

On a Broader Description of Alimentary Consumption Patterns: The Case of Greece (1957-2005)

Ioannis Sotiropoulos

Department of Finance and Auditing, Technological Educational Institute (TEI) of Epirus
210 Ioanninon Avenue, PC 48100, Preveza, Greece
Tel: 30-693-299-7672 E-mail: sotiropoulosioan@yahoo.gr

Constantinos C. Frangos (Corresponding author)

Centre of Gastroenterology & Clinical Nutrition, University College London
Ifor Evans Hall Site, 109 Camden Road, NW1 9HZ, London, UK
Tel: 44-(0)-796-034-0489 E-mail: constantinos.frangos.09@ucl.ac.uk

Christos C. Frangos

Department of Business Administration, Technological Educational Institute (TEI) of Athens
Ag. Spyridonos str., Egaleo, Athens PC 122 10, Greece
Tel: 30-210-283-3756 E-mail: cfragos@teiath.gr

Vassilios P. Filios

Department of Management of Agricultural Products and Food Enterprises, University of Ioannina
2 G. Seferi Street, Agrinio PC 30100, Greece
Tel: 30-697-761-3361 E-mail: filios@cc.uoi.gr

Abstract

Understanding the formation and evolution of alimentary consumption patterns requires a broad and multidimensional approach. Foods originate either from plants and animals, representing the living processes, or agriculture and industry, representing the non-living processes, and in these forms they play their biological role. Additionally, the consumption of foods has multiple consequences (social, economic, health, etc.) on an individual level as well as on a wider collective level. In this essay we attempt to describe alimentary consumption patterns in Greece (1957-2005) from three different dimensions: a natural dimension (animal or plant origin), a technical one (agricultural or industrial origin) and finally, a biological one (nutritional properties). The description, which we will use as the foundation to create an interpretative theory, is done through charts and tables, based on numerical indicators that are deduced from simple illustrative functions. Tables used in the present paper are either simple or double-entry and we present spreading diagrams as well.

Keywords: Alimentary consumption patterns, Natural / technical / biological characteristics, Greece

1. Introduction

The purpose of this paper is to 're-arrange' and reconstruct statistical data from the National Statistical Service of Greece (ESYE); to date, this has not been attempted yet. These data allow the description of the physical characteristics of alimentary consumption patterns (grain, meat, fish, oil-fat, dairy, vegetables, fruit, sugar confectionery, non-alcoholic beverages, expenditure on food away from home, other foods) without making reclassifications however through technical and biological characteristics. As a result, technical and biological characteristics of alimentary consumption patterns cannot be distinguished, but only their physical properties (plant and animal) can be estimated.

In this study, instead, we process the data of the Household Budget Surveys (H.B.S.) and reclassify them with criteria according to agricultural and industrial features; moreover, we consider the biological characteristics of alimentary consumption patterns in our calculations. The results are presented in tables and graphs which depict alimentary consumption patterns of the 1950's (traditional-'Mediterranean') and those of the early 2000-2010 (industrial-internationalized-'Western origin').

This paper is divided into three parts. First, we attempt to explain the importance of division and reclassification of the data of ESYE in order to describe alimentary consumption patterns from a united and whole perspective (physical, biological and technical). The second part describes the method (functions, indices, tables and charts) that can describe

comprehensively alimentary consumption patterns. Finally, the third part presents the empirical results of our paper. We conclude that this new method is possible to describe comprehensively alimentary consumption patterns and, additionally, it allows us to give qualitative descriptions and characterizations of various alimentary consumption patterns (e.g. agricultural, industrial, 'Mediterranean', 'Western origin').

2. Data: Processing and Reclassification

2.1 Algorithmic Description and Natural Features

Under the criterion of natural features, alimentary consumption patterns are characterized as either plant or animal origin. If the costs for plant-origin products surpass those of animal-origin [at rates above 50%, see also Malassis (1979, pp. 188, 198; 1986, p. 187)], as is the case with traditional Mediterranean alimentary consumption patterns, then alimentary patterns are indicated as plant-origin. If however, the cost of animal foods is more, as in the 1980s, then alimentary patterns are indicated as animal-origin.

In the 1950s, rates (%) of participation in two major categories of total expenditure for food were 60.2% (plant ingredients) and 39.8% (animal ingredients) [H.B.S. 1957-58, see Sotiropoulos & Demousis (2002, p. 458)]. At current prices this means: 210.6 drachmae for plant ingredients, 139.1 drachmae for animal ingredients, and 349.7 total drachmas. On the contrary, during the 1980s (H.B.S. 1981/82), animal food ingredients were more (52.1% animal vs. 47.9% plant ingredients), while at the beginning of the first decade of 2000 (H.B.S. 2004/05), plant ingredients exceeded again animal ingredients in food (53.0% plant vs. 47.0% animal ingredients).

2.2 Technical Features

Under this criterion, alimentary consumption patterns are described either as agricultural-origin or industrial-origin. If the costs for agricultural products exceed those of industrial products, like in traditional 'Mediterranean' alimentary consumption patterns, then these dietary patterns are indicated as agricultural-origin. If, however, industrial food products exceed agricultural, then alimentary patterns are designated as industrial-origin.

According to data from H.B.S. 1957/58, alimentary consumption patterns in Greece cannot be considered as agricultural anymore, and are currently in a process of industrialization, which is intensified over time. Agricultural ingredients were 43.5% of the total in data of H.B.S. 1957/58 but 29.9% in the H.B.S. 2004/05. In contrast, industrial ingredients were 56.5% in data of H.B.S. 1957/58 but 70.1% in the recent H.B.S. 2004/05.

2.3 Biological features

Nutrition sciences investigate data such as the concentration of nutrients in alimentary consumption patterns, with a commonly accepted indicator for measuring overall efficiency: energy points (= calories). The data used in this case are the result of the respective findings of nutrition sciences (biology, food chemistry, medicine, etc.), which use specific indices each time for proteins, fats, sugars, vitamins, minerals and a few trace elements, etc. (Malassis, 1986, pp. 28-52). The World Health Organization (WHO) uses the following standards to categorize populations into 4 categories:

A = Less than 2.200 calories per capita per day (malnutrition)

B = 2.200 - 2.600 calories per capita per day (poor feeding)

C = 2.600 - 3.200 calories per capita per day (enough food)

D = more than 3.200 calories per capita per day (overfeeding)

In the early 1960s, Greece (at the general population level) was just moving from the poor feeding category (2.820 calories), according to WHO; at the end though of the study period, Greece now belongs to the overfeeding group (3.680 calories).

3. Methods: Functions and indices used to describe alimentary consumption patterns

3.1 Natural Features... again

In order to describe alimentary consumption patterns from all aspects, it is necessary to create a common index. Lancaster (1966, p. 133) supports that 'consumption is an activity in which goods, singly or in combination, are inputs and in which the output is a collection of characteristics... A meal possesses nutritional characteristics but it also possesses aesthetic characteristics, and different meals will possess these characteristics in different relative proportions. Furthermore, a dinner party, a combination of two goods, a meal and a social setting, may possess nutritional, aesthetic, and perhaps intellectual characteristics different from the combination obtainable from a meal and a social gathering consumed separately... In general, even a single good will possess more than one characteristic, so that the simplest consumption activity will be characterized by joint outputs'.

Under this scope, and taking into account all the characteristics (natural, technical, biological) of alimentary consumption patterns, we can create a simple and applicable index, as follows:

$$Q_{index\ of\ plant\ ingredients} = \frac{rate\ (\%) \ of\ plant\ ingredients}{50} \quad (1)$$

$$Q_{index\ of\ animal\ ingredients} = \frac{rate\ (\%) \ of\ animal\ ingredients}{50} \quad (2)$$

Where: 'plant %' or 'animal %' the percentage % of plant or animal ingredients that make up the respective diets.

Applying the data of H.B.S. 1957/58, our indices receive the following values:

$$Q_{index\ of\ plant\ ingredients} = \frac{rate\ (\%) \ of\ plant\ ingredients}{50} = \frac{60.2}{50} = 1.20 \text{ for plant origin foods, and}$$

$$Q_{index\ of\ animal\ ingredients} = \frac{rate\ (\%) \ of\ animal\ ingredients}{50} = \frac{39.8}{50} = 0.80 \text{ for animal origin food,}$$

with: 50 = the 50% rate when working on data rates (see Note 1).

3.2 Technical Features

When formulas (1) or (2) are applied for agricultural ingredients of alimentary patterns, we get:

$$Q_{index\ of\ agricultural\ ingredients} = \frac{rate\ (\%) \ of\ agricultural\ ingredients}{50} \quad (3)$$

When applied to industrial ingredients we get:

$$Q_{index\ of\ industrial\ ingredients} = \frac{rate\ (\%) \ of\ industrial\ ingredients}{50} \quad (4)$$

Hence, the general form of the index is:

$$Q_{index\ of\ alimentary\ ingredients\ X} = \frac{rate\ (\%) \ of\ alimentary\ ingredients\ X}{50} \quad (5)$$

where: X = plant, animal, agricultural or industrial ingredients.

3.3 Values, Quantities and Biological Features

When processing data concerning values (e.g. costs), quantities (e.g. kg or pieces), indices of food biological composition (e.g. kcal for calories, etc.), the formula takes the following form:

a) In the case of expenditure (costs):

$$Q_{index\ of\ plant\ ingredients} = \frac{cost\ (\%) \ of\ plant\ ingredients}{Total\ Category\ Cost/2} \quad (6)$$

$$Q_{index\ of\ animal\ ingredients} = \frac{cost\ (\%) \ of\ animal\ ingredients}{Total\ Category\ Cost/2} \quad (7)$$

$$Q_{index\ of\ agricultural\ ingredients} = \frac{cost\ (\%) \ of\ agricultural\ ingredients}{Total\ Category\ Cost/2} \quad (8)$$

$$Q_{index\ of\ industrial\ ingredients} = \frac{cost\ (\%) \ of\ industrial\ ingredients}{Total\ Category\ Cost/2} \quad (9)$$

$$Q_{index\ of\ alimentary\ ingredients\ X} = \frac{cost\ (\%) \ of\ alimentary\ ingredients\ X}{Total\ Category\ Cost/2} \quad (10)$$

b) In the case of quantities (where instead of expenditure data we use data quantities):

$$Q_{index\ of\ plant\ ingredients} = \frac{Quantity\ of\ plant\ origin\ ingredients}{Total\ Category\ quantity/2} \quad (11)$$

$$Q_{index\ of\ animal\ ingredients} = \frac{Quantity\ of\ animal\ origin\ ingredients}{Total\ Category\ quantity/2} \quad (12)$$

$$Q_{\text{index of agricultural ingredients}} = \frac{\text{Quantity of agricultural origin ingredients}}{\text{Total Category quantity}/2} \quad (13)$$

$$Q_{\text{index of industrial ingredients}} = \frac{\text{Quantity of industrial origin ingredients}}{\text{Total Category quantity}/2} \quad (14)$$

$$Q_{\text{index of alimentary ingredients } X} = \frac{\text{Quantity of alimentary ingredients } X}{\text{Total Category quantity}/2} \quad (15)$$

c) In the case of biological features (e.g. calories):

$$Q_{\text{index of biological ingredients}} = \frac{\text{Calories}}{\text{WHO's standard (e.g. 2200, 2600, 3200)}} \quad (16)$$

$$Q_{\text{index of alimentary ingredients } X} = \frac{\text{Quantity of biological ingredients } X}{\text{Standard base of biomedical sciences}} \quad (17)$$

Examples (with cost data):

$$Q_{\text{index of plant ingredients}} = \frac{210.6}{349.7/2} = 1.20 \text{ (applying formula (6) to data from H.B.S. 1957/58)}$$

(see also results from formula (1) above).

$$Q_{\text{index of animal ingredients}} = \frac{139.1}{349.7/2} = 0.80 \text{ (applying formula (7) to data from H.B.S. 1957/58)}$$

(see also results from formula (2) above).

$$Q_{\text{index of biological ingredients}} = \frac{\text{Calories}}{\text{WHO's standard}} = \frac{2820}{2600} = 1.08 \text{ (applying formula (16) to WHO data)}$$

Thus, we manage to create a common index, as shown by the results of formulas (1), (2) or (5) and (6), (7) or (10) for plant and animal ingredients, and (16) or (17) for biological.

4. Results

In order to describe all features (natural, technical, biological) of an alimentary consumption pattern, a simple function can be generated:

$$Q_{\text{alimentary consumption pattern}} = (Q_{\text{natural ingr.}}, Q_{\text{technical ingr.}}, Q_{\text{biological ingr.}}) \quad (18)$$

or more precisely

$$Q_{\text{alimentary consumption pattern}} = (Q_{\text{plant ingr.}}, Q_{\text{animal ingr.}}, Q_{\text{agricultural ingr.}}, Q_{\text{industrial ingr.}}, Q_{\text{biological ingr.}}) \quad (19)$$

According to data from H.B.S. 1957/58 (Sotiropoulos & Demousis, 2002, p. 456), relationship (19) receives the following values:

$$Q_{\text{alimentary consumption pattern}} = (Q_{1.20}, Q_{0.80}, Q_{0.87}, Q_{1.13}, Q_{1.08})$$

With data from H.B.S. 2004/05, the same relationship (19) takes the values:

$$Q_{\text{alimentary consumption pattern}} = (Q_{1.06}, Q_{0.94}, Q_{0.60}, Q_{1.40}, Q_{1.42})$$

Thus, alimentary consumption patterns can be described by tables and diagrams as shown in Table 1 and Figure 1, which depict in summary, that the alimentary consumption pattern of 1957/58 consists of the following characteristics:

- (1) It retains plant features
- (2) It begins to become more industrialized and
- (3) It is just above the minimum levels of biological (energy) efficiency.

However, the alimentary consumption pattern of H.B.S. 2004/05:

- (1) Is plant-based also (but significantly reduced after a period of preponderance of animal ingredients over the past two decades)

(2) Presents growing industrial features and

(3) Has significantly exceeded the levels of energy efficiency (see Table 2 and Figure 2).

5. Discussion

Examining alimentary consumption patterns is more close to the real world compare to a mono-characteristic approach. This is because nutrients and foods are consumed in combination, and their pooled effects may best be investigated by considering the entire eating pattern. Hu (2002) mentions that ‘analysing food consumption as dietary patterns offers a perspective different from the traditional single nutrient focus, and may provide a comprehensive approach to disease prevention or treatment’. Additionally, the analysis of alimentary consumption patterns might result in the advance of nutritional public health, where we might understand disease aetiology (e.g. coronary heart disease), formulate dietary guidelines and provide guidance for nutrition intervention and education (Hu, 2002; Kraut et al., 2000).

Sound statistical methodologies are required to measure alimentary consumption patterns and are still in development. Present scientific literature employs three approaches: factor analysis, cluster analysis, and dietary indices (Trichopoulos & Lagiou, 2001; Bach et al., 2006). In the present paper, we have chosen to analyze alimentary consumption patterns through indices.

Using formulas (5), (10) or (15), and (17), it is possible to formulate a common basis for characterizing alimentary consumption patterns from a natural, technical and biological aspect, as shown in formula (18) and more precisely in formula (19). These indices give general descriptions of alimentary consumption patterns in certain time periods, and signify their special characteristics. We found that food being consumed by Greek people in 2004/05 differs from food being consumed in 1957/58 by Greeks, in its energy content (modern Greeks consume more caloric food); the Greek diet maintains, however, plant characteristics and a certain industrial nature.

Our results are in agreement with the definition of Mediterranean diet given elsewhere. Michel de Lorgeril and his colleagues mention that the Mediterranean diet is a non-strict vegetarian diet rich in oleic acid, omega-3 fatty acids, fiber, vitamins of the B group and various antioxidants, but low in saturated and polyunsaturated fat (de Lorgeril, 1998; de Lorgeril et al., 2002). The Greek version of the Mediterranean diet is dominated by the consumption of olive oil and by a high consumption of vegetables and fruits (Trichopoulos & Lagiou, 2001). Hence, we can see that our analysis, which point out plant characteristics of alimentary consumption patterns in Greece, is precise.

Western diet however, presents less vegetable content and includes a diet which consists of ‘a complex interaction of multiple nutritional factors directly linked to the excessive consumption of novel Neolithic and Industrial era foods (dairy products, cereals, refined cereals, refined sugars, refined vegetable oils, fatty meats, salt, and combinations of these foods). These foods, in turn, adversely influence proximate nutritional factors, which universally underlie or exacerbate virtually all chronic diseases of civilization: 1) glycemic load, 2) fatty acid composition, 3) macronutrient composition, 4) micronutrient density, 5) acidbase balance, 6) sodium-potassium ratio, and 7) fiber content’ (Cordain et al., 2005). Our analysis showed that the alimentary consumption pattern of Greece 2004/05 presents growing industrial features. Noteworthy as it is, this westernization process observed in the Greek diet embraces economic changes as well, while it is accompanied by an increase in the incidence of chronic diseases (e.g. cardiovascular diseases). Thus, it seems extremely exciting to monitor alimentary consumption patterns in accordance with the evolution of chronic diseases as well as indices of development and economic growth (e.g. GDP).

Thus, we have achieved giving a fuller description of alimentary consumption patterns, since using these indices, we can construct respective tables and charts (see Tables 1, 2, and Figures 1, 2). Finally, it is easier to understand, classify (e.g. agricultural, industrial, Mediterranean etc.), to analyze their properties and evolution, and to create the conditions under which specific processing techniques can be employed.

6. Applicability in other circumstances: the future

The method of creating these indices, tables and diagrams can be applied as well within each food category (e.g. meat, cereals etc.), in other categories of consumption (e.g. clothing, housing etc.) but also for the interpretation of their patterns and evolution.

In its general form, the basic formula may receive the form (when describing consumption patterns):

$$a) CM_d = (Ch_n, Ch_t)$$

where:

CM_d = Description of the consumption pattern, Ch_n = natural features, and Ch_t = technical features

The biological variable has been added in the case of alimentary consumption patterns, while in each different category of consumption corresponding variables are added, when appropriate.

Regarding the interpretation of consumption patterns, the formula may receive the form:

b) $CM_e = (Ch_e, Ch_s)$

where:

CM_e = Interpretation of the consumption pattern, Ch_e = economic features, and Ch_s = social features

Each variable can be broken down into parts, such as $Ch_e = P * I$ (where P = price, and I = income) and a third variable may be added as well, according to formulas (18) or (19). This was applied with alimentary consumption, where we added the variable of biological ingredients in foods.

It would be interesting to study these data considering more features and processing them with a more complex methodology. For example, Fernandez-Castro & Smith (2002) use non-parametric frontier estimation methods, known as data envelopment analysis, to review Lancaster's (1966) characteristics approach. They conclude that data envelopment analysis, is entirely consistent with the characteristics view of consumer choice found in the economics literature and should help to restrict the number of products to be assessed to manageable proportions, even though some judgement in choosing between competing efficient products by the user remains (Lancaster, 1966). Other non-parametric methodologies, such as jackknife and bootstrap (Frangos & Stone, 1984; Frangos, 1987), could be also used, in order to achieve better confidence intervals for each index in complex data.

Finally, we mentioned above that it is worth monitoring alimentary consumption patterns concurrently with the evolution of chronic diseases. This means to estimate and follow morbidity rates (incidence and prevalence) as well as mortality rates. Looking at these measures would be particularly interesting because the difference between Mediterranean diet and Westernized diet has suggested a northern-southern pattern of food consumption, which in turn has been associated with the same pattern in certain chronic diseases; hence, implying a partial aetiology for alimentary consumption patterns, at least in these diseases. In more simple words, northern countries have a higher risk of cardiovascular diseases, due to their 'harmful' westernized diet, in contrast with a low rate observed in Mediterranean countries, due to their healthy Mediterranean diet. But this northern-southern pattern is not fully capable of explaining all observations, as happens with the French paradox (namely, France has a westernized diet and high cardiovascular disease frequency, although we would expect seeing a Mediterranean diet and a low frequency of cardiovascular diseases in France, since it is a Mediterranean country). Hence, it seems logical to search for better explanations.

A possible explanation could be that there isn't a northern-southern pattern of food consumption, but an eastern-western pattern, in Europe at least. This has been proposed for other diseases, which were thought to follow a northern-western pattern in their frequency rates (Frangos & Frangos, 2007; de Silva et al., 2008). These are Crohn's disease and ulcerative colitis, which are diseases of the human gastrointestinal tract and their aetiology has been associated with food nutrients (Krishnan & Korzenik, 2002). If alimentary consumption followed a similar pattern, this could indicate associations with additional chronic diseases (not only cardiovascular but also gastrointestinal) and explain the French paradox in alimentary consumption patterns: French belongs to the west and has high disease rates due to its westernized diet, independently of its Mediterranean nature. Furthermore, eastern European countries have generally better - in a biomedical sense - alimentary consumption patterns (including the Mediterranean diet), thus leading to lower chronic diseases frequencies (de Lorgeril et al., 2002).

These unanswered questions denote a field of research we are currently examining.

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Notes

1. The logic behind using the 50% rate is as follows: it is a marginal point (≥ 50) of characterization of patterns from a natural (animal or plant products) and a technical aspect (industrial or agricultural products) and, given that percentages of each category do not vary anywhere but only between 0% and 100%, the values of the index range between 0 and 2 ($0 \leq value \leq 2$).

Table 1. Description of the alimentary consumption pattern of 1957/58 based on natural, technical, and biological features.

NATURAL FEATURES		TECHNICAL FEATURES		BIOLOGICAL FEATURES	
Plant ingredients	1.20	Agricultural ingredients	0.87	Energy Efficiency	1.08
Animal ingredients	0.80	Industrial ingredients	1.13		

Table 2. Description of the alimentary consumption pattern of 2004/05 based on natural, technical, and biological features.

NATURAL FEATURES		TECHNICAL FEATURES		BIOLOGICAL FEATURES	
Plant ingredients	1.06	Agricultural ingredients	0.60	Energy Efficiency	1.42
Animal ingredients	0.94	Industrial ingredients	1.40		

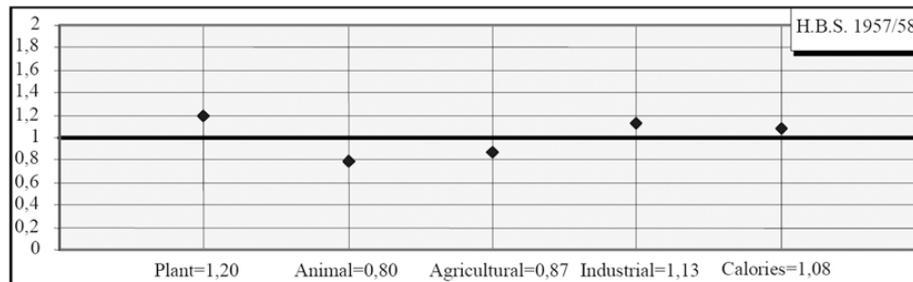


Figure 1. Graphical description of the alimentary consumption pattern of 1957/58 based on natural, technical, and biological features.

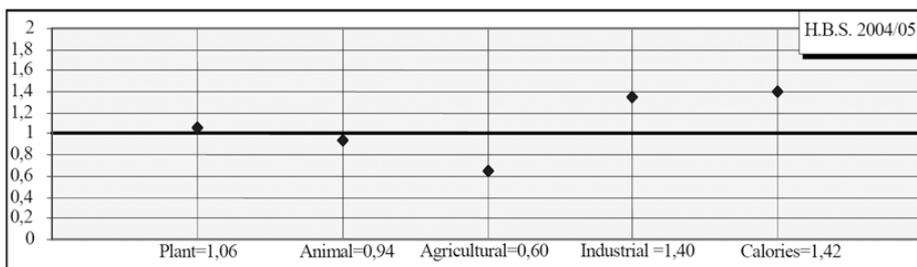


Figure 2. Graphical description of the alimentary consumption pattern of 2004/05 based on natural, technical, and biological features.