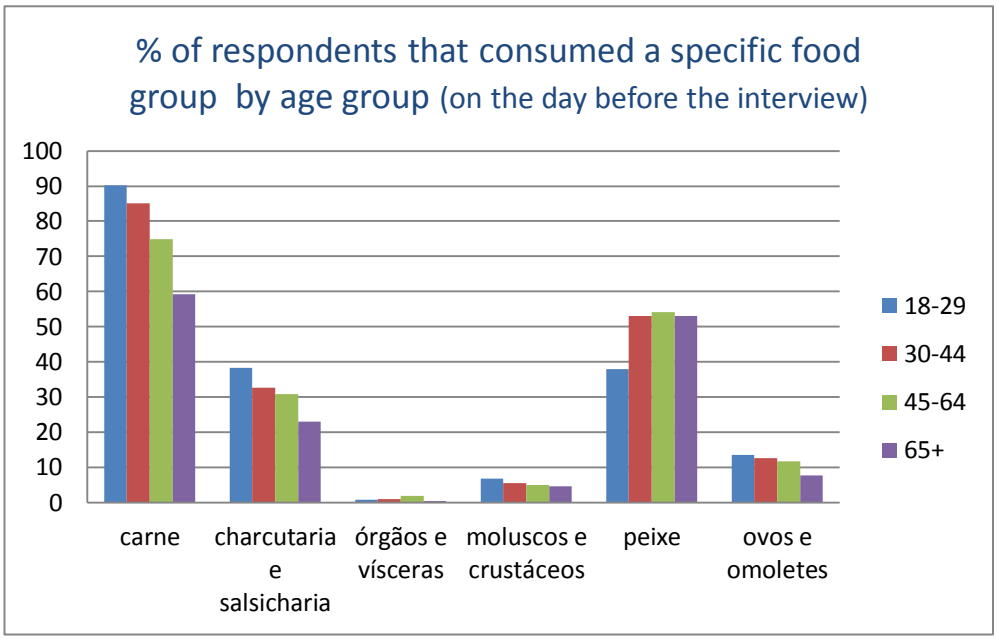
More recently, in 2009, a study conducted by the Portuguese society for food and nutrition (SPCNA) sponsored by Nestlé, also conveyed information on national food habits. Based on an individual survey collected through 24h recall data, the sample of this study included 3529 adults (age ranging from 18 to 93 year old – 45 as median; 52.2% female) from all the Portuguese regions (mainland and autonomous regions). However, its potentiality has not yet been fully achieved and few published data are available. Graphs 9, 10, 11 and 12 summarize some of the available information [9, 10].



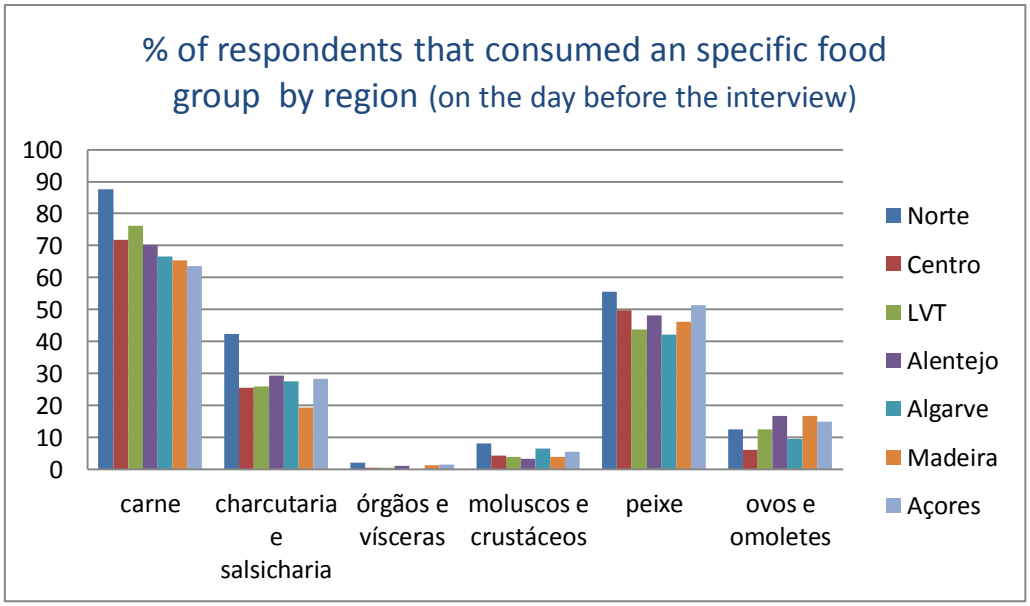

**Graph 9 – Percentage of respondents that consumed a specific food group on the day before the interview. Data from the SPCNA/Nestle study (2009) [9]. The name of the columns from left to right: meat, sausages, offal, seafood, fish, eggs and omelets.**




**Graph 10 - Percentage of respondents by gender that consumed a specific food group on the day before the interview. Data from the SPCNA/Nestle study (2009) [9]. The name of the columns from left to right: meat, sausages, offal, seafood, fish, eggs and omelets. Blue refers to male and red to female.**




**Graph 11 - Percentage of respondents by age groups that consumed a specific food group on the day before the interview. Data from the SPCNA/Nestle study (2009) [9]. The name of the columns from left to right: meat, sausages, offal, seafood, fish, eggs and omelets.**




**Graph 12 - Percentage of respondents by Portuguese regions that consumed a specific food group on the day before the interview. Data from the SPCNA/Nestle study (2009) [9]. The name of the columns from left to right: meat, sausages, offal, seafood, fish, eggs and omelets.**

## 4d) EpiPorto study

The EpiPorto study [11] aimed to collect information about health and nutrition in adults. The study was made from 1990 to 2003 into individuals that lived in the Porto area (located in the North region, Porto is the second largest city of Portugal).

EpiPorto reveals the consumption from one final sample composed by 2415 individuals, of these 61.7% are women and 38.3% are men with ages ranged between 18 and 92 years old (mean age 52.9±15.0 years). The sample was selected by random digital dialling (response rate 70%) and method used to assess quantitative information of food consumption was one validated semi-quantitative food frequency questionnaire (FFQ), relative for the period of 12 months previous the interview moment.

Regarding the consumption of fish and seafood, six different items/groups were assessed (fatty fish: sardines, mackerel, jack-fish, salmon; lean fish: hake, whiting, sea bream; cod fish; canned fish: tuna, sardines; octopus, squids; shrimps, clams, mussels) and data is available either as consumption frequency (Tables 14 and 15), average quantity (Table 16) or energy and nutrient contribution (Figures 6, 7 and 8).

### 4d.1) Frequency of fish and seafood consumption

**Table 14 - Frequency of fish and seafood consumption by gender (F- Female ; M – Male). Data obtained from EpiPorto study [11]**

| Frequency of fish and seafood consumption by gender | | | | | | |
|---|---|---|---|---|---|---|
| | n (%) | | | | | |
| | Gender | Never or less than 1x/month | 1-4 x /month | 2-6 x/week | 1-3 x/day | 4 or more x/day |
| Fatty Fish: sardines, mackerel, jack-fish, salmon | F | 226 (15.3) | 861 (58.3) | 388 (26.3) | 2 (0.01) | 0 (0.0) |
| | M | 143 (15.5) | 538 (58.4) | 239 (26.0) | 1 (0.01) | 0 (0.0) |
| lean fish: hake, whiting, sea bream | F | 60 (4.1) | 756 (51.2) | 648 (43.9) | 13 (0.9) | 0 (0.0) |
| | M | 52 (5.6) | 486 (52.8) | 374 (40.6) | 9 (1.0) | 0 (0.0) |
| Cod fish | F | 118 (8.0) | 1071 (72.5) | 288 (19.5) | 0 (0.0) | 0 (0.0) |
| | M | 55 (6.0) | 637 (69.2) | 229 (24.9) | 0 (0.0) | 0 (0.0) |
| Canned fish: tuna, sardines | F | 817 (55.3) | 633 (42.9) | 27 (1.8) | 0 (0.0) | 0 (0.0) |
| | M | 440 (47.8) | 455 (49.4) | 26 (2.8) | 0 (0.0) | 0 (0.0) |
| octopus, squids | F | 539 (36.5) | 917 (62.1) | 21 (1.4) | 0 (0.0) | 0 (0.0) |
| | M | 268 (29.1) | 633 (68.7) | 20 (2.2) | 0 (0.0) | 0 (0.0) |
| shrimps, clams, mussels | F | 1063 (72.0) | 406 (27.5) | 8 (0.5) | 0 (0.0) | 0 (0.0) |
| | M | 617 (67.0) | 294 (31.9) | 10 (1.1) | 0 (0.0) | 0 (0.0) |

**Table 15 - Frequency of fish and seafood consumption (fresh and total) by gender and age groups. Data obtained from EpiPorto study [11]**

| Frequency of fish and seafood consumption by gender and age | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Female n (%) | | | Male n (%) | | |
| | Age (years) | Monthly 1-4 x/month | Weekly 2-6 x/week | Daily 1 ou + x/day | Monthly 1-4 x/month | Weekly 2-6 x/week | Daily 1 ou + x/day |
| Total | 18-39 | 4 (1.3) | 212 (70.7) | 82 (27.3) | 3 (1.7) | 137 (76.5) | 36 (20.1) |
| | 40-49 | 3 (0.9) | 242 (71.0) | 95 ( 27.9) | 1 (0.5) | 131 (65.5) | 67 (33.5) |
| | 50-64 | 8 (1.6) | 311 (62.6) | 178 (35.8) | 3 (1.0) | 178 (60.1) | 115 (38.9) |
| | ≥65 | 3 (0.9) | 230 (67.8) | 106 (31.3) | 3 (1.2) | 152 (61.8) | 91 (37.0) |
| | **Total** | **18 (1.2)** | **995 (67.4)** | **461 (31.2)** | **10 (1.1)** | **598 (64.9)** | **309 (33.6)** |
| Fresh | 18-39 | 67 (22.3) | 187 (62.3) | 39 (13.0) | 53 (29.6) | 101 (56.4) | 17 (9.5) |
| | 40-49 | 48 (14.1) | 250 (73.3) | 38 (11.1) | 30 (15.0) | 136 (68.0) | 30 (15.0) |
| | 50-64 | 50 (10.1) | 352 (70.8) | 91 (18.3) | 31 (10.5) | 217 (73.3) | 45 (15.2) |
| | ≥65 | 35 (10.3) | 251 (74.0) | 53 (15.6) | 38 (15.4) | 169 (68.7) | 38 (15.4) |
| | **Total** | **200 (13.5)** | **1040 (70.4)** | **221 (15.0)** | **152 (16.5)** | **623 (67.6)** | **130 (14.1)** |

## 4d.2) Fish and Seafood consumption quantity

**Table 16 – Daily consumption of fish and seafood by gender and age groups. The weight is in edible form. (dp – Standard deviation). Data obtained from EpiPorto study [11]**

| Daily consumption of fish and seafood by gender and age groups | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Female | | | | Male | | | |
| | Age groups | Mean (dp) | P25 | P50 | P75 | Mean (dp) | P25 | P50 | P75 |
| Total Fish and Seafood (g/day) | 18-39 | 70.8 (36.6) | 43.2 | 66.8 | 90.3 | 63.4 (31.6) | 38.1 | 59 | 83.6 |
| | 40-49 | 73.7 (33.2) | 49.3 | 71.4 | 94.8 | 81.5 (40.3) | 51.3 | 76.3 | 107.4 |
| | 50-64 | 80.6 (34.3) | 54.1 | 79 | 104.8 | 85.0 (36.0) | 58.3 | 82.9 | 111.7 |
| | ≥65 | 74.4 (32.4) | 50.9 | 71.8 | 100 | 79.6 (36.3) | 49.9 | 79 | 107.7 |
| | **Total** | **75.6 (34.3)** | **49.5** | **73.3** | **100.4** | **78.6 (37)** | **50.9** | **76** | **104.8** |
| Fresh Fish (g/day) | 18-39 | 40.2 (28.2) | 16.3 | 28.6 | 57.1 | 34.3 (24.4) | 14.3 | 28.6 | 57.1 |
| | 40-49 | 41.6 (23.9) | 21 | 42.9 | 57.1 | 44.4 (27.4) | 21 | 48 | 57.1 |
| | 50-64 | 47.9 (27.3) | 28.6 | 49.5 | 57.1 | 46.6 (26.8) | 25 | 49.5 | 57.1 |
| | ≥65 | 47.8 (25.6) | 28.6 | 49.5 | 57.1 | 44.3 (26) | 21 | 42.9 | 57.1 |
| | **Total** | **44.8 (26.6)** | **21** | **46.4** | **57.1** | **43.1 (26.6)** | **21** | **42.9** | **57.1** |

## 4d.3) Contribution of Fish and Seafood consumption in the total daily intake

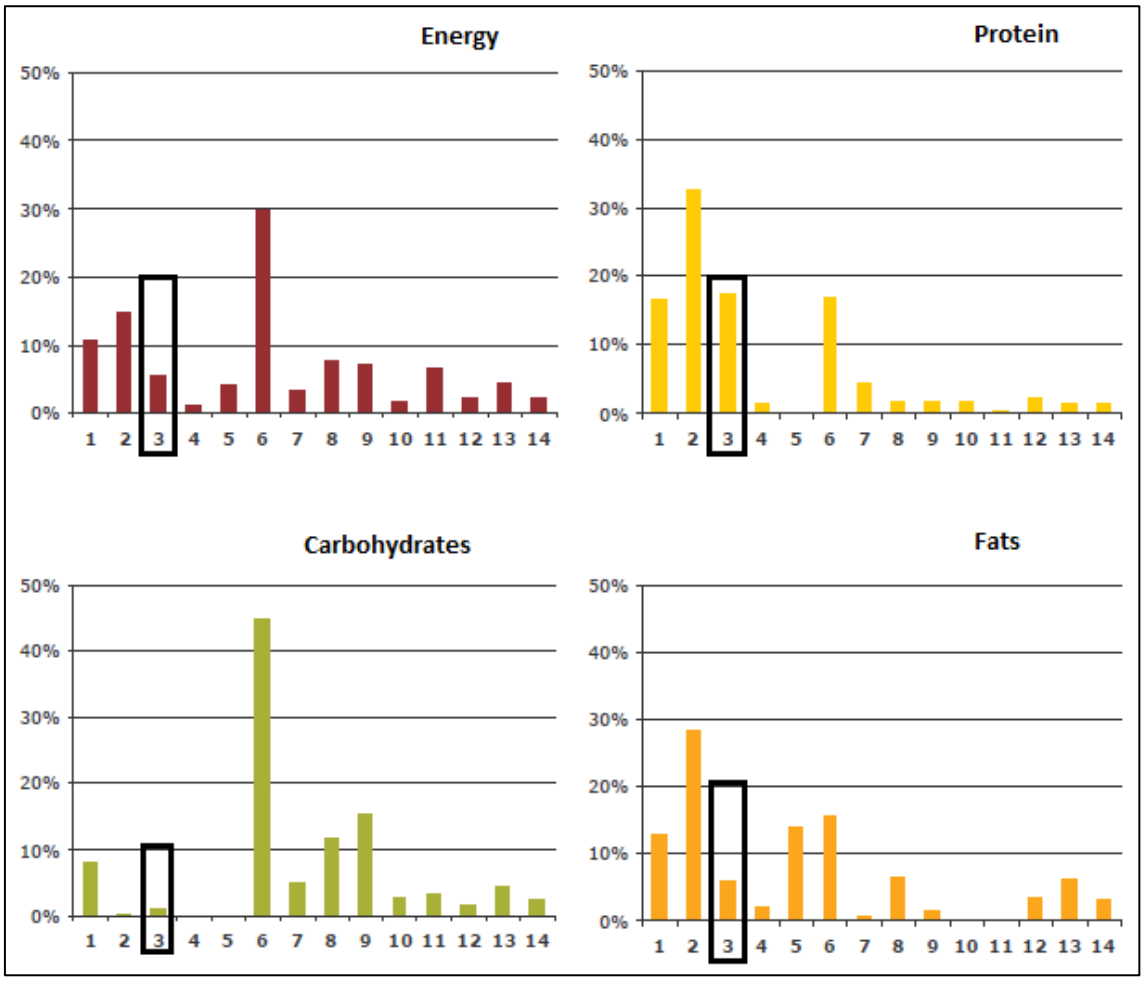



**Figure 6 - Contribution of fish and seafood in the total daily intake (Energy, Protein, Carbohydrates and Fats). The numbers refer to: 1– Milk and dairy; 2– Meat, meat products and offal; 3- Fish and seafood; 4- Eggs; 5- Oils and fats; 6- Cereals and tubers; 7-Pulses; 8- Sweets and pastries; 9- Fresh fruit; 10- Vegetables; 11- Beverages; 12- Fast-food; 13- Soup; 14- Other products. Data obtained from EpiPorto study [11]**

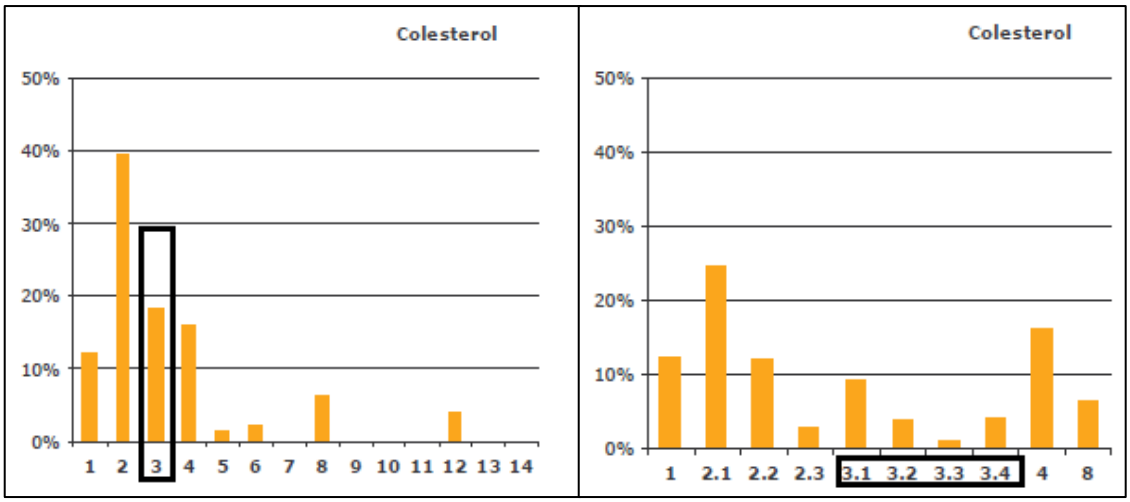



**Figure 7 - Contribution of fish and seafood in the total daily cholesterol intake. The numbers refer to: 1– Milk and dairy; 2– Meat, meat products and offal; 2.1- Red meat and offal's; 2.2- White meat; 2.3- Smoked sausages; 3- Fish and seafood; 3.1- Fresh fish; 3.2- Cod; 3.3- Canned fish; 3.4- Shellfish and crustaceans; 4- Eggs; 5- Oils and fats; 6- Cereals and tubers; 7- pulses; 8- Sweets and pastries; 9- Fresh fruit; 10- Vegetables; 11- Beverages; 12- Fast-food; 13- Soup; 14- Other products. Data obtained from EpiPorto study [11].**

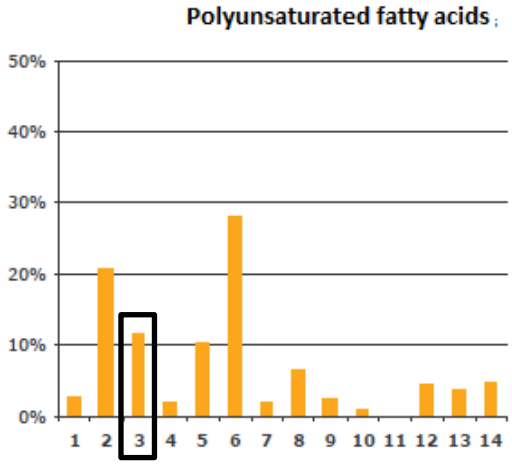



**Figure 8 - Contribution of fish and seafood in the total daily intake of polyunsaturated fatty acids. The numbers refer to: 1– Milk and dairy; 2– Meat, meat products and offal; 3- Fish and seafood; 4- Eggs; 5- Oils and fats; 6- Cereals and tubers; 7- Pulses; 8- Sweets and pastries; 9- Fresh fruit; 10- Vegetables; 11- Beverages; 12- Fast-food; 13- Soup; 14- Other products. Data obtained from EpiPorto study [11].**

## 4e) IPMA study

The consumption of fish and seafood have also been studied by the Portuguese Institute for the Sea and Atmosphere (IPMA) [12]. The developed survey, applied via internet to 1083 adults in 2011/2012, intended to know the consumption frequencies, the average meal portions and the usual culinary treatments. The survey sample was biased in the age (only 2.2% of individuals older than 65 years old), in gender (64% women) and in the education level (more than 80% with higher education).

### *4e.1)* Consumption preferences

*Wild fish vs Farmed fish*

The results showed that Portuguese consumers prefer wild to farmed fish, 62.9% vs 29.3%. (Figures 9 and 10).

*Fat fish vs Lean fish*

They also displayed higher preference for fat fish than for lean fish, 57.3% vs 31.4%; concerning to intake frequency, soaked cod and hake meals – 20.8% and 19.7% consumed more than two meals per week, respectively – in comparison to fatty fish species, such as, salmon or horse mackerel – 11.6% and 10.4%, respectively. (Figure 9).

*Fresh fish vs other ways*

Fresh fish is preferred (83.1%) to frozen (11.2%), smoked (11.4%), salted/dried (16.6%) and canned fish (11.5%). On the other extreme of the scale, smoked fish is particularly disliked (19.3%). In other categories, frozen fish (72.2% like or like much) seems to be better accepted than canned (60.9% like or like much) and salty/dried fish (60.6% like or like much). The meals with higher frequency of consumers were soaked cod (with more than once monthly – 83.4%) and canned tuna (66.6%). Canned sardine consumption frequency values are below than once monthly (77.3%). (Figures 9 and 11).

*Whole fish vs fish steaks vs fish fillets*

Portuguese consumers like whole fish products much more than fish steaks or fish fillets, 49.0% vs 35.5% and 34.1%, respectively. (Figure 9).

### *4e.2)* Consumption Frequency

Results showed that soaked cod, hake and canned tuna are the image of fish products in Portugal, with approximately 20% of the respondents ascribing them frequencies equal to or above two weekly meals. Gilthead sea bream and salmon, also presented relatively high consumption levels (that could indicate the significant penetration of farmed fish products in the Portuguese diet). On the other hand, traditional Portuguese fish such as sardine and horse mackerel, seem to have lost some importance, though keeping a prominent role. Soaked cod (62.6%), hake (45.1%), canned tuna (45.8%), sea bream (44.1%), salmon (45.7%), sardine (32%) and horse mackerel (32.9%) are consumed at least once a week. (Figure 9).

General results (%) for Sections A and B of the survey into the seafood consumption preferences and patterns in the Portuguese population.

| | Utterly dislike (%) | Dislike (%) | Indifferent (%) | Like (%) | Like much (%) |
|---|---|---|---|---|---|
| *A – Consumption preferences* | | | | | |
| Wild fish | 0.6$^{a}$ | 4.2$^{a}$ | 2.9$^{a}$ | 29.5$^{a}$ | 62.9$^{b}$ |
| Farmed fish | 3.2$^{a}$ | 12.3$^{b}$ | 5.4$^{a}$ | 49.8$^{b}$ | 29.3$^{a}$ |
| Lean fish | 1.0$^{a}$ | 9.8$^{b}$ | 9.4$^{b}$ | 48.4$^{b}$ | 31.4$^{a}$ |
| Fat fish | 0.8$^{a}$ | 2.7$^{a}$ | 3.0$^{a}$ | 36.2$^{a}$ | 57.3$^{b}$ |
| Fresh fish | 0.4$^{a}$ | 0.6$^{a}$ | 1.8$^{a}$ | 14.2$^{a}$ | 83.1$^{b}$ |
| Frozen fish | 2.2$^{a}$ | 12.2$^{b}$ | 13.4$^{bc}$ | 61.0$^{d}$ | 11.2$^{a}$ |
| Smoked fish | 19.3$^{c}$ | 24.4$^{c}$ | 18.8$^{c}$ | 26.1$^{b}$ | 11.4$^{a}$ |
| Salted/dried fish | 11.4$^{b}$ | 15.1$^{bc}$ | 12.9$^{b}$ | 44.0$^{c}$ | 16.6$^{a}$ |
| Canned fish | 6.1$^{a}$ | 19.2$^{c}$ | 13.8$^{bc}$ | 49.4$^{c}$ | 11.5$^{a}$ |
| Whole fish | 1.3$^{a}$ | 4.1$^{a}$ | 10.2$^{a}$ | 35.4$^{a}$ | 49.0$^{b}$ |
| Fish steaks | 0.6$^{a}$ | 3.1$^{a}$ | 7.6$^{a}$ | 53.2$^{b}$ | 35.5$^{a}$ |
| Fish fillets | 1.1$^{a}$ | 6.0$^{a}$ | 9.9$^{a}$ | 48.9$^{b}$ | 34.1$^{a}$ |
| | Never (%) | <1 meal/month (%) | 1–4 meal/month (%) | 2–4 meal/week (%) | 5–7 meal/week (%) |
| *B – Consumption frequency* | | | | | |
| Squid | 9.0$^{a}$ | 53.6$^{c}$ | 35.3$^{c}$ | 1.8$^{a}$ | 0.4$^{a}$ |
| Octopus | 10.0$^{a}$ | 56.0$^{c}$ | 31.8$^{bc}$ | 1.8$^{a}$ | 0.5$^{a}$ |
| Cuttlefish | 20.8$^{b}$ | 54.9$^{c}$ | 22.7$^{b}$ | 1.1$^{a}$ | 0.5$^{a}$ |
| Shrimp | 7.9$^{a}$ | 57.7$^{c}$ | 30.5$^{bc}$ | 3.6$^{a}$ | 0.3$^{a}$ |
| Edible crab | 34.6$^{c}$ | 59.6$^{c}$ | 4.9$^{a}$ | 0.5$^{a}$ | 0.5$^{a}$ |
| Common mussel | 40.0$^{cd}$ | 52.1$^{c}$ | 6.7$^{a}$ | 0.9$^{a}$ | 0.3$^{a}$ |
| Grooved carpet shell | 21.7$^{b}$ | 63.4$^{c}$ | 13.4$^{ab}$ | 0.9$^{a}$ | 0.6$^{a}$ |
| Cod (soaked) | 2.8$^{a}$ | 13.8$^{a}$ | 62.6$^{d}$ | 18.8$^{c}$ | 2.0$^{a}$ |
| Gilthead sea bream | 7.9$^{a}$ | 37.1$^{b}$ | 44.1$^{cd}$ | 10.2$^{b}$ | 0.6$^{a}$ |
| Sea bass | 13.9$^{ab}$ | 41.9$^{bc}$ | 36.8$^{c}$ | 6.6$^{a}$ | 0.7$^{a}$ |
| Salmon | 12.4$^{ab}$ | 30.3$^{ab}$ | 45.7$^{cd}$ | 10.2$^{b}$ | 1.4$^{a}$ |
| Panga | 74.5$^{f}$ | 16.3$^{a}$ | 7.3$^{a}$ | 1.4$^{a}$ | 0.6$^{a}$ |
| Hake | 9.9$^{a}$ | 25.4$^{ab}$ | 45.1$^{cd}$ | 18.1$^{c}$ | 1.6$^{a}$ |
| Pink cusk-eel | 37.0$^{c}$ | 35.1$^{b}$ | 22.8$^{b}$ | 4.9$^{a}$ | 0.2$^{a}$ |
| Redfish | 44.0$^{d}$ | 36.5$^{b}$ | 15.7$^{ab}$ | 3.5$^{a}$ | 0.3$^{a}$ |
| Black scabbard fish | 32.9$^{cd}$ | 44.0$^{bc}$ | 19.6$^{b}$ | 3.1$^{a}$ | 0.5$^{a}$ |
| Perch | 54.7$^{de}$ | 30.5$^{ab}$ | 12.7$^{ab}$ | 1.6$^{a}$ | 0.6$^{a}$ |
| Sole | 35.2$^{c}$ | 47.4$^{bc}$ | 14.5$^{ab}$ | 2.6$^{a}$ | 0.4$^{a}$ |
| Sardine | 16.7$^{ab}$ | 42.4$^{bc}$ | 32.0$^{bc}$ | 7.4$^{a}$ | 1.5$^{a}$ |
| Horse mackerel | 14.1$^{ab}$ | 42.7$^{bc}$ | 32.9$^{bc}$ | 9.0$^{ab}$ | 1.4$^{a}$ |
| Chub mackerel | 58.5$^{e}$ | 29.5$^{ab}$ | 9.3$^{a}$ | 2.4$^{a}$ | 0.3$^{a}$ |
| Canned tuna | 5.5$^{a}$ | 27.9$^{ab}$ | 45.8$^{cd}$ | 17.5$^{c}$ | 3.3$^{a}$ |
| Canned sardine | 43.9$^{d}$ | 33.4$^{b}$ | 17.1$^{ab}$ | 4.5$^{a}$ | 1.1$^{a}$ |

For each preference alternatives (wild vs farmed fish; lean vs fat fish; fresh fish and others; whole fish and others), values within a column with different letters are significantly different ($p < 0.05$).

**Figure 9 - Fish and seafood consumption preferences and frequency in the Portugal. Data obtained from the IPMA study [12]**

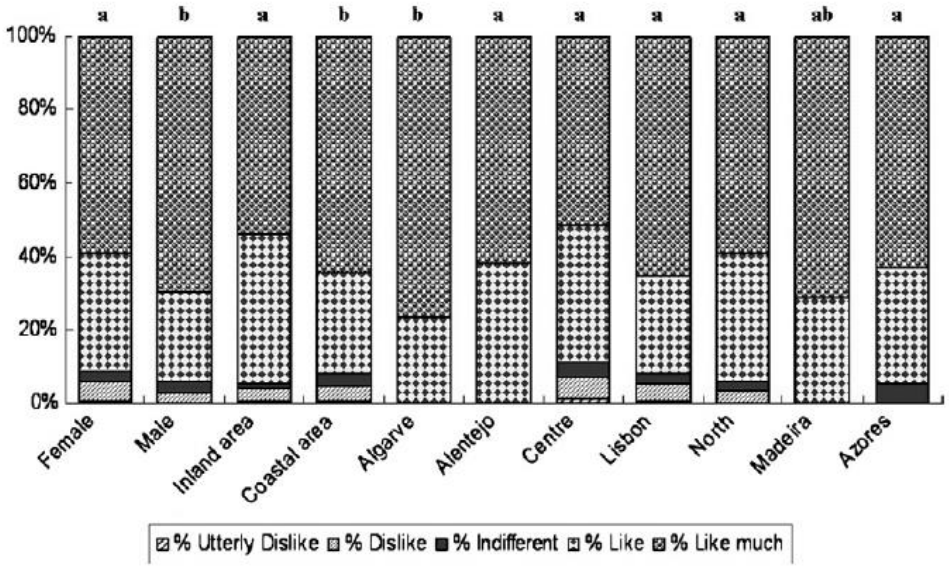



**Figure 10 - Wild fish and seafood preferences by gender and geographical area (coastal distance and region) in Portugal. Bars with different letters are significantly different (p<0.05). Data obtained from the IPMA study [12]**

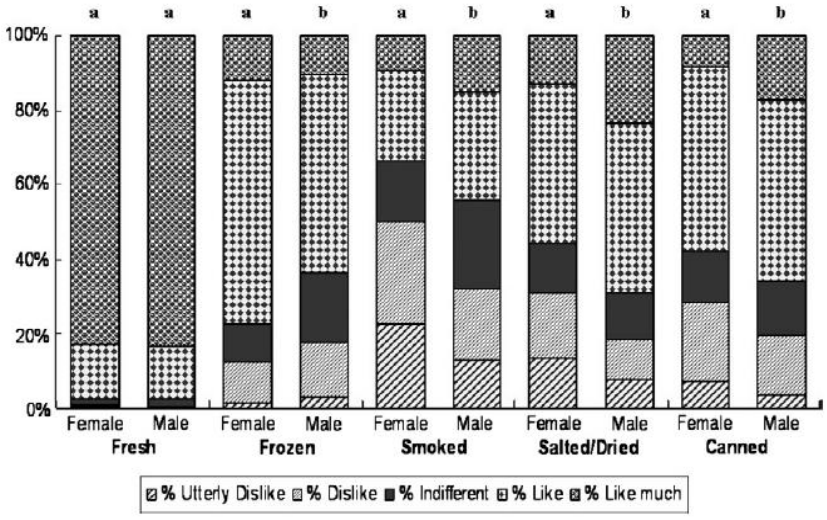
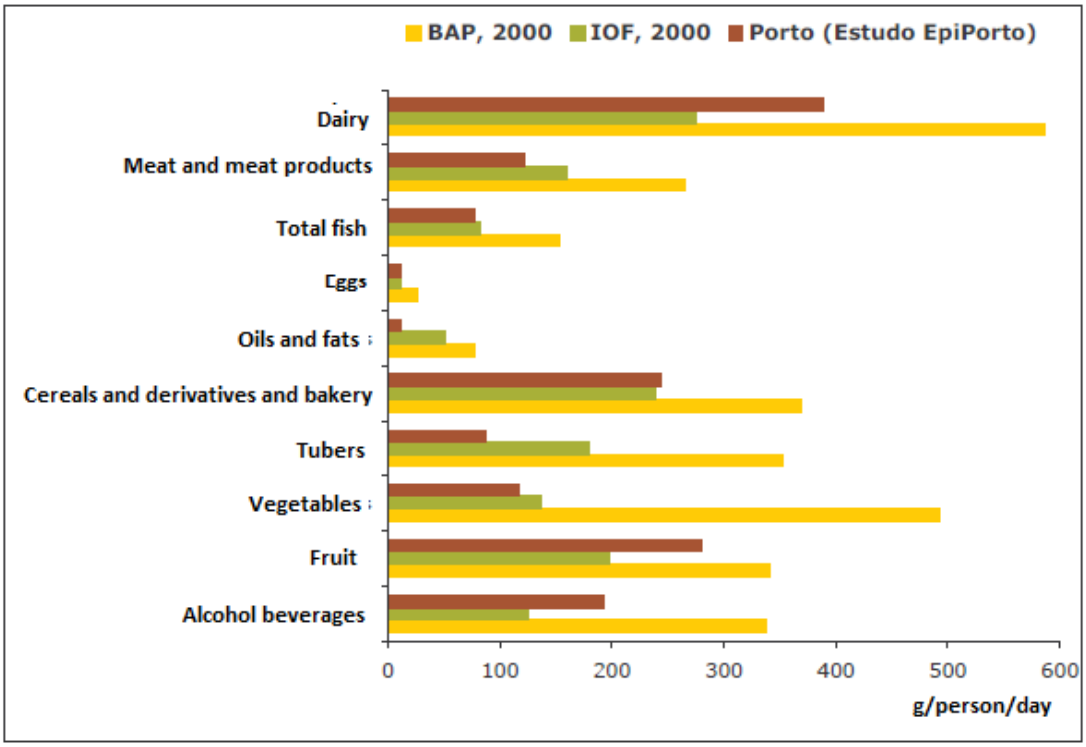



**Figure 11 - Fresh, frozen, smoked, salted/dried and canned fish and seafood preferences by gender in Portugal. Bars with different letters are significantly diferent (p<0.05). Data obtained from the IPMA study [12]**

# 5. Conclusions

Considering the available information, it is evident that Portugal has high levels of fish and seafood availability and consumption but that the information is hardly comparable between sources. Different methodologies and timelines of data collection are the most acknowledged reasons. It is however important to highlight that to be effectively useful, efforts should be taken for the identified data sources to be regularly accessible and updated.

Direct assessment methods such as national representative dietary surveys based on individual food consumption questionnaires are commonly regarded as retrieving the best information. Despite ideal in regarding the detail and accuracy of collected data, this approach not only implies specialized and very well trained technicians but it is also time and cost consuming. When it is not possible to obtain such detailed information on national food consumption, the use of food balance sheets (FBS) and household budget surveys (HBS) is an acceptable and useful alternative that allows to indirectly estimating consumption. In the particular case of fish and seafood products, comparison of Portuguese data from the 3 main measurement sources showed very similar amounts either when using HBS or FFQ individual retrieved data (Graph 13).




**Graph 13 - Portuguese average food and beverages national supply, household availability and individual consumption derived from Food Balance Sheets (BA, 2000), Household Budget Surveys (IOF, 2000) and Food Frequency Questionnaires (Porto, estudo EpiPorto).** [5, 11]

For this specific project objective, once all the food products entering the food chain convey an environmental impact, independently of being consumed by individuals, it is believed that national supply data should be used instead of food consumption data. The latter would refer only to individuals' ingestion of fish and seafood and would not allow estimating the global amount of fish and seafood circulating in the national market.

As for the environmental impact evaluation the identification of fish and seafood consumption by species would be of great relevance, the detailed data available in HBS and some individual surveys should be used simultaneously.

In fact, the diverse data obtained from the different consumption measurement levels may be used not in substitution but to complement each other.

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# 7. Appendix

## 7a – Appendix Index

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# Appendix I

**Table A - Fish and seafood translation (English - Portuguese)**

| Fish and seafood translation (English-Portuguese) | |
|---|---|
| Fish and seafood | Peixe e Derivados |
| Fish - fresh, refrigerated or frozen | Peixe Fresco, Frigorificado ou Congelado |
| Fish - fresh or refrigerated | Peixe Fresco ou Frigorificado |
| Fork-beard (Phycis phycis) | Peixe Fresco - Abrótea |
| Tuna fish | Peixe Fresco – Atum |
| Blackspot sea bream | Peixe Fresco - Besugo |
| Bogue | Peixe Fresco – Boga |
| Snaper | Peixe Fresco - Cachucho |
| Black snapper | Peixe Fresco - Capatão ou Pargo Negro |
| Jack-fish/horse mackerel | Peixe Fresco - Carapau |
| Spanish mackerel | Peixe Fresco - Cavala |
| Pomfret | Peixe Fresco - Xaputa ou Freira |
| Wreckfish/grouper | Peixe Fresco - Cherne |
| Big jack-fish | Peixe Fresco - Chicharro |
| Meagre/sea bass | Peixe Fresco - Corvina |
| Whiting/bib/pout | Peixe Fresco - Faneca |
| Sea bream | Peixe Fresco - Goraz |
| Alfonsino, Imperador, Red Bream (Beryx decadactylus) | Peixe Fresco - Imperador |
| Sole like fishes | Peixe Fresco - Linguado, Azevia, Palma, Pregado ou Solha |
| Hake (small) | Peixe Fresco - Marmota |
| Red snapper | Peixe Fresco - Pargo |
| Sword fish | Peixe Fresco - Peixe Espada |
| John Dory/moonfish | Peixe Fresco - Peixe Galo |
| Red fish | Peixe Fresco - Peixe Vermelho ou Red Fish |
| Hake | Peixe Fresco - Pescada |
| Conger eel | Peixe Fresco - Safio ou Congro |
| Mackerel (*Scomber scombrus Linnaeus*) | Peixe Fresco - Sarda |
| Sardines | Peixe Fresco - Sardinha |
| Fish liver, roes | Miudezas de Peixe (ovas, fígados, etc.) |
| Other fish - fresh or refrigerated n.d. | Outros Peixes Frescos ou Frigorificados n.d. (boca negra, peixe alfacim, peixe juliana, peixe rei, etc.) |
| Fish - frozen | Peixe Congelado |
| Fork-beard (Phycis phycis) - frozen | Peixe Congelado - Abrótea |

| | |
|---|---|
| Snaper - frozen | Peixe Congelado - Cachucho |
| Jack-fish/horse mackerel - frozen | Peixe Congelado - Carapau |
| Hake fillets - frozen | Peixe Congelado - Filetes de Pescada |
| Other fish fillets - frozen n.d. | Outros Filetes Congelados (de bacalhau, de linguado, de tamboril, etc.) |
| Sea bream - frozen | Peixe Congelado - Goraz |
| Maruca (*Genypterus Blacodes*) | Peixe Congelado - Maruca |
| Red snapper - frozen | Peixe Congelado - Pargo |
| Red fish - frozen | Peixe Congelado - Peixe Vermelho ou Red Fish |
| Hake - frozen | Peixe Congelado - Pescada |
| Sardines - frozen | Peixe Congelado - Sardinha |
| Fish liver, roes - frozen | Miudezas de Peixe Congeladas (ovas, fígados, etc.) |
| Other frozen fishes n.d. | Outros Peixes Congelados n.d. |
| Crustacean/molluscs - fresh, refrigerated or frozen | Crustáceos e Moluscos Frescos, Frigorificados ou Congelados |
| Crustacean/molluscs - fresh or refrigerated | Crustáceos e Moluscos Frescos ou Frigorificados |
| Mussels | Amêijoas – Frescas |
| Cockles | Berbigão – Fresco |
| Shrimps and prawns | Camarão e Gambas - Frescos |
| Snails | Caracóis (terrestres e do mar) - Frescos |
| Cuttlefish | Chocos – Frescos |
| Lobster | Lagosta – Fresca |
| Crayfish | Lagostim – Fresco |
| Lavagante (Homarus gammarus) | Lavagante – Fresco |
| Squids | Lulas e Potas - Frescas |
| Crabs | Navalheiras e Caranguejos - Frescos |
| Octopus | Polvo – Fresco |
| Spider crabs | Santola e Sapateira |
| Other fresh/refrigerated crustacean/molluscs species n.d. | Outros Crustáceos e Moluscos Frescos ou Frigorificados n.d. (canivetes, cavaco, cracas, etc.) |
| Crustacean/molluscs - frozen | Crustáceos e Moluscos Congelados |
| Cockles | Berbigão - Congelado |
| Shrimps and prawns | Miolo de Camarão ou Gambas - Congelado |
| Cuttlefish | Chocos - Congelados |
| Squids | Lulas e Potas - Congeladas |
| Octopus | Polvo – Congelado |
| Other frozen crustacean/molluscs species n.d. | Outros Crustáceos e Moluscos Congelados n.d. |
| Fish, crustacean/molluscs dried, salty or smoked | Peixe, Crustáceos e Moluscos Secos, Salgados ou Fumados |
| Fish - dried, salty or smoked | Peixe Seco, Salgado ou Fumado |

| | |
|---|---|
| Salty and dried cod fish - special | Bacalhau Especial |
| Salty and dried cod fish - big | Bacalhau Graúdo |
| Salty and dried cod fish - grown up | Bacalhau Crescido |
| Salty and dried cod fish - average | Bacalhau Corrente |
| Salty and dried cod fish in pieces | Bacalhau Sortido |
| Other parts of salty and dried cod fish (heads/tongues/small pieces) | Partes de Bacalhau (caras de bacalhau, línguas de bacalhau, migas de bacalhau, etc.) |
| Smoked salmon | Salmão Fumado |
| Other salty, dried or smoked fishes n.d. | Outros Peixes Secos, Salagados ou Fumados n.d. |
| Crustaceans/Molluscs - dried, salty or smoked | Crustáceos e Moluscos Secos, Salgados ou Fumados |
| Crustaceans/Molluscs - dried, salty or smoked | Crustáceos e Moluscos Secos, Salgados ou Fumados |
| Canned/Convenience crustaceans and molluscs | Conservas de Peixe, Crustáceos e Moluscos, Produtos Preparados ou Semi - Preparados à base de Peixe |
| Canned fish | Conservas de Peixe |
| Canned tuna fish | Conserva de Atum |
| Canned sardines | Conserva de Sardinha |
| Other canned fishes n.d. | Outras Conservas de Peixe n.d. |
| Canned crustaceans/molluscs | Conservas de Crustáceos e Moluscos |
| Canned crustaceans/molluscs | Conservas de Crustáceos e Moluscos |
| Convenience products based on fish, crustaceans or molluscs | Produtos preparados ou semi - preparados à base de peixe, crustáceos e moluscos |
| Boiled shrimps and | Camarão e Gambas Cozidos |
| Other boiled crustaceans and molluscs n.d. | Outros Crustáceos e Moluscos Cozidos n.d. |
| Immitation seafood | Delicias do Mar (de caranguejo, de lagosta, etc.) |
| Fish or seafood cakes and croquettes | Pasteis de Bacalhau e Rissóis |
| Fish or seafood patée | Patê de peixe (atum, sardinha, lagosta, ) |
| Other convenience products based on fish, crustaceans or molluscs n.d. | Outros Produtos Preparados ou Semi - Preparados à base de Peixe n.d. |

# APPENDIX II

**Table B - Glossary of fish and seafood groups according to the definition criteria established by FishBase.org** (FishBase. Glossary. System Glossary from FishBase.org. Disponível em: http://fishbase.org)

| Glossary of fish and seafood groups |
|---|
| ***Freshwater*** |
| In a broad sense 'freshwater' is used for all continental aquatic systems such as rivers and lakes. In a technical sense it refers to water with less than 0.5 grams per liter of total dissolved mineral salts. |
| ***Demersal*** |
| Sinking to or lying on the bottom; living on or near the bottom and feeding on benthic organisms. (Benthic definition: Dwelling on, or relating to, the bottom of a body of water). |
| ***Pelagic*** |
| Living and feeding in the open sea; associated with the surface or middle depths (usually from 0 to 200m) of a body of water; free swimming in the seas, oceans or open waters; not in association with the bottom. Many pelagic fish feed on plankton. |
| ***Marine*** |
| Pertaining to the sea, from the open oceans to high water mark and into estuaries; salinity modifier of bay coastlines for coastlines where waters are seawater. |
| ***Molluscs*** |
| Invertebrate animals belonging to the phylum Mollusca that includes the snails, clams, chitons, tooth shells, and octopi. |
| ***Cephalopods*** |
| Literally 'head-foot'; animals such as squid and octopus whose tentacles converge at the head; a group of mollusks which have a tubular siphon under the head and a group of muscular suckered arms around the mouth. |
| ***Crustaceans*** |
| Major group of animals, including crabs, shrimps, prawns, lobsters and crayfish; invertebrate organisms whose members have a hard outer skeleton, and occurring in marine and fresh waters and on land. |

# APPENDIX III

**Table C - Nutritional facts from fish and seafood – Energy and macronutrients**

**Data retrieved from the Portuguese food composition table** (Nutrição IDdAe. Tabela de composição de Alimentos Portuguesa. 2006)

| Nutritional facts from fish and seafood | | | | | |
|---|---|---|---|---|---|
| Name (per 100g raw ediбel portions) | Energy (kcal) | Water (g) | Proteín (g) | Fat (g) | Carbohydrates (g) |
| Fresh Cod | 76 | 80 | 17,8 | 0,5 | 0 |
| Salty and dried cod fish | 80 | 76,2 | 19 | 0,4 | 0 |
| Horse mackerel | 105 | 75,6 | 19,7 | 2,9 | 0 |
| Big Jack-Fish | 105 | 75,6 | 19,7 | 2,9 | 0 |
| Spanish mackerel | 202 | 64,3 | 20,3 | 13,4 | 0 |
| Mackerel | | | | | |
| Hake (mean value) | 83 | 80 | 17,6 | 1,4 | 0 |
| Fat sardine | 221 | 63,4 | 18,4 | 16,4 | 0 |
| Half fat sardine | 158 | 68,9 | 18,9 | 9,1 | 0 |
| Canned sardine | | | | | |
| Fresh Tuna | 140 | 68,7 | 24,1 | 4,9 | 0 |
| Tuna (pickled oil) | 214 | 61 | 24,3 | 13 | 0 |
| Squids | 71 | 81,4 | 15,8 | 0,9 | 0 |
| Cuttlefish | 79 | 78,6 | 18,9 | 0,4 | 0 |
| Octopus | 73 | 83,1 | 15,6 | 1,2 | 0 |
| Black sword fish | 88 | 79,7 | 15,7 | 2,8 | 0 |
| White sword fish | 117 | 74,4 | 20,3 | 4 | 0 |
| Salmon | 262 | 60,5 | 16,2 | 21,9 | 0 |

**Table D - Nutritional facts from fish and seafood – Fatty acids, Cholesterol, vitamins and minerals.**

**Data retrieved from the Portuguese food composition table** (Nutrição IDdAe. Tabela de composição de Alimentos Portuguesa. 2006)

| Nutritional facts from fish and seafood | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name (per 100g raw edíbel portions) | Fatty Acids | | | | Cholesterol (mg) | Vitamins | | | | | Minerals | | | | | | |
| | Saturated | Mono | Poli | Trans | | A | D | B6 | B12 | C | Na | K | Ca | P | Mg | Fe | Zn |
| Fresh Cod | 0,1 | 0,1 | 0,2 | | 44 | 7 | 1 | 0,21 | 1 | 0 | 65 | 362 | 15 | 200 | 26 | 0,3 | 0,5 |
| Salty and dried cod fish | 0,1 | 0,1 | 0,1 | 0 | 52 | 4 | 4,5 | 0,072 | 0,95 | 0 | 1483 | 36 | 33 | 116 | 23 | 0,2 | 0,8 |
| Horse mackerel | 0,7 | 0,8 | 0,9 | 0 | 36 | 15 | 4,1 | 0,36 | 5,7 | 0 | 80 | 403 | 69 | 263 | 33 | 1,2 | 1,2 |
| Big Jack-Fish | 0,7 | 0,8 | 0,9 | 0 | 36 | 15 | 4,1 | 0,36 | 5,7 | | 80 | 403 | 69 | 263 | 33 | 1,2 | 1,2 |
| Spanish mackerel | 3,6 | 3,7 | 4,7 | 0,3 | 45 | 28 | 2,4 | 1 | 14 | | 78 | 360 | 39 | 282 | 37 | 1,1 | 2,2 |
| Mackerel | | | | | | | | | | | | | | | | | |
| Hake (mean value) | 0,2 | 0,4 | 0,4 | 0 | 19 | 10 | 0,5 | 0,063 | 0,72 | 0 | 100 | 359 | 31 | 193 | 31 | 0,3 | 0,6 |
| Fat sardine | 4,7 | 4 | 5,6 | 0,5 | 20 | 47 | 21 | 0,57 | 10 | 0 | 65 | 367 | 72 | 314 | 31 | 1 | 1,6 |
| Half fat sardine | 2,5 | 2,2 | 3,3 | 0,3 | 28 | 12 | 17 | 0,41 | 10 | 0 | 65 | 404 | 70 | 296 | 29 | 1,7 | 1,7 |
| Canned sardine | | | | | | | | | | | | | | | | | |
| Fresh Tuna | 1,7 | 1,7 | 0,8 | 0 | 30 | 11 | 4,2 | 0,56 | 2,4 | 0 | 45 | 355 | 4 | 257 | 37 | 2,2 | 1,5 |
| Tuna (pickled oil) | 0,9 | 3,8 | 7,1 | 0,2 | 41 | 23 | 0,4 | 0,23 | 2,4 | 0 | 423 | 255 | 9 | 202 | 40 | 0,7 | 0,9 |
| Squids | 0,2 | 0,1 | 0,4 | 0 | 140 | 10 | 3,5 | 0,05 | 1,1 | 0 | 196 | 225 | 18 | 261 | 49 | 0,3 | 1 |
| Cuttlefish | 0,1 | 0,1 | 0,1 | 0 | 76 | 9 | 0 | 0,06 | 1,2 | 0 | 200 | 320 | 8 | 273 | 49 | 0,1 | 1,7 |
| Octopus | 0,3 | 0,1 | 0,6 | 0 | 64 | 3 | 0 | 0,06 | 1,3 | 0 | 259 | 236 | 13 | 165 | 43 | 0,7 | 1,3 |
| Black sword fish | 0,5 | 1,6 | 0,2 | 0 | 24 | 23 | 2,1 | 0,16 | 1,7 | 0 | 138 | 332 | 14 | 181 | 29 | 0,1 | 0,5 |
| White sword fish | 1 | 1,7 | 0,8 | 0 | 38 | 17 | 1,1 | 0,19 | 2,2 | 0 | 77 | 252 | 16 | 183 | 26 | 0,4 | 0,6 |
| Salmon | 4,2 | 10 | 5,1 | 0 | 40 | 33 | 11 | 0,45 | 1,9 | 0 | 38 | 301 | 12 | 209 | 23 | 0,5 | 0,5 |