Global change
A DISCUSSION ON GLOBAL CHANGE AND BIOTECHNOLOGY

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He was visiting professor at New Jersey Institute of Technology and at Rutgers University (NI, USA) in 1993 and 1994. He is currently the coordinator of the Industrial & Environmental Biotechnology section of the Italian Technology Platform on Sustainable Chemistry and he coordinates/participates in several European research projects in the field of biological monitoring and remediation of contaminated sites and the biotech conversion of wastes and agro-food byproducts, wastes and effluents into flavors, microbial polymers and biofuels.

Fabio Fava ~ Full interview

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1. What are the most remarkable developments in your field of expertise, organic waste and soil remediation?

The integrated valorisation of organic waste streams, in particular of agro food by-products, effluents, waste and surplus, with the production of value-added fine chemicals, materials, biofuels and water is a new and challenging development. Organic waste streams are extensively produced in Europe (about 2,500 millions of tons per year) and they are mainly composed of agricultural waste, garden and forestry waste, sludge, food processing waste and organic household waste (about 1,000, 550, 500, 250 and 200 million tons/year, respectively).

Several food companies are currently paying a lot of money for the destruction of their by-products, waste, effluents and surplus. But these are a source of bioactive molecules and biomaterials and, following proper fermentation or bioconversion, of a large array of conventional and new bio-specialties (food ingredients, pharmaceuticals, fine chemicals), biomaterials (biopolymers, lubricants, fibers, pigments, proteins), base chemicals (organic acids, amino acids, vitamins and other metabolites of fermentation) along with biofuels (bioethanol, biogas). Given their biological origin, biodegradability and non toxicity, they are of special interest for the modern food, pharmaceutical, cosmetic, chemical, textile and energy industry. The market of such products is currently increasing enormously worldwide: from 77 to 125 billions € from 2005 to 2010. Thus, the adoption of such strategies for organic waste valorisation can permit significant improvements in the sustainability and competitiveness of the industrial sectors mentioned above, by allowing them to better fulfill Europe's vision of a sustainable and competitive knowledge-based economy.

However, the costs of technology required for integrated waste valorisation might be high, mostly of the fact that the industry dealing with such issues is still underdeveloped and dominated by processing costs. Such costs can be significantly reduced by intensifying the research and development activities in the field. The low or no costs of starting material along

with the environmental benefits coming from the concomitant waste disposal would mitigate the adverse economical balance of the strategy.

In the field of soil remediation, the use of biological techniques and tools for both monitoring and remediating hydrocarbons-contaminated sites provide interesting results in terms of clean up efficiency and environmental and economical sustainability. The use of biotech tools and strategies in the field of contaminated sites restoration should be boosted and receive much more attention than it has so far.

2. You said we have to work more on this subject. How can or should we do that?

The organic waste and agro food by-products, effluents and wastes are poorly used for generating commodity and specialty chemicals, at least in Italy and some other Mediterranean countries where agro-food wastes are extensively accumulated. Only the production of biogas from some organic wastes is well established, especially with effluents and liquid waste from the agro-food industry.

We need to demonstrate the performances of the currently available thermo-chemical and biological biomass conversion protocols in the valorisation of waste and the actual impact of such approaches on the suitability, effectiveness and economy of the processes and technologies currently available for biomass conversion. To do this we have to favour the transfer of knowledge existing in the field of organic waste valorisation from the laboratory bench to the pilot scale.

Another crucial point is the homogeneity of the waste and related streams. They have to be matched and pre-treated before being sent to the valorisation treatment. It is important to get the desired efficiency and reproducibility in the process.

3. Can biotechnology play a role in the field of waste?

As mentioned before, biotechnology is crucial in this area. Indeed, biotechnological approaches and tools can permit efficient valorisation and in a sustainable and tailor made way a number of waste streams largely produced and accumulated in the EU.

4. And the enzymes or microbes applied are genetically modified in this case?

Not necessarily. We can use conventional enzymes produced by fungi and bacteria; they are largely available at low price in Europe. We can also count on a large variety of robust and specialized “natural microbes” (i.e., bacteria, years, fungi, algae, etc).

Of course, the use of specifically developed microbes (GMOs) in waste valorisation can provide more efficient and/or better tailored conversions and products, including new chemicals or biomaterials, but the catalysts have to be applied in a closed process preventing any releases of GMO cells into the environment. The poor stability of some genetically modified micro-organisms represents an additional limitation on the use of GMOs in waste streams pre-treatment and biological valorisation.

5. Can biotechnology also play a role in bioremediation?

Of course. This is another key issue, because biotechnology can allow us to efficiently remediate a number of contaminated soils and sediments with much lower impacts towards the treated contaminated matrix and costs than of conventional and of several advanced chemical and physical treatments. Therefore the social acceptance of bioremediation is higher than that of other types of treatments; especially when it happens in their back yard.

Biotechnology can also offer special tools and strategies for an improved and more efficient site monitoring and risk analysis. Biotechnology is not suitable for the remediation of heavy metal contaminated soils and sediments and for the aerobic remediation of highly-chlorinated compounds.

6. Do you think there are GM bacteria that can be helpful in bioremediation?

Bacteria can easily be modified. And in my view they can be used in soil bioremediation, but only in bioreactors and well-contained bioremediation schemes and facilities. They might offer a number of advantages: they can perform the complete biodegradation (mineralization) of some pollutants, very specific pollutant biotransformations and conversions and improve rates and yields of pollutant conversion. If we are bioremediating waste by generating new biomolecules and biomaterials, we have to be sure to be able to separate the final products from the biomass, because we cannot have GMOs in the final products. If there are GMOs in the products, we cannot sell them.

7. Are there differences between developed and developing countries concerning organic waste use?

On the basis of my experience, the difference is that developing countries care less about the selective recovery of waste, and therefore the valorisation of different waste streams is difficult to put in practice and be exploited. These countries probably need some time to consolidate their knowledge in the field. However, they generally take all the opportunities they get and they are very often more open to new and more sustainable approaches than developed countries.

If we are able to convert waste into biofuels, in chemicals and biomaterials we will have two benefits. One is that we dispose of the waste and the other is that we produce biofuels and value added compounds that are useful for improving the sustainability and competitiveness of conventional industry. And this is a key opportunity for the developing countries as well.

8. And what will the field of waste look likes in 20 years time?

What I hope is that these ideas of using organic waste streams for producing valorised compounds and biofuels get much more room. There are some FP7 calls dealing with useful waste valorisation through the application of the so called bio refinery concept. And this is a clear and important signal. Many European researchers and institutes will work on this issue. We need some more information on the transferability of the approach and the feasibility of its

scale up, but I am confident that in a few years the large scale production of biofuels, chemicals and materials from wastes will be a reality.

9. Do you have a statement, question or dilemma for the website?

A discussion point could be: ‘Organic waste is an opportunity for sustainable biofuel, biomaterial and biochemical production and biotechnology can have a crucial role in this perspective.’

http://www.globalchange-discussion.org/