GASTRONOMIC BOTANY AND MOLECULAR GASTRONOMY

A. Avalos García[1], B. Cifuentes Cuencas[1], A. Gómez Garay[1], J.E. Llamas Ramos[1], L. Martin Calvarro[1], S. Martín Gómez[2], J. Palá-Paul[1], M.J. Pérez Alonso[1], E. Pérez-Urria[1], B. Pintos López[1], M. Puelles Gallo[3], M.D. Saco[2]

[1] Faculty of Biology, Complutense University of Madrid (SPAIN)
[2] Faculty of Pharmacy, Complutense University of Madrid (SPAIN)
[3] Faculty of Economics, Complutense University of Madrid (SPAIN)
avagar@bio.ucm.es, bcc@bio.ucm.es, magom02@bio.ucm.es, llamasje@bio.ucm.es, lmartin@bio.ucm.es, martingo@farm.ucm.es, quibey@bio.ucm.es, mjpa32@bio.ucm.es, elenapuc@bio.ucm.es, bpintos@bio.ucm.es, mpuelles@ccee.ucm.es, mdsaco@farm.ucm.es

Abstract

Complutense University of Madrid through the "Vicerrectorado de Calidad" develops projects to innovate and improve teaching quality. Among these projects is "Gastronomic Botany and Molecular Gastronomy" which aims to develop new materials and tools for the Virtual Campus and consequently offer new possibilities for teaching and training. Also this project organize and structure a new teaching matter for post-graduate education that will be an example of approach, relationship and cooperation between university and industry in the context of post-graduate learning and life-long learning.

The project focuses on the idea that for most people, plants, algae and fungi are a group of organisms for which there are very different perceptions associated with different interests that make up what may be called areas of specialization in Plant Biology. The "plant world" extends their knowledge to different fields, including horticulture, food science, food, medicine, nutrition, natural products, drug industry or economic and social areas.

There are three aspects around which is organized a body of knowledge related to gastronomy and "plant world": 1) Gastronomic Botany: use of plants, algae and fungi in food, 2) Nutrition and Health: Bioactive principles of functional foods, nutrigenomics 3) Economic Botany: social, economic and health aspects related to the plant products market. Gastronomy is a cultural object changing over time depending mainly on several factors: 1) raw material for food, 2) knowledge about the properties of some of these substances, 3) methods and techniques for the use of these materials.

On the other hand, in recent years has been expanding and using the term "molecular gastronomy" to refer changes in processing food.

Also all these aspects are related to two important questions: food safety and advances in functional foods and nutrigenomics.

Keywords: Botany, Plant biochemistry, nutrition, university, industry, post-graduate learning, life-long learning.

1 CONNECTING LEARNING WITH THE REAL WORLD

Post-graduate education, new educational materials, new materials for teaching and transferring disciplines are educational fields to develop new experiences in teaching-learning, life-long learning and e-learning. In some cases there are university spin-off companies as a result of these experiences.

Complutense University of Madrid through the "Vicerrectorado de Calidad" develops projects to innovate and improve teaching quality. Among these projects is "Gastronomic Botany and Molecular Gastronomy" [5] which aims to develop new materials and tools for the virtual campus and consequently offer new possibilities for teaching and training. Also this project organize and structure a new teaching matter for post-graduate education that will be an example of approach, relationship and cooperation between university and industry in the context of post-graduate learning and life-long learning.

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What is Gastronomic Botany and Molecular Gastronomy as a project of educational innovation? First let us attend to their conceptual basis and then consider the project structure.

All of us have ever heard "you have to eat vegetables, cauliflower, broccoli, for example, varieties of Brassica oleracea, plants rich in fiber, vitamin C and vitamins of group B, folate and minerals like potassium and phosphorus". *Plants, Food, Nutritional Content, Health.*

An air freshener or a cup of tea: Plants composition, processing plants, aromas, essential oils, plant products derived from plant secondary metabolism. They are also called natural products many of them have an important and significant medical and economic value, the latter from their use in cosmetics, pharmaceuticals and food industry, medicines, resins, gums, flavor enhancers (read the composition of many products, flavor enhancers, aromas, colors, etc.) *Secondary products of plant metabolism* (Fig. 1).

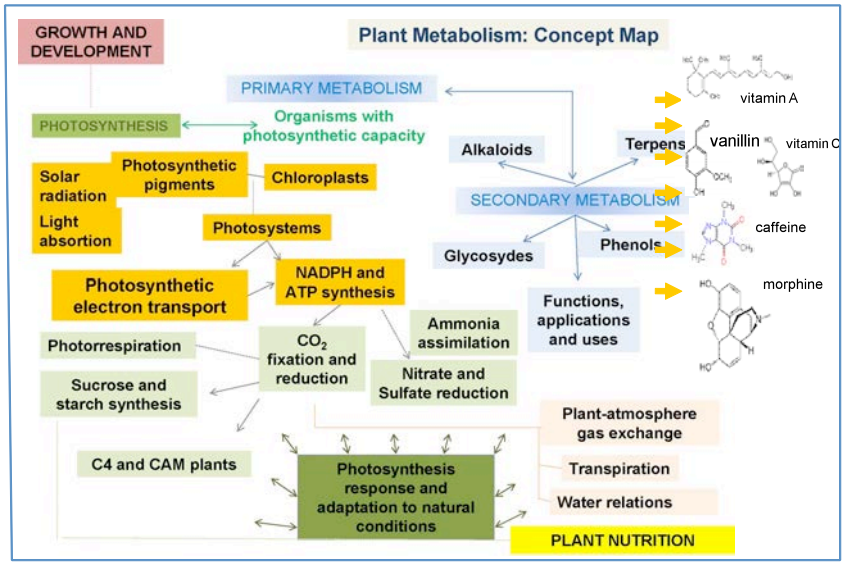

Figure 1. Concept map about primary and secondary plant metabolism, main processes and relationships.

A cotton shirt. Cotton (G.*Gossypium*), threads, fibers surrounding the capsule containing seeds. *Textile fibers*. Paper, *cellulose*, *plant polysaccharides*. A linen dress, *Linum usitatissimum* The linen wrapped egyptian mummies gives us an idea of the antiquity of the linen cultivation for textiles: the stem for the costume and seeds to extract oil (oleic, linoleic and alpha-linolenic acids). The same plant and different uses and applications.

Cannabis sativa, "industrial hemp" without tetrahidrocannabinoides for the production of fiber and seed oil for biofuel, and "medicinal hemp", the genetic variation which female reproductive organ is rich in cannabinoids, especially in tetrahydrocannabinol (hashish is obtained from the trichomes covering the flower). *Secondary Plant Products* as psychoactives.

Bergamot, *Citrus bergamia*, a citrus fruit that looks like a pear-shaped lemon. The oil of bergamot, the essence is extracted from the skin and used by food industry and cosmetics as a flavoring.

You could try a mixture of olives, sodium alginate and xanthan gum or xanthan, an extracellular polysaccharide produced by *Xanthomonas campestris* that is used as a thickener (you get a powder that dissolves in water to produce different viscosities). And the sodium alginate? It is a natural compound, a polysaccharide produced by brown algae, for example G. *Laminaria* and G. *Macrocystis*, formed by two types of monosaccharides: glucuronic and mannuronic acids. Alginic acid and its sodium, calcium or potassium salts are offered in three different qualities determined by the purification process. These qualities are "food quality" (completely free cellulose product, white or slightly yellow color), "pharmaceutical quality" (completely cellulose free product, white color) and "technical quality "(usually cellulose free product although it may contain a certain proportion, different

colors from white to yellow or brown, used primarily for the textile, paint, chipboard, etc). Alginates have many uses and applications derived from their properties as hydrocolloid thickeners, stabilizers, gelling agents and film formers.

The project described below meets knowledge and experiences based on the importance of plant biology in science, economics and society. Certainly for most people plants, algae and fungi are a group of organisms for which there are very different perceptions associated with different interests. Botany, biochemistry and plant physiology, phytochemistry, ethnobotany and plant biotechnology are levels of perception and interest, or areas of specialization in plant biology, that extends their knowledge to fields of agronomy, biotechnology, horticulture, plant pathology, improved species and plant productivity, managing natural resources, food science, medicine, natural products, the drug industry and socioeconomics. This importance stems from our absolute dependence on plant diversity (Fig. 2).

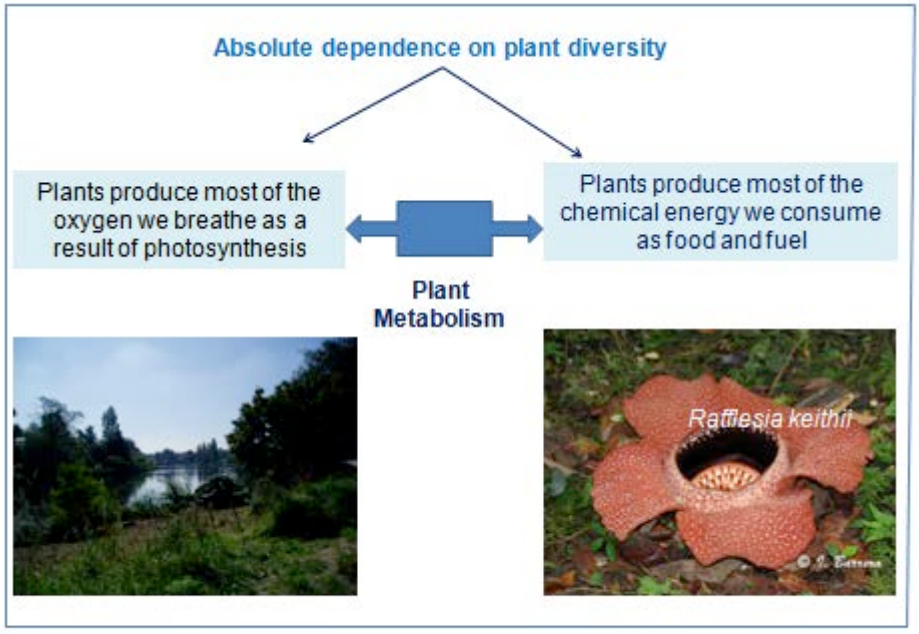

Figure 2. Meaning and relevance of plant metabolism.

We are considering the importance of plant biology, the world of plants, algae and fungi, from many points of view but particularly to take advantage of their biochemical and metabolic capabilities [3] that provide us food, medicine, energy and, ultimately, development and improvement tools in the context of nutrition, food, health and socioeconomics.

And a look at the history. Robert Hooke, english scientist born in Freshwater in 1635 and died in London in 1703, first described a "cavities" observing a sheet of cork (*Quercus suber*) under the microscope, the microscope in 1665, the year he published "Micrographia", a collection of microscopic observations reflected in detailed drawings. These "cavities" were the first observed cells, killed plant cells in the cork with a characteristic polygonal shape. And viruses were first isolated from plants. And Mendel conducted his studies about inheritance in pea plants (*Pisum sativum*).

And the great problem of humanity, malnutrition and hunger. Plant biology certainly helps and alleviates this problem by providing basic tools and products to increase and improve food production [4] (Fig. 3).

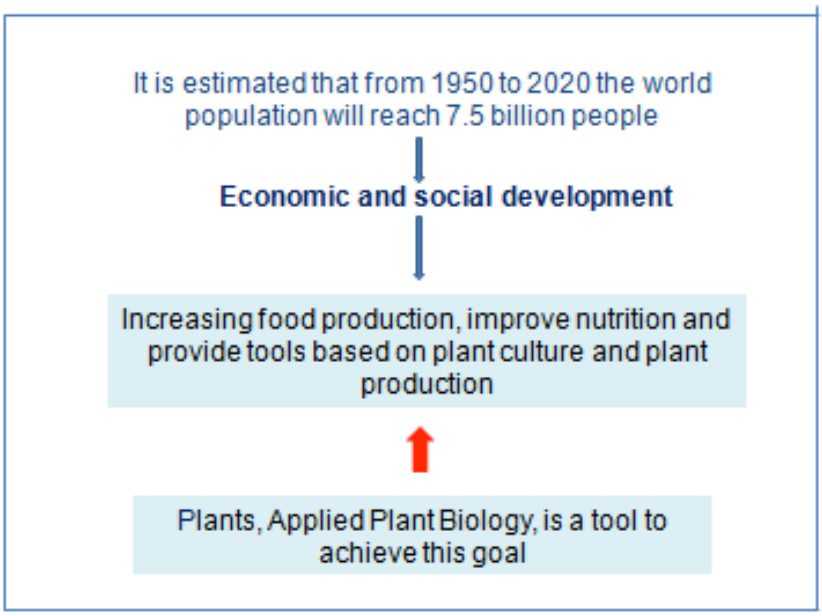

Figure 3. Economic and social development based on applied plant biology.

This project focuses on three areas:

1) Gastronomic Botany, use of plants, algae [1] and fungi in food.

2) Nutrition and Health: bioactive principles from plants, algae and fungi: nutritional aspects and influence on human health (Figs. 4 and 5).

3) Botany Economy: tools for development; social and economic aspects (Fig. 6).

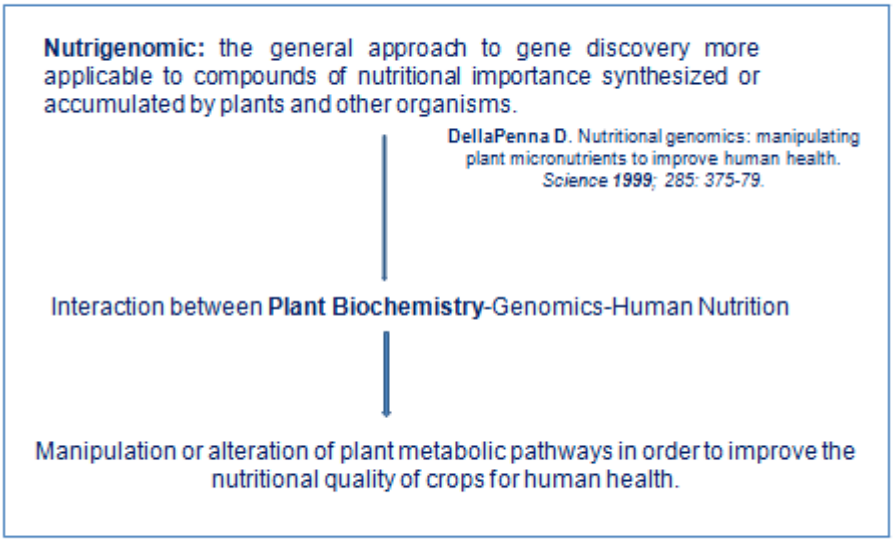

Figure 4. Applications of plant biochemistry and physiology.

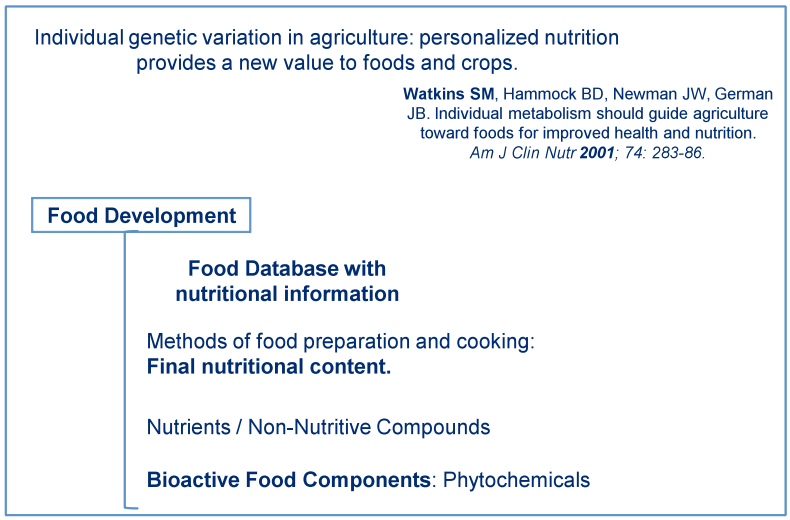

Figure 5. Aspects of food development.

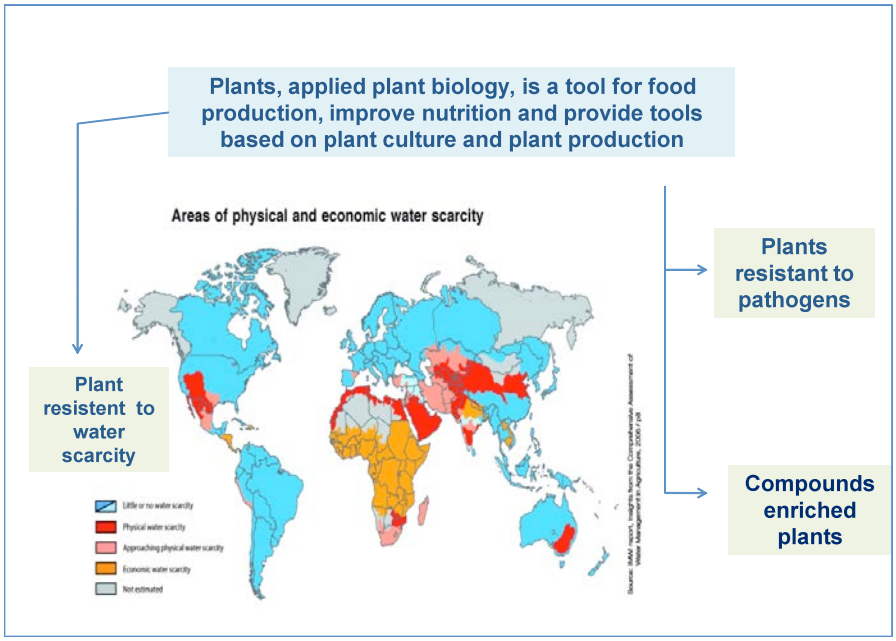

Figure 6. Tools for development based on applied plant biology.

2 NEW TRENDS AND EXPERIENCES: GASTRONOMIC BOTANY AND MOLECULAR GASTRONOMY

This project seeks an approach between the training function of the university and the professional reality outside the university, the productive society. In other words, the project seeks to integrate knowledge and experiences.

Gastronomy is a cultural object changing over time depending mainly on several factors: 1. The raw materials (animal and vegetable) that man could be found naturally in the environment. 2. The knowledge on the properties of some of those materials. 3. The availability of the same. 4. Processing methods and techniques for natural products consumption. 5. The introduction of new raw materials, which became grown in specialized areas and places.

Moreover, in recent years has been expanding and using the term "molecular gastronomy". It was coined by Hervé This and Nicholas Kurti in the 1970s to refer to the changes experienced in processing food. This project will address this issue and provide scientific answers to simple questions of biochemistry in the kitchen.

In all these respects there are two important scientific aspects with social screening as part of Public Health: food safety and advances in functional foods [2] and nutrigenomics. This last field can be defined as a "young science" that studies the interaction of food and its components with the genome at molecular, cellular and systemic levels, with the aim of using diet to prevent or treat diseases. Born as a result of the confluence and interaction of Plant Biochemistry-Genomics-Human Nutrition at the sight of the metabolic pathways in plants can be manipulated or modified to improve the nutritional quality of crops for human health (Fig. 4). When it comes to functional foods, the term refers to the development of products with beneficial effects on physiological functions that contribute to improving health and reduce the risk of disease (Fig. 5). In this sense, since 1960 seeds were obtained with high content of polyunsaturated fatty acids to reduce cholesterol levels [2].

Related to vegetables, it is called "food development" considering that methods for preparation and final nutritional content can be modified. All this is "molecular gastronomy", non-nutritive components and bioactive components (phytochemicals) (Fig. 5).

This project structure a body of knowledge and professional experience that is progressively incorporated into the university. The main contents are:

1) Develop training materials for the virtual campus as an open classroom, which serves to organize and structure a new teaching on "Gastronomic Botany and Molecular Gastronomy" which has no place in the undergraduate and covers an important gap in educative programms at the university.

2) Materials for the virtual campus will incorporate two types of documents:

2.1. Training documents on the following issues:

2.1.1. Plant, algae and fungal products in food, nutrition and gastronomy. Gastronomic botany and molecular gastronomy

2.1.2. Food Security.

2.1.3. Trends in food. Gastronomy as a cultural object.

2.1.4. Food and Health. Plant Biochemistry-Nutrition-Health. Functional Foods [2] and Nutrigenomics.

2.1.5. Plant products market: Changes in tastes and preferences of consumers over time. In this sense, market research is an essential tool that helps detect these changes and also the acceptance of new products. Therefore, it is also interesting to focus research on those products most suitable fields and promising with respect to marketing. Analyze consumer behavior, know the market and product demand are important social and economic aspects. Know what you buy and why buy in this sector is important to know how to improve [6].

2.2. Image bank.

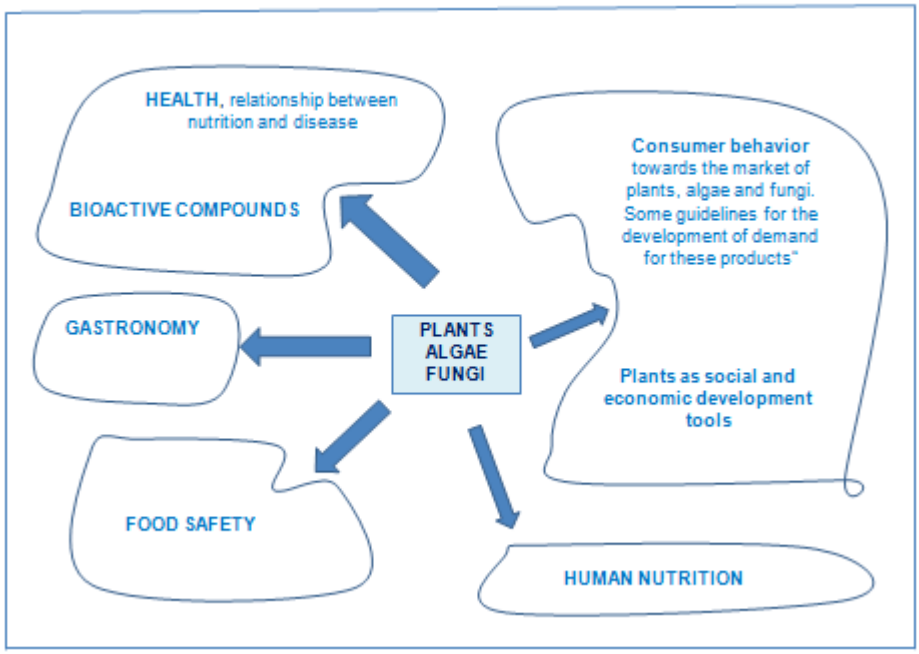

Figure 7. Knowledge organization.

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