The piece below in italics is part of a note written in 2006 by David Kennedy, writer, founder of the NGO 'Leaf for Life' in the USA and promoter of green leafy vegetables in general and leaf concentrate in particular.

"Our food begins as rays of sunlight race across 93 million miles of empty space in less than 9 minutes and land on the tender green leaf of a living plant. A few trillionths of a second later chlorophyll in the leaf has combined carbon, hydrogen and oxygen from the air and water into glucose, the fuel of life.

Glucose is converted into more complex sugars, starches and fibres and combined with other elements from the soil to make proteins, fats and vitamins. There is always some energy lost when plants store the food produced by leaves in their stems, roots, fruits and seeds. The loss of energy, or trophic loss, is even greater when that food is fed to animals.

This basic ecological fact explains why leaf crops can produce more nutrients in a given space or time than any other agricultural system."

How could we put it more simply and clearly? This basic reality is also APEF's *raison d'être*: all you have to do is separate the nutrients in leaves that can be directly assimilated by humans from those that can't! The latter can be consumed by cows, sheep, goats or rabbits and its value realised in milk and/or meat production. This 'fractionation' of the leaf is obtained by grinding and pressing the leaves to extract the juice, using heat to coagulate the juice, and then rinsing and possibly drying the coagulum.

If she were better listened to and respected, the Earth could be incredibly generous; unfortunately, we humans are all too often more occupied with blindly exploiting land and animals, as well as our fellow humans, in an irresponsible rush for short-term profits.

On the contrary, the fractionation of leaves from leguminous plants can help feed the soil with the nitrogen stored in their roots, cattle with the fibre and co-products of fractionation, and humans with leaf concentrate. The process can thus refine the symbiosis between agriculture and animal husbandry (activities too often in competition, despite the fact that they are fundamentally complementary) in order to optimise the two. As an example:

Lucerne grown on 1 hectare can contribute to the production of 3,500 kg of milk powder if consumed directly by cattle; the same lucerne, fractionated as described above into leaf concentrate, fibre cake and whey, can contribute to the production of about 3,200 kg of skimmed milk powder (SMP), with the added production of 1,100 kg of leaf concentrate, whose nutritional qualities are often equal to, and sometimes better than, those of milk powder!

	Vitamins & minerals (per 100g)							Essential amino acids (mg/g of protein)							
	Beta-carotene (mg)	Vitamin E (mg)	Vitamin B9 (µg)	Calcium (g)	Phosphorus (g)	Iron (mg)	Zinc (mg)	Histidine	Isoleucine	Leucine	Lysine	Methionine & cysteine	Phenylalamine & tyrosine	Threonine	Tryptophan	Valine
LLC	44.9	90	75	3.2	0.78	50	2	24	55	95	65	31	88	52	25	62
SMP	0.17	0.7	41	0.95	0.75	0.5	0.3	26	52	94	68	33	92	43	13	61

APEF's OBJECTIVES

In order to ensure the promotion of this promising concept, APEF has adopted the following objectives:

- Study the characteristics and nutritional effectiveness of leaf concentrate;
- Study alternatives to lucerne better adapted to equatorial and tropical regions for leaf concentrate production;
- Develop fractionation equipment as follows:
  - For family/multi-family use, a manual press with a capacity of a few kg of leaves per hour. This is meant principally for rural / semi-urban population;
  - But our main priority is to design machinery on a scale we refer to as "intermediate-scale production" (ISP), intended rather for the supply of nearby urban population. ISP facilities have a production capacity of between 0.5 and 2 tonnes of fresh leaf per hour.
- Promote the incorporation of leaf concentrate into the family diet in general and into the diets of specific in-need groups (schoolchildren, patients, emergency situations);
- Organise and share information available on leaf concentrate;
- Follow up and assist with various projects concerned with the study, distribution or production of leaf concentrate.

The sections below provide a glimpse of the activities undertaken in 2013 in pursuit of these objectives.

CLINICAL TRIALS: PEOPLE LIVING WITH HIV IN BURUNDI AND CAMEROON

In 2007 in Burundi, APECOS (Association for looking after orphans of AIDS) and APEF undertook a short-term clinical trial with a limited number of participants to assess the effects of LLC (lucerne leaf concentrate) as a nutritional complement. The trial was led by Dr. Ph. Remezo and its encouraging results formed the subject of Philippe Allart's thesis for his PhD at the University of Reims.

A further, more ambitious trial, financed by the Tolkien Trust, joined more recently by the Mérieux Foundation, was conducted between May and November 2013 on approximately 100 children of between 5 and 14 years of age, all HIV+ but not on anti-retroviral (ARV) treatment. The trial was run by ANSS (/National Association for the support of people living with HIV and AIDS) at its centres in Bujumbura and Kirundo. The objective of this trial was to see if LLC could contribute to strengthening the immune system and thereby delay the need to start ARV treatment, by comparing the development of the nutritional status and general health of two groups of children, each receiving an isoproteic daily supplement, either 10g of dried LLC or 15g of skimmed-milk powder. We are currently awaiting blood test results for the 73 children who completed the trial (CD4 count, viral load, blood counts, etc.).

In the coming months, the team of investigators, led by Eric Bertin, Professor of Nutrition at the University Hospital, Rheims, will analyse all the results.

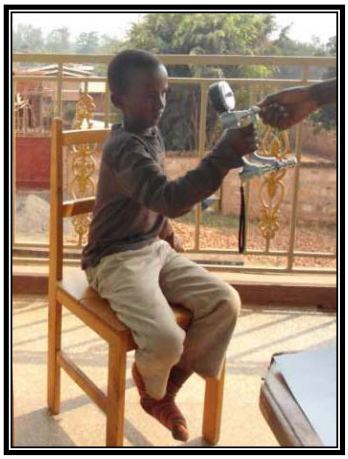
The project benefited from extremely committed and motivated local teams. It has demonstrated our capacity to organise a trial compliant with legal requirements (authorised by the National Ethics Committee) and under difficult conditions (supply of upplements and reagents, multiple sites, adherence to procedures etc.).

In parallel with our clinical trials

Burundi is currently one of the poorest countries in the world. It is also the country most affected by lack of food security: 58% of children under 5 years of age are chronically malnourished. Agricultural production is very weak. The lack of micronutrients results in a situation where 45% of children under 5 years of age and 19% of women are anaemic. This is why APEF has started trial growing of lucerne and cowpea in Kirundo, Ruyigi and Nyabihanga, near Gitega. Prof. Prosper Kiyuku, of the Agronomic University of Bujumbura, a colleague of our partner D. Bounie, lecturer at the University of Lille, is following these trials and is planning to construct a small-scale leaf fractionation plant, starting with the making of a press for the pulped leaves.

Two solar driers were constructed last November by Charles Joly, a young French carpenter / cabinet-maker, first of all to dry fruits such as mangoes and tomatoes; in the future, they will also be used to dry leaf concentrate.

In addition, APEF will soon submit a dossier to the BBN (Bureau Burundais de Normalisation / Burundi Standards Office) on both LLC and CLC (cowpea leaf concentrate).



A second trial, for adults starting their ARV treatment, is planned for the St Jean de Malte hospital in Njoumbé, Cameroon, in collaboration with the Order of Malta (France). Its protocol is currently being revised to take into account difficulties with recruitment and lessons learnt from our trial in Burundi. Preparations for both trials have placed a heavy demand on the resources of APEF throughout 2012 and 2013.

LOCAL PRODUCTION: "SAFE NUTRITION" PROJECT IN SENEGAL


Concerning the capitalization of experience, it is worth mentioning the highly favourable report on the Safe Nutrition project prepared by Gilles Lemaire, former Director of Research at the INRA (French National Institute for Agronomical Research), on his return from a support and evaluation visit financed by APEF:
"SAFE Nutrition project: Development of ecologically and sociologically sustainable agricultural systems in the Senegal river area"
This report is available on request – please do get in touch.

Despite numerous difficulties, the local production project launched in Gaé, near Richard Toll in Senegal, by Bernard Giroud, APEF member and social entrepreneur, has scored various undeniable successes:

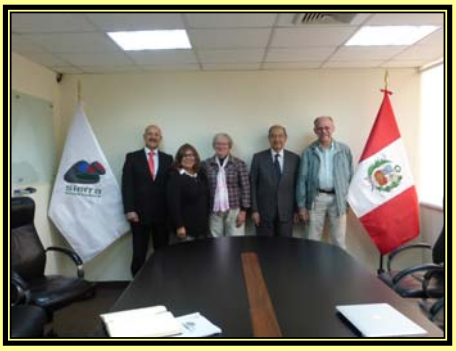
- Establishment of a business under Senegalese law;
- Access to 25 hectares of land close to the Senegal River, irrigated by pumping and gravity, together with 5 hectares at slightly higher elevation for the construction of buildings;
- 12 full-time workers have been employed and trained, with 20 seasonal workers available during sowing and harvesting;
- Some mechanisation was implemented in 2013 thanks to equipment (tractor, plough, bed former, mower, baler) imported in 2012 with funds from the French Ministry of Cooperation;
- A 260m^2 hangar has been constructed;
- 17 hectares of lucerne and 8 hectares of rice have been successfully cultivated;
- Some of the rice was sown without the addition of nitrogen fertiliser, in an area previously devoted to lucerne and cowpea. This rice has been growing well, which tends to support the effectiveness of this approach, whereby the atmospheric nitrogen naturally fixed by the legumes benefits the subsequent rice crop – this is one of the objectives of the project. It is important to remember that nitrogen fertilisers are most often imported, with considerable financial and ecological consequences.

The Safe Nutrition project is currently in need of new investors in order to consolidate present achievements and to move on to the next stages, including the installation of a leaf concentrate production facility

LOCAL PRODUCTION: PERU & DRC

Peru is a country well known to APEF, as we conducted two LC validation trials between 2004 and 2006. Unlike in Senegal, lucerne is a traditional crop in Peru.

Bernard Leclerq, APEF President, travelled to Peru in the summer of 2013 to re-establish our old contacts and identify some new opportunities. His report follows:



Visit to Peru, 25th August to 10th September 2013

On the 10th September 2013, SIERRA EXPORTADORA, a Peruvian governmental organisation, and APEF signed an agreement whose aims include the fight against malnutrition and the development of economic activities in the Andean Altiplano where lucerne is already widespread (at about 3980m!).

Another partnership, with CARITAS PERU, was renewed and the Programme Against Malnutrition, started in 2005 with APEF, was relaunched in Phases 2 (study of the acceptability of LLC in a daily diet) and 3 (local LLC production). In addition, a lucerne dehydration production facility is planned in Acora, in the province of Puno, and it would be extremely beneficial to add an LC extraction capability: we shall work on this, as it is far from straightforward, and CARITAS France will help us put together and submit a request for finance to the French Overseas Development Agency!

The French organisation MUNAY, based in Nantes, whose President is Monique Manya, is doing great work in Andahuaylas, where the Andean women have shown interest in LLC. Leaf fractionation is a reality and the women use two simple solar driers to dry the LC in order to conserve it as a powder. APEF has recently given them an electric grinder, which allows them to extract the green juice directly from the leaves. A new phase of development is underway. Bravo!

Adriana Cordero is a Doctor of Pharmacy. She lives in Huaycan, 40 km from Lima, in a particularly poor region. However, in the very heart of the orphanage, she makes LLC and, from it, enriched fruit juices, such as apple and LLC. She has even created an LLC "syrup" for the youngest children, in which the LLC is held in very fine suspension in a particular type of starch. This allows her to have a sort of liquid LC, which offers many advantages over the dried, more coarsely granulated form.

We have also established numerous contacts with Peruvian universities who will work on formulating 'ready-to-use-supplementary-foods' or RUSF containing LLC. We also plan to put them in contact with the Association Franco-Mexicaine, Suisse et Belge de Bienfaisance, our Mexican partner that distributes daily and free of charge, LLC snacks under the brandname FORTIPLUS to some 18000 children.

In addition, Marie-Hélène Fourlegnie of the Order of Malta, who helped supply 8 hospitals and 3 health centres in the Archdiocese of Bukavu, DRC, at the start of the century, has been in touch again with a view to establishing an LC production plant on the Bateke plateau near Kinshasa. Preliminary lucerne cultivation trials are underway with the support of APEF.

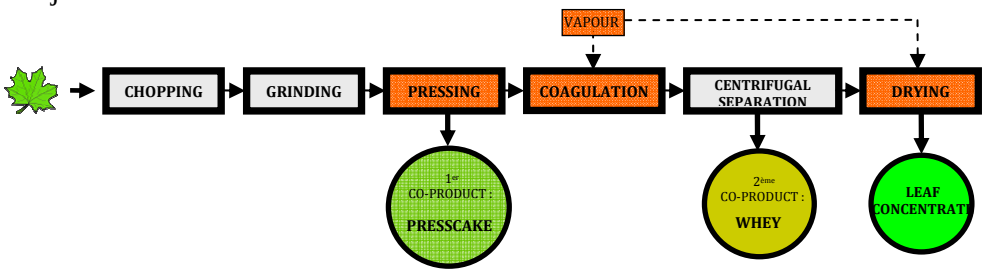
You can see from the above that we do not lack local production projects, but unfortunately APEF is not yet able to advise our partners on means of production that would be effective, robust and affordable. We shall be re-doubling our efforts in this regard in the coming year: see the next section.

EXTRACTION EQUIPMENT

Our work on the design and development of prototype extraction equipment is following two main paths:

- Acquiring the financial support necessary for rapid progress;
- Using the "low technological intensity" approach permitted by the resources we have available.

Adopting this spirit, two groups of students from the Ecole Centrale Lille are currently collaborating with APEF: the first group, known as *Leafittude*, is working on coagulation of the curd (by vapour production) and subsequent drying, while *Beleaf*, the second group, is focusing on ways to press the ground-up leaves to extract the leaf juice.



Leafittude: a team motivated to help APEF in its fight against malnutrition!

We are six students from the Ecole Centrale de Lille who have the opportunity to undertake, as part of our training, a two-year project. When we met with APEF for the first time, it was the human aspect of their project which inspired us six to get together, or put another way our shared desire to use our knowledge for the benefit of those who are disadvantaged. Successful completion of this project will have multiple benefits for local populations: it will contribute to improved food security, create new employment and, most importantly, will allow communities to become more autonomous.

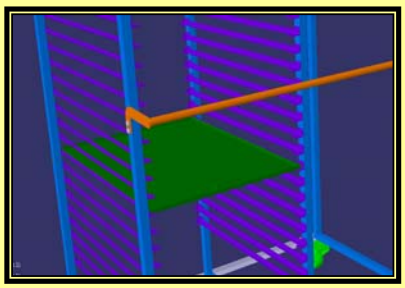
The most difficult thing for us is to 'put ourselves in the shoes' of the local populations in order to provide them with equipment that will be most suited to them. As APEF reminds us: the priority is robust, easy-to-use equipment that is appropriate to the situation in which it will be deployed.

Our project comprises three distinct but interrelated parts:

First, design a biomass heater which will provide steam for all stages of production. The heater must realise the value of local biomass – rice husks, reeds, sugar cane, bagasse, wood ... all are possible sources and come in various forms: pellets, bulk or green coal ... we aim, by offering guidance, to help users choose the most appropriate equipment depending on the context in which production is being implemented: what size is their budget? What quantities do they envisage processing?

Second, design and make a prototype steam injection system to coagulate the green leaf juice. We have chosen an elbow injector to introduce the vapour into the juice. An initial trial will allow us to observe the turbulence created in the leaf juice, necessary to ensure thorough mixing, following which we shall be able to select the preferred type of injector and start production of a prototype.

The third part is to design and make a drier for the leaf curd. We have chosen a technologically simple solution in order to comply with the project specifications: a drying rack. It will consist of a trolley with several trays, on which the curd can be spread out; the trolley can then be rolled into a large drying cupboard. Drying will take about an hour. Initially we conducted some drying experiments using lucerne from Luzéal; currently we are modelling out drier in 3D using Catia CAD programme prior to moving on to the construction phase.



This project differs from other projects undertaken at Ecole Centrale Lille thanks to its international dimension, its humanitarian aspects and also its size: we are conducting three small projects rather than just a single larger one. After more than a year of work, we are still very motivated and, despite the difficulties and doubts we have experienced, we hold the successful completion of this project very close to our hearts.

INCORPORATING LC INTO FOODS: PROJECT QUALIMAPA

Three teams of students at Polytech Lille have been working on the creation of 'LC school biscuits' to be produced from local ingredients by neighbouring artisans. However, we realised that it wasn't a straightforward task to do this in France and introduce them into a large variety of local contexts. As a result, we concluded that the LC biscuits would need to be *developed*, as well as produced, locally. The aim now is to get together groups of 2 or 3 motivated local women to create and test several recipes, probably based on traditional products. APEF plans to provide some small financial support. The communication aspect of this project has been entrusted to a new group of students from the Master's degree program QUALIMAPA at Polytech Lille. The project is described below in the students' own words:

One of APEF's projects is the design of LC-enriched school biscuits for use in Africa, Latin America and India. These biscuits, formulated with local ingredients and produced locally, will help to combat infant malnutrition.

APEF's work to date in combating malnutrition using LC appealed to us and inspired us to contribute our efforts to the 'school biscuit' project.

Our involvement in this project concerns the aspect of communication.

In short, our objective is to produce a 'how-to' pack to help people make the biscuits and to provide them with supporting information: recipes, nutritional background, details of equipment needed for small-scale local production, hygiene and safety, planning, economics and distribution. This pack will take the form of various individual sheets/guides, to be available on the APEF website.

We have entered collaboration with Soynica, APEF's partners in Nicaragua. We decided to use as a starting point Soynica's work in order to improve our understanding of the challenges likely to be encountered when launching the biscuits, from production through to distribution to the children.

Our aim is to make the 'how-to' pack applicable to launching LC biscuit production in other countries as well.

APEF - MOVING FORWARD

An important initiative in 2013 was to re-think APEF's statutes at an Extraordinary General Meeting in order to enable APEF to grow as we want it to. We have also rationalised the decision-making process taking into account a geographically-diverse Association's Board. At the same time, APEF's membership has tripled in 2013, from 15 to 45 members!

Our association has also committed itself to specify its role more precisely and to increase its visibility:

- APEF and the LC producers in Champagne-Ardenne have a common past and similar concerns, even if our objectives are different. We have had a lot of communication this year in order to clarify our respective positions and to collaborate in a more independent yet more effective manner.
- We have contributed to various publications in addition to APEF-INFO: *Lucerne References* (circulation 15,000) and three successive editions of *Appropriate Technology*, an international journal on development with a circulation of 25,000 in English and French.
- A group of students from the Institute de Développement et Enseignement Multimédia (IDEM) in Perpignan has worked on our website and made some proposals for a refreshed communication strategy (logo, booklet, marketing goodies etc.).

apef Association pour la Promotion des Extraits Foliaires en nutrition

2014 will be, like 2013, a year of opportunities, challenges and intense activity for APEF. We shall therefore need, more than ever, your continued support, which we hope you can offer in any or all of the following three ways:

- *Become a member of APEF (leclerq.bernard@wanadoo.fr);*
- *Contribute your skills and competences in one or more of our fields of activity;*
- *Make a donation (davienne.blanc@orange.fr).*

If making a donation, please address it to our Treasurer, Michelle Davienne, 21 Chemin de Centimes, 26400 Crest. She will send you a tax receipt to enable you to benefit from the legal reduction if you are a French taxpayer.

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