

The Athena team discovered the gene responsible for the high anthocyanin content of these fruits

Between history and genetics: on the trail of blood orange

Blood oranges of Sicily are unique in the kingdom of citrus. They have a distinctive deep, sweet, flavor well known by anyone who has tasted them, but this is only part of the story. More importantly they have a high content of anthocyanins, which are powerful antioxidants and are responsible for their characteristic colour. The anthocyanins in blood oranges place them among the foods that a healthy diet should include. Scientists collaborating in the European Project, Athena, discovered the gene responsible for the high anthocyanin content of blood oranges, and how this gene respond to the peculiar climate of Sicily, to create such colorful, healthy and tasty fruit. This research has also a very interesting historical perspective. Researchers tried to trace the origins of Sicilian blood oranges' using genetic techniques, consulting antique books, and even a painting from Bartolomeo Bimbi, a Florentine artist painter of plants and animals at the Medici court in the 18th century. We talked about this "quest" with Eugenio Butelli, first author of the study. (continues on page 3)



From the Lab to the Roman ruins: when Research means discovery



The Athena meeting in Campobasso represented a good opportunity to discover one of the less known area of Italy. The Molise region, placed in the Southern part of the country, is hosting the site of Altilia, one of the greatest archaeological sites of Europe.

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An alternative way to get “marine” omega-3 fatty acids for your health

Wild plants seem to offer solution to the deficiency in our diets of these healthy fatty acids



Michel de Lorgeril

Lack of plant and marine omega-3 in diets is one of the major concerns for nutritionists. Indeed most of the diets are low in omega-3, precious fatty acids that are indispensable for the correct function

of organism, in particular the brain, and have been shown to play a role

also in the prevention of cardiovascular disease.

Michel de Lorgeril, from the University of Grenoble, is in charge of studying the effects of these fatty acids on health. The picture he's describing is not actually comforting. Yet a great help may come from unlikely sources.

What is the situation regarding omega-3 fatty acids consumption?

Our diets are poor in plant and marine omega-3 while we have an overconsumption of omega-6, which are good, of course, but only in limited amounts. Each meal we have every day is mainly rich in omega-6, also meat for example, since animals are fed food rich in omega-6. This overconsumption of omega-6 is due to a quite recent (second half of the 20th century) and deep change in our dietary habits. Once things were quite different since we had a more balanced intake of such fatty acids, i.e. a nice omega-3/omega-6 ratio.

Anyway, the task is to boost the daily intake of omega-3 fatty acids.

In the traditional Mediterranean diet the main source of omega-3 was from wild plants and fish. In ancient times

people from Mediterranean areas use to have these plants daily and all year long and they fed animals wild plants as well.

Their source of omega-3 was pretty good but now things are changed. We can't satisfy our nutritional needs just by getting marine omega-3, as fish for example has become a rare and precious food (overfishing) often contaminated by heavy metals and other pesticides. Thus we have to find new ways to boost our intake by eating wild plants.

The Masai tribe in Kenya (for instance) does not eat fish but they have adequate amounts of marine omega-3 and their blood and tissues. This means that they synthesize them from plant omega-3 and from plants with enhanced content of polyphenols. We actually have shown that polyphenols help to synthesize marine omega-3 from plant omega-3 in our body.

People from Okinawa, where you find a high number of centenarians, get omega-3 from soy and do not eat a lot of fatty fish.

Our major problem is that western populations do not eat enough plant-derived polyphenols and plant omega-3 either because their diets do not include enough plants, in particular wild plants, or because animals are no longer fed wild plants. In this way, we do not get enough sources of these essential compounds.

What is the diet of the future then?

We have two possibilities. We shall conceive a new diet by taking into account the industrial world and the evolution of the environment, but it is a quite slow process. You need long time before getting results. Another option is to look at the traditional diet, especially to the Mediterranean one. Ancient people already made the job for us, although the conditions are deeply changed since then. Fish, for example, is now full of heavy metal and pesticides. Moreover, consuming fish regularly has become quite expensive for all.

Visiting the Pasta Factory in Campobasso...



Between history and genetics: *on the trail of blood orange*

Athena scientists discovered the gene responsible for the high anthocyanin content of these fruits

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You conducted a lot of researches, in and out of your lab, tracing blood orange origins.

Yes. It is a very interesting topic. Many people have been fascinated for centuries by blood orange origins, due to their unusual color. And we have some interesting anecdotes. So to speak, the legend that they would have been bitten by vampires, therefore being contaminated by blood. A little more seriously, some people thought blood oranges were the result of a cross between ordinary oranges and pomegranates, something we know to be impossible. Again, more recently there was the idea that those plants were affected by a disease, maybe a virus.

After all, you discovered that blood oranges owe their peculiarity to a category of DNA sequences called retrotransposons, acting somehow like viruses.

That is true, but it is important to highlight that we are not talking about a real virus or a disease. Anyway, after we understood the molecular basis at the heart of blood oranges, we started thinking about other interesting questions: where do they come from? And when did they appear? We had two hypothesis: a spontaneous mutation of blonde orange could have happened in Sicily in recent times; or blood oranges could have been imported from Asia.

How did you carry on these researches?

We started examining various historical archives in Sicily. In an ancient book we found mention of red oranges "brought in Sicily by a Genoese missionary returning from a trip to Asia, China and Philippines". The point is that the book talks only about generic "red" oranges. We found the same problem for ancient paintings, such as the one from Bartolomeo Bimbi, a Florentine artist author of the Medici Citrus collections early in the 18th century. We see red oranges, sure, but we do not know where the color come from. Many citrus are red, but not necessarily because of anthocyanins, like real blood oranges. Other substances, carotenoids and lycopene in particular, can confer that color.

But in any case the clues point to China.

It was a good bet. Imported from there to Sicily, where they found ideal conditions to fully develop their potential. If this is true, we should find the ancestor in China.

Indeed, we met Chinese researchers talking about a blood orange variety they consider original, whose existence has been known for at least a hundred years. The plants are in an isolated valley, never reached by western people in ancient time.

But when we got to genetics things changed quickly. The DNA mutation giving Chinese blood oranges their anthocyanins content is similar to the one we observed in Sicilian ones: a retrotransposon acting on the same gene. But it is not exactly the same, and it is inserted in the opposite orientation. They are different events leading to the same effect.

So we do not have an answer on blood orange origins?

Unfortunately not. What we know is that we have two independent varieties: the Sicilian (that gave origin to all the commercial blood orange varieties) and the Chinese one. For sure, Sicily is crucial in this story: all the blood oranges in the world, such as those in North Africa, Spain and even America are related to the current Sicilian varieties.

« We started thinking about other interesting questions: where do they come from? And when did they appear? »



Eugenio Butelli

The two EU reviewers: we're looking forward for the following part of the project

A view from Europe: interview with Isabelle De-Froidmont-Goertz and Stefan Martens



**Isabelle De-Froidmont-Goertz and
Cristina Andrés-Lacueva**

The efforts made during the last years in supporting projects on nutrition and health represent an important signal of the deep interest of Europe in studies of this kind. Isabelle De-Froidmont-Goertz and Stefan Martens joined the last Athena meeting held in Campobasso, and besides a comment on the project's development, we asked them to give a personal view on some of the

hottest topics drawing Europe's attention. Stefan Martens looks absolutely enthusiastic about the project and shows a real interest for its future development.

"Athena is a very interesting project - the reviewer says- It focuses on the mechanism by which food exerts a beneficial effect on health. Everybody talks about it, but nobody really knows why food is so important for health. The food issue is becoming dramatically important also for developing countries which are now facing the same problems of western countries. Lack of time in preparing healthy food for example is one of the most effective changes that have led contemporary societies to a radical reversal of their eating habits, with the consequent increase of food-related health problems. Ready-to eat food is changing people's eating habits with products to be just put in the microwave, consequently losing vitamins and other nutritional compounds".

What is your personal consideration regarding GMO?

"The strength of Athena relies also on the comparison between

traditional food and GMO food.

GMO are already the future and represent a great resource for human feeding. Genetic engineering is not different from plant crossing: they're both based on DNA combination. The advantage is that genetic engineering is faster and you get early results. Studies like Athena are extremely important also in shedding light on controversial beliefs within public opinion on GMO food and their future usage."

EU reviewer Isabelle De-Froidmont-Goertz, involved in studies on nutrition and health all along, says that "in Europe there is a major concern on the epidemic of obesity and diabetes which are closely related to food and lifestyle habits in general". Although she said to be really satisfied with the project, she's looking forward for the second part of the study "When the most of the work will be done".

The new shape of food approaching in modern times has important repercussions on health, yet it does not rely only on personal choices. New features have emerged in recent years, and their role in promoting or discouraging healthy choices is not marginal at all.

Money, for example, as suggested by Isabelle. "The cost of healthy food may represent an obstacle for disadvantaged groups. Lower-income groups may have problems in getting healthy fruits and the persisting economic crisis suggests things can go even worse".

Stefan Martens



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ATHENA Partners

Cathie Martin, John Innes Centre, Norwich, UK
Chiara Tonelli, University of Milan, Milan, Italy
Pier Giuseppe Pelicci, University of Milan and IEO, Italy
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Daniele Cusi, KOS-Genetic SRL, Milan, Italy