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Issue Highlights

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Control of Mites in Honey Bees

By Dawn Berkelaar with Kristin Davis and Darrell Cox

Varroa mites (two strains of *Varroa destructor*), which parasitize the Western honey bee (*Apis mellifera*) over much of the world, can seriously weaken and even kill honey bee colonies. These mites, which were long thought to be *Varroa jacobsoni* but are now known to be a separate species, are natural parasites of specific strains of the Asian hive bee (*Apis cerana*). Around 1940, they transferred from *A. cerana* to *A. mellifera* and have since spread to Europe, the Middle East, North and South America (including some Caribbean islands), select parts of Africa and more recently New Zealand. Australia is the only major beekeeping country that is free of the mites. These mites have a much more damaging effect on *A. mellifera* than they do on their native hosts, the Korea and Japan/Thailand strains of *A. cerana*.

Varroa mites are the most serious problem for beekeepers in the United States. In Europe, infested colonies die within 3-7 years. The mites can be seen with the naked eye (see Figure 1). To determine if your hive is infested with *Varroa* mites, put a piece of white paper on the bottom of the hive and blow tobacco smoke into the hive. Close up the hive for five minutes. Remove the paper after an hour to check for mites. *Varroa* mites look like small brown dots on the paper, and can also sometimes be seen on the bodies of adult bees. *Varroa* mites feed on the haemolymph (i.e. insect blood) of adult honey bees. The mites mate and reproduce within capped honey bee brood cells, and during this time they feed on the developing pupae. In the process, they may transfer any of several different viruses to honey bees.

As a result of mite parasitism, many pupae are deformed when they emerge as adults. Thus, another clue that *Varroa* mites have infested a hive is the presence of adult bees with deformed wings or abdomens.

Figure 1: Varroa mites seen on a honey bee pupa. Photo by Jim Kalisch, University of Nebraska, Department of Entomology.

Varroa mites are often controlled by chemical poisons. In North America fluvalinate-impregnated strips are hung in the hive for six weeks. In many countries beekeepers use non-approved chemicals which can and do leave residues in honey. Such residues may be dangerous to human health, but could also jeopardize the beekeeping industry. To avoid contamination, chemicals should not be used during nectar flows (times of heavy flowering) or for four weeks prior to a nectar flow.

Extended use of chemical pesticides can result in mite resistance to the chemicals. In addition, chemical acaricides (i.e. chemicals used specifically to kill mites) are costly and may be unavailable to beekeepers. No method is totally effective in controlling *Varroa*. However, several techniques can help to keep *Varroa* infestation at a manageable level.

Neem for Control of Mites

In the search for less toxic and cheaper acaricides, neem oil has emerged as a possible candidate for the control of

Varroa mites. Neem (*Azadirachta indica*) is a tree that is related to mahogany and is rapidly becoming common in many tropical countries. Oil from seeds of the tree has been found to be an effective control against hundreds of different agricultural pests, while being harmless to mammals and relatively non-toxic to beneficial insects. The main effective ingredient in neem is a compound called azadirachtin.

Adony P. Melathopoulos and colleagues at Simon Fraser University in British Columbia studied the effectiveness of neem oil in controlling mites. Their results, published in the *Journal of Economic Entomology* volume 93(2) and 93(3), demonstrated that neem was an adequate acaricide against *Varroa*, though not as effective as chemical acaricides such as fluvalinate. After frames were sprayed with neem oil, *Varroa* showed a 50-90 percent mortality. The effectiveness of the neem oil varied between batches used at the same concentration; this is because batches were from different sources and probably contained varying amounts of azadirachtin.

Melathopoulos discovered that neem also affected tracheal mites. Tracheal mites (*Acarapis woodi*) are microscopic mites which infest honey bee tracheae (breathing tubes). They are another serious pest of honey bees. Neem spray did not kill tracheal mites in the experiment, but it did prevent transfer from host to host and thus seemed to prevent further infestation by *A. woodi*.

Neem oil caused some negative effects upon experimental hives, and these effects must be taken into account before deciding to use neem. Some queen loss was experienced after treating hives with neem. The effect seemed to be dependent on the concentration of neem oil used. In the studies at Simon Fraser University, half of colonies sprayed with 10% neem oil (as an emulsion in water) lost queens. No queens were lost in colonies sprayed with 5% neem oil.

Neem spray also reduced the area of sealed brood (i.e. pupae in cells, capped over by wax), by 50%. This figure remained the same at different dosages. Loss of half the hive's pupae would reduce the population of adult honey bees once the surviving pupae began to emerge, but if a hive was so badly infested by *Varroa* mites that you would otherwise likely lose the whole hive, you might decide to risk losing half the hive's pupae in order to get rid of the mites.

Unfortunately, neem is more labor-intensive to use than many chemicals. In the study, the most effective treatment was to use neem oil as an emulsion in water (see *Amaranth to Zai Holes*, p. 200 for information about how to extract neem oil from the seeds. *Amaranth to Zai Holes* is also on our website). Two percent by weight Tween-20 (strong detergent) was added as an emulsifier. Another detergent such as dish washing detergent could be used instead as an emulsifier, but keep the concentration of detergent at 2% since higher concentrations could harm honey bee brood and adults by blocking their spiracles (breathing holes). Frames were moved to make a 5 cm (2 inch) gap, and about 20 ml of the emulsion were sprayed over the length and depth of each frame (10 ml per side). In the experiment, a backpack sprayer was used; a spray bottle might work as well. Multiple applications (six applications at four day intervals) were necessary. When applied in a sugar syrup feed, neem was not effective in controlling mites. The bees did not seem to like the taste. They ate more of the neem sugar syrup when the neem oil was debitterized, but it still had little effect.

Laboratory experiments by Melathopoulos and his colleagues suggest that mineral and vegetable oils such as grapeseed, peanut, or canola oil will work as well as neem. The oils can be applied in a similar way.

Biotechnical Control of Mites

In Vietnam, *Varroa* mites cause problems in *Apis mellifera* hives. Beekeepers there are able to control the mites without using chemicals. Instead they use a series of management techniques or biotechnical methods, described in an article in *Bee World* 78(2) by Nguyen Van Dung, *et al* ("Control of honey bee mites in Vietnam without the use of chemicals"). In order to use these techniques successfully, the life cycle of *Varroa* needs to be understood.

Varroa mites reproduce only inside capped honey bee brood cells, so removal of infested brood is one way to control the mites. Mites prefer drone brood to worker brood. Although Varroa is able to reproduce within both worker and drone brood of *A. mellifera*, drones have a longer development time than workers, so *Varroa* mites have more time to reproduce and mature within drone brood cells. If a frame without comb foundation is put into a strong colony, often the workers will build drone comb on the frame. Drone comb is easily recognizable because the cells are larger than those used to rear worker brood or for honey storage. Beekeepers will remove the frame when it is full of drone brood larvae up to four days old. They introduce the frame into a heavily infested colony and remove it once the brood is capped over. Cell cappings are cut off, and the brood is removed and eaten (it is a good protein source). The empty comb can be reused to trap more *Varroa* mites.

In another somewhat labor-intensive method, often used during the season when new colonies are established, *Varroa* is treated cooperatively using two hives. In each colony, a broodless period is created. This means that any *Varroa* mites remaining in the hive will be on adult bees. They can then be trapped and removed in the next brood comb that is produced. We will call the two hives colony A and colony B. All brood is removed from colony A and placed in colony B, creating a broodless period in colony A. The queen in colony A will continue to lay eggs. Once those eggs hatch and the larvae begin to pupate, the first resulting two combs with capped brood are removed and destroyed (or the brood can be eaten). The *Varroa* mites within the capped brood are removed at the same time.

In the meantime, colony B has received the original brood from colony A. The queen in colony B is removed and replaced with a recently capped queen cell. There will be a period of a week or so before the new queen emerges, mates and begins to lay eggs. Once the pupae from the old brood hatch out, a broodless period will be created. After the queen begins to lay eggs, the first two resulting combs of sealed brood are again removed and destroyed/eaten, along with remaining *Varroa* mites.

Because of the broodless periods that are created in the hives, this method has the advantage of also controlling another parasitic mite called *Tropilaelaps clareae* (found in Asia) which cannot survive on adult bees for more than two days. *Tropilaelaps* mites can be killed by creating a short broodless period in the colony.

A final biotechnical method involves destroying capped brood at the end of the main honey harvest each year. *Varroa* mites will invade the remaining uncapped brood, which can be removed several days later once it is newly capped. This method, although it weakens a colony, has two additional benefits. After the nectar flow, fewer bees in the colony means a beekeeper will have to feed the colony less sugar water. And, as mentioned, brood can be eaten as a good protein source.

In some cases, these management techniques can be combined with chemical control for a more effective treatment. When very little sealed brood is present in a colony, chemicals that are applied will affect more of the *Varroa* mites that are present.

Essential Oils for Control of Mites

Jorge Murillo-Yepes in Grenada reported in *Beekeeping and Development* Issue 46 about the use of essential oils to kill mites. Researchers in Grenada have used an oil cream to target *Varroa* mites. They use 170 g beeswax, 450 g coconut oil (or other vegetable cooking oil) and 15 g essential oil (they have tried eucalyptus, nutmeg, peppermint and spearmint). To prepare the cream, they melt the beeswax and oil together in a double boiler. Once the wax is completely melted, they allow the mixture to cool until it just starts to harden at the surface, but is still quite fluid. Then the essential oil is mixed in until it is thoroughly blended.

To treat a hive, one or two teaspoons of the cream are spread evenly onto a strip of bamboo, cardboard, plastic, plywood or tin measuring 2 to 5 cm (1 to 2 inches) wide and 20 cm (8 inches) long. The strip is pushed into the entrance in the morning, preferably on a hot, sunny day. If the weather is hot and dry, the treatment should begin to work within two to four hours (dead *Varroa* mites should be seen on the bottom of the hive) and treatment should be complete after 24 hours.

Murillo-Yepes recommends that essential oil treatments not be used within one month of a heavy nectar flow. Since colonies in tropical conditions seem to be particularly susceptible to *Varroa* during periods of heavy rain, treatment might be well-timed just prior to the rainy season.

An article written by Adony Melathopoulos for *Bee Culture* gives an overview of the use of essential oils for mite treatments in Europe and North America. Over 150 essential oil compounds and blends have already been evaluated for *Varroa* control. Most of these have been found unsuitable for use in colonies, because they are toxic to honey bees as well as to *Varroa* mites. However, the essential oil thymol has been tested extensively and used successfully. For treatment to be successful, ambient temperatures must be higher than 15ºC (59ºF) and the colony must have only low amounts of sealed brood. Thymol is effective against both *Varroa* and tracheal mites, and causes little or no harm to bees. Residues in wax do not persist, and residues will not be a problem in honey if thymol is applied outside of the honey-producing season. Plants which contain thymol include *Thymus vulgaris* (thyme) and *Monarda punctata* (horsemint).

Open Mesh Floors for *Varroa* Control

Several new designs for the bottom boards of hives have been proposed as a method of controlling *Varroa* mites. Some of these designs were described in recent issues of *APIS*, a publication by Malcolm T. Sanford providing "Apicultural Information and Issues from IFAS/University of Florida, Department of Entomology and Nematology".

One of the designs uses a bottom board made from parallel transparent 34 mm tubes, separated by 3.5 mm. The tubes are in a wooden frame which becomes the hive stand. Information about this "anti-*Varroa* bottom board," developed by M. Legris, can be found in English, French and German at the website (http://www.apiculture.com/ plateau-anti-varroa). On the website, Mr. Le Pabic from France describes the reasoning behind the bottom board: "The principle of the anti-*Varroa* bottom board has come from the fact that wild colonies of honey bees can be found, free of *Varroa*, in highly infested areas. The assumption is that many *Varroa* mites fall from the colony and are eliminated in this way, having no means to climb back. On the contrary, in [an ordinary] hive they do not have any difficulty joining up with their initial environment from the classic bottom boards. The Legris anti-*Varroa* bottom board is designed so that they fall through the tubes under the hive.

"According to my experience on my colonies, this bottom board eliminates any need for chemical treatment. The *Varroa* mites are not fully eliminated, but they remain in such a small number that they are no longer harmful. In the worst case, only one treatment per year might have to be done, which is enough to economically justify it."

A second modified bottom board, described in *APIS* 17(6), separates the bee nest from the hive floor with the use of wire mesh (#8 hardware cloth). With this kind of design, it would probably work to use sticky papers under the mesh to actually trap the *Varroa* once they fall through. Papers could be made sticky with petroleum jelly. They would need to be removed and replaced periodically.

A third design is described in *APIS* 17(8), with a summary of Dr. Helmut Horn's article, "Observations on the Overwintering of Honeybee Colonies in Hives with Open and Solid Floorboards" (published in German in *A.D.I.Z.*, November 1987, and translated by A.E. McArthur for *Bee Craft* in July 1990).

Dr. Horn's open mesh hive floor uses a sturdy wood frame with wire mesh (8 wires per inch), instead of the usual solid bottom board. Because of better ventilation, a smaller entrance hole can be used above the mesh floor and less fanning will be necessary. The constant exchange of air means that less condensation is likely to occur, so there is less likelihood that fungus will grow on the combs. The open floor also enables *Varroa* mites and debris to fall out of the hive. One drawback in Dr. Horn's experiments was that food consumption was 10-15% higher with the use of the wire mesh floor, but there were no adverse effects on colonies. Although this open mesh floor is designed for colder climates where bees need to overwinter, the design may also benefit those keeping bees in tropical areas.

In addition to the benefits already listed, an open mesh floor might help to control small hive beetle. Small hive beetle (*Aethina tumida*) is another honey bee pest that was recently introduced to North America. The beetle larvae burrow through the comb within a hive, feed on stored honey and pollen, and very quickly cause honey to spoil. Small hive beetle larvae must leave the hive to pupate in the soil. Perhaps a container with soil in it could be placed beneath the open mesh floor to catch the beetle larvae. The soil could be sifted regularly, and the beetle pupae fed to chickens or destroyed.

Other Methods of Control

Certain populations of honey bees seem to be more resistant to *Varroa* mites than others. For example, Africanized bees and Russian bees seem to have a higher level of natural resistance to *Varroa* than most European bees. Selective breeding is also being done by scientists to confer specific characteristics on honey bees. For example, a shorter pupal stage for workers would mean that *Varroa* would have less time to mate and reproduce in capped cells. Bees are also being selected for hygienic behavior, in which bees groom each other to remove the mites.

Other alternative methods of control for *Varroa* mites are also published. These methods, like the biotechnical methods, can best be utilized when the mite's life cycle is understood. In an earlier EDN (58-4), we wrote about using smoke from dried grapefruit leaves to remove mites. The smoke does not seem to kill the mites, but rather makes them fall off of the bees. If a sticky paper were placed under a screen on the bottom of the hive (as aforementioned), this method could provide some control of the mites. But it would have to be done numerous times, because *Varroa* mites reproduce within capped cells containing honey bee pupae. Smoke would be ineffective against these sealed mites until they were again exposed with the newly emerging honey bee.

An Improved Method for Ripening Mangoes

By Darrell Cox, Ph.D.

An article in *Food Chain* (7/97) describes the following procedure as an improved method of mango ripening (information taken from *Food Digest*, Ceylon Institute of Scientific and Industrial Research, 363, Bauddhaloka Mawatha, Colombo 7, Sri Lanka):

"Mangoes are generally harvested when fully matured, but green. The conventional method of ripening in hay has disadvantages like long ripening time, excessive handling, and a high degree of spoilage due to stem-end rot. The spoilage during the ripening period is reported to be as high as 25-30%. In order to improve upon the ripening method, a simple technique has been worked out. It consists of dipping the fully matured, but green mangoes in hot water at 126ºF (52ºC) for 5 minutes, draining and keeping at room temperature until adhering surface water evaporates. Fruits are then packed in ventilated boxes or crates. No hay or other packing material is needed. The ripening generally starts on the 6th day of treatment and is complete on the 12th day. The operation can be made continuous in fruit processing factories where large quantities of mangoes are handled. The hot water treatment is found to reduce the spoilage to the extent of 50% and also helps in uniform ripening of fruits. The color development in the flesh is better than conventionally ripened fruits."

Now let me add some perspective that will be relevant both for those of you with a single tree and those of you that may be involved in marketing mangoes as an income-generating activity.

'Maturity' refers to full development of the fruit, while 'ripening' refers to such things as skin color changes from green to yellow, texture changes from hard to soft, and associated chemical changes including the conversion of starch to sugar. The crop is considered mature when the shoulder of the fruit broadens and some fruits on the tree have begun to change color from green to yellow. Prior to this external color change, the fruit is considered mature when the flesh near the seed changes color from white to yellow. Although the fruit will ripen on the tree, commercially it is usually picked when firm, green and mature. As anyone who is familiar with mangoes can attest, fruits picked while immature will ripen, but will remain sour.

Harvesting is done manually. When a mango fruit is mature, the stem will snap easily with a slight pull. If a strong pull is necessary, the fruit is still somewhat immature and should not be harvested. The picker should twist the fruit stem from the twig. Harvesting fruit with approximately 4 inches (10 cm) of stem intact prevents leakage of the milky, resinous sap. If the sap gets on fruit, it will burn the skin of the fruit making black lesions which lead to rotting.

Losses in yield and quality occur when sap damages the fruit (as mentioned above), from anthracnose fruit rot, from the bruising that occurs when fruit drops to the ground, from non-uniform ripening, and when ripening occurs at temperatures above those optimal for ripening (70 to 75ºF; 21 to 24ºC). The hot water treatment (5 minutes at 126ºF/52ºC) has successfully reduced many of these problems. Fruit is picked while green, fewer pickings are required, and greater uniformity in ripening can be achieved. In addition, anthracnose, which can appear as a storage disease of mature fruit causing fruit staining and fruit rot, can be reduced by hot water immersion.

Insecticide-treated Nets for Malaria Control: a Directory of Suppliers of Insecticides and Mosquito Nets for sub-Saharan Africa

In *EDN* issue 68, we published an article on treating bednets with insecticide for the prevention of malaria. This is a technique which is currently being widely promoted throughout the developing world. It seems very effective when compared to other low-cost methods of malaria prevention. Since publishing that issue, we received a request for sources of the insecticides used in the process. We found a useful web site which gives sources for purchasing nets and appropriate insecticides in sub-Saharan Africa. If you have access to the World Wide Web, you can read this document at (http://www.synapse.net/~path/ direct.html). If you do not have access to the web and live or work in sub-Saharan Africa, you may write to ECHO for a printed copy of the list.

An April 2001 IDRC report (www.idrc.ca/reports/read_ article_english.cfm? article_num=920) discusses the growing use of insecticide-treated nets in Tanzania. Research and development "has shown that nets impregnated with pyrethroid insecticide are effective at preventing malaria." A book called *Net Gain*, published by IDRC and the World Health Organization, claims that the use of insecticide-treated nets could reduce child mortality by 17 to 63 percent.

Clearly the nets will be effective only if they are used. IDRC's report indicates that the use of insecticide-treated nets is increasing. Three factories in Tanzania currently produce mosquito nets; one of these, in the northern city of Arusha, is now among the largest net manufacturers in the world. In 1999, the three factories together sold 1.5 million nets. Largely as a result of social marketing, costs for the nets have fallen from US$10 (for a large family net) to US$4. Single nets sell for as low as $2.

Grants from the International Foundation for Science

The International Foundation for Science (IFS) is an NGO that provides support to scientists in developing countries to do research on the management, use and conservation of biological resources. IFS awards research grants in amounts up to US$12,000. Research periods usually last one to three years, and awards may be renewed up to two times. The awards are intended for purchase of research equipment, supplies and literature. Awards are not intended for salary, travel or education. The selection process is rigorous, and the criteria are very specific (see below). Since 1974, IFS has provided support to over 2,900 scientists in 99 developing countries.

In order to apply for an IFS Research Grant, you must be a scientist and citizen of a developing country (not eligible are citizens of Turkey, Cyprus, Argentina, Uruguay, the former Soviet Union, and countries in Eastern Europe). You must be under 40 years of age (under 30 for Chinese applicants), have a M.Sc. degree or equivalent, and be at the beginning of your research career. You must be employed at a university or research institution in a developing country that will provide a salary and research facilities. You must be qualified to do research in one of the IFS Research Areas, which are Aquatic Resources, Animal Production, Crop Science, Forestry/Agroforestry, Food Science, and Natural Products. If you wish to collaborate with other researchers on a project, each person must meet the criteria. In the case of a team effort like this, each person involved should submit an application describing his or her area of responsibility for the project. Applications are judged based on "personal qualifications; the scientific quality and feasibility of your proposal, and the relevance of the research results you plan to achieve."

If you are eligible, you may apply for a grant on the appropriate IFS Application Form. Application Forms are available in English or French and can be downloaded from their web site (http://www.ifs.se), or you can request a paper form via e-mail by writing to info@ifs.se. You can also write to the IFS headquarters at the following address to request a form: IFS Secretariat; Grev Turegatan 19, SE-114 38; Stockholm, Sweden; Telephone: +46 8 545 818 00; Fax: +46 8 545 818 01.

Citrus Refractometers

A friend of ECHO recently wrote to us on behalf of a farmer in Chili who raises naval oranges. Apparently oranges are at

their sweetest when they are still green. When the farmer thinks they have reached the pinnacle of sweetness, he moves them to a greenhouse, where they turn orange. We were asked whether there is a device he can use to test the oranges for sweetness. Danny Blank, ECHO's farm manager, had this response.

"The least expensive way to accurately test the sugar concentrations in fruits is through an instrument called a refractometer. It is easy to use. A couple drops of juice are placed on a prism glass and then the refractometer is held up to light while a person looks through an eyepiece to get a reading. A certain sweetness should be achieved before certain citrus fruits are harvested. Growers will use the refractometer to get an idea when they can start picking. In Florida, there is an association of growers called Gulf Coast Citrus that has set standards (called brix readings) for each of the different varieties. In another country one would need to come up with his own standards, either ones used in that country or based on taste/experience and comparing taste with refractometer readings.

"FrostProof.com is a good source for obtaining refractometers and other horticultural supplies. They have two models, one for $125.00 and another for $250.00. For sweet oranges, he should get one that ranges between 0-32 degrees Brix." For more information, contact FrostProof Growers; 512 North Scenic Highway; Frostproof FL 33843; USA. Phone: (863) 635-3620. Fax: (863) 635-3700. E-mail: info@frostproof.com.

For Your Interest Only

Rice Genome Mapped

By Edward Berkelaar, Ph.D.

In late January of this year, two private companies announced that they have mapped the entire genome (i.e. all of the genes) of the rice variety 'NIPPON barre.' Rice is only the second plant (and the first agronomically important plant species) to have its genome decoded. Only recently was the genome of the first plant, a small weed (*Arabidopsis thaliana*) often used in research, decoded.

Genetic material is stored in genes, and many genes together make up a chromosome. Rice has 12 chromosomes containing a total of approximately 50, 000 genes. The 50, 000 genes are made up of 430 million chemical subunits called bases of DNA. There are only four different subunits, and they are repeated. The sequence of these subunits makes up an individual gene and determines its properties. To decode the genome means to determine the entire sequence of the subunits in all 50, 000 genes. Although the functions of many of the 50, 000 genes are known, the function of about 20% of them has not yet been determined. The similarity between the various cereal crops means that the genome of rice will serve as a blueprint for similar crops such as wheat and corn.

The completed DNA sequence will not be published. However, the two companies, Syngenta and Myriad, will make it available to researchers worldwide through research contracts. Syngenta has a policy of working with local research institutes in the developing world to explore how information can be used to develop products for subsistence farmers, without charging royalties or technology fees. Syngenta was recently formed as a result of a merger between Novartis and AstraZeneca, and is the world's largest agribusiness with about $7 billion in sales in 1999.

The knowledge of rice's genome will be used by plant breeders to develop new varieties of rice. Knowledge of the precise locations of specific genes will also allow biotechnologists to identify and transfer individual genes between cultivars. It is expected that the information will have an impact on new rice varieties within the next five years.

BOOKS, WEB SITES AND OTHER RESOURCES

Drying Green Leaves in the Sun

By Dawn Berkelaar

A booklet by Leaf for Life called "Drying Green Leaves in the Sun" has some helpful hints about drying leaves and what to do with the leaf powder.

EDN Issue 64 included a report about a moringa project in Senegal. Moringa leaf powder made an enormous difference in people's health when they added it to their food. Healthful leaf powder can be made from many other green leafy plants in addition to moringa. "Drying Green Leaves in the Sun" contains information about characteristics of the best leaves, the best plant families for leaves, and other leaf crops.

The booklet also has information about how to grow leaves, basics of food drying, making a solar leaf dryer, how to dry leaves and how to use dried leaves. For example, if you are going to store leaf powder for a long time, you can blanch leaves for three minutes in steam or in a microwave oven before drying to improve flavor and to reduce the risk of spoilage.

[Corey Thede, working in La Gonave, Haiti, reports of a nutritional analysis showing that blanching did not appear to affect the nutrition of *Moringa oleifera* leaf powder compared to leaf powder from unblanched *M. oleifera*

leaves. We assume the same would be true of *M. stenopetala*. This is good news, because Thede reports that blanched and dried *M. stenopetala* leaves are noticeably less bitter than those which are not blanched before drying.]

Once it is dried and powdered, store leaf powder in a well-sealed container, away from light, in a cool place. Use it within six months.

According to Leaf for Life's booklet, "About 20% of the flour in most recipes can be replaced with leaf powder. Experiment with how much leaf powder you can add to recipes without an unacceptable effect on flavor or texture."

Here is a recipe for pasta made using leaf powder: 4 cups all purpose or bread flour (wheat), 1 cup dried green leaf powder, 1 tablespoon salt.

"Mix flour and salt, then add leaf powder and a small amount of water. Knead for ten minutes. Dough should be very heavy, but elastic. Roll the dough out as thin as possible and cut into strips. These can be cooked as is or dried in a dark room, sealed in a plastic bag and cooked when convenient. This pasta cooks somewhat faster than commercial pasta."

Other recipes in the booklet include Curried Potato Soup; St. Patrick's Shake, and Leaf Burgers. Cookies that are green and green birthday cakes have apparently been well-accepted.

If you wish to request a copy of this booklet, write to us with a full mailing address. Please include $2.00 to cover the cost of printing and shipping. Those working overseas in agricultural development may request a free copy. The booklet can also be downloaded from Leaf for Life's web site at (http://www.leafforlife .com/PAGES/DOWNLOAD.HTM).

See the next section (Echoes from our Network) to read about experiences with drying leaves in Latin America, shared by David Kennedy from Leaf for Life.

ECHOES FROM OUR NETWORK

Eating Green Leaves

David Kennedy, Leaf for Life

A few years ago (August, 1999), David Kennedy from Leaf for Life shared some experiences with drying leaves in Latin America:

"Generally, Latin America doesn't have as strong a tradition of eating leaf crops as Africa or Southeast Asia. This I think has slowed acceptance somewhat. Where there is a linked nutritional education program, leaf powder is better accepted.

"I greatly enjoyed Lowell Fuglie's book about using moringa in Senegal. I think we dry the leaves faster with better ultraviolet protection and grind the dried leaves more finely. This probably results in a somewhat more nutritious and hygienic food, but it bears the additional cost of making the dryer. Materials are roughly $8-12 US in Mexico for a 1 meter square dryer. We have found local sources of 3-year, 6 mil ultraviolet-resistant greenhouse polyethylene in both Mexico and Brazil. In both cases it was more expensive than in the US, where it is $0.06 - 0.10 per square foot. Women seemed to very much like the idea of making and owning their own solar dryer. The pride of making the dryer helps them commit to using it.

"Where it has been used, there is pretty good acceptance of leaf powder and very good acceptance of some of the foods made from it (e.g. Churritos and dinosaur cookies). Some mothers simply put a spoonful of powder and a spoonful of sugar in a glass of water and have their kids chug it down.

"Drying leaves for food is a concept very easy to grasp for most Latin American women. They generally think that eating green vegetables is good for their family's health and that the leaf powder offers an inexpensive way to serve more vegetables and have them better accepted by their children. The greens most commonly available in the markets (Swiss chard, cilantro, spinach and purslane) are not in good supply year round and quickly wilt without refrigeration. Drying leaves is a technique simple enough that people could conceivably adapt it directly from booklets or video without an expensive project in place; or it could be passed on from persons who had attended a project workshop.

"Many women were excited about being able to use weeds (mainly lambsquarters, amaranth, plantain, and dock) and about using some of the leaves from crops like chayote, beans, cassava and sweet potatoes. These both were seen as bonus food rather than just another way to prepare traditional greens. Several 'curanderas' or botanical healers have begun using the solar dryers, feeling that they may preserve more of the active principals in the herbs.

"We get similar undocumented reports from the women. Most frequent reports are fewer respiratory and gastrointestinal infections, clearer facial complexion, and more energy. These would be consistent with improved vitamin A and iron nutrition. We also get some backache improvement reports. I've wondered if the latter reports may possibly be related to kidneys and to an increased fluid intake associated with the program. I suspect a lot of it is a psychological response to increased attention from the projects.

"At this point I would say that there is genuine interest and few strong constraints to widespread acceptance

(especially compared to the problems we have with leaf concentrate). The leaf powder project is still at a very early stage of development. One positive development is that our sister organization in Mexico (Hojas para la Vida – Mexico) has gotten its legal status and has received a grant from the Mexican government to train women in this leaf meal technique."

More recently (June, 2001), David gave us an update:

"The projects initiated by us and Hojas para la Vida Mexico are mainly still running and a lot of dryers were still in use when I last visited the area in April. It is not catching on like wildfire but does seem to gradually take hold given a little support from Hoja para la Vida (Leaf for Life). Hoja para la Vida is struggling to get enough funding to extend its work effectively but is committed to the idea and in for the long term."

FROM ECHO'S SEEDBANK

Cranberry Hibiscus

By Dawn Berkelaar

Cranberry hibiscus (*Hibiscus acetosella,* also called false roselle) is one of the most striking and colorful plants in the "edible landscape" section at ECHO (see Figure 2). The red leaves remind those of us who come from temperate climates of the red maple tree.

If the plant is not pruned it tends to grow so tall, perhaps 3 meters, that its modest sized stem is unable to support it. It eventually bends way over. On the other hand, when it is young it responds very quickly to pruning by using your fingers to pinch off growing tips. In this way it can very easily be made into a densely branching bush. Cranberry hibiscus is an annual or short-lived perennial. It grows so quickly that it is sometimes grown from seed as a frost-tender annual even in cool-temperate regions.

Cranberry hibiscus makes a colorful temporary hedge, which can be pruned and harvested at the same time! The attractive flowers are only produced during short days. At ECHO they begin blooming late in September. We have seldom had any disease or insect problems with it, though if our winters are unusually cool it goes dormant and looks a little "ragged" for a few months. It grows so fast that it is easy to replant from seed, but can usually be kept for a second year if desired.

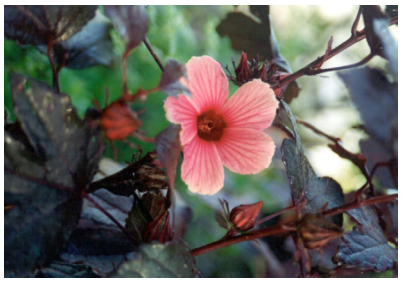

Figure 2: Hibiscus acetosella, also called cranberry hibiscus or false roselle. Photo by Martin Price.

African in origin, Cranberry hibiscus may have been domesticated in Angola or Zaire. It is found throughout tropical Africa. It is only known as a cultivated plant and is mainly grown in home gardens. Cranberry hibiscus grows on all kinds of soil, but requires good drainage. The plant can be propagated from its abundant seeds or by cuttings. It is most likely the result of a cross between two wild plants. (For the reader well versed in genetics, it is thought to be an allotetraploid, containing the diploid set of chromosomes from both *H. asper* (a wild plant from tropical Africa) and *H. surattensis* (another wild plant, found in tropical Africa and Asia).)

At ECHO, Cranberry hibiscus leaves are regularly eaten in salads and cooked in stir fries of mixed vegetables. The red leaves remain reddish even after cooking, making for an attractive addition to any dish. The leaves are pleasantly sour and slightly mucilaginous (i.e. slimy), and are most often added in small quantities to foods. Cooking the leaves with peanuts may help reduce the sourness.

In Central America, flowers are blended with ice, sugar, lemon juice and water to make a purple lemonade. Contrary to roselle (*Hibiscus sabdariffa*), a sister species whose calyx (a collective term for the sepals of the flower) makes a popular drink in the tropics, the calyx of cranberry hibiscus is not fleshy and is not eaten. The stem is not edible, although it yields a small amount of good quality fiber.

Cranberry hibiscus is available from ECHO's seedbank.

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