The use of Misola and Spiruline in the nutrition rehabilitation of Undernourished children of Sub-Saharan area.

HOW FIGHT MALNUTRITION

Our experience with Misola and Spiruline supplemented to tradicional meal suggest to develop the production of this two integrators in the developing countries. The production of Misola may be a starting point of the nutrition rehabilitation: the procedure for the production is very simple and require only reduced economical reseourse. The production of Spirulin as a supplement in the rehabilitation of HIV positive and HIV negative children represent another miliar stone in the program of nutrition rehabilitation and the production of this blue microalgae need only simple technologies of cultivation.

HISTORY of MISOLA

MISOLA adventure has as a starting point a concrete need and not a theoretical will: the exhaustion of food of supplementation, provided until 1981 (the Misola flour are manufactured in Burkina Faso since 1982 starting from cereals and leguminous plants cultivated in sub-saharian areas), in the Center of Rehabilitation and Nutritional Education (C.R.E.N.) hospital of Fada gourma.
At the beginning, in November 1982 the composition was the following one: millet, soya milk, arachides plus the additives (iron, vitamin complex) from where the name Misola came. Taking into account multiples problems due to milk and vitamins, these ingredients have been eliminated and the current formula uses only local products i.e the millet, soya, arachides, sugar and a little salt.

The composition of the Misola flour is based on a cereals/legumineuse association, which allows a balance of the amino acids close to that of animal proteins. The cereals and the small millet bring glucids and proteins; the leguminous plants, arachides and soya, are rich in proteins and fat content which makes it possible to increase the energetic value in unsatured fatty acids.

The ingredients of the flour are mixed in the following ponderal proportions: Small millet roasted 60%, Soya roasted 20%, Arachides roasted 10%, Sugar 9%, Salt 1% the selection of the ingredients facilitates digestion and gives to the soup a good appreciated taste even of the children undernourished and anorexics.

The use of local food (millet) allows the easy passage in future of a traditional family food. It is possible to replace the millet with corn 30% and rice 30%. The flower can be enriched with orange juice, of lemon or tomato, dry fish or meat. The contribution of vitamine C and beta-carotene (provitamin A) can be done by the addition, at the end of cooking, of fresh fruit juice.

HOW IS FLOUR MISOLA PRODUCED

The manufacture of MISOLA flour comes with simple traditional artisan techniques that allow a perfect technological control. It is simply a question of making roasted cereals, to grind them and to weigh after addition of sugar and salt. The ingredients are mixed in proportions of volumes and not in weight. This operation requires simplified technology, the use of cutlery and other kitchen articles. At beginning the ingredients must be cleaned from the contamination of insects, escrements and little stones through washing and decantation (figure 4).

Figure 4: phases of preparation of MISOLA flour until the conservation in sigilled sachets

A badly conserved flour or sufficiently not cleaned is responsible of gastroenteritis. To prevent from these inconvenients the following precautions are taken: washing of hands; sifting of the flour in clean dishes adapted for this purpose; cooling with the shelter before bagging; thermal welding to abolish air in the sachets; conservation of the sachets in bottles hermetically closed. If it is prepared and stored under satisfactory conditions, the flour can be preserved for 6 months and sometimes more.
Rarely the bacteriological analyses carried out at the laboratory of nutrition of the Centre Medical St Camille revealed a high level of contamination

COMPOSITION OF FLOUR MISOLA Glucids 61 grams, Lipids 11 grams, Protides 15 grams, the energy value 425 kcal (1775 kjoules /100 grams. The consumption of a soup covers half of the daily requirements out of zinc and iron for a child of more than one year. Naturally rich in vitamins B, the contribution in vitamin C and of provitamin A will be done by the addition at the end of cooking of the fresh fruit juice.

HOW IS PREPARE AND UTILIZE COOKED MISOLA The teaching of the preparation and the use of MISOLA soup is placed from the point of view of nutritional education. To propose a codified receipt: " one volume of flour for two volumes of water mixed with cereal amylase germinated to prepare an energy soup of low density (figure 5).

Figure 5: Preparation of soup (one volume of flour for two volumes of water) and phases of cultivation of the ingredients (millet, soya and arachides) with the active partecipation of mothers.

GUARANTIES ON BIODIVERSITE

The Millet, Soya, Arachides, Corn or Rice are produced locally without use of pesticides, chemical fertilizer or others. To guarantee the quality of cereals the Centre Medical St Camille and the sister of CREN encourages the groups of women to cultivate the ingredients for the preparation of MISOLA using the biological criteria for cereals production and applying storage methods without use of chemicals.
If the need for offering to the child a specific food is generally recognized, the economic or social difficulties ensure many mothers from making profit for their child from such a food. The manufacture of the flour in the groups of Centre Medical St Camilel is very simple. Each mother having taken part in the cultivation of cereals and in the transformation of the agricultural matters gets benefits on the local

products. The structure produces the quantity of flour necessary to her child until the following meeting. Otherwise, women can buy the flour in the pharmacy of Centre Medical St Camille at the price of 350 F CFA (euro 0,533) the package of 500 grams: the cost to treat a moderate malnutrition requiring one to two soups per day is 1200 to 3000 F CFA (euro 1,83 to 4,57) per month of expenditure.

IT IS PERHAPS ONE OF THE CHARACTERISTICS OF THE MISOLA TO BE PRODUCED WITHIN THE STRUCTURES OF HEALTH. This collaboration constitutes a major asset to have an impact of the public health. Other than producing a special food (the flour) it helps to sensitize the mothers on the importance of nutrition for their children: the flour is a product able to give good health. Furthermore, the structure can be used for distribution of drugs and vaccines for their children. The collaboration of mothers has several other advantages: - "privatiser" the production equipment by financially interesting the women to profit from their knowledge and their permanence on the structure; - to profit from their practical direction since they can control their results - to allow a direct sensitizing of the mothers of the group to the nutrition of children. The collaboration of a O.N.G. of support allows to consider a financial assistance. This collaboration is often articulated with other shutters of a project of development and makes it possible to integrate the project in a broader context. The creation of a network among various centre of production disseminated in the country, is necessary to keep the coherence of the objective (Public health) and the means (artisanal, female groupings). This network is often coordinated by a sister if the Structure is directed by religious or by a representative of the Management of Health and the Family or by functionary of the UNICEF.

The refunding of modest investments, in particular those necessary to the construction of buildings, is not the ambition of this type of project. On the other hand, the self-financing of operating expenses and if possible the self-financing of the investments are part of the objectives to reach. In order to determine the threshold of availability one can proceed as follows: - to calculate the cost price out of all rough matters for the production of one kg flour; - to determine the reasonable selling price, which allows an accessibility of flour to a greatest number of children (30 % of increment on the price of the rough matters) in a spirit of wellfare; - to calculate the fixed loads per month (salaries, rents, water, transport, electricity, reinvestment, losses and others); - one can determiner then the minimal production-sale necessaire to the economic balance of artesian production, assembling fixed loads by the margin of gain on each sold kg. For example in 2004 and 2005 at the centre of St Camille Ouagadougou the economical balance was:

2004 - Cost price of the rough matters : 462 Fs/kg; Selling price: 719 Fs/kg; . That is to say a gross margin of 257 Fs/kg; the fixed loads constant of 96,906 Fs per month, the minimum quantity to sell each month was of 1,308 sachets of different weight from 200 to 500 g, that is to say 554 kg. The gain at the end at December 2004 was 1,713955 million Fs.

2005 - Cost price of the rough matters : 508 Fs/kg; Selling price: 731 Fs/kg; . That is to say a gross margin of 223 Fs/kg; the fixed loads constant of 155,510 Fs per month, the minimum quantity to sell each month was of 1771 sachets of different weight from 200 to 500 g, that is to say 787 kg. The gain at the end at December 2004 was 2,108270 million Fs.

The need of a rigorous management imposes a certain number of measurements, in particular the behaviour of a careful account for the purchased, stocks, the production and the sales and the diffusion of information on the efficacy of this product among the mothers.

In the Centre Medical St Camille the investments in rough matter was supported at beginning by C.N.H (Culture Nutrition Healthy), which funded the realization of MISOLA production centre in 2000.

HOW TO REACH THE TARGET GROUPS AND TO IMPROVE THE NUTRITIONAL STATE OF CHILDREN.

The target groups probably constitutes the most difficult problem, much more difficult than to reach the solvent population, and this difficulty has limited up to now the extension of the project. Collaboration with the health services is essential in the prospective of commercial goal. This collaboration allows: - to conceive and develop the project in synthony with the Public Health and sensibilizy the personal of Health to the infantile nutrition (training courses); - to use the structures of distribution and sale of the drugs (pharmacy); - to start campaigns against malnutrition as there exists - to organize campaigns to the use by the mothers of the nutrition programs part of the prevention; programs of vaccination; food additional from 4 to 6 months; Furthermore the Misola flour has been proposed for the precocious weaning of the child of HIV positive mother. The dispersion of other centres for the production of MISOLA on the territory facilitates the distribution towards the target groups more easily accessible.
Another means of reaching the target groups is to develop and promote the "Community Village Manufacture" of flour.

It is necessary, but it is not sufficient that an infant eats when he is hungry. The food, which calms its hunger, must have a good nutritional value. It is thus important to be able to guarantee the quality of the product, the stability of its formula, the absence of toxicity, and its good conservation; in order to achieve these requirements the food must respect the international standards. Does this requirement for quality constitute a fundamental criterion to gain partecipation of mathers, but also to involve the national and international organizations to buy raw matters within the framework of their actions of fighting against malnutrition. It is well clear that these types of actions cannot achieve a quality control of the industrial process, with complete and systematic analyses of the batches, and eventually correction of the formula at the end of the manufacture. It is thus necessary to take a particular care in the promotion of the flour: - requirements of hygiene; - rigour of manufacture (significant points: sorting and cleaning of seeds); - rigour of measurements for the mixture of ingredients; - quality of conditioning. This constant rigour of manufacture, will complete if possible of chemical and bacteriological analyses (composition in nutrients and aflatoxines; bacteriological controls) constitutes the only guarantee of quality. The follow-up of the quality falls on the MISOLA centre of production. The biological controls falls on the Services of Nutrition. The intervention of the analysis laboratory on the Ministry for Health, or on other laboratories with the O.N.G. support.

HYSTORY of SPIRULINE

The spiruline story starts approximately 30 years ago, when two ethnologists made research on the edges of the lake Chad, in full period of Saudi famine. They noted that one of the tribes was in full form and that there was no symptom of malnutrition. These people consumed a green pie. They brought back this green mass to the Pasteur Institute to Paris. The researchers then discovered the spiruline. The American researchers were also interested because of the utility of the spiruline in nutrition. Research on spiruline lasted 10 years with the aim of identifying different species of spirulines, their characteristics, their clinical trials, the studies of acceptability and toxicity and the installation of a system which is most productive starting from the ingredients available and a less cost. It is a small blue microalga (Cyanophicées) (0,3 mm length), whose scientific name is "cyanobactery Arthrospira platensis" (not to confuse with the cyanobactermarinates called scientifically "Spirulina subsalsa"), which exercite photosynthesis like the plants and thrives naturally in the salted and alkaline lakes of the hot areas of the sphere. Traditional food of Aztec of Mexico and Kanembous of Chad, the spiruline is now cultivated in large factories in the U.S.A., in India, in China, in Thailand, etc, because of the many qualities related to food and health, both for men and the animals. For example a child suffering of malnutrition can be restored by giving him a supplement (10 g) per day of spiruline for one month. The spiruline reinforces immunizing defences and reduces sufferings in people affected by AIDS. It makes it possible tuberculosis to better support their treatment. The spiruline is also used as active ingredient in cosmetic. In nature, the spiruline has need "to push" only one argillaceous basin retaining a brackish and alkaline water, under a hot climate, and of some animal manure. The spiruline is presented in the form of filaments made up of juxtaposed cells. The repro-duction of the spiruline, asexual, is done by division of the filaments. The industrial crop of the spiruline is intensive and very technique. Its end product, dried by atomization, is lower in quality than the fresh product; moreover, the product dried manually does not plait with certain consumers who dislike the strong odour of dry fish.
Composition of Spiruline: protein 70%, i.e. 2 times more than soya and 3 times more than beef. The human body assimilates proteins of Spiruline 4 times more quickly and better than proteins of the meat and cheese. Very rich in vitamins (A. B1, B2 B12, E) and in assimilable iron, it contains also calcium, phosphorus, magnesium (in quantity comparable with cereals and the cow's milk) and linoleic acid gamma (rare in the current food).
In the Centre Medical St Camille, the investments of the spiruline were supported at beginning by "Fondation Jean Paul II pour le Sahel" in 1997.
The Camillians has been first to introduce the spirulina in Burkina Faso. At beginning two centers have been created for the cultivation of Spirulina at Koudougou and Lombila. Having seen the good ones the Guvernment of Burkina Faso has made a large plan for more than 1.372.160 euro for the recovery of the undernourished children in Burkina Faso utilizing Spiruline

INSTRUCTION TO EVEN CULTIVATE THE SPIRULINE ONESELF

There are many ways of building an adequate basin, variables according to local conditions': out of plastic covers, hard clay, low walls. It is generally useful, to install a greenhouse or at least a roof on the basin allowing to protect it from the bad weather. The roof can be in white or translucent plastic, or other solutions making it possible to let pass a part of the light (see figure 6).

Figure 6: Particular of basins for the Spiruline cultivation

To cultivate Spiruline it is necessary to recreate the close culture medium of which it growth naturally. The culture medium is a controlled salt solution in water; this liquid must bring to Spiruline all the chemical elements which are necessary for him. The pH of the culture medium must lie between 8.0 and 11. The solutions, for a basin of 4 m^2 which may be realize in a small space are reported in Table VIII:

Spiruline are the carbon whose normal source is carbon dioxide; one can increase the contribution of C02 by composting under greenhouse contiguous to the basin. The temperature ideale is between 35° and 37.
To control the level of the basin which must be at least 20 cm of water (to add water when necessary).

Agitation of the water of the basin it is necessary to homogenize and ensure a good distribution of lighting among all the filaments of Spiruline. One can agitate various ways - manually, with a brush or a wheel ruota 4 times per day, for 2 minutes. This motor could be alimented with solar system.

To collect by skimming surface with a basin and to initially empty Spiruline in a filter mosquito net, then in a filter 60 microns. Slight drying and conservation are worth to consume Spiruline fresh (2 times more effective), but it should be consumed 6 hours to the maximum after harvest, if not it is possible to preserve it up to one year by making it dry with the sun or in a solar drier.

USE OF SPIRULINE

Mixed with a basic food, it makes it possible to overcome a malnutrition moderated with acute. By way of example, an amount of spiruline from 1 to 5 grams per day managed during 4 weeks with an child severely undernourished from 0 to 5 years, functions like a genuine catalyst in the resumption of weight. The nutritional rehabilitation is some spectacularly improved. Many studies and clinical trials bring the proof of therapeutic values in ferriprives anaemias and the reinforcement of immunizing defenses and the lightening of the sufferings of the people affected of AIDS. A suffering child with kwarshiokor (malnutrition) can be restored by giving him one spun (10 g) per day of spiruline for one month (figure 7).

Figure 7 : Child with severe malnutrition (Kwashorkor) before and after rialimantion with MISOLA and supplement of Spiruline (10 g/day)

Beyond 5 years, one needs 2 grams of spiruline per day. The spiruline is a supplement micro-nutrient and it is one energizer. It has nutritional effects as well as therapeutic. Its food use has been suggested as therapeutic supplement in the treatment of certain pathologies:

cancers, AIDS, weakness, hypercholesterolemia, deficit of immunizing defenses – stress. 10 grams per day of Spiruline, with a cereal and vitamin C, is enough to fight malnutrition in 28 days. The spiruline reduces the transmission of the HIV of the mother to the child.

The material used for the of the spiruline consists of stocks of spiruline which come from natural layers such as those of the lake Chad.