Small-scale production of spirulina

Spirulina is a green algae which has found value as an alternative source of first quality protein. It is also rich in vitamins and iron and has several medicinal uses. It is relatively easy to culture, using the minimum of equipment and as such is suitable for production at the small scale. The nutritional benefits have been proven in feeding programmes for malnourished children in India and Africa. This article describes the production of spirulina and gives brief accounts of its use to alleviate malnutrition.

Introduction

Spirulina is a food product derived from green algae which grows rapidly in brackish ponds when the conditions are favourable for multiplication. It has long been used by groups of people from across the globe – Chad, India, China, Japan and Mexico to name but a few. It is simply collected by skimming algae from the surface of a pond and allowing the green purée to dry in the sun. After drying it is broken into pieces for sale at market (it is called dihé in Chad). In Chad, the purée is used without drying as a replacement for meat in the preparation of sauces to accompany the staple cereal and women increase their intake during pregnancy.

Spirulina is not a new food source, it has been around for centuries. There is evidence that the Aztecs harvested spirulina in a similar manner on Lake Texcoco (on the site of Mexico City). However, scientists did not 'discover' spirulina until 1939, when the remarkable nutritional value of this micro-algae soon became well known.[1] It is now the richest source of protein known to man (60–70% of its weight) and its proteins are of an excellent quality since they contain all of the essential amino acids. Spirulina is also extremely rich in beta-carotene, vitamin B12, vitamin E and iron, making it extremely effective in fighting infections, xerophthalmia, skin diseases and anaemia. It is important for growth and the maintenance of a healthy nervous system. It is rich in gamma-linolenic acid which helps fight cardio-vascular ailments and stimulates the immuno-defence system. It has shown very good results in the care of children suffering from protein-energy deficiency, of children exposed to radiation around Chernobyl and in the reduction of cholesterol levels.

In India, a study carried out on 5,000 children of pre-school age showed that after five months of taking 1g of spirulina per day, the proportion of children suffering from xerophthalmia dropped from 80% to 10%; for malnourished children a dosage of around 10g per day was prescribed.

Finally, spirulina is very easily digested which enables it to be used following operations on the colon. The inventory of its therapeutic applications has yet to be completed.[2,3]

Industrial production of spirulina

In 1978, the first industrial production of spirulina began in Mexico, in the form of a fine powder. In 1993, world production was around 1,000 tonnes per year, generated largely by Mexico, California, Thailand, Hawaii, India and Israel. Japan is the largest consumer (especially of prepared dishes where meat is replaced by spirulina). In Europe, spirulina can be found in chemists and in health food shops, generally in capsule form.

Use of spirulina

Powdered spirulina has a smell reminiscent of dried fish that may be off-putting to those unfamiliar with the product. This smell is caused by the drying process. The smell disappears when the powder is mixed into sauces, purées, drinks or other foods, with no

A 22m² pool at Bangui

Keywords

Spirulina, nutrition, malnutrition, algae, small scale

One method of harvesting: a bag suspended above the culture.

side effects on the taste of the food. Powdered spirulina does however alter the colour of food it is added to, unless it is already green (as in okra or spinach sauces). Acceptance of food fortified with spirulina may therefore take some time to get used to and may be subject to personal preference. Spirulina in capsule form does not have this negative side effect on the appearance of the food, but is around fifty times more expensive. Individuals who take spirulina – either in food or capsules – for health benefits notice an encouraging increase in wellbeing, especially at times when they require greater physical or intellectual strength (for example, athletes, students, people involved in accidents, and the sick).

The idea of culturing spirulina, or similar algae, in arid zones (in addition to those which grow naturally in some areas) was considered some time ago but has only recently been put into practice. Given its wholesale price and qualities, the price of producing spirulina industrially makes it quite a cheap product for markets in developed countries but too expensive for the poor populations of the South. The cost price essentially covers labour, depreciation of equipment, packaging and transport. There have been different attempts using various types of cheap small-scale equipment[4–9] and these are of particular interest if domestic consumption is being considered. The first small-scale production was developed in India, and Chile has also had some interesting experiences in this respect.

The following production method has been successfully carried out in several countries.

Pools established in Kabinda, DRC, in 1996

Description of the production system

The main requirement is for a watertight pool with a surface area of at least $10m^2$ and a minimum depth of 20cm. The pond should have rounded corners to allow for easier churning and mixing of the water. The pond can be made from a range of materials, depending on what is available locally, the permanence of the pond and the finances available. In some locations it may be necessary to cover the pond with a plastic film which acts as a sun shade, protecting the growing algae from the strong rays of the sun and contamination. It is useful to consider using a sheet-metal cover to protect the surface against heavy rainfall. Unless a translucent glass polyester fibre cover is available, the metal cover should be removed after the rain to allow the sun to reach the algae.

Culture conditions are very simple and the amount of intervention needed is minimal:

- The optimum temperature should be around 35°C. Temperatures above 38°C and below 25°C should be avoided.
- In areas where there are large numbers of insects, the pools should be protected by mosquito nets if possible.
- The culture must be agitated, either by aquarium pumps if electricity is available,

Some small-scale production experiences in Africa

The following give examples of cases where spirulina production has been put into practice in various African countries. All were initially started with the view to using spirulina in feeding programmes for children suffering from protein-energy deficiency.

In the Kasai Oriental region of the Democratic Republic of Congo

Kabinda hospital, run by the Community of the Beatitudes, specializes in the care of malnourished children. The children were fed for one year using imported spirulina as a supplementary food. The results were sufficiently satisfying to establish local production. This was done in November 1993. It also enabled commencement of production in a neighbouring nunnery (of the order of St. Clare).

In Burkina Faso

In 1996, Brother Dieudonne Zaongo from the Renutrition and Nutritional Education Centre in Nanora decided to commence production of spirulina in Nanoro. The first pool built was fairly small at 9m². After cultivation had been successfully established in this pool, a second pool and a small building for tools and materials was subsequently built with support from Codephi. Both pools were equipped with an automatic method of stirring using paddle wheels (activated by a solar panel). Originally, the stirring had to be carried out eight times per day for periods of 3 minutes each which was time consuming and limited the time available for harvesting and looking after the culture.

Harvesting has commenced in both pools. The fresh spirulina is distributed to the children being cared for at the Renutrition Centre, either pure or mixed with sugared water or with tô (a traditional dish made from millet flour). It has already been possible to note that those children receiving spirulina make a far more rapid recovery than those who do not.

Near Abomey, in Benin

The Camillien Centre at Davougon[11] which includes a health centre and a leprosy clinic (the largest in Benin) was able to obtain imported spirulina in 1992 thanks to the Committee of Friends of Emmaüs des Ulis (CAEU).[12] In 1993, with the financial support of Technap,[13] a small pool of around 4m² built from polyethylene sheeting was established. A local person was trained in spirulina culture and given a salary by the Camillien Centre.

In 1994, two permanent pools of 8m² each were built, with support from Codephi, and a second person was trained in spirulina culture.

In 1995, a visit from Codephi[14] enabled the establishment of a butane gas dryer which could be used during the rainy season, along with a system of injection of carbon dioxide (from a brewery in Cotonou) which enabled the yield to be increased.

Yield was no greater than 6g/m²/day because mosquito nets had been placed over the pools and so exposure to the sun was sub-optimal (there was also the partial shade of palm trees). Production, of course, decreased during the rainy season. In view of the number of sick people who came to the Centre, it was necessary to establish more pools. In the meantime, imported spirulina continued to be received thanks to the CAEU and this enabled spirulina to become known in other health centres (some of these health centres also wanted to begin production).

Bangui, in the Central African Republic.

The Bangui Charitable Home[15] includes a health centre specialising in the care of malnourished children, of which there are many in the region. This health centre received 3 tonnes of spirulina from the largest producer at the time (Sosa Texcoco of Mexico). In 1994, the NGO N.S.B. that supports this health centre, asked Antenna Technologie to establish spirulina production. By the end of 1996, the total pool surface area was 230m² over three different sites.

or with a brush or scoop, at least four times every day (more when the light reaches around 50,000 lux).

- Drinking water must be available into which can be added various substances to ensure a suitable pH (basic, but pH less than 11) and which will be used to feed the culture. To achieve the desired pH, sodium bicarbonate and urea are usually used. The bicarbonate could be replaced by a wood ash lye and possibly the urea by urine coming from a healthy individual (one who is not taking any medication). This latter alternative is not always acceptable.

To commence the growth of algae, it is important to use as large and concentrated a sample as possible. If the sample is small, cultivation must be initiated in small receptacles (bowls and then pools), slowly increasing the volume as the culture multiplies. This is to ensure that the concentration of algae is never too weak. A simple test is carried out to check for the correct concentration.

A white disc is immersed in the culture at a distance of 5cm from the surface. If the disc is not visible, the concentration of the algae is correct. If it is visible, the concentration is too weak. When the disc is not visible at 5cm, it is said that the 'secchi' is less than 5.

If the concentration is too weak, there is a risk that the culture will be destroyed by exposure to the sun. To avoid this, the protection of a sun screen is required, but this will slow down the growth of spirulina. If commencing the culture in a pool, it may be necessary to use such screens, but it is preferable to commence with a culture of a small thickness and surface area (variable surface areas can be obtained in pools by using sheeting). The thickness and surface area can be increased as the algae develop, ensuring that the 'secchi' always remains less than five. Growing the culture in this way may take four or five weeks whilst with a larger sample it can be obtained within a few days.

The first pool established in Nanoro (Burkina Faso) after the paddle wheels were put in place

When a growth of around 15cm thick and of an appropriate concentration (secchi three) has been obtained over the whole pool, harvesting can be done every day or every other day.

A nylon or polyester bag can be suspended above the pool, into which the culture is poured through a sieve. This sieve removes any rubbish. The filtrate generally falls back into the culture but from time to time it is necessary to renew the environment. This can be achieved by periodically throwing away the filtrate (thus purging the environment). The bag retains the spirulina from which the water is squeezed by compressing it.

Fresh spirulina is thus obtained and can be consumed in this form (it is the most pleasant way and that which provides the most vitamins). It can be kept for several days in a refrigerator or by adding 5–10% of cooking salt and covering it with oil.

To keep it for longer periods, the spirulina must be dried. This can be carried out in a solar-powered drier.

Conclusion

Traditional methods of spirulina production:

- Suitable for establishing at the small scale since they do not require sophisticated equipment or large financial investment
- Only require modest investment and brief training;
- Enable record production in terms of protein yield per hectare (at least double that of soya which previously held the record, without requiring more water);
- Yield a high value food product which is beneficial for the alleviation of malnutrition and in the prevention of many vitamin deficiency diseases.

It is to be hoped that spirulina cultivation may become more widely known and disseminated throughout the world, especially in regions that are economically and socially disadvantaged.

The pools at Davougon (Benin)

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Essential oil distillation

Essential oils are high value, low volume commodities that can provide incomes to both farmers and producers provided markets can be found for the oils. This article describes the basic principles of essential oil distillation. The following article gives a detailed account of the extraction of citronella oil as an example of small scale production.

Essential oils can be extracted from various parts of plants including roots, leaves, stems, seeds and flowers. The oils represent the aroma of the material and find use in perfumery and flavourings. An oil consists of an often complex mixture of heat sensitive chemical compounds that boil at temperatures between 150 and 300°C. Many of these compounds are soluble in steam and a process known as steam distillation is used to extract them from the plant material. Others are not steam soluble and are known as 'fixed' oleoresins. These have to be extracted using organic solvents.

The preparation of the raw material for distillation varies from plant to plant. Some, in particular flowers, should be distilled immediately after harvest, others have to be stored or dried and some require fermentation. Woody materials and roots require cutting and grinding to aid the release of the essential oils.

There are three basic types of distillation:

- water or hydro-distillation where steam is generated by boiling water in the still body
- water and steam or wet steam distillation
- dry steam in which steam is generated by an external boiler.

Keywords

Essential oil, distillation, small scale

Water Distillation is the simplest method and is widely used in developing countries. The charge of material is placed in the still, covered with water and boiled. The essential oils leave the still via a condenser. Very often heating is over a wood fire. Open fire heating can cause problems due to lack of control and burning which result in poor quality oils.

Water and steam distillation. In this method, the charge of material is supported on a mesh above water which boils in the base of the still. Wet steam passes through the charge carrying away the essential oil. If open fire heating is used there is little chance of burning of the charge. It is important that the steam is able to find its way through the charge and often several screens are used to support the charge to avoid material packing down.

Steam distillation is the most advanced method. Steam is generated in a boiler and passed to a perforated coil in the base of the still. The charge is held on screens, as in water-steam stills. Steam distillation has the advantage of higher fuel efficiency, greater controllability and produces high quality oils.

The advantages and disadvantages of the three systems are summarized in Table 1.

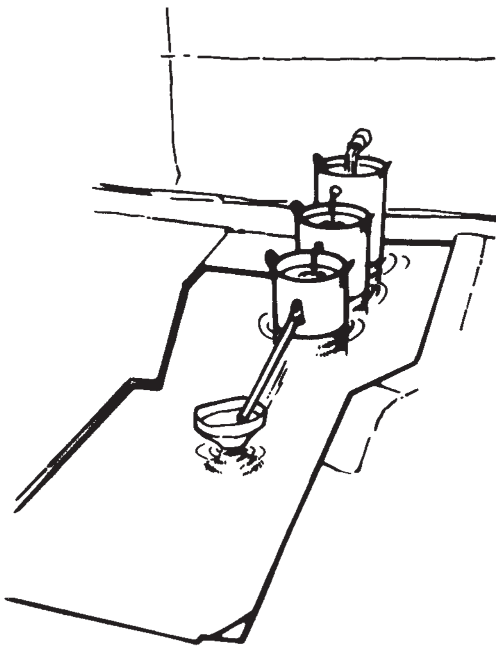
The steam, carrying the oil, leaves the still body via an exit called a gooseneck. A mesh is frequently placed in the gooseneck to avoid material being blown out of the still by the steam pressure.

Condensers. After leaving the still, the steam must be condensed back to water by cooling it in a condenser. Two types of condenser are used, coil and tube.

Coil condensers are easy to make and low in cost. However, they use a considerable amount of water, are not efficient and can generate back pressures to the still.

Tube condensers are efficient, have low back pressure and use less cooling water, but they are expensive and need a good workshop for fabrication.

The metal used for constructing a condenser depends on the type of oil being distilled because it must not react with the oil. Mild steel is rarely suitable and the ideal material, stainless steel, tends to be very expen-



Matthew Whitton

Florentine flasks

Table 1

Water/steam distillation		*Steam distillation*	
Advantages	*Disadvantages*	*Advantages*	*Disadvantages*
Low capital cost	Danger of overheating	Higher yields	High capital cost
Ease of construction	Lower yields	Consistent quality	Workshop required
Low pressure	High water/fuel use	Good energy efficiency	Dangers with high pressure steam

sive. In many cases, copper pipe or, better, tin plated copper is acceptable.

As the steam leaving the still condenses the essential oil separates and normally, but not always, begins to float to the surface. A special separator, called a florentine flask, is used to allow the water to continually run away while trapping the oil. There are two basic types of florentine flask; one for light oils that float on the water and another for heavy oils which sink. These are shown in Figure 2. In some cases, such as Bay leaf oil, both light and heavy oils condense. Such cases require great skill from the operator who has to change the florentines as distillation proceeds. Very often several florentines have to be used in series to effect complete oil recovery. The water temperature at this stage can be critical to high recoveries and in many primitive stills the temperature of the condensate is too high for good recoveries. High temperatures can also lead to the loss of the lightest part of the oil which may have an important aroma characteristic.

Figure 3
Traditional distillation units in Sri Lanka

At the end of the distillation the oil is finally separated in a glass separating funnel, dried by filtering it through a funnel plugged with cotton wool and packed in a sealed glass bottle.

Citronella, the plant of a thousand properties

The editors of Food Chain are grateful to the journal Le Grenier for allowing this version of the article to be produced in English. Citronella oil is produced by steam distillation from plants of the Citronella or Cymbopogon family. The oils have a characteristic lemon smell and find wide use in a range of products including soaps, fragrances, insect repellents, herbal medicines and food products. It is produced in many countries and, after citrus oils extracted from oranges, lemons and limes, is one of the major essential oils of commerce. Well known trade sources of the oil include Sri Lanka and Java. The distillation of essential oil from Citronella offers opportunities for the small scale processor.

Keywords
Essential oil, steam distillation, citronella

Citronella is a large grass of the Cymbopogon family which originated in the East Indies. Several species (*Cymbopogon citratus*, *C. narus*, *C. winterianus*, *C. martini and C. flexuosus*) are cultivated for oil distillation. C. citratus is commonly known as lemon grass and is cultivated for use in south east Asian cookery and in the food industry.

Citronella is grown in people's backyards and taken, brewed in water, to remedy coughs and malaria. An infusion is taken as a refreshing and digestive drink.

C. narus is slowly being introduced into Togo from Ghana, where its cultivation is commonplace. Its oil is primarily sought after by soap factories, which is why the grass is given the name of 'adjalégbé', that is, the soap grass.

Conditions for cultivation

Citronella will grow in most tropical climates up to 1000m provided that there is an evenly distributed rainfall of at least 900mm. The plant flourishes in light but can withstand partial shade. In the absence of sufficient light it will grow less and will yield less essential oil. Planting is recommended at the beginning of the rainy season. Continual rain encourages attacks of rust whereas a long dry season will stunt its growth. It is adaptable to all soils as long as they are permeable. For commercial production, a well drained rich shaly/sandy soil plus organic manure combined with mineral fertiliser are recommended. The plant is propagated by dividing the base.

The harvest

The first harvest can take place between four to six months after planting. The long leaves are cut from the plant at around 10cm from the ground. Yields vary enormously, from 57 to 300 tonnes per year, according to the growing conditions and the length of the period for which it is planted. Subsequent harvests can be gathered at between two and six monthly intervals. The number of times the plant can be harvested depends on the condition of the vegetation, but to ensure good yields, plants must be replanted every two years. Citronella grass is highly inflammable and should be protected from fire.

Distillation of Citronella oil

After harvest the leaves are left to dry and wilt. Citronella can be distilled by any of the methods described in the previous article, although steam distillation is the cheapest

Citronella oil has many uses, in particular:

- As a therapeutic oil in aromatherapy. The oil has vasodilatory, anti-inflammatory, sedative, stimulating and digestive properties.
- As an aseptic. The oil has antibacterial and antifungal properties.
- As an aromatic/deodoriser. These are the properties it is best known for. The oil is extremely pungent and is a powerful fixative. It is highly sought after in the perfumery, cosmetics and soap industries and, for the *C. citratus* species, in the food industry.
- As an insect repellent. Citronella oil is effective against midges and mosquitoes.

method. In West Africa, the German Agency for Technical Co-operation (GTZ) has developed and promoted a low cost extraction method based on a still that is used for the brewing of palm wines.

The cut leaves are placed in a drum and covered with an equal amount of water. The still is closed and the oil distilled off over a wood fire. The oil which floats on top of the water is separated in a Florentine flask. Typical yields of oil are 2 to 3%.

After extraction of the oil, the leaves can be used as fodder for sheep, goats and cattle. A combination of citronella cultivation and livestock rearing would be a good way of making use of the waste products.

Characteristics of the oil

Citronella oil is a yellow colour with a strong lemon fragrance. The oil is darker if the leaves are fermented prior to distillation. The commercial value is related to the composition and the relative contents of citronelal and eugenol, the two main components. Citronelal and eugenol are usually present in the ratio of 65:35.

Marketing

Enormous amounts of citronella oil are imported into the West African sub-region. GTZ is encouraging local distillation of citronella and lemon grass oil to replace costly imports. It is estimated that around 700 tonnes of lemon grass oil alone are imported each year into Benin, Togo and Ghana. Currently local annual production is only 100 tonnes, most of which is produced in Ghana. There is thus an obvious potential for expansion of the industry to meet the needs of the ten or so companies currently importing the oils for use in local soap factories and other industries. GTZ believes there are opportunities for producers to obtain incomes provided that common marketing structures are put in place that will allow producers to identify better markets.

Further information can be obtained from Etse K Kuma, NGO T.2A, PO Box 7446, Lomé, Togo. Tel: (228) 25 16 05.

Essential oil distillation in Ecuador

Ecuador has a very diverse natural flora with over 25,000 different plant species. Around 1200 of these are known for their medicinal properties and are seen on sale in the local markets. The domestic demand for essential oils for use in traditional medicine is high and is increasing, but the local production of oils is still in its infancy, Each year, 15 tonnes of essential oils have to be imported, mainly from the USA and Australia.

There is some local production of essential oils. Alfredo Kattan runs a small distilling unit, extracting essential oils to supply clinics and doctors in Quito and Riobamba. These natural medicines are very important in Ecuador, especially for the primary health services in rural areas. The method Alfredo uses – steam distillation – and the equipment are very simple and are available locally. He believes that small scale distillation offers great potential as an income earner in rural areas and hopes that one day every small community could run its own distillery. The demand for the essential oils is evident, it is the practical know-how that is lacking.

There are a number of factors which prevent the true potential of these crops being exploited. One of the most basic problems is that the names of the plants vary from region to region and there is no local expertise available to classify the species. Another major stumbling block is the lack of suitable distillation equipment and local technology. There are only three companies in Quito that construct and sell the equipment and much of the plant material is exported for processing.

Quality control and quality assurance are essential, especially if the oils are to be exported. There is a close correlation between quality and price for essential oils and, in aromatherapy, only unadulterated oils can be used. However, the introduction of adequate quality assurance mechanisms is costly and beyond the means of many processors.

Most of the knowledge on the medicinal properties and use of these essential oils is not documented. The traditional medicine men of Ecuador (the shamans) have a wealth of knowledge that has been passed down through the generations. However, this knowledge varies greatly from region to region with the changing flora. A major development in this area was the bringing together of shamans from all over Latin America at a workshop in Quito. This provided an opportunity for exchange of information and discussions on how to establish an information network.

This exciting development in the sharing of information and knowledge could mean that Alfredo's dream of small distilleries in each community could soon become a reality.

This is an extract of an article by Andreas Greiner which appeared in GATE (4/98), the journal of GTZ. For more information contact GTZ, GmBH, Post Box 5180, D-65726 Eschborn, Germany. E-mail GATE-ISAT@GTZ.DE

Empowering small-scale cashew processors in Sri Lanka

This article describes how Intermediate Technology worked with the small-scale cashew processing sector in Sri Lanka. Through work improving the technologies used to process the cashew nuts, the quality of cashew nuts produced has been improved and the quantity increased. This, along with better marketing of the cashew nuts has resulted in increased incomes for the producers and many improvements in their quality of life.

The Cashew Tree

The Cashew tree, *Anacardium occidentale,* is native to Latin America, but it is now widespread throughout Asia and Africa. The tree is particularly well suited to dry areas as it can withstand dry conditions and infertile soil. The cashew nut with its thick shells is resistant to drought and pests. The tree takes two to three years to bear its first fruit and then continues producing for over 20 years. The cashew season in Sri Lanka is very short, from April to June.

The cashew tree has an unusual fruiting body which consists of a swollen nutrient filled stalk known as the 'cashew apple' and the cashew nut which is an extension of the apple.

The cashew nut is one of the most popular edible seeds in the world. Raw or cooked, sweet or spicy, devilled (spicy) or fried, in a cake or in a curry, cashew nuts can delight your taste buds.

Cashew processing in Sri Lanka

In Sri Lanka, cashew processing as an industry has been in operation since the early 20th century. In the traditional processing system, cashew processing is done mainly by low income women in rural parts of the country. They are hired by a *mudalali* (a middleman) who packages and sells the processed cashew to the buyers/exporters.

Small-scale cashew processing is an important source of income for many women in Sri Lanka. However, within the traditional, small-scale sector, cashew processors have produced a low quality, low value product. In addition, processors have been entirely dependent on powerful middlemen to provide them with loans and to purchase processed kernels. This situation has been further exacerbated by the fact that until recently neither the government nor the private sector have acknowledged the potential for small-scale processors to run their own commercial processing enterprises and to compete on a national level.

Cashew processing is not a pleasant task. It requires the removal of two pericarps before the cashew kernel (the part we consume) is extracted. The outer shell is very hard and contains a resinous fluid that can cause skin irritation and blisters. Traditionally, this shell is removed by tapping it with a heavy 'rod' until the nut cracks. At this point, the cashew nut liquid seeps out. As the liquid is corrosive, the women have to protect their hands. The nut is turned over and tapped again until the nut has cracked completely open. The kernel inside is levered out using a sharpened metal probe. Experienced shellers in Sri Lanka can shell 3,000 nuts in one day.

After this shell is decorticated, the thinner inner shell (testa) has to be scrapped off. It is easier to remove the testa if the decorticated cashew is dried. Drying the cashew at this stage also prevents enzyme activity and reduces spoilage and discolouration. The dryers or 'ovens' are owned by the *mudalalis*. The women also use makeshift heating devices: a flat metal tray on a firewood stove. This informal system of cashew processing is widely practised. Yet, there is another system that can increase the quality of the final product and is being practised in several rural communities scattered throughout Sri Lanka. It all began as a technology intervention.

Cashew Processing

Sun Drying
↓
Removing the outer shell
↓
Drying
↓
Removing inner shell
↓
Sorting
↓
Packaging

IT Sri Lanka got involved in the cashew industry in 1992, when they received a request from a group of cashew processors for a more affordable and efficient way to dry the cashew nut.

IT Sri Lanka aimed to empower small-scale cashew processors by helping them access information on markets and technologies, and by improving their status within the cashew industry.

The cashew fruit – the kernel is at the base of the fruit

Improved drying technologies

IT Sri Lanka pilot tested a 'tray dryer' that had been developed and used in Peru, with a group of processors in Vanathavilluwa (Puttalam District). The tray dryer used in Peru consisted of a cabinet with a series of trays inside. Hot air produced by diesel or gas burners was blown through the trays to dry the produce. A leverage system was used to lift the trays so that the tray at the bottom of the cabinet (with the driest material) could be removed.

Tray dryer field tests have been completed in initial pilot sites in Vanathavilluwa and Buruthakele. This led to substantial modification of the heating and tray moving system based on feedback from users. The heat source was changed so that the dryer used saw dust rather than gas or diesel. The dryer now works, looks better, and the cost has been reduced to 26,000 Rupees (US$300). The final version is called an 'Anagi' dryer.

To disseminate this technology effectively, IT Sri Lanka has trained seven manufacturers and provided them with appropriate inputs (including full working engineering drawings) so that they can produce high quality dryers. They were also invited to a workshop with users to discuss user problems in relation to the dryer and its operation and this has given them a better insight into user needs.

Cashew processing in Vanathavilluwa

Raw cashew nuts	
Processed in the unit	6,557 kg
Processed by the members	8,277 kg
Cashew nuts processed:	3,015 kg
Processed nuts sold to exporters:	
Large nuts (180W)	938 kg
Medium (240W)	408 kg
Small (320W)	380 kg
Amount of kernels sold to Cashew Corporation without grading.	117 kg
Total income received for value added cashew:.	779,335 Rupees

Access to Credit: Seylan Bank has given 800,000 Rupees as a group loan to the society. Regional Rural Development Bank has given 35,000 Rupees per person. Each member received an average additional income of 3,090 Rupees per month from processing of cashew.

The Cashew Corporation was influenced by IT Sri Lanka to ensure that representatives from the Vanathavilluwa group participated in a seminar to raise awareness about the changes in quality requirements as a result of the introduction of Export Certification Scheme of March 1996. The Vanathavilluwa group at the time was the only example of small processors in Sri Lanka that were producing high quality cashew (apart from the Cashew Corporation and organized industry.) Their experience was widely discussed, and a site visit to the small processing unit was made. This made the Vanathavilluwa group very proud and happy to be recognized as the pioneers of improving the quality of small-scale cashew processing in Sri Lanka. They challenged some businessmen who commented on the process saying that they adhere to quality controlling methods that were better than the methods used by many big businessmen.

The chairperson of the Group Ms. Sujeewa was subsequently interviewed by the national radio. She advised other small processors to change their practices and let people know about all the potential benefits.

Cashew processing in Yodhakandiya

Yodhakandiya is a dry-zone village in the Hambantota District in Sri Lanka. Here cultivation is mostly confined to one season (the 'Maha' season), although a few people also farm as tenants during the 'Yala' season. During the rain-fed Maha season farmers carry out 'chena' (slash and burn) vegetable cultivation in nearby forested areas. Most villagers are totally dependent on this for their livelihoods. The practice began when the village suffered crop failure after severe drought that lasted for four consecutive seasons. Last year there was a total loss of crop-which left them with no other income generating options.

At this time, IT Sri Lanka conducted a programme to motivate the community who had lost hope. Through this programme, cashew processing was identified as a potential alternative income generation avenue. In 1987, villagers learned about cashew processing and started doing it as a business. IT Sri Lanka facilitated this process by providing support for skills development in processing and exchange visits to Kaluwelgoda and Madelgamuwa. The activity of this group was at a much lower level than all other villages since they had no access to credit.

The cost of production was also comparatively higher due to processing of smaller batches. However, this very small income was extremely useful in a context where there were few other options. IT Sri Lanka highlighted this experience to local authorities who agreed to extend credit facilities to the group. The group is now very strong, highly motivated and determined to build a stronger organization.

This has been successful. Eight villages are now using this improved drying technology to increase the quality and quantity of the cashew nuts they produce. At least three more villages plan to use the technology in 1999.

Collective processing and improved marketing

Technology is just one aspect of improving the processing of cashews. The women have been encouraged to conduct their enterprise collectively in order to increase their access to credit (to purchase a substantial cashew stock) and to market their products more effectively.

A processing unit has been built at Vanathavilluwa which can accommodate the drying and other processing activities as well as provide sufficient storage capacity for raw cashew nuts. Other units have been built in the other villages which are smaller and house only the dryer. Shelling generally takes place at processors homes (except at Vanathavilluwa).

This collective processing has enabled the processors to access credit. Access to credit has improved considerably in five villages

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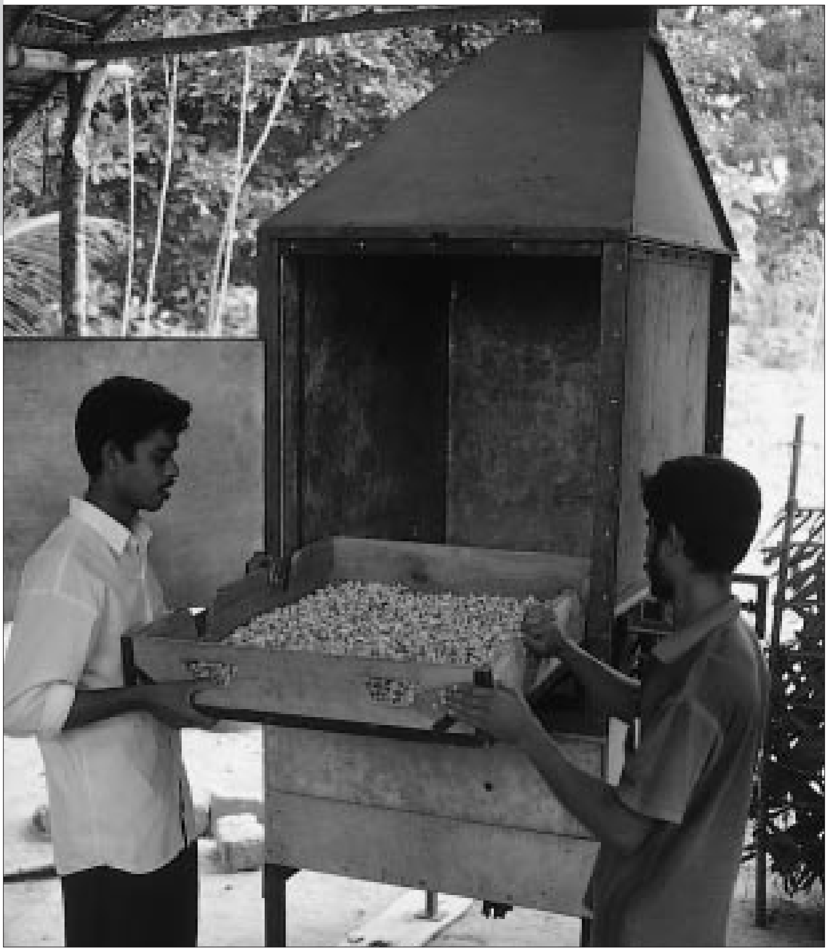
Protective gloves must be worn for cracking cashews to prevent burning from the corrosive liquid



Tray dryer modified for drying cashews

(Vanathavilluwa, Palugassegama, Kaluwelgoda, Madelgamuwa and Santhanagama). For example, the group in Vanathavilluwa had access to only 290,000 Rupees initially through Regional Rural Development Bank. This has now increased to up to 750,000 Rupees.

The women have also begun to grade the cashew kernels according to sizes, as required by the international market.

The improvements above have led to increased productivity and an improved quality. The groups in Madelgamuwa and Vanathavilluwa are now producing more than 1,200 kg of processed cashew nuts a month, while Kaluwelgoda is producing more than 700 kg. The quality of the final product has been improved. An indication of this is that the percentage of broken nuts is less than 20% in all villages which have been involved with the programme for at least a year and varies from 5–10% in mature sites compared to 30% and over in new ones. In Vanathavilluwa, it has been reduced to less than 4%.

Cashew processors in four villages (Kaluwelgoda, Vanathavilluwa, Madelgamuwa and Santhanagama) are now selling 100% of their produce directly to exporters; some 3,000–4,000 kg of processed cashews being sold per month. They are acknowledged as a reliable source of a quality product.

Increased incomes for producers

Due to the above changes the processors in Vanathavilluwa, Kaluwelgoda, Madelgamuwa have increased their incomes by more than 10%. In Santhanagama and Palugassegama, the increase has been 5%. Each processor in Vanathavilluwa, Kaluwelgoda and Madelgamuwa is now earning 4,500–5,000 Rupees (US$60–70); in Santhanagama and Palugassegama at least 2,000–2,500 Rupees (US$25-30) per month; and Yodhakandiya income is about up to 1,500 Rupees (US$20) per month.

This has made a big impact on the women's lives. For example, the women have said that they can now 'get income from

Whole, shelled cashew kernels

cashew directly rather than through their husbands'. Earlier, their husbands generally sold cashew to middlemen on behalf of them, as the women worked at home rather than going out.

The women have used this income for:

- good food
- better clothing
- better family healthcare
- new furniture and other necessary household items
- a better education for their children
- improvements to their houses, e.g. white washing, permanent roof and new toilet
- repaying housing loans.

They have even been able to save money and increase their savings in the banks. In Kaluwelgoda, eight members of the group are now setting aside 3,000 Rupees per month for *seettuwa* which is a famous traditional saving system mainly practised by women.

The increased incomes have enabled the women to gain respect and recognition by the villages as self employed business people.

Improved status for small-scale production

Small-scale cashew processors are now regarded as reliable producers and good investment opportunities by a range of organizations. The Cashew Corporation, the Export Development Board and the Industrial Service Bureau have recognized that small producers are capable and reliable. One export company is directly buying from the small-scale cashew processing groups in Vanathavilluwa, Kaluwelgoda and Madelgamuwa. The Seylan Bank and RRDB have provided increased credit to small processors in Kaluwelgoda, Madelgamuwa, Vanathavilluwa and Santhanagama. Seylan Bank released Rs.100,000 per project beneficiary in Kaluwelgoda, Madelgamuwa and Vanathavilluwa. RRDB has increased the loan amount from Rs.35,000 to Rs.75,000 for Vanathavilluwa after assessing work progress. The Samurdhi beneficiaries who are involved in cashew processing work in Santhanagama were also able to obtain a loan of Rs.20,000 from Kurunegala RRDB.

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Traditional method of cashew processing

The story of new businessmen in Kaluwelgoda

Mr Keerithirathna is the dryer operator as well as a member of the Kaluwelgoda cashew processing unit. From the income he received by working in the processing work he has started his own business by opening a small retail shop in his home. He sells goods such as sugar, tea, and salt which are necessary in most houses. He repays the bank loan instalment from the little income received from this shop, and soon he will be able to sell his own garden produce too ,such as pineapples, cassava and bananas. Not only does he have the shop but he has also started to sell his own cashew products in his shop with his label:

> KEERTHI CASHEW PRODUCTS
> Net wt …Gram Price Rs…
> Exp Date…….
> No. 38 Kaluwelgoda, Makewita-Ja-Ela

He prepares his cashew nuts by cooking them with a little oil, chilli and salt powder before putting them into packets. He goes from shop to shop marketing his cashews. He has been able to purchase his own motorcycle and is able to do his work much more quickly than before.

Mr Keerithirathna continues his cashew processing work as a member of the society and also markets individual products to the Cashew Corporation as well as to the retail shops in Colombo. He has produced about 276,460 kg of processed cashew during the month of September 1997 and sold out to the Cashew Corporation and others earning an income of 75,879 Rupees.

The manufacture of yoghurt and cottage cheese

Dr Hamilton from Jamaica describes how perfectly acceptable yoghurt and cottage cheese can be prepared at the small scale using simple equipment. The article includes detailed methods and a short section on how to overcome basic problems in yoghurt production.

Introduction

The small scale production of high quality yoghurt and cottage cheese is perfectly possible but does require care and an understanding of the process. While the production of good cheese and yoghurts involves a degree of art, it is based on sound scientific principles. The production of yoghurts and cheese involves a living organism and it is therefore important to understand the needs and requirements of the organisms. It is essential to pay attention to detail and accuracy in controlling temperatures and incubation times.

Yoghurt Production

The minimum equipment required to make yoghurt is a large saucepan, a thermometer and a clean spoon for stirring. A slightly more professional approach is to use a thermostatically controlled electric yoghurt maker which incubates the organisms at their optimum temperatures. A set of scales will be required to accurately weigh out ingredients.

The science behind making yoghurt is in the culturing. Fresh milk contains a range of acid and flavour producing micro-organisms, but only two of these work together to turn milk or cream into yoghurt. These are called *Streptococcus thermophilus* and *Lactobacillus bulgaricus*.

If raw milk is kept warm, it will sour due to the growth of lactic acid forming bacteria which grow first. These compete with the two desirable strains, preventing them from growing. It is therefore necessary to start the process by pasteurising (boiling or simmering) the milk to stop or slow the growth of the undesired bacteria. Heating also removes much of the oxygen present in the milk, providing a better medium for the growth of the desired organisms.

Streptococcus thermophilus grows best between 45 and 47°C. *Lactobacillus bulgaricus* on the other hand, grows best between 37 and 42°C. What actually happens is that the *Streptococcus thermophilus* is the first to start growing, then as the temperature of the medium falls the *Lactobacillus* (which is responsible for the flavour) takes over.

Keywords

yoghurt, cottage cheese, small-scale, fermentation

Methodology

While yoghurt can be made entirely from fresh milk, a richer flavoured, thicker product will result if half a cup of evaporated milk or three heaped tablespoons of powdered milk (either whole or skimmed) is added to each litre of fresh milk. The final recipe used will depend on the preferences of customers. A typical outline for yoghurt preparation involves the following steps:

- Pour one litre of fresh pasteurised, homogenized milk into a saucepan or double boiler, if available, and slowly heat with constant stirring to avoid burning, to 82–84°C. Turn off the heat and hold at that temperature for approximately five minutes. Use a thermometer that has been checked in boiling water (water boils at 100°C).
  NOTE: If UHT (Ultra Heat Treated or sterilized) milk is used it is not necessary to pasteurise but simply heat to 49°C.
- Allow the milk cool to 49°C. The cooling process can be accelerated by immersing the saucepan or double boiler in a cold water bath. At 49°C the milk is ready for the addition of the starter culture.

Preparation of starter.

The starter consists of milk containing the two strains of actively growing yoghurt bacteria. It is either prepared from a commercially available freeze dried culture if available (5 gms/litre of milk), or one or two teaspoons of a fresh commercial plain or natural yoghurt. The milk used should be pasteurised as described above. While starters can be maintained in an actively growing state for a long time by transferring small amounts into fresh milk daily or weekly, it is much easier to save a few grams of finished yoghurt from one batch for use in the next batch.

- Mix well and dissolve the dried culture or commercial plain yoghurt in about half a cup of the warm milk, pour back into the remainder of the milk and mix well. The temperature of the milk in the saucepan will now have fallen to the desired range of 44–46°C.
- The cultured milk is then allowed to incubate in a warm place, or in an insulated box, until it sets. The time taken will depend on how active the starter culture/starter was and how well the temperature was maintained. If everything

was carried out correctly, the yoghurt should set in about four hours. At this point, using a spoon that has been sterilized in boiling water, check the flavour and consistency. Note the level of acidity, flavour and texture.

- If the yoghurt has the desired flavour and texture, stop the growth of the organisms by placing in a refrigerator for a minimum of eight hours.

Problems

Although the production of yoghurt is relatively simple, it does not always work well on the first attempt. There are several reasons for this and the following checklist (table 1) can help to rectify some of the more common problems. If you are making yoghurt for the first time, do not give up if the product falls below your expectations. Experiment with different combinations of raw ingredients and incubation times until you find a method and a product that suits your customers' needs.

Yoghurts with fruits and flavouring

A variety of fruits and flavourings can be used to create exciting new tastes and textures in yoghurt desserts. When adding fruits or flavourings, whether the yoghurt is incubated separately or in combination with the fruit, it is important to allow it to set in a refrigerator for a minimum of eight hours.

Fruit Yoghurt: Use fresh, canned or frozen fruit. It can be added as slices, chopped or pureed as toppings or mixed into yoghurt.

'Swiss Style' yoghurt: Stir pureed fruit into yoghurt until it is a heavy cream consistency; refrigerate for 2 to 3 hours.

Yoghurt sundaes or yoghurt parfaits: For sundaes, put favourite fruit at the bottom of a serving dish and spoon yoghurt on top. Garnish with cherries or nuts. For parfaits, layer fruit or preserves with yoghurt in a glass bowl, and again garnish with nuts, cherries and honey.

Flavoured yoghurt: Use flavours to create a fruit flavoured syrup, thickened with corn starch and sweetened with sugar.

Cottage cheese

Cottage cheese is a soft, crumbly, acid cheese prepared from skimmed or partially skimmed milk or skimmed milk reconstituted from milk powder. Cottage cheese differs from other acid coagulated cheese in that the pieces of curd are kept separate by cutting, scalding and washing.

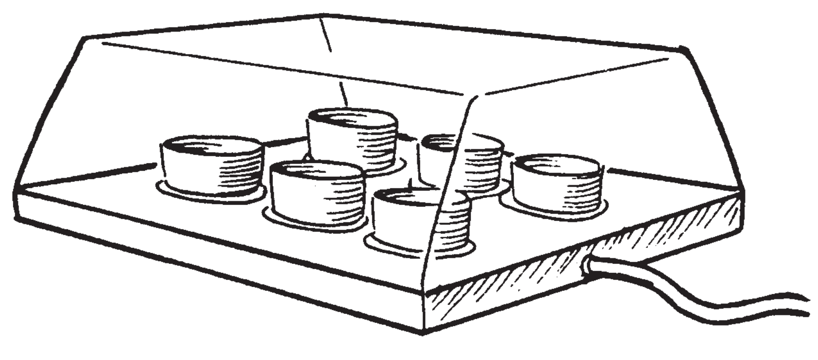
The organisms involved in the preparation of cottage cheese are a mixture of lactic acid producing Streptococcus and Lactobacillus. As with yoghurt production, the starter can be a freeze-dried culture, or, since the finished product contains living organisms, commercial cottage cheese can be used to develop a starter. When making a starter from commercial cottage cheese, the cheese should first be blended to break down the curd to a liquid and added at the rate of 5% or more to small amounts of skimmed milk. It is then incubated at 32°C for about five hours to allow the starter culture to grow.

Two methods for making cottage cheese: the short and long set methods.

In the short set method, a small amount of rennet (an enzyme used for the coagulation of milk) is added to ensure the formation of a firm curd. The milk is first pasteurised by heating to 82–84°C, and rapidly cooling to 32–33°C. 5% starter culture is added (50ml per litre of milk) together with rennet at the rate of 0.5ml per 10 litre. The mixture is then incubated at 32°C for five hours.

Table 1 – Common problems in yoghurt production and possible solutions

Problem	*Remedy*
The yoghurt fails to set or take on the desired consistency after the normal time of incubation	a) Check the quality of the milk used. It should be fresh. b) The temperature was too high when the starter was added (over 50°C). c) The temperature of incubation was too high. Maintain temperature between 43-44°C. d) The starter was added when the milk was too cold. (Less than body temperature 37°C).
A liquid (whey) forms on the top of the yoghurt, or it has a grainy texture	a) The milk was too hot when the starter was added. b) The time of incubation was too long. c) The level or amount of starter was too high and/or it was not properly stirred into the pasteurised milk. HINT: Adding gelatin will greatly inhibit whey formation.



A thermostatically controlled yoghurt incubator

When using the long set method, the amount of starter is reduced to only 1–2% and the incubation temperature is reduced to 22°C, but the incubation time is increased to 12 hours. When the curd has set at the end of the incubation, a liquid (whey) will be seen on the surface.

Good results can also be obtained by adding the starter, as in the short set method at 32°C, and incubating overnight without the use of rennet.

The cheese is ready when sufficient acid has been produced. This is confirmed by the release of whey from the cheese when it is cut with a clean knife. The curd is next cut into small cubes about 8–13 mm. On a larger scale, a special rectangular cutter made from stainless steel wire that produces regular sized pieces is used. At home, the same effect can be achieved in a bucket using a thoroughly cleaned, sterilized tennis or badminton racquet.

After cutting, the curd pieces are cooked in the whey in a double boiling pan at 49–53°C for a minimum of two hours. The scald temperature must be sufficient to control the growth of spoilage organisms.

After scalding, the curd is placed in a cheese cloth bag and allowed to drain. Finally the curd is washed three times in water at progressively lower temperatures, namely 24, 10 and 3°C.

After the final cold water wash, the curd is drained for one hour. At this point, the curd has a firm, chewy texture. Plain cottage cheese (low calorie) is produced by washing the curd in a 1–2% salt solution before packing. The product must be refrigerated at 2 to 4°C and will have a shelf life of three weeks.

Fruit and vegetable pieces may be added to the curd to produce a number of flavoured varieties, for example, onion, chives, sweet pepper and pineapple.

by M.O. (Pat) Hamilton, Ph.D

International Workshop on Drying and Improvement of Shea and Aeile

Ngaoundere, Cameroon
1—3 December 1999

Objectives of the workshop

- Review research on drying, shea and aeile
- Develop an instrument for strengthening regional collaboration
- Exchange information on research results
- Inform leaders of NGOs and policy makers about the possibilities of reducing post harvest losses

Expected outputs

- Capitalisation of knowledge on drying and improvement of shea and aiele
- Determination of research priorities and strategies
- Inventory of institutions and individuals working on drying
- Publication of workshop proceedings

Main topics

- Agroforestry and domestication
- Biology, plant improvement and protection
- Chemistry, biochemistry and nutrition
- Technology
- Equipment and socio-economic aspects
- Other contributions

For further information contact Pr C Kapseu, Co-ordinator, Workshop on Drying, ENSAI-IUT, University of Ngaoundere, PO Box 455 Ngaouendere, CAMEROON.
Tel: (237) 25 27 51/25 25 99. Email Kapseu@syfed.cm.refer.org

Training in food processing – a sustainable approach in India

Teaching the art of catching a fish requires more effort than merely giving a fish to a hungry man. However, once the techniques have been learnt, they remain with the individual for a lifetime and he is able to continue catching fish whereas the hungry man had his hunger satisfied for one day only. There is a general opinion that Non-governmental Organisations are meant for charity, but the financial and funding agencies always ask about viability and sustainability of any project. This can be fulfilled only when adequate and appropriate training is provided to the potential entrepreneurs. Training helps them to acquire more knowledge and skills and yield better results.

Introduction

The Palmyrah Workers Development Society (PWDS) is a registered Voluntary Organisation established in 1977. It was initiated with the objective of improving the socio-economic conditions of Palmyrah Workers and their families in Kanyakumari and Trivandrum Districts of Tamil Nadu and Kerala States respectively. Several programmes were introduced to the community with the objectives of empowerment and self-reliance.

Palmyrah

Palmyrah is a palm tree that grows in several countries including India, China, Sri Lanka, Bangladesh, Indonesia, Malaysia, Thailand and Nepal. The palmyrah tree gives a sweet sap called neera from its flowers which is collected and made into a solid sweetener called jaggery. There are 500 thousand families engaged in palmyrah work in Tamil Nadu alone.

Palmyrah workers

In general, palmyrah workers and their families are poverty ridden and oppressed and live in small thatched huts. Their main occupation of palmyrah tapping and processing is neither remunerative nor safe. It is a seasonal and accident-prone occupation that usually involves the whole family. The tapper climbs to the top of the tree to collect the neera which is processed by the woman. Children help the parents to transport the neera, collect the firewood and boil the neera to produce a palm sugar called jaggery. Sometimes the elder children are forced to look after the younger ones which denies them their childhood and formal education.

Most of the palmyrah workers work as wage labourers for landlords who own the trees. On average a tapper can tap thirty to forty trees and collect 50 to 80 litres of neera per day. The meagre income they earn from this occupation is inadequate to provide the most basic of family needs. In addition, they are not given proper recognition in society and are subject to discrimination.

Even though there is tremendous potential to increase employment opportunities, the palmyrah industry shows a declining trend because of the poor remuneration. This could be solved in two ways: producing alternate value added products such as palm candy and devising alternate marketing strategies for palm products.

Palm product development

The studies and experience of PWDS showed that it is impossible to improve the socio-economic conditions of the palmyrah artisans unless marketable value added products are produced from neera instead of the traditional jaggery. In the late eighties, a German develoment organization, FAKT, began to work with PWDS to study suitable alternative products such as refined jaggery, spiced jaggery, palm candy and palm syrup. After careful analysis of the situation, top priority was given to the production of palm candy.

Palm Candy

Palm candy is a crystalline form of neera. It is a natural sweetener with both nutritive and

Keywords
Training, food processing, India, sustainable

IT/Mike Battcock

Traditional tapping of sap

medicinal values. The technology for producing palm candy is not complicated. After collecting the sweet sap from the tree top it is heated to 40°C then treated with lime and filtered. The pure neera is boiled to 108°C until it becomes a syrup of a specific viscosity. The boiled syrup is transferred to a crystalliser and kept undisturbed for at least 40 days to allow crystallisation to take place. After harvest the crystals are cleaned and neatly packed. Since it is a natural, medicinal product, there is good demand for palm candy.

Transfer of technology through community based candy processing units

To transfer the technology from the lab to the field, a palmyrah worker group was identified in one village – Madichal. Initially, people were hesitant to adopt the new technologybut after a series of discussions they agreed to try the process and the pilot project started in 1992. This was a learning experience for both the palmyrah workers and the technical team of PWDS. The pilot project proved that candy making is technically feasible and economically viable. After seeing the success of the Madichal candy unit, people from nearby villages were keen to replicate the same model in their villages. At present five palm candy making units are being managed successfully by the palmyrah artisans.

In each unit, ten to fifteen palmyrah workers joined together as producing partners. They regularly supply their neera to the centre and process it centrally. After selling the product (candy), each member is given a share of the profit in proportion to the neera supplied. Their income has doubled through candy making as compared to jaggery making.

Training approach

Our approach is to identify the needy and potential candidates and train them to become experts in the particular field and enhance their entrepreneurial skills. The training can be divided into three parts.

Sale of traditional jaggery products

IT/Mike Battcock

1. Pre-training

This is an essential pre-requisite to any training course. It involves the identification of trainees, preparation of course content, sequence, design, duration, methodology, venue and links with other support organisations.

2. Training

This is the actual delivery of training, including both theoretical and practical aspects.

3. Post-training

This phase is centred on follow-up. The success of any training depends on how many persons have put it into practice. There may be some starting problems, for example setting up a production unit, availing finance, fulfilling the cumbersome government formalities and becoming established in the market place, where trainees need some counselling and encouragement. Many agencies do not give due importance to post training. I can say, it is a negligence on the part of the Organisation which provides training as follow-up is inevitable and inseparable from the actual training.

Designing training courses

From our experience we have designed three types of training programme, suitable for different types of people:

- trainers
- members of a candy making unit (producing partners)
- technicians/candy makers

Trainers training programme

This is designed for the NGO staff who wish to replicate the community based palm candy making units in their target villages.

The training includes orientation about community based income generation programmes, candy making and information on skill training, comparative economic analysis of jaggery and palm candy processing, technical feasibility and economic viability, concept of rural entrepreneurship development programme, entrepreneurial behaviour, business plan, appropriate technology, quality control, basic knowledge to initiate a production unit including environmental scanning, government formalities, marketing, record maintenance, management inputs, base-line study, monitoring and accompaniment, evaluation and follow-up.

The methodology followed is classroom input, group discussions, experience sharing, exposure visits and on the spot training.

Training module for tappers

This course is for individuals who will be involved in candy making as producing partners. The duration of the training is two days.

The trainees are given the basic concept of enterprise, entrepreneurship, project and product idea, the advantages of palm candy making, marketing and management and monitoring of the production unit. The methodology is class-room input, experience sharing, group discussion and exposure visit.

Training for technicians and candy makers

The purpose of this training package is to impart the technology or skills. The course includes the salient features of the raw material, economic benefits of candy preparation, process details, precautions, technology and the installation of unit.

The duration of the training is forty five days, either continuous or in two modules because the palm candy can only be harvested after forty days of crystallisation. After the successful completion of the training, the trainees become fully qualified technicians.

Evaluation and impact assessment

Evaluation is a tool to measure the effectiveness of the programme and enable the producing partners to improve. We insist on participatory joint evaluation by the trainees and the evaluation team. Broadly speaking, the evaluation is carried out in two stages:

I. evaluation of trainees immediately after the training programme
ii. performance evaluation of the unit after one year by the internal and external teams

The tools used to monitor progress and impact are pre-test and post-test filled questionnaires and feedback of the trainees. On the other hand, in the performance evaluation the indicators are palmyrah workers participation and co-operation, quantity and quality of neera supplied, candy yield, quality control mechanism, profitability, maintenance of accounts, dynamics in decision making and self-management.

The very purpose of the training is to enable the producing partners to manage their units by themselves. Managing a unit by a single person is comparatively easy whereas managing a community based unit by a group of members is very difficult. Here we apply the Participatory Impact Monitoring (PIM) mechanism.

In the conventional method, an outsider is appointed to assess the impact of the unit. There are a lot of disadvantages in this process. The preconceived notions of the assessor may dilute the real growth and it also creates dependency on outside experts which is more expensive. As a result, the producers are hesitant to conduct regular impact studies.

The participative impact monitoring is a simple monitoring tool to assess the impact effectively. Once trained, they can easily

IT/Mike Battcock

The studies and experience at PWDS showed that it is impossible to improve the socio-economic conditions unless marketable products are made instead of traditional jaggery

assess their own strengths, weaknesses, successes and failures on a weekly basis using the indicators and make necessary corrections in their system which protect them from heavy loss or damage.

The impact assessment has been carried out at two levels: unit level impact monitoring and NGO level impact monitoring. The impact of each unit is shared and reviewed in the joint reflection meeting of all the candy making units promoted by PWDS. It gives more clarity and strength among the individual units. After seeing the successful application of PIM in candy units, many other NGOs have come forward to adopt this monitoring tool.

Conclusion

The systematic training and follow-up provided by PWDS enables the poor palmyrah workers to become efficient entrepreneurs. When the product quality has been improved by value addition through appropriate technology and training, people's power is also strengthened. Once a palmyrah worker only dreamt of having a hundred rupee note. Now they are handling hundreds of thousands of rupees through this food processing programme. In such a situation, how can we deny that food processing training will not be a strategy for sustainable development?

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Book Lines

Mushroom Cultivation — A Practical Approach

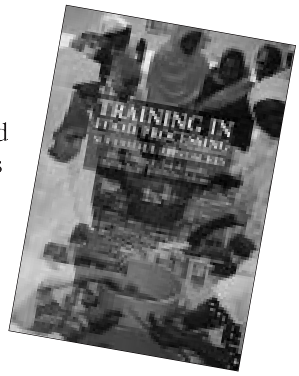
Dawit Abate, 1998

The author of this handbook on mushroom cultivation has several years of first hand experience of the subject in Africa. Although the book is based on experiences in Ethiopia, the principles are clearly explained and are applicable to a range of developing countries. The handbook begins with a brief overview of mushrooms and fungi and their various uses. The importance of fungi in agriculture, health and medicine, industry and biotechnology are briefly mentioned before the book moves onto more practical issues.

One of the benefits of cultivating mushrooms is that they require very little specialised equipment and can be grown on a variety of waste substances. The book describes a range of growth substrates which are either by-products of other food industries or are waste products. The range of options discussed should ensure that there are opportunities for people to adopt this technology in a range of countries and situations. There is a very useful section on the control of pests and pathogens and another one which describes how to preserve mushrooms.

The resource section of the book contains a comprehensive glossary and suppliers of spawn and cultures and laboratory supplies. The handbook is recommended for those who wish to begin or improve existing mushroom cultivation in developing countries.

Training in Food Processing: Successful Approaches



1998, ISBN: 1 85339 425 4, 152 pp, £9.95

This book carries an optimistic title and indeed the authors suggest that its contents have been the result of many years of implementing such training exercises. The lessons learned over the years have been distilled into this compact volume. The emphasis on small-scale production is also strongly maintained throughout.

The book is in two parts. The first four chapters deal with the mechanics of training courses in their preparation, implementation and finally, but most importantly, in the assessment of their success. These chapters never lose sight of the nature of the audience for the courses, usually adults with limited formal education, whilst paying attention to the details which make any course a success — publicity, material preparation, scale, costs and teaching methods. The scope of the courses covers the obvious practical skills of food preparation but also suggests the inclusion of business/financial and legislative aspects .

The second part, ten chapters, describes case studies based on experiences in Latin America, Africa and Asia and includes examples from eleven different countries. The processes employed and final products generated are also varied: from snacks to fruits, involving drying and cooking although the actual processes given are not important in my opinion. The themes discussed in these studies could form the basis for a course on any product/process in any part of the world.

The book is extremely well presented with photographs taken at courses, simple diagrams suitable for handouts and individual stories which include some failures as well as successes. This type of extension work is not glamorous but essential to enable the large mass of individuals, particularly women, to improve their income by adding value to their usual agricultural products. The spin-off from such income can be seen in improved educational opportunities and health in children besides material comforts.

G. M. Hall

Cassava doughnuts

Cassava doughnuts are thick, cylindrical, fried products which are approximately 8cm in diameter and 3cm thick. The texture is stiffer than cake and the crust is soft with a deep, uniform brown colour. They have a shelf-life of a few days under correct storage conditions and are used as a snackfood or in packed meals.

As in all cassava products, especially those made from bitter cassava, it is necessary to detoxify the cassava by removing or deactivating the components that yield cyanide. The main quality factors are the colour and fineness of the flour and freedom from dirt, mould and insects. Oil used for frying should be clear, of good quality and free from rancidity.

Hygiene

Heat during frying destroys most contaminating bacteria and the soft crust restricts recontamination during storage. Good hygienic practices should be enforced during preparation of the dough to prevent gross contamination and possible survival of large numbers of bacteria after frying.

Packaging and storage

The product should be properly cooled before packaging into a moisture proof bag in order to prevent water vapour condensing onto the inside of the pack, moistening the surface of the cake and promoting mould growth. The pack should also be oil resistant and prevent contamination by soils, insects etc. The product should be stored in a cool, dry place away from sunlight which would accelerate rancidity of the oil in the product.

Equipment required

Mixer (optional)
Heat sealer
Scales
Thermometer

Process	Notes
Cassava Flour	
|	
Mix ↓	1kg cassava flour, 75g baking powder, 200g sugar, 6 eggs, 125g margarine, 1/2 teaspoon salt and 1/2 litre milk or water. Mix to a smooth dough.
Shape ↓	Shape with floured hands, take mixture in spoonfuls, shape into rounds with a hole in the middle.
Fry ↓	Deep fry the doughnuts in hot oil (approx 150°C) until golden brown on both sides.
Drain |	Remove excess oil.
Cool |	Cool to room temperature.
Pack ↓	Pack in plastic bags, preferably in units of ten for easy counting and wholesale.
Store	Store in cool and shaded place to slow down rancidity.