

Do we really know the composition of our foods?

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Abstract

We are currently witnessing important changes in the feeding patterns of the world population, especially in developing countries. These changes are leading to higher incidence of overweight, obesity, and non-communicable chronic diseases. These changes are influenced by a series of factors regarding the food, the individual, and the environment, which determine the selection of foods to buy and consume.

The knowledge of our foods, such as their composition and the technological and cooking processes, among others, is important given their impact on the nutritional status and health. One of the key steps in the decision of what foods we incorporate to our diet is the time spent for shopping. Therefore, it would be important to develop standardized and computerized systems for food classification that connected to databases of foods composition could bring real time information about nutrients and energy content, as well as other food components. The most developed system so far is LanguaL ("Langua aLimentaria"). We should also be knowledgeable on how cooking modifies not only the orosensorial properties but also the nutritional and health aspects of foods. Nowadays it is almost essential to also be informed about the foods we consume out of our homes, such as in collective canteens or restaurants given the work and school timetables, as well as leisure time.

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The food offer

The first definition of the Spanish Royal Academy of Language for the foods that comprise our usual diet

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¿CONOCEMOS LA COMPOSICIÓN DE NUESTROS ALIMENTOS?

Resumen

En la actualidad estamos asistiendo a cambios importantes en los patrones alimentarios de la población mundial, especialmente en los países en desarrollo. Estos cambios están conduciendo a una mayor incidencia de sobrepeso y obesidad y de enfermedades crónicas no comunicables. Estos cambios vienen influenciados por una serie de factores del alimento, el individuo y el medio que determinan la elección de los alimentos a comprar y consumir.

El conocimiento de nuestros alimentos, como su composición y los procesos tecnológicos y culinarios a los que se han sometido entre otros, es importante por sus repercusiones en el estado nutricional y en la salud. Uno de los momentos claves en la decisión de que alimentos incorporar a nuestra dieta es el momento de comprarlos. Es importante que se desarrollen sistemas estandarizados de clasificación de alimentos que conectados a bases de datos de composición puedan, a través de sistemas informatizados, aportar información en tiempo real acerca del contenido en nutrientes y energía y de otros componentes alimentarios. El sistema más desarrollado es LanguaL ("Langua aLimentaria"). También debemos conocerlos cuando los cocinamos ya que se modifican no solo en sus propiedades orosensoriales sino en sus aportes nutricionales y aspectos de salud. En la actualidad también se hace casi imprescindible la información sobre los alimentos que consumimos fuera del hogar, en comedores colectivos o restaurantes, debido a los horarios laborales y escolares y al ocio.

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Palabras clave: *Composición de los alimentos. Elección de alimentos. Transición alimentaria.*

is: "The set of things that humans and animals eat and drink to survive". The second definition states: "Each one of the substances that a living body eats or receives for its nutrition".¹

Today the range of foods offered to the consumer is notably higher than that existing only 30 years ago. Nowadays, we usually buy the foods that we consume in big supermarkets and exceptionally in local neighborhood grocery stores. If we stand by the line of for example dairy products at a supermarket, we may observe that there exist several types of milks: whole milk, semi-skimmed milk, skimmed milk, vitamins-enri-

ched, calcium-enriched, with isoflavones, etc., and other dairy products in which the fat content has been substituted: milk with omega-3, milk with olive oil, milk with omega-3 and nuts. Regarding yogurts, there is a similar situation: there are multiple variants considering the probiotic used, the fat content, the presence of foods of other origins such as fruits, grains, etc., the addition of other nutrients or different bioactive components (phytosterols, isoflavones, fiber, etc.). A similar situation occurs when we enter the area of products derived from cereals, an example of this being the different breads offered: brown bread, bread with nuts, olives, tomato, onion, garlic and oil, rye bread, soy bread, etc. All this makes the consumer be hesitant when he has to choose a food to take part of his daily diet. By contrast, the offer is much reduced at local grocery stores where there only are the basic foods that, by the way, are those more often consumed and that we can buy almost everywhere.

The other issue to consider of the current food offer is the increasing presence of highly processed foods that take part of our daily diet. For instance, we may buy easy-to-cook fish and vegetables packs ready to fry (snacks, delicatessens, sticks, etc.), bars with grains, nuts, or fruits, or industrial bakery products (laces, donuts, muffins, *ensaimada*, croissants, *napolitana*, *caña*, etc.). Also pre-cooked foods are being offered more and more at the supermarkets, the so-called “ready-to-cook” and “ready-to-eat” products of fourth and fifth generation.

Changes in the feeding pattern

Since the last decade of the 20th Century and the first of the 21st, we are unquestionably witnessing important changes in the feeding patterns worldwide, not only in developed countries but also, and most especially, in developing ones. Some people speak about the globalization of feeding. It is expected that these changes may be more pronounced in the next 20 years.

The main conditioning factors implicated in the future changes of the feeding patterns are:²

- The slowing down in the population growth, as has been published by the United Nations in 2003.³ This fact would determine greater availability of foods for the population, meaning an increase in the available energy of about 300 Kcal/person/day.
- An increase in the urbanization of the population. It is thought that the population increase will be in urban areas in the following years. This situation implies important feeding changes derived from a higher participation of women in the working population. As a consequence, home cooking of the foods, which is labor intensive, would be relegated with greater presence of pre-cooked foods ready to be consumed and fast foods and snacks out of the main meals. Urbanization also implies important changes and convergences in big areas

of the planet. Urbanization facilitates the commerce between countries. All this makes that traditional diets will progressively be changed by others with higher amounts of processed foods, rich in sugar, fat and energy.

Besides, increasing urbanization has led to a significant increase in sedentarism, with a reduction in the energy waste that has been calculated in 10-15%.⁴

- Globalization in food distribution and the emergence of supermarkets and big shopping areas worldwide, especially in developing countries. Transportation and preservation methods. The easiness of transporting food products all over the world has significantly contributed to these changes in world feeding habits. This transportation easiness is not only based in more effective and frequent aerial, sea, and terrestrial transportations, but also in the parallel development of preservation methods of foods so that they can reach the consumers in the best preservation conditions, both organoleptic and of food safety. Not too long ago, it was not easy to have a fresh tomato in January, unless it was a canned food. Today, we have tomatoes in wintertime, tropical fruits in countries with an almost polar climate, etc.
- We should also highlight that supermarkets offer more varied, safe and cheaper products to the population, which determines important changes in the feeding patterns, for instance, higher consumption of dairy products and derivatives, but also of non-healthy snacks and platforms for chains of fast food and junk food restaurants.

This has led to a uniformity of the diet of the populations from different countries, which was based before more fresh products, the so called seasonal and local products. In this regard, it is important to highlight the immigration phenomenon and its consequences in the introduction of foods from the countries of origin. It is not only the introduction of foods in the grocery stores but also the opening of restaurants offering the gastronomy of those countries to the immigrants and also to the population of the host country. Today we may find in every city a Chinese, Thai, Japanese, Mexican, Arab restaurant, etc.

- The rapid increase of the population money income, although with important regional differences, has increased, and will still do so, the buying power for the general population, especially in urban areas. This fact is determined by the lower population increase mentioned above, which changes the population structure. Thus, the segment of active population increases and the expenses in education and pensions decrease. Unquestionably this changes the access to foods and consequently the dietary pattern.
- The elderly population has also an impact on the dietary pattern. In this scenario, the parents and

grandparents focus their attention on the little number of descendants, for example as in China with only one child, which has increased and will increase, from a feeding perspective, pediatric overweight and obesity.

- Mass media. Today communications are one of the tools that have more developed. In audio-visual media particularly, although also in the advertisement spaces, magazines, and even in the opinion columns of the paper media, it is talked about foods, new foods, new feeding trends, foods for all, functional foods, foods for losing weight, for better sleeping, for getting energy, for getting rid of stress, etc. This mass media “bombarding” that reaches many millions, makes the consumers assimilate this messages and, at first by curiosity, and then by orosensorial or hedonic reasons, they incorporate these new foods in their usual diet. This phenomenon is worldwide.
- The work and school timetables have determined that at least one (lunch) and sometimes two (breakfast and lunch) of the daily meals are done out of the house, either at the workplace, the school, or at a restaurant. Again, this situation affects the feeding pattern of the population since part of it is determined externally by the menus offered by the catering service or the restaurant.
- Social networks and leisure also condition the dietary pattern. Currently almost all social events are celebrated around a table, in a broad sense: cocktails, receptions, etc. The role played by the big characters of cooking and popular chefs is also important. Today every paper publication, television or radio station allocates part of their programming to cooking, gastronomy, etc. This fact, together with food advertisements, has an unquestionable impact on the consumers’ attitudes towards foods regarding foods choice and cooking techniques.

What does the consumer look for when he buys food?

One of the determinant factors of the feeding pattern of the people is the selection of the foods they are going to eat. Every day we make several decisions regarding the food: where to eat, what to eat, with whom, and when. In this sense, it is important to analyze what are the main reasons influencing a consumer to buy and/or consume a food.

The determinant factors in food choice are complex and are related with: 1) the food; 2) the person making the choice; and 3) the current physical and social environments.⁵

- 1) As regards with the food, the choice is determined by the orosensorial properties including the sight, the taste, the smell (the flavor as an

integrated perception), and the texture with the inter-individual differences there exist.

Satiety also has an influence, being determined by the orosensorial properties, which also determines the diversity of foods in our usual diet. The size of the servings also has an influence. This is what happens when we eat at a free buffet with a great diversity of foods with different sensorial properties and with high palatability as compared to a traditional meal of an individual menu.

The existence of taste preferences and aversions, which are conditioned by previous experiences with post-intake consequences of particular foods on our body, also have an influence.

We should also think about that the previous hunger or satiety state determines the orosensorial conditioning factors of the available foods. We should also include in this context the social experiences with food, such as the social environment and the family.

- 2) The determinant factor related with the individual may be classified in intra-personal and inter-personal, being related with the perceptions, feelings, and expectations towards the food.

Regarding the intra-personal factors, the people want that their foods to be tasty, easy to eat, cheap, nutritive, and familiar. When buying and eating a food, the consumers value the taste, the easiness to get it and eat it, the price, the quality, the freshness, the nutritional value, or the family preferences. The ranking is different in the different countries. In the USA the first factor is the taste whereas in Europe it is the quality and/or the food freshness. In all this process the environmental stimuli (diseases of known people related with the consumption of foods), the relations between different foods (between healthy properties, palatability, and cultural expectations), the knowledge on foods and feeding and nutrition (daily servings of fruits and vegetables that have to be consumed or the foods composition) take relevance. Also, the social and cultural rules.

Regarding the inter-personal conditioning factors, the family, the workmates, and the social interactions.

In Spain, a study performed by the Ministry of Agriculture, Food and Environment (MAGRAMA) showed that the consumer looks in foods for quality, convenience, pleasure, time, and health. From this information, the food choice is based on quality but mainly organoleptic more than nutritional value. This same study shows that what determines most food buying is the proximity of the grocery store (54.8%), the quality (54.0%) and the economic issue (prices) (35.3%). It may be observed that the nutritional issues are not among the reasons considered for buying a food, at least explicitly, although within the term quality the nutritional quality may

be implied although hedonic quality comes in the first place most frequently.⁶

- 3) Social and environmental determinant factors should be taken into account when explaining the choice of foods to be consumed.

Regarding the physical environment built by mankind, the availability and accessibility to foods are one of the choice factors. Today there are more than 50,000 foods or feeding products easy to handle, cook, and eat at a supermarket, and this figure increases year by year. Therefore, the availability and accessibility to foods is impressive. On the other hand, the type of facility in which we get our food influences our choice. The amount and quality of the foods we select are determined by the offer of small grocery stores versus the big supermarkets, the physical location of the first ones close to homes versus the second ones, generally located at the outskirts of the cities needing transportation, and the prices in ones and the others. The determinant factors for food choice of meals outside the home should also be considered and depend on the presence of canteens at the place (workplace, school, residence, etc.) and the establishments that offer meals close to the work-sites. At last, this physical environment determines physical activity patterns —sedentarism, of special importance in relation to the feeding patterns and non-communicable chronic diseases.

The social structures and the cultural environment are also important conditioning factors in food choice. The social relationships, including the family, may lead to dietary patterns different from those that we would have in the case we eat alone. The cultural issues in a broad sense also determine the food choice in our diet, even in the current multi-ethnic societies.

Finally, other determinant factors in food choice include economic factors (prices, incomes, the family structure, education, etc.) as well as information factors, especially advertising.

Why should we know the foods we consume?

The knowledge of food composition is important because of its repercussion on the nutritional status and thus health. Today, it is a fact that obesity has reached pandemic proportions and diet-related chronic diseases are still increasing, being the main cause of morbidity and mortality worldwide. On the other hand, as mentioned above, there are more than 50,000 foods at a supermarket and we have to choose which ones are going to be part of our diet. Besides, the daily pace and the work and school timetables make the meals out of home being more frequent. All this makes important to know the content of nutrients and other bioactive components in the foods we will eat.

This knowledge is specially important for those individuals that have food intolerances and allergies, hypertension, cardiovascular risk factors, diabetics, those with a tendency to constipation or with gout, the stringent vegetarians or vegans, etc. All of them need to know the qualitative and quantitative composition of the different nutrients and other food components that may precipitate and/or aggravate an illness or prevent it. The general population should also know the foods with the aim of preventing different diseases that today we know are related with our feeding pattern.

Although it may seem paradoxical, the nutritional and food safety information has increased in the last decades thanks to the labeling legislation, which is more and more advanced and comprehensive. The labels may be as simple as those showed at the fish shops, in which only the location of fishing or breeding, the commercial name, the production method, and the presentation are indicated. There are however other so complex that it will be difficult for the average consumer to find out the real composition, and therefore to deduce the properties of the food he is going to get and consume.

On the other hand, the messages and statements on nutritional and health issues have been regulated by national and supranational administrations to protect, as far as possible, the consumer from receiving messages without scientific exactness that induce consumption and create false nutritional and health expectations. However, we still do not know or correctly interpret, at least from a nutritional viewpoint, the information provided on foods.

To know them when buying them⁷

The key step in choosing a food to consume is when we buy it at the supermarket or at the local grocery store. However, as mentioned above, the consumer is more hesitant when he is faced to big amounts of foods and processed products of which he has little information about their ingredients and the technological processes to which they have been submitted.

In this regards, there are important initiatives aimed at the consumer knowing in real time, that is to say, at the time of buying the food, its composition, which can be useful in case of food allergies and intolerances and in other pathological conditions.

Within this purpose some food classification and description systems have been developed, which allow us unequivocally to identify the foods. The LanguaL ("*Langua aLimentaria*")⁸ system is an automated method that describes, captures, and recovers the data on food composition. This multilingual and thesaurus-based system has been developed since the late 70's although it is still under development, using a classification by different aspects. Each food is described by a set of standard and controlled terms chosen from the aspects that characterize the nutritional quality and the hygiene of

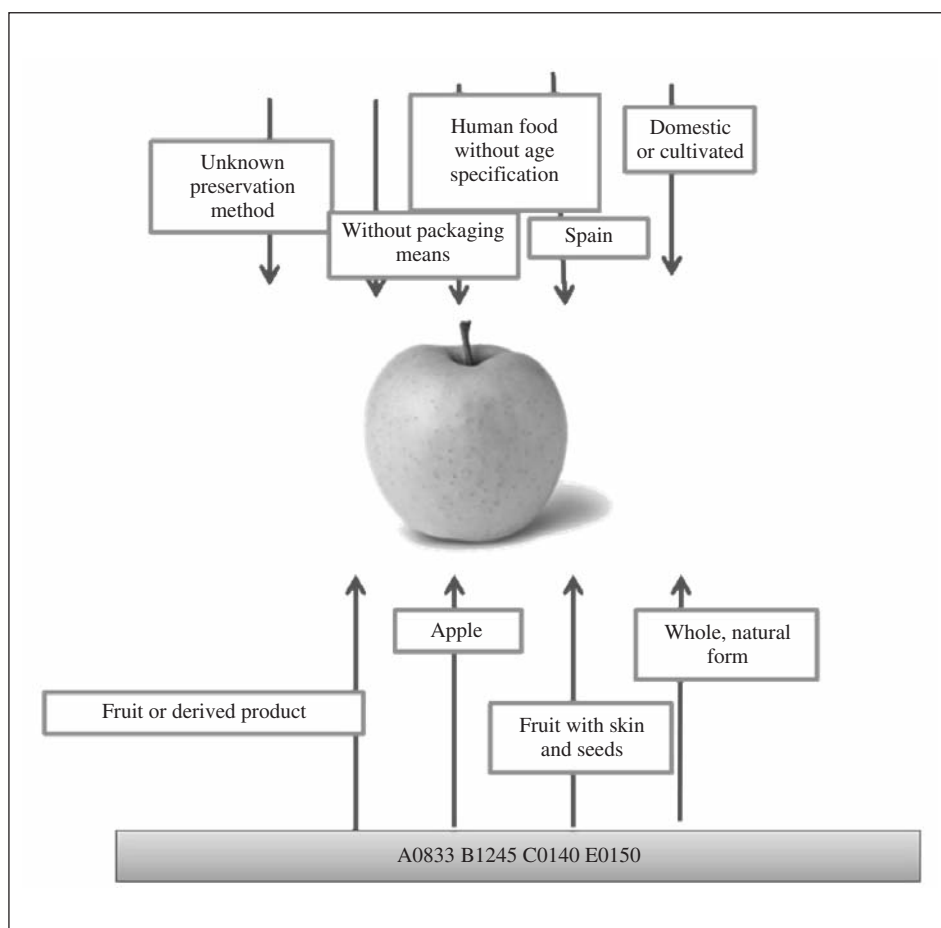


Fig. 1.—Description with the LanguaL system of a food (apple). The LanguaL code of the different aspects are included.

a particular food. These aspects include descriptors informing us about the origin, the cooking and preserving methods, the technological treatments, and the geographical origin. The classification of a natural food, such as an apple, using the LanguaL system is described in figure 1, and figure 2 includes the aspects that comprise this system. Currently the thesaurus is in several languages (Czechoslovakian, Danish, English, French, German, Italian, Portuguese, Spanish and Hungarian) and the foods indexed at present are more

than 30,000. This makes possible to consult in real time the nutrient composition of any food at different European food composition databases through the tool EuroFIR AISBL (*eSearch Prototype facility*) (<http://www.eurofir.net/>) and the USDA (Department of Agriculture of the United States) database.

On the other hand, it is necessary to consult the Food Composition databases to know the nutrients and other dietary components e.g. (bioactive components) contained in foods. In this sense, in the last five years an important work focused on harmonization of the Food Composition databases in Europe (NoE *European Food Information Resource*) and the World (INFOOD, FAO) has been made. In this European network in which participate stakeholders from more than 23 European countries, the fundamentals of the structure of the database have been put in place. This database includes documentation on all the components of the foods regarding their origin, analytical method for each component, food sampling, etc., and quality assessment of every available data. This is important because it allows us having the possibility to know the composition of foods from other countries (e.g. French cheese, Dutch butter, Norwegian salmon, etc.) when we buy them at the supermarket by accessing all of these databases that bring us the information with the same format as the

- A. Product type [A0361]
- B. Food source [B1564]
- C. Part of plant or animal [C0116]
- E. Physical state, shape or form [E0113]
- F. Extent of heat treatment [F0011]
- G. Cooking method [G0002]
- H. Treatment applied [H0111]
- J. Preservation method [J0107]
- K. Packing medium [K0020]
- M. Container or wrapping [M0100]
- N. Food contact surface [N0010]
- P. Consumer group/dietary use/label claim [P0032]
- R. Geographic places and regions [R0010]
- Z. Adjunct characteristics of food [Z0005]

Fig. 2.—Items that comprise the LanguaL Thesaurus.

national database. Also, this standardized information allows carrying out pan-European studies of nutritional assessment.

In coincidence with the work of the EuroFIR network, the Spanish Database of Food Composition (BEDCA, <http://www.bedca.net/>)⁹ has been developed in our country. In this database the foods and data on food composition information from different databases existing in Spain have been indexed in LanguaL, standardized, compiled and documented (fig. 3). BEDCA, which originated from a network from the recent Ministry of Science and Innovation (MICINN), is financed and coordinated by the Spanish Agency on Food Safety and Nutrition (AESAN), being the BEDCA Boar who is in charge of its maintenance and update.

These tools are necessary to develop an information system in real time on food composition. Some European initiatives have implemented a system that uses the last generation mobile phones (*smartphones*) and the bar codes of the marketed foods to readily know their composition.¹⁰ The bar codes include information

that links through the smartphone to the database and the nutritional composition or the qualitative composition of potential allergenic foods are sent back to the phone.

Another hot topic is the recent introduction in the market of functional foods, ecological or “organic” foods, new foods, etc. We should be cautious with this kind of foods that are even presented on specific shelves at the supermarkets. We should not forget that many of the foods that we eat in our diet are functional foods. Blue fishes, whole meal bread, fruits and yogurts, for example, are as functional as other foods that have been enriched, modified, added with another nutritional or bioactive component. In this regard, we ought to know about these natural foods and incorporate them to our diets since they are cheaper and they bring us the same benefit than more processed foods. This does not mean that functional foods may not be necessary, it just means that they have been designed for people that do not have a varied and balanced diet, and that through these foods they may be able to balance their diet.

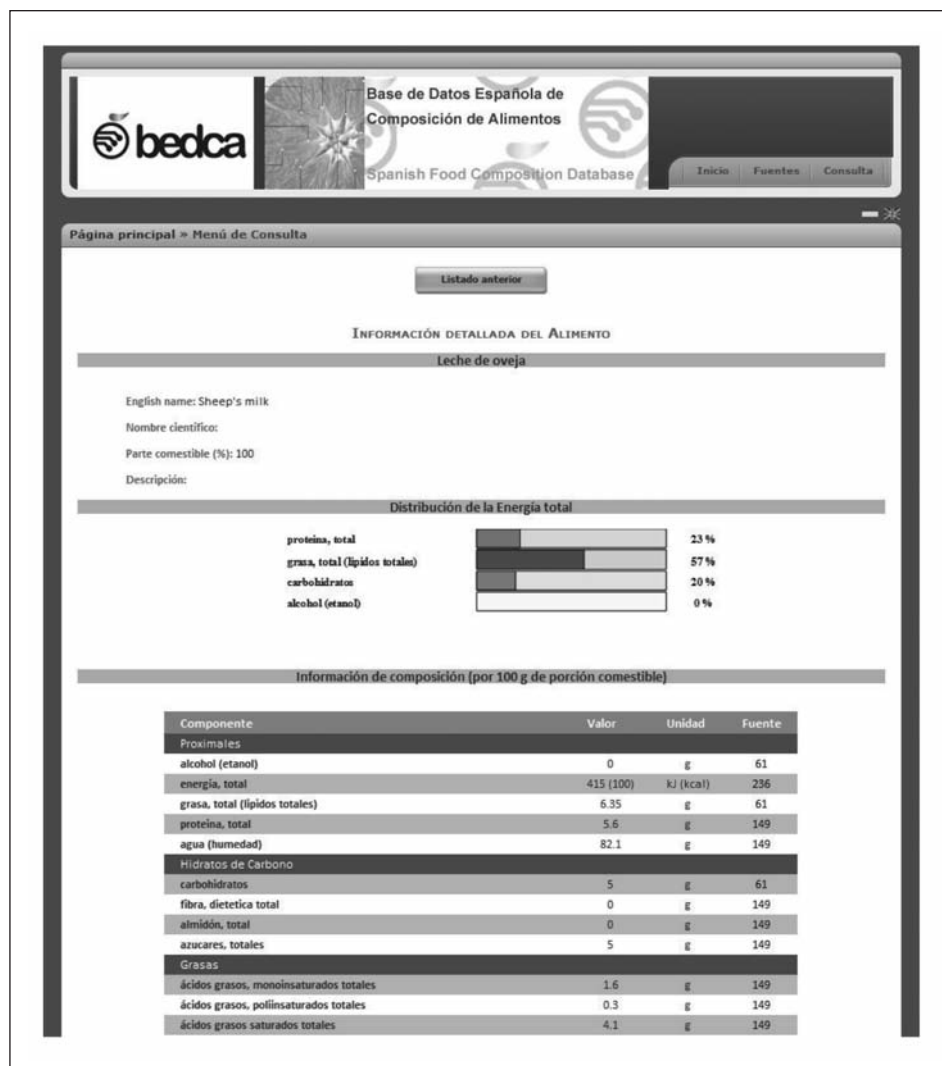


Fig. 3.—Example of the BEDCA webpage (<http://www.bedca.net>).

To know them when cooking them⁷

Culinary processing of foods gives rise to changes in the taste, texture and color of foods (organoleptic changes) that may lead to higher palatability (the individual response to the sensorial properties of foods); it also produces changes in the nutritional properties, especially in energy and micronutrients (minerals and vitamins).

When we a food is prepared under different culinary techniques, two main changes may occur:

- Weight changes of the cooked food as opposed to the raw food “weight performance”. Some foods weigh more and other less after being cooked. Those gaining weight do so by incorporating water (boiled pasta, for instance) or fat (fried foods in general); those losing weight do so by dehydration (baked breads) or fat losing (grilled meats).¹¹
- Loss of different nutrients due to the cooking method “nutrients retention”. Nutrients retention, that is to say, the nutrient loss by culinary processing is essentially produced by two factors: heat, which gives rise to loss of nutrients and bioactive components (for instance, heat-related loss of vitamin A), loss in the cooking water of minerals and other water soluble components (e.g., loss of minerals in the water thrown away after boiling vegetables).¹⁰

These changes in weight and in nutritional intake can be calculated according to weight performance¹² and nutrient retention¹³ tables.

An especial important case is that of the influence on the composition and the nutritional value of the deep frying technique used in Spain. It is usually perceived that fried foods are less healthy than those cooked on the pan, boiled, or baked, especially when they are related with body weight reducing diets. This statement is not always true. The issue with frying implies knowing how to do it correctly. In the first place, choosing the type of oil is essential. Oils with high content in polyunsaturated fatty acids and low content in antioxidant components, such as sunflower seed or soy, are bad oils for frying since they decay rapidly by heating them at high temperatures giving rise to undesirable substances (fatty acid polymers, oxidation products, etc.) and, on the other hand, by creating a thinner crust they penetrate more in the food, increasing thus its caloric content. By contrast, virgin olive oil has higher content in monounsaturated fatty acids and phenolic compounds, decays more slowly and thus supports a higher number of frying cycles, creates a more resistant crust so that it does not penetrate into the food and therefore the final caloric content is not much increased as compared to the food raw or cooked by other technique not including oil. Besides, the foods will also incorporate bioactive components from oil, especially phenolic compounds, which are potent antioxidants.¹⁴

To know them when eating outside⁷

Due to work, school, or leisure, we eat more and more outside. This implies that we do not know the foods that are served in the places where we eat, either the workplace canteen, the school canteen, or the restaurant. The foods served at these places, especially the restaurants, are usually more elaborated, using mixed foods and culinary techniques that are not frequent in our usual diet, and using the technological resources (thickeners, foaming agents, etc.) that generate more sophisticated textures, colors, and presentations. Indeed, in many cases it is not easy to recognize the component of a particular dish unless it is written on the menu; examples of this may be the deconstructed Spanish omelet, tomato popcorns, or an olive oil semolina.¹⁵

Another important factor in our diet when eating out is the size of the servings. Several studies have shown that the size of the servings chosen by the cooker is due to conditioning factors other than the nutritional ones. The factors determining the size of the servings of the dishes in restaurants ranked by influence order are: a more attractive presentation of the food on the plate, the price of the dish, the consumer's expectations, competition with other restaurants, and also, although less importantly, the caloric content of the foods included.

If we compare the serving size of the foods included in the menu of a restaurant with those recommended by the dietary guidelines for a given population, in almost all the cases the serving size of a restaurant is bigger. This tendency to increase the serving size is clearly observed with the dishes served by fast chains. For instance, French fries and hamburgers portion sizes of a well-known chain of fast food has increased from 30 to 90 grams of meat since the beginning of the business in the fifties until today. It occurs something similar with non-alcoholic beverages that have increased their normal serving size from 200 mL to 350 mL.^{16,17}

Finally, it is important to highlight that most of the consumers ignore the content in calories, saturated fats, and salt of the foods listed on the menu. This lack of information can be solved by the incorporation of important nutritional information on the menu. Some attempts have been done in this sense although the results are not very much promising so far.¹⁸

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