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# Trends in the consumption of animal food products in Mediterranean countries

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**SUMMARY -** Future perspectives of the feed sector depends greatly on the evolution of animal food product consumption trends. The objective of this paper is to analyse those trends in Mediterranean countries taking the EU as a reference as it is thought that they are mainly dependent on economic development. However, this is only true to a certain extent as the consumption of animal food products in Arab countries has remained quite stable in the last ten years while *per capita* income has increased substantially. Moreover, animal food consumption is not expected to increase further in the future as income elasticities are very low. In non-Arab Mediterranean countries, the feed sector has future opportunities as pork, poultry and eggs consumption has increased. Alternative measures have been used to determine if whether animal food product consumption patterns are converging among Mediterranean countries, on one hand, and among EU countries, on the other. Results from both dynamic factorial analysis and convergence has shown that a divergence process is taking place in both cases and that it is not possible to talk about a single European diet or a single Mediterranean diet. Feed companies must be aware of such trends in order to implement the appropriate marketing strategies in each geographical area.

**Key words:** Consumption, animal food products, Mediterranean, convergence, feed.

***RESUME -*** *"Tendances de la consommation des produits d'origine animale dans les pays méditerranéens". Les perspectives futures du secteur des aliments de bétail dépendent, en grande partie, de l'évolution des tendances de la consommation des produits d'origine animale. L'objectif de cet article est d'analyser ces tendances dans les pays méditerranéens en prenant l'UE comme référence, étant donné que ces derniers dépendent principalement de leurs développements économiques. Ceci est vrai seulement dans le cas où la consommation des produits d'origine animale dans les pays arabes s'est maintenue stable durant ces 10 dernières années, tandis que le revenu par habitant a augmenté d'une manière substantielle. En plus, on ne peut pas affirmer que la consommation des produits animaux augmentera dans le futur vu que les élasticités revenu sont très faibles. Néanmoins, dans les pays arabes non méditerranéens, le secteur des aliments de bétail présentera une opportunité future à cause de l'augmentation de la consommation des porcs, volailles et œufs. Différentes mesures alternatives ont été utilisées pour déterminer si la tendance de consommation des produits animaux converge dans les pays méditerranéens d'une part et dans les pays de l'UE, d'autre part. Les résultats obtenus de l'analyse dynamique factorielle et celle de convergence ont montré que le processus est divergent dans les deux cas, pourtant il n'est pas possible de parler d'une diète européenne unique non plus que d'une diète méditerranéenne unique. Les entreprises d'aliment de bétail doivent être conscientes de cette tendance pour une application appropriée des stratégies de commercialisation au niveau de chaque région.*

***Mots-clés :*** *Consommation, produits d'origine animale, méditerranéen, convergence, aliments de bétail.*

## Introduction

Any process of economic development is generally associated to a more satisfactory situation in terms of the nutritional quality of the population's diet (Reig, 1992). However, Senauer (1990) pointed out that this improvement, measured as the increase of total calorie intake, was not proportional to income increases. Furthermore, in any economic development process, food expenditure elasticities tend to be higher than calorie intake elasticities. As an example, in most developed countries, total calorie intake has reached a maximum as income grew and even has decreased in the last years.

The analysis of food consumption patterns in Mediterranean countries is not an easy task. In most of the Southern Mediterranean countries little attention has been paid to consumer preferences which has led to a low quality and little variety food products consumption. The main objective of food policies in that countries has been to cover basic food needs for most of the population (some of food products have been heavily subsidized). Also, some cultural aspects have become relatively important in explaining food consumption trends. In Northern Mediterranean countries and, in general, in EU countries, food consumption trends have been related to economic development, food availability, cultural values, socio-demographic characteristics and preferences and lifestyles. Although some convergence has been found (Blandford, 1984; Wheelock and Frank, 1989; Grigg, 1993; Hemmann and Röder, 1995; Gil *et al.,* 1995a; Boccaletti, 1997) some differences still exist between Mediterranean and non Mediterranean EU countries.

As the topic of this conference deals with the feed sector, in this paper we are going to concentrate in food products of animal origin. In general terms, these products are more expensive than the rest of food products and a higher consumption is expected as economic development is taken place. Although this is truth for most of the countries, in the most developed, health, animal welfare and environmental considerations have provoked a significative reduction of animal food products consumption like red meat and eggs.

The objective of this paper is to analyse future trends in animal food products consumption in Mediterranean countries taking the EU as a references. To know the potential market for these products is important for both policy makers, in order to estimulate and organize food supply, and foreign potential suppliers (mainly EU countries).

To achieve this objective, the paper is organized as follows. In the next section, an overview of trends in animal food products consumption is included. Three main topics will be covered: (i) the relationship between animal calorie intake and economic development; (ii) the evolution of the consumption of animal food products in the EU and Mediterranean countries; and (iii) the degree of self-sufficiency. Section 3 formalized the evolution of animal food products consumption over the last fifteen years using a dynamic factor analysis. Also, a cluster analysis will be carried out in order to detect homogeneous groups both among the EU countries and the Mediterranean countries. In section 4, some measures of convergence are deemed to determine whether EU countries, on one hand, and Mediterranean countries, on the other, are achieving similar consumption patterns and whether it is possible to talk about a single European diet or a single Mediterranean diet, respectively.

## The evolution of animal food products consumption in EU and Mediterranean countries

### Food consumption and economic development

Table 1 shows the evolution of the apparent *per capita* daily food consumption for EU and Mediterranean countries. Mediterranean countries have been divided in three more or less apparently homogeneous groups. The first one includes the EU countries, the second one contains the Arab countries and the third one comprises the rest. Also, Non-Mediterranean EU countries are considered as an homogeneous group.

Economic theory suggest that main determinants of changes in food consumption are changes in real income, food prices, preferences and socio-demographic factors. In developed countries, in which food expenditure share is decreasing, income and prices have less relative importance in explaining total food consumption whilst preferences and sociodemographic factors are playing a more important role. However, when considering specific products, income and prices are important in the sense that they determine dietary structure. In developing countries, as it is the case of most of the non EU Mediterranean countries, income and prices are relatively more relevant even in those countries where food consumption is heavilly subsidized. Furthermore, in the case of total food, few other goods can be considered close substitutes and, then, it is likely that the main economic determinants of long-run changes in *per capita* food consumption in those countries still are changes in real income.

Table 1. Evolution of average food consumption and *per capita* GDP in EU and Mediterranean countries (Kcal/capita/day and 1990 dollars)

| | 1969-1971 | | | 1979-1981 | | | 1991-1994 | | | AC94 | Maximum | Income Elast |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | TC | %AC | GDP | TC | %AC | GDP | TC | %AC | GDP | | | |
| Non Med EU countries | | | | | | | | | | | | |
| Austria | 3215 | 0.33 | 11,953 | 3331 | 0.36 | 16,686 | 3482 | 0.35 | 20,989 | 1229 | 1572 | 0.30 |
| Bel-lux | 3169 | 0.34 | 11,521 | 3215 | 0.36 | 15,336 | 3682 | 0.34 | 19,606 | 1251 | 1636 | 0.34 |
| Denmark | 3342 | 0.42 | 17,425 | 3446 | 0.44 | 20,901 | 3712 | 0.44 | 25,805 | 1596 | 2392 | 0.48 |
| Finland | 3130 | 0.42 | 15,027 | 3032 | 0.43 | 20,520 | 3048 | 0.39 | 24,218 | 1145 | - | - |
| Germany | 3137 | 0.34 | 15,203 | 3304 | 0.34 | 19,745 | 3392 | 0.33 | 19,726 | 1104 | 1480 | 0.28 |
| Ireland | 3445 | 0.37 | 6,967 | 3623 | 0.39 | 9,425 | 3632 | 0.32 | 13,809 | 1137 | - | - |
| Netherland | 3028 | 0.34 | 13,667 | 3054 | 0.35 | 16,679 | 3342 | 0.32 | 19,456 | 1015 | 1141 | 0.08 |
| Norway | 3019 | 0.40 | 19,977 | 3305 | 0.40 | 22,811 | 3236 | 0.34 | 29,199 | 1125 | - | - |
| Sweden | 2865 | 0.34 | 19,143 | 2979 | 0.38 | 22,679 | 2918 | 0.37 | 25,529 | 1113 | 1200 | 0.08 |
| UK | 3249 | 0.40 | 11,435 | 3137 | 0.39 | 13,755 | 3211 | 0.33 | 16,875 | 1042 | 973 | 0.03 |
| Med EU countries | | | | | | | | | | | | |
| France | 3270 | 0.36 | 13,564 | 3398 | 0.39 | 17,707 | 3548 | 0.38 | 21,144 | 1338 | 1863 | 0.38 |
| Greece | 3170 | 0.20 | 5,206 | 3437 | 0.24 | 7,518 | 3692 | 0.24 | 8,324 | 897 | 1588 | 0.69 |
| Italy | 3377 | 0.19 | 11,021 | 3557 | 0.23 | 15,359 | 3503 | 0.26 | 19,561 | 913 | 1261 | 0.43 |
| Portugal | 2973 | 0.16 | 3,518 | 2860 | 0.19 | 5,195 | 3598 | 0.26 | 7,454 | 992 | 1703 | 0.13 |
| Spain | 2833 | 0.23 | 7,592 | 3267 | 0.29 | 9,790 | 3671 | 0.33 | 12,927 | 1217 | 1394 | 0.07 |
| Non Arb Med countries | | | | | | | | | | | | |
| Albania | 2429 | 0.16 | na | 2703 | 0.15 | na | 2353 | 0.25 | na | 642 | na | na |
| Cyprus | 3214 | 0.22 | 3,611 | 2859 | 0.25 | 4,802 | 3554 | 0.34 | 8,634 | 1311 | 1737 | 0.62 |
| Israel | 3066 | 0.20 | 5,499 | 2996 | 0.21 | 9,615 | 3144 | 0.20 | 11,632 | 628 | 679 | 0.05 |
| Malta | 3138 | 0.23 | 1,892 | 3241 | 0.27 | 4,883 | 3384 | 0.25 | 7,306 | 796 | 898 | 0.11 |
| Turkey | 2986 | 0.15 | 1,056 | 3292 | 0.14 | 1,683 | 3524 | 0.12 | 1,854 | 410 | 437 | 0.03 |
| Yugoslavia† | 3438 | 0.18 | na | 3687 | 0.23 | na | 3432 | 0.22 | na | na | na | na |
| Arab Med countries | | | | | | | | | | | | |
| Algeria | 1817 | 0.10 | 992 | 2632 | 0.11 | 2,353 | 2955 | 0.11 | 2,580 | 306 | 354 | 0.16 |
| Egypt | 2351 | 0.07 | 517 | 2917 | 0.07 | 879 | 3214 | 0.07 | 900 | 216 | 279 | 0.28 |
| Lebanon | 2357 | 0.14 | na | 2727 | 0.16 | na | 3278 | 0.12 | na | 399 | na | na |
| Libya | 2455 | 0.14 | na | 3437 | 0.17 | na | 3287 | 0.11 | na | 309 | na | na |
| Morocco | 2417 | 0.08 | 692 | 2733 | 0.07 | 870 | 3104 | 0.07 | 1,067 | 205 | 224 | 0.14 |
| Syria | 2341 | 0.12 | 1,290 | 2955 | 0.15 | 2,199 | 3244 | 0.11 | 2,201 | 337 | 446 | 0.18 |
| Tunisia | 2278 | 0.08 | 771 | 2818 | 0.09 | 1,333 | 3191 | 0.09 | 1,857 | 264 | 302 | 0.18 |

†Former Yugoslavia. In the last period only data of 1991 is used
na: not available
Source: FAO (1996) and IMF (several years)

In general terms, it is expected a positive correlation between income and food consumption, that is, countries with higher income levels are expected to show higher consumption levels. However, a minimum level of food consumption must be attained. Therefore, with low income levels, food consumption is relatively high and, as income grows, food consumption increases at a lower rate, up to a threshold which is difficult to surpass because of physical limitations (population is growing relatively slowly in developed countries), although it generally becomes more diversified.

Table 1 shows clearly these results. In non Mediterranean EU countries, total calorie intake was 3,160 Kcal/capita/day in the early seventies (1970 from now) and increased at an average rate of 0.35% per year to reach 3,365 Kcal/capita/day, in the early nineties (1990 from now). During the same period, *per capita* income increased from 14,232 dollars/*per capita* to 21,521 dollars/*per capita*, respectively, growing at an annual average rate of 2,56%. In other words, it seems that a maximum food consumption level has been reached.

In the Mediterranean EU countries total calorie intake was 3,125 Kcal/*per capita*/day, in 1970, and 3,602, in 1990. Real *per capita* income has grown from 8,180 dollars, in 1970, to 13,882 dollars, in 1990. Total food consumption is more elastic in these countries as it grew at an average rate of 0.8% during the last twenty years whilst *per capita* income annual growth was 3.5%.

In non Arab Mediterranean countries, total calorie intake is lower than in EU Mediterranean countries and has increased at an annual rate of 0.31% while *per capita* income growth has been slightly above 7.2% in the last twenty years. Finally, in Arab countries, total calorie intake increase has been more spectacular and has increase from 2,288 to 3,182 Kcal/*per capita*/day, in the 1970-1990 period. The annual growth rate has been 1.95% while *per capita* income has increased at an annual rate of 5.1%. Summing up those results, we can conclude that in countries with lower income levels, total food consumption has increased quicker than in higher income countries.

A second step in the relationship between food consumption and economic development is when the maximum calorie intake has been reached. Then, as income rise consumers are willing to incorporate greater variety into their diet. Therefore, a substitution process among different food products begins. This process used to begin with a substitution among calories coming from vegetable origin towards animal sources. In Table 1, this process can be clearly seen for most European and non Arab Mediterranean countries in which the proportion of calories coming from animal products has increased in the last twenty years. The upward trend took place mainly during the seventies.

However, during the eighties, the proportion of calories coming from animal products has stabilized. In Mediterranean countries the relative importance of animal calories is still very low compared to Non-Mediterranean EU countries. Although it has diminished along the considered period, in all cases percentages are above 30%. Only in France, Spain and Cyprus animal calories are above 30% of total calorie intake. In the rest of Mediterranean countries, percentages are around 20 to 25%. The exception is, obviously, the Arab countries and Turkey where religious factors determine a nil consumption of pork (meat with a high calorie content). In these cases, animal calories represent around 10% of total calorie intake and this percentage has remained constant over time. From Table 1, it can be concluded that for most Mediterranean countries some perspectives of a slightly increase in animal products consumption still exists.

However, in the EU countries, in the early nineties, a third stage has started which is characterized by a food consumption saturation in quantity terms and an increasing competitiveness among food products (as a consequence of lower rates of population growth). At this stage, other factors apart from income are significant determinants in consumer demand, such as the aging of the population, smaller household size, increased concern about health and nutrition and changing lifestyles. The attained food consumption saturation and the new factors drive a turning point in the consumption of some food products in EU countries since 1990. Thus, the increasing trend in meat, milk and fish consumption reversed in 1990 and the consumption of meat decreased in Denmark, Finland, France, Germany and Greece; the consumption of milk in Denmark, France, Greece, Italy and Great Britain: and the consumption of fish in Belgium-Luxembourg, France, Germany, Ireland and Sweden (Angulo *et al.*, 1997).

In the next lines we will formalize the relationship between animal calorie intake and *per capita* income. As it has observed in Table 1, animal calorie intake has reached a ceiling, while income is still increasing. To measure the relationship between both variables and to calculate the maximum consumption level, a functional form that relates total animal calories and *per capita* GDP is specified. The selected functional from has to hold two requirements: income elasticites must be decreasing (Engles's Law) and it must have an upper asymptote (maximum consumption level). The log-reciprocal functional form satisfies both requirements. Then, for each country, the following equation has been estimated:

$$ANICAL_t = e^{\alpha+\beta\frac{1}{y_t}} e^{u_t} \quad t = 1968,...,1994 \qquad (1)$$

where ANICAL is the total animal calorie intake (Kcal/*per capita*/day); $Y_t$ is the *per capita* GDP at constant 1990 prices (dollars); $u_t$ is the error term; $e^{\alpha}$ is the upper asymptote; and $\beta$ is the income parameter to calculate elasticities.

Annual data from 1968 to 1994 have been used. Total animal calorie intake data comes from the "Food Balance Sheets" gathers by the FAO and, GDP data from "Finantial Statistics" published by the International Monetary Fund. Equation (1) was estimated by Generalized Least Squares (GLS) only for countries where *per capita* GDP data were available.

The last three columns in Table 1 show the animal calorie intake in 1994, the maximum consumption level and the income elasticity at mean values, respectively. Some significant positive relationship between animal products consumption, in calorie terms, and income has been found in all countries except for Finland and Norway, where animal calorie intake has sustantially decreased while *per capita* income has continuously increased in the last years. Differences between consumption in 1994 and the maximum consumption level are very low in non EU countries. The largest differences have been found in Portugal, Greece and France. However, in general terms, it can be said that a saturation level has been attained.

Income elasticities are higher in EU countries than in the rest of countries, therefore, a large increase in animal products consumption in non EU countries is not expected in spite of income increases. The exception is Cyprus with the largest income elasticity after Greece.

## The diversification of the consumption of animal food products

Table 2 shows the distribution of animal food products consumption in EU and Mediterranean countries. Nine products have been considered: (i) beef and veal; (ii) lamb; (iii) pork; (iv) poultry; (v) milk; (vi) eggs; (vii) fish; (viii) animal fats; and (ix) butter. All figures are apparent consumption in kg/*per capita*/year provided by the FAO. Three periods have been selected: 1969-71, 1979-81 and 1991-1994. Average values for each period have been calculated to avoid yearly variation in production and/or external trade. Due to the large amount of figures included in Table 2, we are going to point out only main trends by product.

(i) Beef and veal: Two main trends have been detected. In Mediterranean countries (EU and non EU) the consumption of beef and veal has increased while in the EU countries has slightly decreased along the period of study. In the first group the only exception is Israel where consumption has decreased by 70%, and in the second group the exception is Norway where consumption has increased by 25% in the last twenty years. The consumption of beef and veal has lost relative importance in comparison to the rest of meats in most countries. In EU countries it accounts for 28% of total meat consumption on average, while in Mediterranean countries it varies a lot ranging from 11% of total meat consumption in Israel to 58% in Albania and Egypt. In Arab countries the consumption is substantially lower than in the rest of countries considered.

(ii) Lamb: *Per capita* lamb consumption varies greatly among countries considered. Within the EU, Greece shows the highest consumption level (14.25 kg/*per capita*/year, in 1991-94) followed by Ireland (7.85), UK (6.53) and Spain (6.42). Apart from Ireland and UK, it can be said that lamb is a typical Mediterranean product. However, consumption has increased in most EU countries (although

the consumption is still very low in comparison with other countries). Among Mediterranean countries consumption increases significantly in Algeria, Syria and Egypt. In general terms, in Arab countries the relative importance of lamb on total meat consumption is higher than in other countries due to religious and tradition factors although in the last year its relative importance has diminished due to the increase of poultry consumption.

(iii) Pork: Pork consumption has sustantially increased in all EU countries, specially in the Mediterranean ones (Greece, Italy, Portugal and Spain). Consumption is almost nil in Muslim countries. In the former Yugoslavia, Malta and Cyprus, consumption is similar to EU countries. In all countries, the relative importance of pork on total meat consumption has increased. In Spain and non Mediterranean EU countries it accounts for almost 50% of total meat consumption with the exception of UK (34%), Ireland (42%) and Norway (48%). In the rest of EU Mediterranean countries, except for Greece, the percentage is around 40%.

(iv) Poultry: *Per capita* poultry consumption has sustantially increased in all considered countries. Ireland, Italy, UK and Spain have been traditionally higher poultry consumers. Among the non Arab Mediterranean countries, Cyprus and Israel have the highest consumption, reaching 33 and 39.7 kg/*per capita*/year, respectively, in 1991-1994. Among the EU countries, consumption has increased more rapidly in non Mediterranean. In the Arab countries, consumption is still lower than in other countries but it has been multiplied by 2.5 times, on average, in the last twenty years.

(v) Milk: Milk products used to be income elastic in most countries so it is expected a higher increases in the less developed countries. Table 2 shows that milk consumption has remained steady in the last twenty years. Among EU countries the higher increases have taken place in Austria, Germany, Sweden and in the Mediterranean ones, being Portugal the country which shows a higher growth rate. Among the rest of countries, milk consumption is lower in southern Mediterranean countries while consumption in Cyprus and Israel is not far away from that of the EU countries.

(vi) Eggs: *Per capita* consumption of eggs is sustantially higher in EU countries with the exception of Malta and Lebanon which show the highest consumption levels (16.67 and 16.15 kg/*per capita*/year). In the last case, eggs consumption has been multiplied by 5 times in the last twenty years. Within the EU, eggs consumption lies between 12 and 13 kg/*per capita*/year. Only in Portugal consumption is below 10 kg, although this country has experienced the highest increase along the 1970-1990 period.

(vii) Fish: Fish consumption is important in Nordic countries as well as in Portugal and Spain. The highest consumption level corresponds to Portugal (58 kg/*per capita*/year) followed by Norway (46 kg) and Spain (38 kg). However, consumption has decreased by 10% in Portugal, in the last twenty years. In Finland, Ireland and Italy, consumption has sustantially increased (48%, 48% and 71%, respectively). Among non European Mediterranean countries, fish consumption is relatively high in Cyprus, Israel and Malta while is irrelevant in Lebanon and Syria. In Arab countries, consumption is very low although in countries with higher *per capita* income (Algeria, Egypt, Morocco and Tunisia), consumption has doubled along the period considered.

(viii) Butter and animal fats: In the last columns of Table 2, the evolution of the animal fats consumption is considered. The proportion of butter on total animal fats consumption is not very high. Only in Finland and France it accounts for more than 50% of total animal fats consumption. In most EU countries, with the exception of the Mediterranean ones, (Greece, Portugal and Spain), butter consumption has decreased. The situation in non EU countries is similar. Animal fats consumption has decreased since 1990 with the exception of Albania, Cyprus, Algeria, Egypt and Tunisia.

Summing up the results shown in Table 2, it can be concluded that, in general terms, the consumption of animal products show big differences according to the country groups we have considered. In some cases, Mediterranean countries exhibit similar consumption patterns (excluding the Arab ones) and differ from EU trends while in others EU countries show similar trends which are different from that of the Mediterranean. It seems that is not possible to talk neither about a single Mediterranean diet nor a single European diet. Similar conclusions will be outlined with the analysis carried out in sections 3 and 4.

Table 2. Evolution of animal products consumption in EU and Mediterranean countries (kg/*per capita*/year)

| | Beef and veal | | | Lamb | | | Pork | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1969-71 | 1979-81 | 1991-94 | 1969-71 | 1979-81 | 1991-94 | 1969-71 | 1979-81 | 1991-94 |
| Non Med EU countries | | | | | | | | | |
| Austria | 22.50 | 25.00 | 20.80 | 0.30 | 0.50 | 1.20 | 35.30 | 44.80 | 57.30 |
| Bel-lux | 26.63 | 27.63 | 20.92 | 1.00 | 2.00 | 2.08 | 33.43 | 41.10 | 49.30 |
| Denmark | 19.90 | 14.26 | 19.80 | 0.40 | 0.46 | 1.05 | 29.93 | 50.90 | 64.40 |
| Finland | 21.00 | 22.90 | 19.40 | 0.30 | 0.20 | 0.40 | 20.40 | 29.50 | 31.10 |
| Germany | 24.36 | 23.67 | 19.55 | 0.23 | 0.86 | 0.97 | 45.60 | 57.70 | 55.90 |
| Ireland | 18.73 | 27.86 | 16.62 | 10.93 | 7.90 | 7.85 | 30.03 | 32.30 | 37.10 |
| Netherlands | 21.37 | 21.30 | 20.60 | 0.20 | 0.57 | 1.22 | 29.53 | 40.80 | 44.45 |
| Norway | 14.90 | 18.90 | 18.70 | 4.70 | 5.40 | 5.75 | 17.60 | 20.70 | 20.30 |
| Sweden | 17.90 | 18.00 | 18.20 | 0.50 | 0.70 | 0.70 | 27.40 | 34.70 | 36.10 |
| UK | 23.47 | 23.33 | 18.65 | 10.07 | 7.26 | 6.53 | 27.37 | 26.20 | 23.50 |
| Med EU countries | | | | | | | | | |
| France | 29.93 | 32.50 | 28.93 | 3.03 | 4.00 | 5.52 | 30.77 | 37.90 | 37.17 |
| Greece | 16.46 | 22.10 | 21.25 | 15.53 | 13.40 | 14.25 | 6.06 | 17.57 | 22.05 |
| Italy | 25.16 | 25.56 | 25.73 | 1.13 | 1.50 | 1.82 | 12.63 | 23.93 | 33.00 |
| Portugal | 11.50 | 12.00 | 16.97 | 2.40 | 2.50 | 3.75 | 12.43 | 16.96 | 31.47 |
| Spain | 11.67 | 11.56 | 13.05 | 4.00 | 3.67 | 6.42 | 13.93 | 26.43 | 52.50 |
| Non Arab Med countries | | | | | | | | | |
| Albania | 4.60 | 5.37 | 13.02 | 5.53 | 4.70 | 3.85 | 2.90 | 2.83 | 4.00 |
| Cyprus | 11.20 | 9.83 | 13.25 | 14.83 | 10.37 | 11.15 | 19.37 | 25.03 | 45.57 |
| Israel | 19.03 | 16.27 | 5.25 | 1.30 | 1.03 | 1.18 | 1.63 | 2.40 | 1.47 |
| Malta | 20.20 | 17.73 | 33.05 | 1.90 | 1.13 | 1.37 | 13.20 | 16.67 | 28.45 |
| Turkey | 3.73 | 3.40 | 6.47 | 9.17 | 6.67 | 6.38 | 0.00 | 0.00 | 0.00 |
| Yugoslavia† | 9.27 | 14.10 | 13.50 | 2.20 | 2.56 | 2.30 | 23.77 | 32.93 | 30.80 |
| Arab Med countries | | | | | | | | | |
| Algeria | 2.46 | 3.26 | 4.57 | 3.56 | 4.03 | 6.00 | 0.00 | 0.00 | 0.00 |
| Egypt | 6.66 | 7.67 | 9.00 | 1.47 | 1.23 | 1.78 | 0.00 | 0.10 | 0.10 |
| Lebanon | 6.37 | 11.43 | 6.95 | 7.50 | 4.90 | 3.00 | 0.63 | 0.93 | 1.25 |
| Libya | 4.13 | 18.93 | 4.65 | 14.10 | 16.90 | 6.38 | 0.13 | 0.00 | 0.00 |
| Morocco | 5.97 | 6.00 | 6.25 | 4.63 | 3.80 | 4.00 | 0.00 | 0.00 | 0.00 |
| Syria | 1.90 | 3.60 | 2.20 | 7.27 | 10.30 | 8.92 | 0.00 | 0.33 | 0.00 |
| Tunisia | 3.50 | 4.40 | 5.70 | 4.40 | 4.13 | 5.00 | 0.00 | 0.33 | 0.00 |

Table 2. (cont.) Evolution of animal products consumption in EU and Mediterranean countries (kg/*per capita*/year)

| | Poultry | | | Milk | | | Pork | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1969-71 | 1979-81 | 1991-94 | 1969-71 | 1979-81 | 1991-94 | 1969-71 | 1979-81 | 1991-94 |
| Non Med EU countries | | | | | | | | | |
| Austria | 8.00 | 11.00 | 15.00 | 216.56 | 243.83 | 268.30 | 13.63 | 14.60 | 13.28 |
| Bel-lux | 9.13 | 12.47 | 18.70 | 182.60 | 192.40 | 198.72 | 13.26 | 13.46 | 13.27 |
| Denmark | 4.73 | 8.53 | 13.52 | 204.56 | 200.03 | 185.40 | 11.63 | 13.63 | 15.38 |
| Finland | 0.90 | 3.20 | 8.40 | 320.70 | 329.97 | 319.23 | 9.90 | 10.70 | 10.18 |
| Germany | 8.23 | 9.77 | 12.48 | 179.60 | 195.20 | 228.00 | 15.63 | 16.93 | 12.90 |
| Ireland | 11.60 | 14.20 | 24.85 | 315.33 | 331.40 | 279.83 | 11.50 | 11.36 | 8.67 |
| Netherlands | 5.97 | 9.17 | 20.42 | 276.43 | 323.93 | 313.70 | 12.67 | 12.50 | 12.88 |
| Norway | 1.50 | 2.60 | 5.10 | 257.80 | 317.47 | 258.30 | 9.63 | 10.50 | 10.50 |
| Sweden | 3.40 | 5.20 | 7.90 | 289.23 | 369.70 | 353.35 | 11.93 | 12.57 | 12.43 |
| UK | 10.60 | 13.37 | 20.77 | 227.56 | 224.87 | 217.45 | 14.93 | 13.93 | 10.22 |
| Med EU countries | | | | | | | | | |
| France | 7.63 | 16.50 | 21.75 | 245.43 | 287.13 | 284.65 | 12.20 | 14.43 | 14.75 |
| Greece | 8.33 | 13.23 | 17.83 | 158.23 | 202.53 | 228.50 | 10.40 | 11.37 | 11.42 |
| Italy | 11.67 | 17.93 | 19.35 | 186.40 | 255.33 | 247.30 | 10.53 | 11.47 | 12.25 |
| Portugal | 6.70 | 16.23 | 20.82 | 77.33 | 97.70 | 183.47 | 3.46 | 5.33 | 9.20 |
| Spain | 13.53 | 21.77 | 24.45 | 123.76 | 161.73 | 159.07 | 12.56 | 15.56 | 15.92 |
| Non Arab Med countries | | | | | | | | | |
| Albania | 1.63 | 2.90 | 2.12 | 101.46 | 133.50 | 176.40 | 1.57 | 2.87 | 3.87 |
| Cyprus | 15.47 | 16.06 | 32.90 | 137.03 | 132.97 | 203.60 | 7.63 | 6.33 | 8.72 |
| Israel | 26.67 | 35.73 | 39.65 | 172.77 | 202.87 | 192.45 | 20.93 | 19.40 | 15.75 |
| Malta | 7.47 | 13.20 | 9.67 | 126.70 | 141.47 | 134.15 | 12.47 | 15.47 | 16.67 |
| Turkey | 2.66 | 4.67 | 5.75 | 163.80 | 173.40 | 144.95 | 2.47 | 4.23 | 6.72 |
| Yugoslavia† | 6.70 | 11.86 | 9.50 | 121.37 | 166.40 | 164.10 | 6.27 | 9.00 | 7.80 |
| Arab Med countries | | | | | | | | | |
| Algeria | 1.97 | 3.16 | 7.50 | 52.33 | 80.70 | 110.18 | 0.80 | 3.27 | 4.62 |
| Egypt | 2.60 | 4.23 | 4.60 | 35.63 | 40.47 | 37.30 | 1.37 | 1.63 | 2.08 |
| Lebanon | 7.60 | 17.56 | 19.20 | 82.90 | 110.27 | 115.75 | 3.17 | 10.20 | 16.15 |
| Libya | 1.47 | 9.00 | 14.15 | 61.03 | 103.57 | 101.28 | 1.80 | 4.93 | 6.15 |
| Morocco | 2.00 | 2.83 | 5.62 | 28.57 | 34.30 | 31.90 | 2.47 | 3.27 | 6.00 |
| Syria | 2.37 | 6.47 | 6.15 | 58.10 | 95.47 | 83.45 | 3.00 | 6.93 | 5.90 |
| Tunisia | 2.43 | 5.90 | 5.73 | 49.07 | 68.30 | 70.98 | 2.27 | 4.97 | 5.35 |

Table 2. (cont.) Evolution of animal products consumption in EU and Mediterranean countries (kg/*per capita*/year)

| | Fish | | | Animal fat | | | Butter | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1969-71 | 1979-81 | 1991-94 | 1969-71 | 1979-81 | 1991-94 | 1969-71 | 1979-81 | 1991-94 |
| Non Med EU countries | | | | | | | | | |
| Austria | 7.66 | 5.73 | 9.75 | 12.77 | 15.13 | 15.68 | 5.63 | 5.30 | 5.00 |
| Bel-lux | 16.63 | 18.06 | 18.17 | 13.23 | 14.80 | 25.60 | 9.30 | 8.93 | 7.25 |
| Denmark | 21.03 | 18.63 | 20.10 | 26.23 | 21.00 | 23.48 | 8.97 | 8.27 | 3.05 |
| Finland | 21.93 | 27.33 | 32.55 | 7.33 | 6.23 | 7.23 | 15.17 | 12.37 | 7.25 |
| Germany | 11.60 | 10.83 | 12.38 | 10.80 | 11.50 | 11.95 | 9.63 | 8.77 | 6.88 |
| Ireland | 10.53 | 14.93 | 15.65 | 3.83 | 7.77 | 11.10 | 12.63 | 12.43 | 3.48 |
| Netherlands | 13.23 | 10.07 | 11.65 | 11.77 | 9.93 | 5.80 | 2.53 | 3.40 | 2.43 |
| Norway | 39.73 | 42.67 | 46.07 | 17.93 | 15.90 | 14.55 | 5.43 | 5.27 | 2.83 |
| Sweden | 29.13 | 27.83 | 26.85 | 10.43 | 12.50 | 15.10 | 6.10 | 6.47 | 5.30 |
| UK | 20.46 | 16.67 | 18.57 | 9.87 | 11.47 | 6.10 | 8.80 | 6.07 | 3.48 |
| Med EU countries | | | | | | | | | |
| France | 17.10 | 17.73 | 22.58 | 3.20 | 4.57 | 8.80 | 8.87 | 9.53 | 8.38 |
| Greece | 16.90 | 16.37 | 22.90 | 1.40 | 1.57 | 2.53 | 0.70 | 0.80 | 1.15 |
| Italy | 12.76 | 14.30 | 21.85 | 2.90 | 5.77 | 8.30 | 2.00 | 2.13 | 1.98 |
| Portugal | 62.80 | 28.00 | 58.02 | 1.43 | 1.87 | 4.40 | 0.73 | 0.73 | 1.33 |
| Spain | 30.26 | 30.83 | 38.10 | 2.10 | 2.03 | 3.28 | 0.27 | 0.53 | 0.40 |
| Non Arab Med countries | | | | | | | | | |
| Albania | 3.10 | 3.40 | 1.60 | 4.83 | 3.36 | 3.93 | 0.80 | 2.86 | 2.35 |
| Cyprus | 7.53 | 7.93 | 16.70 | 2.03 | 2.07 | 3.25 | 0.80 | 0.80 | 1.23 |
| Israel | 14.83 | 17.90 | 19.75 | 4.77 | 4.06 | 5.25 | 1.03 | 0.83 | 0.73 |
| Malta | 10.80 | 20.90 | 21.37 | 8.00 | 8.67 | 8.02 | 2.50 | 3.07 | 1.33 |
| Turkey | 4.63 | 6.90 | 6.73 | 3.33 | 2.77 | 2.18 | 3.23 | 2.73 | 2.05 |
| Yugoslavia† | 2.73 | 3.03 | 3.30 | 11.13 | 14.03 | 10.80 | 1.00 | 0.70 | 0.50 |
| Arab Med countries | | | | | | | | | |
| Algeria | 1.57 | 2.60 | 3.22 | 1.16 | 2.20 | 2.15 | 0.50 | 1.50 | 1.58 |
| Egypt | 3.13 | 5.10 | 7.03 | 2.43 | 4.23 | 2.78 | 1.70 | 2.40 | 2.18 |
| Lebanon | 3.53 | 0.63 | 0.40 | 2.46 | 2.60 | 2.05 | 1.70 | 2.17 | 1.65 |
| Libya | 6.03 | 7.73 | 3.08 | 1.27 | 3.60 | 1.75 | 0.60 | 2.67 | 1.38 |
| Morocco | 3.16 | 6.27 | 7.23 | 2.93 | 2.43 | 2.40 | 1.77 | 1.57 | 1.58 |
| Syria | 1.10 | 2.17 | 0.52 | 3.33 | 5.20 | 2.70 | 2.33 | 3.77 | 1.55 |
| Tunisia | 4.73 | 8.20 | 8.95 | 1.20 | 1.77 | 1.35 | 0.57 | 1.23 | 0.78 |

†Former Yugoslavia. In the last period, only data from 1991 are used
Source: FAO (1996)

### Self-sufficiency

As a final step in the descriptive analysis we have considered the data on self-sufficiency. The aim is to give an idea of whether the production of animal products is able to satisfy consumption needs or imports are needed. It also gives an idea of potential production growth. In Table 3 self-sufficiency data is shown for all products considered above except for butter and animal fats. Non Mediterranean EU countries generally produce more than they consume, at least in traditional productions like beef, pork, poultry, milk and eggs. Some exceptions have been found for each product but the general trend is towards self-sufficiency. In fish and lamb, self-sufficiency only takes place in large producers. On the other hand, Mediterranean countries (with the exception of France) hardly arrives to self sufficiency even in traditional products. Only in poultry and eggs, numbers are close to 100. In Arab countries main deficits have been found for milk and beef and veal.

## Similarities and differences in animal food products consumption in EU and Mediterranean countries

As mentioned above, animal food products consumption differs enormously between EU and Mediterranean countries. In the last three decades, animal food consumption in EU has dramatically increased but now it seems that it has reached a stagnation or even has started a declining trend. However, Mediterranean countries have still a low animal food consumption, specially in non-European Mediterranean countries for meat and fish, with zero values for pork consumption in Muslim countries.

Differences in economic development, learned preferences, cultural values and food availability among countries have driven different animal food consumption structures and different consumption evolution. Therefore, animal food consumption evolution and structure have been analysed considering two groups of countries: EU and Mediterranean. However, among the 27 countries, five of them belong to both categories: France, Greece, Italy, Portugal and Spain. We will keep them in both groups and they will be analysed in two different contexts. Then, EU countries consist of Austria, Belgium-Luxembourg, Denmark, Finland, Germany, Ireland, The Netherlands, Norway, Sweden, United Kingdom, France, Greece, Italy, Portugal and Spain; and Mediterranean comprises, France, Greece, Italy, Portugal, Spain, Albania, Cyprus, Israel, Malta, Turkey, Yugoslavia, Algeria, Egypt, Lebanon, Libya, Morocco, Syria and Tunisia.

The STATIS (Structuration des Tableaux à Trois Indices de la Statistique) method (Lavit, 1988) has been used to analyse the dynamic evolution of animal food consumption structure in EU and in Mediterranean countries. This method analyses, simultaneously, the same group of individuals characterized by a common set of variables in different time periods. Two time points, early 1980's and 1990's (1979, 1980 and 1981 average and 1991, 1992, 1993 and 1994 average, respectively) have been used as the reference period.

The following animal food products has been considered: (i) beef and veal; (ii) lamb; (iii) pork; (iv) poultry; (v) milk; (vi) eggs; (vii) fish; (viii) animal fats; and (ix) butter. All data are in kg/*per capita*/year. This method involves three stages: (i) inter-structure, where the global evolution of the variables in the analysed periods is studied and a compromise or intermediate matrix is calculated; (ii) intra-structure, where from the intermediate matrix a factor analysis is carried out; and (iii) the average position and the position of each country in each of the analysed periods is represented in the first two factorial axes. This graph gives an idea about countries' global movements from period to period.

Correlations between variables and the main factors obtained from the dynamic factor analysis for EU and Mediterranean countries are shown in Tables 4 and 5, respectively.

In the case of the EU countries, the first three factors explain 71% of total variance. The first one explains a 33.6% and it is negatively correlated with the consumption of pork, eggs, animal fats and butter (high fat and cholesterol diet), and positively correlated with lamb consumption. Pork and eggs correlations diminish over time while that of butter increases, in absolute terms. This factor separates countries with low consumption of high fat and cholesterol products from countries with high lamb consumption. Factor 2 explains a 20% of total variance. It is positively correlated with poultry and

eggs consumption and, negatively with milk. Poultry correlation diminishes over time. On the other hand, eggs correlation increases while that of milk remains constant. This factor classifies countries with a high consumption of poultry and eggs and low of milk. The third factor is positively correlated with beef consumption and negatively with fish; therefore, it characterizes countries with high red meat and low fish consumption.

The evolution of the EU countries animal food consumption can be seen in Fig. 1 in which it is shown each country punctuation for each period in the first two factors. Movements along the horizontal axis indicate changes in the consumption of pork, eggs, animal fats, butter and lamb, while movements along the vertical axis indicate changes in poultry, eggs and milk consumption. Movements in the same direction means that consumption is approaching while movements in opposite direction indicates that a divergence process is taken place. Norway and Denmark show an upward trend and Austria and Germany a downward one which indicate that pork, eggs, animal fats, butter and lamb consumption change in opposite direction and, then, a divergence process occurs. Most of the movements are diagonal with a downward and left trend for Portugal, Greece, Italy and France; and an upward and left shift for Spain. United Kingdom shows a downward and right path while The Netherlands, Ireland and Sweden, move in an upward and right direction. Therefore, the consumption of animal food products in the mentioned countries moves in opposite directions, that is, a divergence process is taken place in EU countries.

Animal food products consumption similarities among EU countries have been analysed using a cluster analysis with these three factors. EU countries have been classified into six groups (Fig. 2). Cluster 1 consists of Austria, Belgium-Luxembourg, Germany, The Netherlands and Denmark. Cluster 2 comprises Ireland, UK, France and Italy. Cluster 3, 4 and 5 are respectively, Greece, Spain and Portugal. Cluster 6 consists of Scandinavian countries (Finland, Sweden and Norway).

Animal food products consumption for each cluster is shown in Table 6. Cluster 1 is characterized by the highest consumption of pork, animal fats and butter and the lowest of lamb. Cluster 2 has a high consumption of beef and milk. Mediterranean countries (clusters 3, 4 and 5) have a relatively low milk, animal fats and butter consumption. However, they show important differences in the consumption of the remaining animal food products. Spain has the lowest consumption of beef, milk, and butter and the highest of pork, poultry and eggs. Portuguese fish consumption is the highest while eggs consumption is the lowest. Cluster 6 is characterized by a low consumption of lamb and poultry while milk and fish consumption is high.

As far as the Mediterranean countries concerns, the first three factors of the dynamic factor analysis explain a 74% of total variance. The first one explains the 45% and it is positively correlated with beef, pork, poultry, milk, eggs and fish consumption. Correlations between factors and variables diminishes over time except for milk and eggs in which remain constant. Factor 2 explains a 16% of total variance and it is positively correlated with animal fats and butter. It separates countries with high consumption of animal fats from countries with low consumption. Finally, factor 3 explains a 13% of total variance and it is negatively correlated with lamb consumption. Therefore, this factor differentiates countries according to lamb intake.

Figure 3 shows the position of each country in the first two factors in the two periods considered. Movements along the horizontal axis indicate changes in meat (except lamb), milk, eggs and fish consumption, while movements along the vertical axis indicate changes in animal fats and butter intake. No changes in animal food consumption can be observed for muslin Mediterranean countries. However, most of the remaining countries show movements along the vertical axis (Libya and Portugal are the exceptions as they move towards the left and the right, respectively). Albania, Italy and Malta show an upward trend while Yugoslavia, Cyprus, France, Greece and Spain move slightly downward (specially slight in the last three cases). These shiftings indicate that those countries follow different food trends and only some similarities exist in lamb and animal fats consumption.

The cluster analysis done with the Mediterranean countries allow us to classify them into eight groups (Fig. 4). Cluster 1, 5 and 8 include only one country (France, Yugoslavia and Lebanon, respectively). Greece and Cyprus belongs to the same group (cluster 2) as well as Italy and Malta (cluster 4). Cluster 3 consists of Portugal, Spain and Israel. Cluster 7 comprises Algeria, Morocco, Tunisia and Egypt. Finally, cluster 6 includes Albania and Middle East countries (Turkey, Syria and Libya).

Table 3. Production self-sufficiency of annual products in EU and Mediterranean countries in 1994 (1,000 t)

| | Beef and veal | | Lamb | | Pork | | Poultry | | Milk | | Eggs | | Fish | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Produc. | Self-suff. | Produc. | Self-suff. | Produc. | Self-suff. | Produc. | Self-suff. | Produc. | Self-suff. | Produc. | Self-suff. | Produc. | Self-suff. |
| Non Med EU countries | | | | | | | | | | | | | | |
| Austria | 263.0 | 143.3 | 5.5 | 64.7 | 514.5 | 100.1 | 92.5 | 82.2 | 3303.3 | 104.5 | 95.0 | 87.2 | 4.8 | 2.4 |
| Bel-lux | 399.5 | 185.0 | 4.0 | 19.0 | 903.0 | 175.2 | 176.5 | 122.6 | 3700.3 | 137.1 | 193.5 | 129.9 | 37.3 | 8.5 |
| Denmark | 218.0 | 177.2 | 2.5 | 50.0 | 1346.0 | 400.6 | 148.0 | 205.6 | 4486.8 | 222.6 | 87.3 | 97.5 | 1714.3 | 252.7 |
| Finland | 119.5 | 118.9 | 1.0 | 100.0 | 176.5 | 108.6 | 36.0 | 100.0 | 2503.8 | 113.9 | 69.3 | 127.1 | 144.8 | 37.9 |
| Germany | 2315.0 | 138.3 | 44.0 | 65.2 | 3556.0 | 80.3 | 583.0 | 58.8 | 28031.5 | 124.1 | 868.3 | 79.5 | 299.3 | 20.8 |
| Ireland | 612.0 | 647.6 | 96.5 | 301.6 | 181.0 | 140.9 | 86.5 | 98.9 | 5367.5 | 265.0 | 34.0 | 90.7 | 286.0 | 344.6 |
| Netherlands | 499.5 | 208.6 | 32.0 | 182.9 | 1946.5 | 290.5 | 531.5 | 224.3 | 11194.5 | 122.6 | 621.3 | 271.0 | 464.3 | 100.2 |
| Norway | 82.5 | 103.8 | 24.5 | 100.0 | 88.0 | 101.1 | 21.0 | 97.7 | 1917.3 | 113.3 | 50.8 | 106.3 | 2459.8 | 245.9 |
| Sweden | 134.0 | 91.8 | 4.0 | 72.7 | 267.5 | 95.7 | 50.5 | 98.1 | 3244.3 | 96.1 | 107.0 | 94.5 | 314.0 | 78.8 |
| UK | 1084.5 | 92.9 | 388.0 | 101.4 | 992.5 | 71.4 | 1107.0 | 94.4 | 14762.5 | 96.5 | 635.5 | 96.9 | 868.5 | 37.9 |
| Med EU countries | | | | | | | | | | | | | | |
| France | 2052.5 | 116.1 | 163.0 | 51.8 | 1904.5 | 90.1 | 1827.0 | 138.1 | 26362.8 | 119.9 | 938.5 | 99.1 | 823.0 | 38.4 |
| Greece | 64.5 | 29.9 | 120.5 | 85.5 | 153.0 | 68.0 | 160.0 | 93.3 | 2010.0 | 76.0 | 129.5 | 30.3 | 184.0 | 53.4 |
| Italy | 912.0 | 59.0 | 60.5 | 57.9 | 1225.5 | 66.0 | 1054.5 | 98.0 | 11781.3 | 67.1 | 702.5 | 96.3 | 552.5 | 32.4 |
| Portugal | 125.0 | 74.2 | 30.0 | 75.9 | 263.0 | 90.1 | 147.5 | 102.1 | 1648.8 | 97.8 | 103.8 | 102.0 | 293.5 | 46.3 |
| Spain | 470.0 | 90.4 | 232.5 | 89.1 | 1839.5 | 93.8 | 835.5 | 89.9 | 6892.3 | 85.0 | 666.8 | 97.7 | 1307.5 | 59.3 |
| Non Arab Med countries | | | | | | | | | | | | | | |
| Albania | 25.0 | 59.5 | 12.0 | 100.0 | 13.5 | 100.0 | 6.0 | 85.7 | 653.3 | 93.7 | 13.3 | 81.5 | 3.8 | 150.0 |
| Cyprus | 5.0 | 52.6 | 7.0 | 87.5 | 33.0 | 97.1 | 20.5 | 91.1 | 154.0 | 86.3 | 7.5 | 96.8 | 3.0 | 6.2 |
| Israel | 37.5 | 47.8 | 6.0 | 100.0 | 8.0 | 100.0 | 199.0 | 101.8 | 1066.3 | 98.9 | 112.5 | 113.4 | 19.5 | 8.5 |
| Malta | 2.0 | 13.8 | 0.0 | 0.0 | 8.5 | 70.8 | 4.0 | 88.9 | 26.0 | 34.3 | 7.0 | 96.6 | 3.0 | 14.6 |
| Turkey | 317.0 | 85.8 | 385.5 | 106.5 | 0.0 | 0.0 | 310.5 | 99.4 | 10371.5 | 99.3 | 446.5 | 100.4 | 478.5 | 65.2 |
| Yugoslavia† | 253.0 | 78.3 | 56.0 | 103.7 | 705.0 | 92.5 | 233.0 | 102.2 | 2515.5 | 96.4 | 113.5 | 100.7 | 14.0 | 7.8 |
| Arab Med countries | | | | | | | | | | | | | | |
| Algeria | 92.5 | 80.4 | 151.5 | 98.4 | 0.0 | 0.0 | 189.0 | 99.0 | 908.0 | 31.1 | 138.8 | 98.8 | 89.0 | 88.8 |
| Egypt | 339.0 | 69.5 | 89.5 | 100.0 | 2.5 | 83.3 | 226.0 | 97.2 | 2532.8 | 88.5 | 139.8 | 100.0 | 298.3 | 65.8 |
| Lebanon | 4.0 | 12.7 | 4.0 | 47.1 | 1.0 | 25.0 | 22.5 | 38.1 | 187.3 | 48.3 | 61.3 | 101.2 | 2.0 | 100.0 |
| Libya | 4.5 | 18.8 | 31.0 | 96.9 | 0.0 | 0.0 | 62.0 | 87.9 | 135.8 | 29.2 | 34.5 | 96.5 | 8.8 | 30.2 |
| Morocco | 160.0 | 95.5 | 107.0 | 100.5 | 1.0 | 100.0 | 146.0 | 98.6 | 945.8 | 86.7 | 182.8 | 100.0 | 596.3 | 156.4 |
| Syria | 30.0 | 96.8 | 109.5 | 85.5 | 0.0 | 0.0 | 78.5 | 99.4 | 1298.0 | 92.8 | 96.0 | 104.1 | 7.3 | 55.8 |
| Tunisia | 35.0 | 70.7 | 42.5 | 98.8 | 0.0 | 0.0 | 48.0 | 97.0 | 455.3 | 72.8 | 52.8 | 97.2 | 86.3 | 119.0 |

†1991
Source: FAO (1996)

Table 4. Correlations between variables and main factors from the dynamic factor analysis for European countries

| | Beef | Lamb | Pork | Poultry | Milk | Eggs | Fish | Animal fat | Butter |
|---|---|---|---|---|---|---|---|---|---|
| Factor 1 | | | | | | | | | |
| 1979-81 | -0.44 | 0.6 | -0.89 | 0.44 | -0.39 | -0.59 | 0.43 | -0.7 | -0.66 |
| 1991-94 | -0.33 | 0.67 | -0.61 | 0.35 | -0.38 | -0.39 | -0.67 | -0.7 | -0.74 |
| Factor 2 | | | | | | | | | |
| 1979-81 | -0.06 | -0.014 | 0.33 | 0.76 | -0.67 | 0.49 | -0.52 | -0.12 | -0.33 |
| 1991-94 | 0.01 | 0.09 | 0.63 | 0.68 | -0.67 | 0.62 | -0.33 | -0.02 | -0.22 |
| Factor 3 | | | | | | | | | |
| 1979-81 | 0.83 | 0.50 | -0.1 | 0.26 | 0.33 | 0.12 | -0.51 | -0.4 | 0.23 |
| 1991-94 | 0.56 | 0.45 | -0.38 | 0.42 | 0.37 | -0.23 | -0.5 | -0.34 | 0.26 |

Table 5. Animal food products consumption in the European Union clusters (kg/*per capita*/day)[†]

| | Beef | Lamb | Pork | Poultry | Milk | Eggs | Fish | Animal fat | Butter |
|---|---|---|---|---|---|---|---|---|---|
| Cluster 1 | 20.33 | 1.3 | 54.3 | 16.0 | 238.8 | 13.5 | 14.4 | 16.5 | 4.9 |
| Cluster 2 | 22.48 | 5.4 | 32.7 | 21.7 | 257.3 | 11.5 | 19.6 | 8.6 | 4.3 |
| Cluster 3 | 21.25 | 14.2 | 22.1 | 17.8 | 228.5 | 11.4 | 22.9 | 2.5 | 1.15 |
| Cluster 4 | 13.1 | 6.4 | 52.5 | 24.5 | 159.1 | 15.9 | 38.1 | 3.28 | 0.4 |
| Cluster 5 | 17.0 | 3.7 | 31.5 | 20.8 | 183.5 | 9.2 | 58.0 | 4.4 | 1.33 |
| Cluster 6 | 18.8 | 2.3 | 29.1 | 7.1 | 310.3 | 11.0 | 35.1 | 12.3 | 5.1 |

[†]Countries included in each cluster are show in Fig. 1

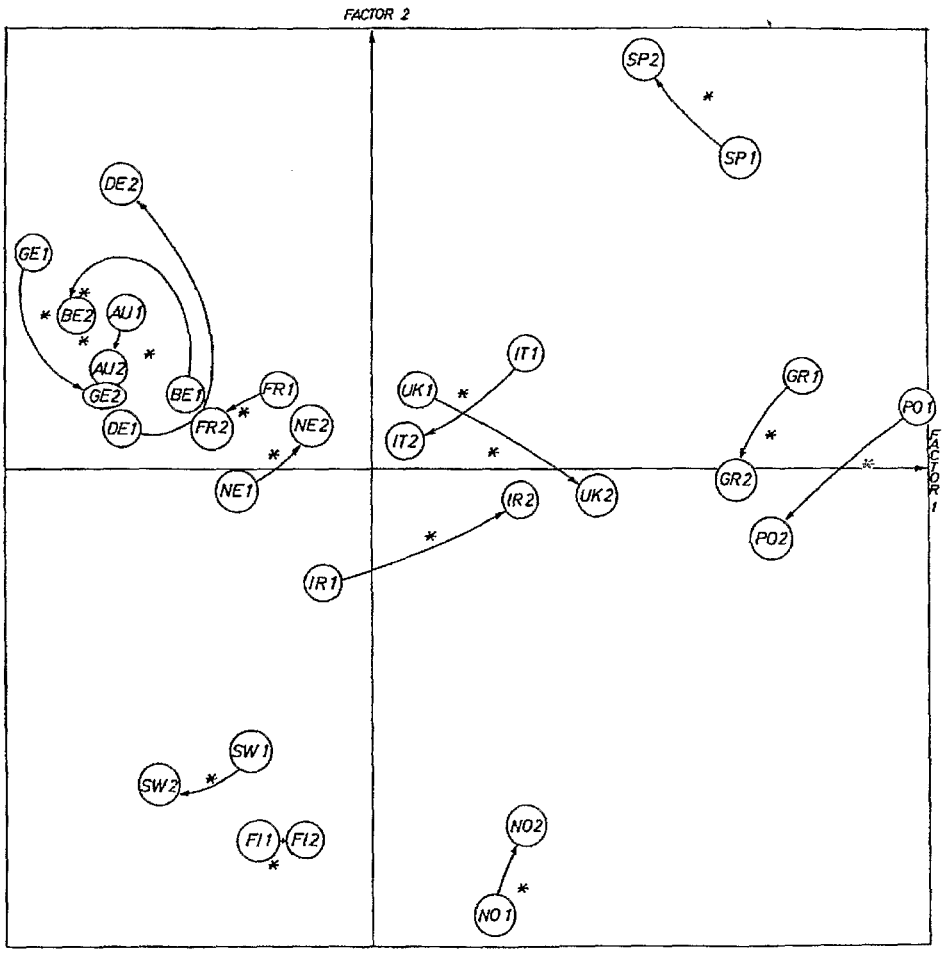


Fig. 1. Evolution of animal food products consumption in EU countries.

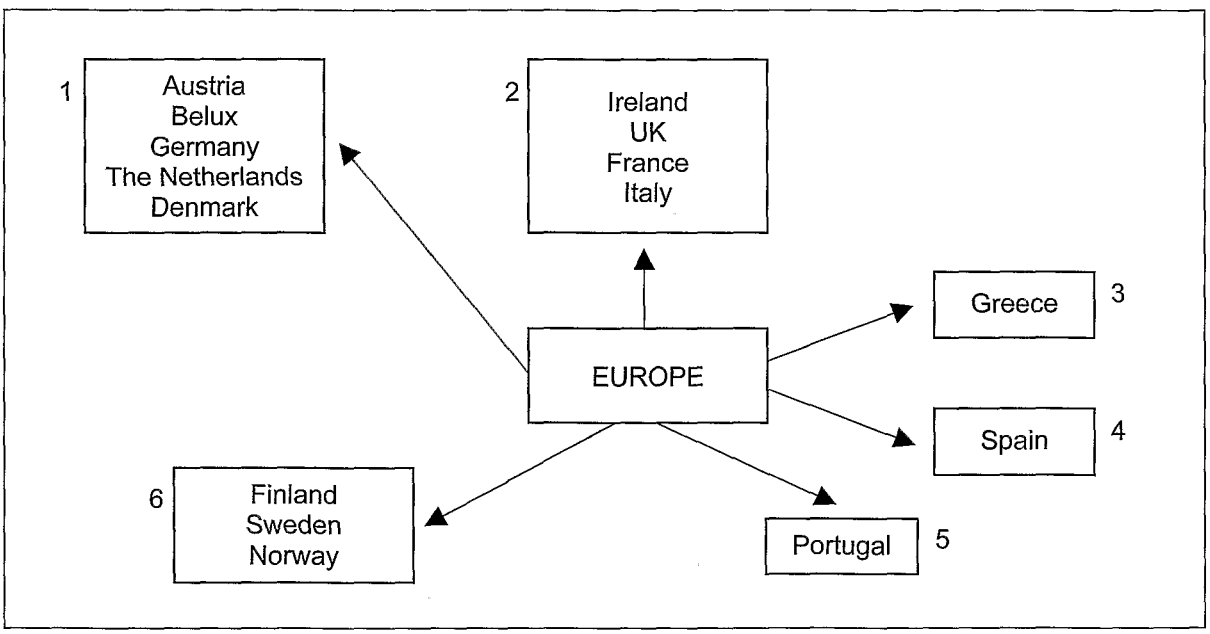


Fig. 2. Grouping of European countries according to animal intake.

Table 6. Correlations between variables and main factors from the dynamic factor analysis for Mediterranean countries

| | Beef | Lamb | Pork | Poultry | Milk | Eggs | Fish | Animal fat | Butter |
|---|---|---|---|---|---|---|---|---|---|
| Factor 1 | | | | | | | | | |
| 1979-81 | 0.83 | -0.25 | 0.84 | 0.74 | 0.83 | 0.82 | 0.71 | 0.27 | 0.28 |
| 1991-94 | 0.78 | -0.07 | 0.79 | 0.66 | 0.84 | 0.8 | 0.63 | 0.72 | 0.36 |
| Factor 2 | | | | | | | | | |
| 1979-81 | 0.2 | -0.24 | 0.15 | -0.44 | 0.17 | -0.17 | -0.43 | 0.59 | 0.68 |
| 1991-94 | 0.3 | -0.37 | -0.14 | -0.55 | 0.01 | -0.22 | -0.46 | 0.53 | 0.6 |
| Factor 3 | | | | | | | | | |
| 1979-81 | -0.23 | -0.75 | -0.09 | 0.23 | -0.24 | 0.18 | 0.09 | 0.48 | -0.45 |
| 1991-94 | -0.05 | -0.8 | -0.05 | -0.03 | -0.32 | 0.13 | 0.07 | 0.33 | -0.5 |

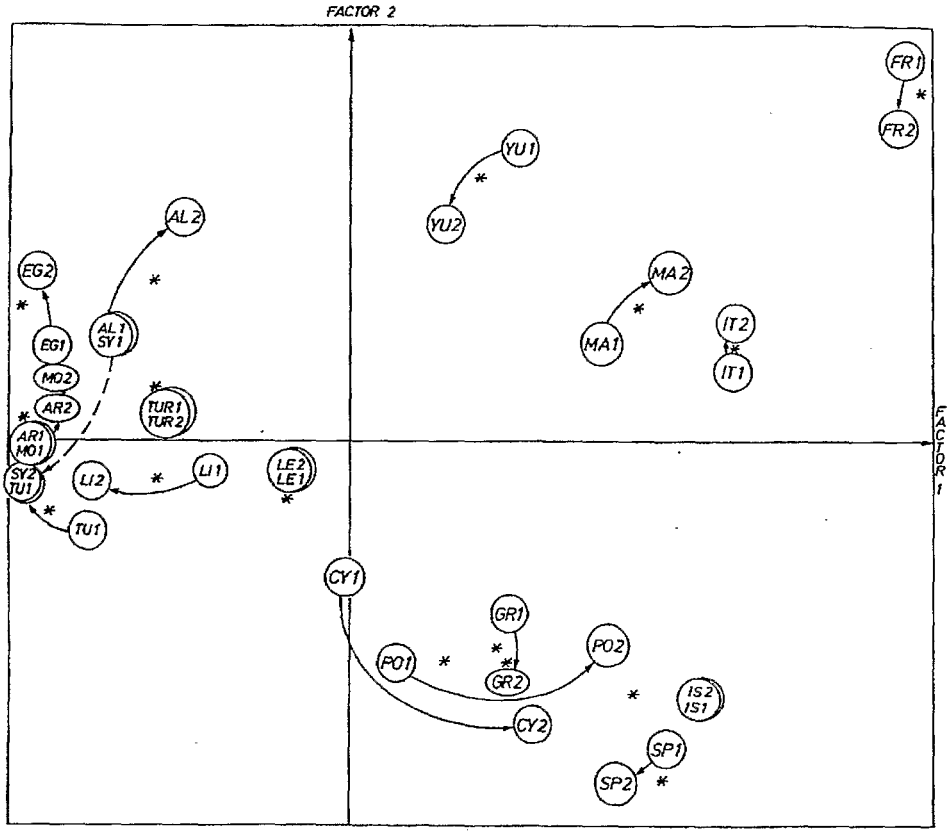


Fig. 3. Evolution of animal food consumption in Mediterranean countries.

The analysis of the average consumption of animal food products in each cluster (Table 7) indicates that cluster 6, 7 and 8 have the lowest consumption of all the animal products except for the case of eggs in cluster 8 which shows the highest consumption level. However, some differences among these clusters are detected. For instance, the higher consumption level of lamb is in cluster 6, while in cluster 7 the consumption of fish is more important and, in the case of cluster 8, poultry is more consumed.

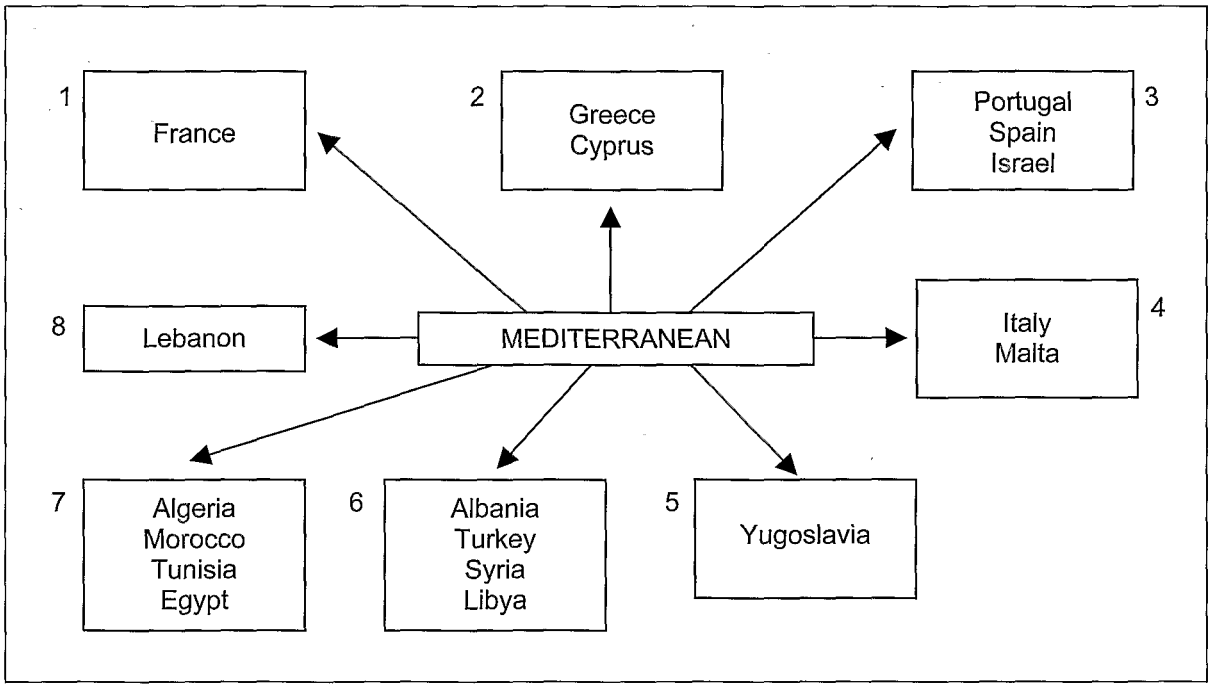


Fig. 4. Grouping of Mediterranean countries according to animal intake.

Table 7. Animal food products consumption in Mediterranean clusters (kg/*per capita*/day)†

| | Beef | Lamb | Pork | Poultry | Milk | Eggs | Fish | Animal fat | Butter |
|---|---|---|---|---|---|---|---|---|---|
| Cluster 1 | 28.9 | 5.5 | 37.2 | 21.8 | 284.6 | 14.7 | 22.6 | 8.8 | 8.4 |
| Cluster 2 | 17.2 | 12.7 | 33.8 | 25.4 | 216.1 | 10.1 | 19.8 | 2.9 | 1.2 |
| Cluster 3 | 11.8 | 3.8 | 28.5 | 28.3 | 178.3 | 13.6 | 38.6 | 4.3 | 0.8 |
| Cluster 4 | 29.4 | 1.6 | 30.7 | 14.5 | 190.7 | 14.5 | 21.6 | 8.1 | 1.7 |
| Cluster 5 | 13.5 | 2.3 | 30.8 | 9.5 | 164.1 | 7.8 | 3.3 | 10.8 | 0.5 |
| Cluster 6 | 6.6 | 6.4 | 1.0 | 7.1 | 126.5 | 5.7 | 3.0 | 2.6 | 1.8 |
| Cluster 7 | 6.6 | 3.9 | 0.0 | 5.9 | 59.8 | 4.2 | 5.8 | 2.4 | 1.8 |
| Cluster 8 | 7.0 | 3.0 | 1.25 | 19.2 | 115.7 | 16.1 | 0.4 | 2.0 | 1.7 |

†Countries included in each country are shown in Fig. 2

On the other hand, clusters 1 to 4 have the highest consumption of most of the products although cluster 3 differs sustantially from the rest. Yugoslavia (cluster 5) is characterized by the highest consumption of pork and animal fats and the lowest of butter. In comparison with the Northern Mediterranean countries, the consumption of poultry, eggs and fish is lower.

## Convergence patterns in animal products consumption in EU and Mediterranean countries

Once it has been analysed the path followed by each country with respect to its average over the last ten years and the degree of similarity in the of evolution consumption of animal food products

across countries through the cluster analysis, in this section we will analyse whether exists a trend towards a convergence on animal food products consumption across countries or not. Taking into account the results obtained in the previous section, we have firstly carried out the convergence analysis within each of the four groups of countries that have been considered in the descriptive section of this paper: (i) EU non Mediterranean countries; (ii) EU Mediterranean countries; (iii) non Arab Mediterranean countries, and (iv) Arab Mediterranean countries. As a second step, the convergence analysis has been done considering (i) and (ii) (that is, EU countries), on one hand, and (ii) and (iii) (Mediterranean countries excluded the Arab ones), on the other.

Several approaches have been used in the literature for testing the hypothesis of convergence in food consumption. Some of them follow a merely statistic criterion. For instance, Blandford (1984) calculates the coefficient of variation of *per capita* food consumption in calorie terms. This approach is similar to the concept of sigma-convergence of Barro and Sala i Martin (1991, 1992). They also applied a second measure, called beta-convergence, to the problem of income convergence among countries at different stages of economic development. Both measures were applied by Gil *et al.* (1995a, 1995b) to the analysis of convergence of food diets in EU and Mediterranean countries, respectively. Finally, Hermann and Röder (1995) proposed a theoretical model which explains cross-country differences in *per capita* consumption by standard economic determinants and by convergence or divergence in preferences. This last approach measures convergence by ($q_i$-$q_{MIN}$) (difference between the consumption level of the country of interest and the country with the lowest consumption level). This is a somewhat an arbitrary measure as the same number can indicate convergence or divergence. On the other hand, using ($q_{MAX}$-$q_i$) as a similar convergence measure, results are completely different.

In a strict sense, convergence in food consumption is defined as the reduction of food consumption variance across countries over time, that is:

$$\frac{d\,[var\ (\ln C_{it})]}{d_t} < 0 \qquad (2)$$

where $C_{it}$ is the consumption of animal food product i (i = beef and veal, lamb, etc.) at time t and var ($\ln C_{it}$) represents the variance across countries. If only two time periods are available, indexed by 0 and 1, convergence exists if:

$$\frac{var\ (\ln C_0)}{var\ (\ln C_1)} > 1 \qquad (3)$$

Although a lot of papers have used this measure of convergence only Lichtemberg (1994) formally introduced a test on expression (3). Most of the empirical literature, however, has tested the convergence hypothesis from the specification of the following regression equation.

$$c_1 - c_0 = \alpha - \beta y_0 + u \qquad (4)$$

where $c_1 = \ln (C_1)$; $c_0 = \ln (C_0)$: $\alpha$ is the intercept and u is the error term. Rearranging expression (4), we get:

$$C_1 = \alpha + (1-\beta) C_0 + u_1 \qquad (5)$$

In expression (5) convergence takes place if $\beta>0$. Then, some authors has tested this hypothesis, also called the mean-reversion hypothesis, to check if convergence exists. This test, however is not equivalent to a test based on expression (3). Barro and Sala i Martin (1991) recognized that both measures are not equivalent and that $\beta>0$ is a necessary but not sufficient condition of convergence. Lichtemberg (1994) not only formulated a test of convergence based on expression (3) but also established under what assumptions both tests were equivalent.

Assuming that in (5), $C_0$ is simply a random draw from some arbitrary distribution, the variance of $c_1$ ($\sigma_1^2$) from equation (5) (the intercept is suppressed for simplicity) is:

$$\sigma_1^2 = (1-\beta)^2 \sigma_0^2 + \sigma_u^2 \quad (6)$$

or

$$\frac{\sigma_1^2}{\sigma_0^2} = (1-\beta)^2 + \frac{\sigma_u^2}{\sigma_o^2} \quad (7)$$

From expression (5) it is easy to get:

$$(1-R^2) = \frac{\sigma_u^2}{\sigma_1^2}$$

where $R^2$ is the adjustment coefficient of regression (5). Rearranging terms:

$$\sigma_u^2 = (1-R^2)\sigma_1^2 \quad (8)$$

and substituting expression (8) in (6), we get:

$$\sigma_1^2 = (1-\beta)^2 \sigma_0^2 + (1-R^2)\sigma_1^2$$

Rearranging:

$$\frac{\sigma_0^2}{\sigma_1^2} = \frac{R^2}{(1-\beta)^2} \quad (9)$$

Lichtemberg (1994) shows that expression (9) is distributed as a $F_{N-2,N-2}$ where N is, in our case, the number of considered countries.

Table 8 shows the results from the Lichtermberg's test for the nine animal food products considered in section 2.2 and for each of the groups of countries mentioned above. The period of study covers the last ten years (1979-81 to 1991-94). The table also includes the values of β and $R^2$ in equation 5.

Results indicate that in the last ten years no convergence process has been found in any of the groups. Only, we have found some evidence on convergence within the EU countries (Mediterranean countries included and excluded) in beef and veal. In other words, it is not possible to talk about one single European diet or one single Mediterranean diet even if we consider countries with similar cultural values and religion as it is the case of Arab countries.

A weaker evidence on convergence is the mean-reversion test. In this sense, a positive β coefficient would indicate mean-reversion but only would be relevant if this coefficient is significative (an * indicates that the β coefficient is statistically different from zero at the 5% level of significance).

Among EU countries, the null of no mean-reversion is rejected for most products with the exception of fish and pork. In these cases, in countries with higher consumption levels at the beginning of the analysed period consumption has increased while the opposite has taken place in countries with starting lower consumption levels. In any case, where mean-reversion exists, the speed of this process is very slow. These results are very consistent with those obtained in section 3. Excluding the Mediterranean countries, EU countries exhibit a certain convergence in beef and veal, lamb, poultry and fish. In the case of beef and veal this is due to the increasing concern about red meat consumption. In the case of lamb and fish, consumption has increased quicklier in countries which had a lower consumption level in the early eighties. Among EU Mediterranean countries, some convergence (in the sense of mean-reversion) is found in beef, milk, eggs and poultry.

Arab countries only exhibit an approximation in the consumption levels of the most expensive meats (beef and lamb) as well as in the case of animal fats. In the case of the non Arab countries, a slow convergence process takes place in animal fats, milk and eggs. If we consider together the non Arab and the EU Mediterranean countries only in beef, eggs and animal fats there is weak evidence on convergence.

Table 8. Convergence tests for animal products consumption in EU and Mediterranean countries

| | Beef and veal | Lamb | Pork | Poultry | Milk | Eggs | Fish | Animal fats | Butter |
|---|---|---|---|---|---|---|---|---|---|
| Non Mediterranean EU countries | | | | | | | | | |
| β | 0.099* | 0.024* | -0.017 | 0.023* | 0.021 | 0.038 | 0.014* | -0.002 | 0.04 |
| $R^2$ | 0.91 | 0.57 | 0.25 | 0.33 | 0.19 | 0.13 | 0.31 | 0.003 | 0.20 |
| T.L.† | 9.58* | 1.60 | 0.69 | 1.43 | 1.23 | 0.76 | 1.28 | 0.50 | 0.93 |
| D.F.†† | (8.8) | (8.8) | (8.8) | (8.8) | (8.8) | (8.8) | (8.8) | (8.8) | (8.8) |
| Mediterranean EU countries | | | | | | | | | |
| β | 0.03* | 0.008 | 0.04 | 0.05* | 0.05* | 0.05* | -0.01 | 0.009 | 0.01 |
| $R^2$ | 0.75 | 0.11 | 0.19 | 0.66 | 0.75 | 0.93 | 0.05 | 0.07 | 0.1 |
| T.L.† | 1.86 | 1.11 | 0.99 | 2.47 | 3.18 | 3.59 | 0.61 | 1.07 | 1.11 |
| D.F.†† | (3.3) | (3.3) | (3.3) | (3.3) | (3.3) | (3.3) | (3.3) | (3.3) | (3.3) |
| Non Arab Mediterranean countries | | | | | | | | | |
| β | 0.06 | 0.006 | -0.02 | -0.01 | 0.11* | 0.03* | -0.02 | 0.03* | 0.03 |
| $R^2$ | 0.31 | 0.14 | 0.21 | 0.10 | 0.53 | 0.64 | 0.12 | 0.48 | 0.37 |
| T.L.† | 1.06 | 1.10 | 0.68 | 0.69 | 1.04 | 1.79 | 0.57 | 1.71 | 1.57 |
| D.F.†† | (4.4) | (4.4) | (3.3) | (4.4) | (4.4) | (4.4) | (4.4) | (4.4) | (4.4) |
| Arab Mediterranean countries | | | | | | | | | |
| β | 0.07* | 0.05* | | 0.03 | -0.11 | 0.004 | -0.02 | 0.056* | 0.06 |
| $R^2$ | 0.54 | 0.61 | | 0.27 | 0.12 | 0.01 | 0.08 | 0.54 | 0.39 |
| T.L.† | 1.96 | 2.42 | | 1.37 | 0.76 | 0.90 | 0.52 | 2.20 | 1.38 |
| D.F.†† | (5.5) | (5.5) | | (5.5) | (5.5) | (5.5) | (5.5) | (5.5) | (5.5) |
| EU countries | | | | | | | | | |
| β | 0.05* | 0.02* | 0.02 | 0.03* | 0.04* | 0.54* | 0.006 | 0.03* | 0.03* |
| $R^2$ | 0.62 | 0.41 | 0.14 | 0.55 | 0.57 | 0.54 | 0.02 | 0.38 | 0.40 |
| T.L.† | 2.59* | 1.38 | 1.09 | 1.80 | 2.08 | 2.17 | 0.96 | 1.59 | 1.57 |
| D.F.†† | (13.13) | (13.13) | (13.13) | (13.13) | (13.13) | (13.13) | (13.13) | (13.13) | (13.13) |
| Mediterranean EU countries and non Arab Mediterranean countries | | | | | | | | | |
| β | 0.04* | 0.004 | -0.02 | -0.015 | 0.05 | 0.03* | -0.03 | 0.04* | 0.018 |
| $R^2$ | 0.29 | 0.03 | 0.16 | 0.12 | 0.42 | 0.66 | 0.26 | 0.41 | 0.16 |
| T.L.† | 1.31 | 1.02 | 0.69 | 0.68 | 1.69 | 1.89 | 0.56 | 1.68 | 1.19 |
| D.F.†† | (9.9) | (9.9) | (8.8) | (9.9) | (9.9) | (9.9) | (9.9) | (9.9) | (9.9) |

†Lichtemberg's (1994) test
††Degrees of freedom. Cortical values are: F(3.3)=29.46; F(4.4)=15.98; F(5.5)=10.97; F(8.8)=6.03; F(9.9)=3.18; F(13.13)=2.57
*incidates significance at the 5%

## Conclusions

Total calorie intake in both the European Union and Mediterranean countries have increased but at a lower rate than income has done. However, the proportion of calories coming from animal origin is still very low in Arab Mediterranean countries (where it accounts for around 10% of total calorie intake) in comparison to the rest of the countries considered. It seems that in all countries, Arab included, animal calories will not further increase in forthcoming years because a maximum has been detected. Moreover, income elasticities show that as income changes, animal food calories will not

sustantially increase, specially in non European Mediterranean countries (except for Cyprus). Therefore, although total calorie intake is not very different among countries, animal calories in Non European Mediterranean, specially Arab, countries still are relatively low and this will be the trend in the future.

Regarding to different meat products and eggs, it has been observed that EU countries show the highest consumption of beef, pork, poultry and eggs along with Cyprus, Malta and Israel (except for pork). However, lamb consumption is a typical Mediterranean product, highly consumed in those countries, although some important consumption levels can be observed in Ireland and Great Britain. The following trends have been observed. Beef consumption has increased in Mediterranean countries and decreased in non Mediterranean EU. Lamb and pork consumption has increased in EU countries, specially in the Mediterranean ones. Poultry consumption has also increased in all countries, specially in the Arab and non Mediterranean EU ones. Finally, eggs consumption has remained constant or slightly increase or decrease in EU countries while it shows an important increase in all Mediterranean countries except for Israel. In general, all animal products consumption needs are covered by own production in all EU countries. However, Mediterranean countries (except for France) hardly achieves self sufficiency even in traditional products (only in the cases of poultry and eggs production almost satisfies consumption). Arab countries show the greatest differences between production and consumption for milk and beef.

The above evolution drives a divergence process among Mediterranean countries in the consumption of most of the products. Only beef and eggs consumption shows some convergence trend in some cases. On the other hand, a slow convergence is taken place among EU countries in the consumption of all products except for pork and fish.

As a final consideration, we can conclude that the feed sector faces future opportunities in both EU and Mediterranean countries. The consumption of products which are more related to the feed sector (pork, poultry and eggs) has increased in the last years and only in the case of the eggs a certain stabilization is observed. Poultry consumption has spectacularly increased in the last twenty years and it is thought that still there is room for further increases due to the new health concerns on red meat. This situation is common to all countries considered. Finally, pork consumption is very important in EU and non Arab Mediterranean countries. It represents a significant part of total meat consumption and its consumption has been continuously increasing. The main limitations of the future expansion of the feed sector are related to the increasing health concerns in countries which oversatisfies basic food needs. Consumers concerns on cholesterol may affect animal food products consumption in the future. If the feed sector is able to develop new technologies in order to produce low cholesterol products, future perspectives are very positive.

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