



Editorial

Feeding humans is one outlet for agricultural products, but not the only one: agresources are an amazing mine of new products, both food and non-food. One of the challenges for CIRAD researchers is to use these renewable raw materials to produce molecules with a high added value.

Once promising properties are detected in a given plant, sometimes by studying traditional practices, subsequent research takes three forms: identifying worthwhile molecules in the raw material, extracting those molecules, and processing them to improve their shelf life and efficacy. The same approach applies to products as exotic as camel's milk and as humble as production waste.

In addition to their beneficial effects on consumer health and nutrition, the new products resulting from such research have a positive impact on the economy, since they represent new opportunities for agriculture and industry, thus generating new sources of added value and jobs.

The projects described were all mounted with partners capable of helping to disseminate the innovations developed. Working now with socioeconomic partners who will in turn be producing innovations in future is one of CIRAD's priorities. If you are interested in the topics covered in this issue, please get in touch so we can build new projects together.

Véronique VISSAC-CHARLES
CIRAD Technology Transfer and
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News from the world of cotton

CIRAD has just launched a newsletter on the different cotton policies worldwide and on the reactions those policies arouse among stakeholders, within the framework of an EU project, Integrating Social Science Research Cotton Reform Implementation Lined with the International Outlook. The newsletter is compiled by monitoring online newspapers from the main cotton-growing countries worldwide. It exists in both English and French. To subscribe: www.isscri.org/fr/

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All you need to know about bananas

With more than 100 million tonnes sold in 2003, dessert bananas are the world's leading fruit crop. CIRAD has just published a new book about bananas and their cultivation, in response to the concerns of stakeholders involved in producing bananas for export. Recaps on the existing information on the plant, of parasite constraints and of recent economic trends concerning the product are followed by an account of the concepts of rational cultivation and organic bananas.

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Training in avian influenza control

CIRAD is now offering a new training course in animal epidemiology, specifically tailored to avian influenza surveillance and control. The course is intended for technicians and veterinary surgeons from countries in Africa and Asia affected by or under threat from the disease. The sessions are held in the countries concerned, and last five days. Twelve sessions have already been organized in 2007 in conjunction with the FAO and the World Organization for Animal Health, and others are planned for 2008. In addition, a self-training CD-ROM, Ranema-flu, will be available at the end of September.

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Fruit and vegetable chip production

CIRAD recently signed an operating agreement for a patented chip production process with the agrifood equipment manufacturer FEMAG (Hérault, France). The process consists in drying and then frying fruit and vegetable pieces. The slices of banana, pineapple, kiwi or carrot produced have an attractive colour, crunchy texture and low fat content. FEMAG has developed a chip production unit suitable for all types of temperate and tropical fruit and vegetables.

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A competitiveness cluster in Réunion

QUALITROPIC is a competitiveness cluster for agronutrition in tropical environments, based in Réunion. It supports research projects in the agrifood and agrihealth fields, preferably involving firms from the Indian Ocean region. Several CIRAD projects have been approved and funded in 2007, on sugarcane, onion, poultry litter, water treatment, etc. QUALITROPIC has just published its first newsletter, which is available on its website: www.qualitropic.fr.

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Science

▶ ALBICIDIN BIOSYNTHESIS

Albicidin is a powerful antibiotic produced by *Xanthomonas albilineans*, a bacterium that affects sugarcane. Determining the structure of albicidin should enable the development of a new family of antibiotics, as the molecule is unlike any of the antibiotics described to date. However, the low level of albicidin production in *X. albilineans* is hampering studies of its spectrum of activity and its therapeutic applications.

determining the structure of albicidin should enable the development of a new family of antibiotics

In conjunction with the University of Florida, CIRAD has cloned all the albicidin biosynthesis genes and developed a way of producing albicidin in other bacterial species. This means that it is now possible

to produce large quantities of albicidin (30 mg/l of culture), in a cost-effective way. The quantity required to determine the structure of the molecule should soon be available. Tentative links have been established with the pharmaceuticals industry with a view to developing new albicidin-based antibiotics. ■

▶ Are you interested in this new antibiotic?

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▶ CAMEL'S MILK, A HEALTH FOOD

Camel's milk is used in many countries for its medicinal and therapeutic properties and renowned nutritional quality. In central Asia, it is used to fight tuberculosis, as a stimulant and as a health food.

To identify the active ingredients in the milk, CIRAD and the University of Kazakhstan embarked upon an in-depth study of the physicochemical and biochemical composition of camel's milk in a wide range of conditions: different seasons, regions and camel species.

the amount of vitamin C is between three and ten times higher than in cow's milk

The level of antibacterial substances (lactoferrin, immunoglobins) is slightly higher than in cow's milk. The amount of vitamin C, which has stimulant properties, is between three and ten times higher than in cow's milk. Lastly, the fat in the milk contains a particularly high proportion of unsaturated fatty acids, which are known to be good for health. ■

▶ Are you interested in this project?

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▶ THE NONI, A FRUIT REPUTED FOR ITS MEDICINAL PROPERTIES

The noni is a fruit of Asian origin that has long been used as a traditional remedy in Polynesia, Central America and Oceania. It is reputed to have numerous antibacterial, antibiotic, antioxidant, hypotensive, antihistaminic and anti-cancer properties, among others. For modern pharmacopoeia to make optimum use of the noni, we need to understand what lies behind its medicinal characteristics.

CIRAD has thus launched a study in partnership with the *Centro de Investigación en Tecnología de Alimentos* in Costa Rica and the Universities of Montpellier I and II, to test the functional and nutritional properties of the compounds found in noni and determine the physicochemical, nutritional and microbiological changes in cultivated noni after harvesting. Moreover, the methods currently used to process noni juice in Costa Rica are still

for modern pharmacopoeia to make optimum use of the noni, we need to understand what lies behind its medicinal characteristics

highly empirical. Stabilization processes such as noni pulp pasteurization and tangential microfiltration of noni juice are being tested, and their impact on the nutritional and functional potential of these products is being analysed. ■

▶ Would you like to find out more about the noni?

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A new range of palm sugar-based products.

Market

▶ FOOD POLYPHENOL COMPOSITION

Polyphenols are molecules with antioxidant properties that are found in every fruit and vegetable, and also in processed products such as chocolate, tea and wine. Numerous studies suggest that these compounds may play a beneficial role in protecting against cardiovascular disease and in slowing cell ageing.

compiling a national database on the polyphenol content of all fresh fruits and vegetables

In an attempt to boost fruit and vegetable consumption, CIRAD has recently been involved in compiling a national database on the polyphenol content of all fresh fruits and vegetables, and on their contribution to total polyphenol consumption. Work is continuing on the most commonly consumed processed products (juices, purees, jams, etc). The project should thus provide relevant information on the effect of processing on total polyphenol content and certain specific molecules. ■

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▶ FRUIT JUICES FROM LATIN AMERICA

Rural populations in Latin America eat a wide range of fruits containing molecules that are good for health (polyphenols, vitamins, minerals, etc): Andean blackberry, red pitahaya, camu-camu, berrycactus, cashew apple, tree tomato, etc. These fruits are of vital economic importance, but are often only sold on local markets, notably due to a lack of processing and stabilization techniques suitable for the production zones concerned.

With EU funding, CIRAD and its local partners are currently working to develop cold filtering membrane technologies to conserve and concentrate these fruit

Technology

► OLIVE OIL WASTE WATER TREATMENT

The waste water produced during olive oil extraction is considered to pollute the environment, and is costly to dispose of. However, it is also a source of antioxidants, which are highly sought-after due to their health properties.

With the financial support of the Languedoc-Roussillon Regional Council, CIRAD has developed a simple, economical way of extracting antioxidant phenolic compounds from olive oil waste water, and also from green coffee and artichoke aqueous extracts. The process has been patented. It recovers polyphenols such as tyrosol or chlorogenic acids, which have a high biological value. The products obtained are useful for making health foods and cosmetics.

the products obtained are useful for making health foods and cosmetics

A Moroccan firm has recently set up a pilot olive oil waste water treatment unit using the process, to demonstrate the feasibility of large-scale treatment operations. ■

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► BIOREFINING, A NEW WAY OF OPTIMIZING AGRIPRODUCTS

Biorefining is a new agriproduct processing approach that can produce a range of target products from a given biomass, unlike the conventional approach, which generally centres on a single product, with the remainder being coproducts for which a use has to be found.

CIRAD is working with the British firm PHYTATEC to develop an original biorefining concept, for instance with a view to isolating various fractions with specific functional properties from an oilseed: active compounds, chemical intermediaries, biofuels, polymers, etc. The process concerned combines and makes use of the advantages of several modern technologies, including supercritical fluids (CO₂, water), for their high diffusivity and solvency, low viscosity and the possibility of adjusting their selectivity according to temperature and pressure. Moreover, the process avoids the need for organic solvents and does not leave any harmful residues in the end products. The progress made to date means that it should be possible to apply the results on an industrial scale in the near future. ■

the process avoids the need for organic solvents and does not leave any harmful residues in the end products

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► DEVELOPING PLANT MILKS

The lactic bacteria in fermented dairy products are good for health. They maintain the equilibrium of the intestinal flora and reduce pathogenic bacteria populations by producing bacteriocins. Nisin in particular, which is secreted by *Lactococcus lactis*, hampers the development of various germs—*Salmonella*, *Listeria*, coliforms and *Clostridium*—in food products.

To develop new “lactic” food additives for both nutritional and sanitary purposes, CIRAD has developed an *L. lactis* culture method on maize, rice and cassava flour. It is associated with another lactic bacterium capable of hydrolysing starch and converting it directly into lactic acid. The end product is dry and can be used as an antibiotic or a probiotic.

CIRAD has developed an *L. lactis* culture method on maize, rice and cassava flour

The product can be combined with a third *Lactobacillus* that stimulates growth in chickens, to make a preparation that is used on poultry farms in Thailand. The many live microorganisms it contains colonize the intestinal flora, facilitate digestion and prevent the development of pathogenic microbial strains. ■

► Would you like to work with us?

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juices while preserving their flavour and heat-sensitive antioxidant compounds.

Their work in Costa Rica, Ecuador, Mexico and Brazil have already led to the production of stabilized blackberry juice that keeps its red colour and “wild fruit” flavour, and of a deep red pitaya extract that could be used as a colouring. ■

production of stabilized blackberry juice that keeps its red colour and “wild fruit” flavour

► Are you interested in our projects?

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► PALM VINEGAR AND WINE

In Cambodia, 85% of the population depends on agriculture for a living. Sugar palms, which are emblematic of the country, make a significant contribution to rural life by providing a sweet sap that is harvested from the buds, and also timber and fruit, among other things. Their sweet juice is traditionally heated to make a brown sugar.

The Cambodian firm CONFIREL was keen to make better use of palm sap, and contacted CIRAD with a view to developing new, stable products suitable for the export market. Cold microfiltering on ceramic membranes was tested as a way of avoiding heating the juice. The juice produced is stable in bacterial terms, and retains its specific flavour. This “clean” juice is currently being used to develop other products. In particular, it can be subjected to acetic fermentation, to make palm wine and palm vinegar. These products are now being sold on the export market. ■

developing new, stable products suitable for the export market

► Are you interested in these products?

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BIOHAINAUT

BIOHAINAUT is a young Belgian company providing scientific services to agrifood, pharmacological and cosmetics firms. Since 2005, CIRAD and BIOHAINAUT have been working together on the extraction and industrial use of plant enzymes from papaya latex.

Interview with Mr Frantz Scheirlinckx, Research and Development Manager at BIOHAINAUT



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○ What does BIOHAINAUT do?

BIOHAINAUT is primarily a service provider for other agrifood firms: scientific arguments, laboratory trials, pilot-scale production, etc. Alongside these activities, BIOHAINAUT is stepping up its own research into plant enzymes and recycling of waste from snail (shell, mucus, spires, etc) and mushroom production. In particular, we have developed a pilot morel mushroom production plant.

○ How did you make the switch from snail extract to pharmacology?

Don't forget that snail soup is a traditional cough remedy! We set out to find out why. After studying the scientific literature and existing patents and conducting laboratory tests, we isolated compounds in the mucus that indeed seemed to be effective against dry coughs and even certain skin conditions. We are currently trying to size up the market for these products.

BIOHAINAUT at a glance

Nationality: Belgian
 Status: private limited company
 Founded: 2004
 Staff: 7
 Turnover: 300 000 euros/year
 Field: enzymology

○ How did you get to know CIRAD?

Some of our raw materials come from the tropics, where CIRAD is well known. Moreover, as we work on enzymes, I was familiar with publications by Pierre Villeneuve, a biochemist at CIRAD. When he got in touch to ask us for papaya enzyme samples, we realized we could probably work together. We therefore decided to set up a project in line with EUREKA, the EU initiative to support research in partnership with businesses, along with the CNRS.

○ What are the most significant results of your collaboration with CIRAD?

The project consisted in extracting plant lipase from the waste generated by papain production. It was given EUREKA approval in January 2007, a sign of quality that is important for the image of our SME. We have already obtained an extract containing lipase. Its enzymatic activity is good, which bodes well for future organic chemistry applications in industry. We have even taken on a new staff member, based on the prospects for such a product.

○ Do you have any plans for new projects with CIRAD?

In future, we could look at extracting other plant enzymes from different tropical plants or fruits with industrial potential.

○ You set up your own company: how did you do start?

The founder of BIOHAINAUT was already involved in supplying industrial enzymes. The constant search for new applications for such enzymes led him to offer this service to other firms. The company was lucky enough to have the material and methodological support of the business incubator based at the Mons science park. There were two of us on the staff in 2004, and now there are seven!

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Thailand



Thailand is the world's leading natural rubber producer. CIRAD has been conducting research there for more than ten years now, on the major global issues relating to sustainable development: improving the productivity of agricultural and animal production operations while tackling the main environmental challenges, product quality and food safety, reducing the gaps between urban and rural areas, etc. These operations are open to the Greater Mekong sub-region.

► **CIRAD in Thailand** has eight researchers. Each year, it helps train around twenty Thai students and provides training in food safety, water management, etc. A new Masters course in rubber growing is being set up.

CIRAD works in partnership with universities and agricultural research centres in Thailand, and with international research organizations. A research platform in partnership on rubber growing is currently being established.

Its main operating fields are:

- improving rubber plantation productivity: physiology of rubber production, rubber quality criteria, rubber tree genetics;
- soil agroecological management;
- use of multi-agent systems for integrated natural resource management;
- participatory modelling of public water management policies;
- food safety;
- breeding rice varieties resistant to blast;
- trypanosomiasis in Southeast Asia.

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► Specific experience of agrifoods

CIRAD's researchers are concentrating on food safety (pathogens, antibioresistance in aquaculture, etc), on determining product traceability by studying the microbial ecology, and on bacteriocins derived from lactic bacteria as a substitute for chemical antibiotics. They also provide training in the new European food legislation and designations of origin, which is of use with regard to the export market.

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