THE CONTRIBUTIONS OF THE NIGHTSHADE FAMILY (SOLANACEAE) TO HUMAN WELFARE

Charles B. Heiser, Jr.*
Indiana University
Bloomington, Indiana 47405

Few would deny that the grass family (Poaceae) and the legume family (Fabaceae) are the two plant families of greatest importance to humankind. The many contributions of the nightshade family have not been as widely recognized, but certainly the family ranks, if not third, at least among the top five plant families for its significance to humankind. The family has contributed food, medicinal and ornamental plants, and no genus has contributed more than *Solanum* which is not surprising for it is the largest genus in the family, containing several hundred species.

The Irish potato (*S. tuberosum*) ranks after the major cereals as the most important source of food for humans. The potato was domesticated in the Andes, where some of the wild species are still used. It perhaps was the original freeze-dried food. The potatoes were allowed to freeze at night and as they thawed the next day they were stamped with the feet. This process which was repeated for a few days resulted in a dehydrated product called *chuño*. The reasons for making *chuño* were twofold: the bitter and toxic alkaloids were removed from the potato and the keeping property of the potato was greatly increased. The potato was introduced to Europe by the Spanish in the sixteenth century but it was to be some time before it amounted to much there. The potatoes that first reached Europe were not well adapted to the climate and then too, many people regarded the plant with suspicion, probably because it was associated with the other members of the family already known in Europe, most of which were extremely poisonous. However, it was slowly accepted and then spread rapidly, soon becoming almost the sole food of the Irish. Then when the blight struck in the middle of the last century, disaster followed as has been told in fascinating detail by Cecil Woodham-Smith in *The Great Hunger*. This led to a huge number of the Irish emigrating, many to the United States, where they were to have a great influence on the political life.

Although most of the food plants in the family are native to tropical America, the eggplant (*S. melongena*) comes from southeastern Asia. It, too, was thought to be poisonous when it first reached Europe and was called *Mala insana*, or mad apple, for the eating of it was thought to cause insanity. This feeling lingered among some people until recently. They believed it necessary to soak it in vinegar or salt water to remove the toxic properties before eating it. Why the plant was called eggplant puzzled me as a child, for I knew of no egg so large. If one were to see the fruits of the wild and primitive varieties, however, he would understand, for they do resemble a hen's eggs in size and color.

Returning to the Americas, we find several other species of *Solanum* with edible berries, most of them very little known in the United States. One of my favorites

---

*Indiana Academy of Science, "Speaker of the Year," 1984-85. After it was announced that I had been selected Speaker-of-the-Year for the Indiana Academy of Science, I received a note of congratulations from Harry G. Day, Professor Emeritus of Chemistry at Indiana University and a former president of the Academy. In it he pointed out that my selection for this honor and service reminded him of Ralph E. Cleland, another former president of the Academy, who had done much for science in Indiana, including fostering the Speaker-of-the-Year Program. It is most appropriate that I acknowledge Dr. Cleland here, for it was he who, as chairman of the Department of Botany at Indiana University, brought me to Indiana University in 1947. As a native Hoosier I welcomed the opportunity to return to the state of Indiana.

is the *naranjilla* or *lulo* (*S. quitoense*) a shrub cultivated mostly at mid-altitudes in Colombia and Ecuador. Its fruit yields a juice that has few or no equals. Unfortunately much of the flavor is lost when the juice is canned so the juice is not as widely appreciated as it deserves to be. Presently improved canning techniques and freeze-dried methods are being used which preserve much of the original flavor so that we may eventually be able to enjoy it in this country. Closely related to this species is the *cocona* or *tupiru, S. sessiliflorum*, which is cultivated in much of the Amazon basin and whose fruit gives a juice and is also used as a vegetable in meat dishes. Another South American species with an edible fruit is the pepino (*S. muricatum*) of western South America. It is now being cultivated in New Zealand, and fruits from there reach our markets occasionally through Frieda's Finest Produce Specialties, Inc. I have done research on all three of these plants, and I am tempted to tell you more about them, but if I were to do so I would have to omit some of the other important species in the family.

One that is interesting but not terribly important is the garden huckleberry (*S. scabrum*), which of course is not a huckleberry. It perhaps is familiar to some of you, for it is carried by many seed companies and is grown in Indiana. It is related to the weedy black nightshades of our gardens, but its origin is a mystery. We are not even certain as to the continent on which it originated. To my way of thinking it is much inferior as a food plant to the related wonderberry or sunberry (*S. burbankii*) of Luther Burbank which was introduced in the early part of the century but which has now virtually disappeared.

It is now time to leave the genus *Solanum* but I should point out that it also includes medicinal and ornamental plants which I shall speak of later. Also I should mention that it contains a number of harmful plants. In addition to many poisonous species, it also includes a number of weeds. The horse-nettle (*S. carolinense*), well known in Indiana, is one of our worst weeds. Long rhizomes make it most difficult to eradicate once it becomes established.

Closely related to *Solanum*, and considered by some as a member of that genus, is *Lycopersicon*, which includes the wild and domesticated tomatoes. All of the wild tomatoes are native to western South America but all the evidence points to Mexico as being the center of origin of the cultivated tomato (*L. esculentum*). How is that to be explained? Somehow seeds of a wild tomato must have been carried to Mexico by humans or some other animal, perhaps birds, early in the prehistoric period. Our cherry tomato which has become so popular in salad bars is probably very similar to the wild tomato that gave rise to the domesticated one. After its introduction to Europe the tomato suffered the same fate as the potato and eggplant, and as recently as the last century it was still regarded as poisonous by some people. At one time it was called love apple, and solely because of the name, was thought to be an aphrodisiac. One story of the origin of this name is that it is a transformation of an Italian name *pomi d'oro* (apple of gold) into *poma amoris* (apple of love). Some of the earliest tomatoes to reach Europe were yellow or golden in color. Yellow tomatoes, of course, are still grown and supposedly are less acid than red tomatoes and hence are preferred by some people. Certainly few vegetables are more popular than the tomato. This popularity cannot be explained on the basis of nutritional value, for several other vegetables, broccoli, for example, are a better source of vitamins and minerals.

Another kind of tomato, the tree tomato (*Cyphomandra crassifolia*) is another contribution of the family from western South America. I fail to see the resemblence of the fruit to the tomato in shape or flavor and it is used more as a fruit than a vegetable. Moreover, the plant is a small tree or shrub, quite unlike our tomato. Today the plant is also grown in New Zealand and fruits from there occasionally reach our

markets under the name *tamarillo*. The plant is also advertised by a nursery in this country for growing in the home, with claims of yields up to 60 pounds. I haven't recently purchased plants from this nursery, but with the ones I have grown from South American I am lucky to get two or three fruits to a plant and then only if I hand pollinate the flowers.

With the increasing popularity of Mexican foods, another Latin American contribution, the *tomatillo* or *tomate* (*Physalis philadelphica*) is becoming common in our markets. The tomate is a ground cherry or husk tomato related to those of Indiana which are sometimes collected by wild food fanciers. The tomate was domesticated in Mexico, and mixed with chili pepper or by itself, is used to prepare the green sauces so widely found in Mexico and Guatemala on enchiladas and other foods. Our word tomato is derived from tomate, but in Mexico *Physalis* is tomate and the tomato is *jitomate*. The prefix of the latter was dropped by the Spanish when they carried the plant to new areas.

In the Andes the fruit of another species, *uchuva* (*P. peruviana*) is eaten out of hand, but apparently the plant is not cultivated there. It is, however, sometimes cultivated in the United States under the name of Cape Gooseberry. Insofar as I have been able to learn the plant went from South America to South Africa and from the Cape of Good Hope it was taken to Australia where it was called Cape Gooseberry. The fruit does resemble the gooseberry in shape and size, but, of course, the true gooseberry belongs to a completely different family.

After black pepper, a member of another family, the red or chili peppers are the world's major spice. The red peppers come to us from Latin America where four or five different species were domesticated. Nearly all of the ones grown in the United States, including such as chili, pimiento, cayenne, jalapeño and the sweet peppers, belong to a single species, *Capsicum annuum* which was originally domesticated in Mexico. So far I have said little about the changes that occur when a wild species becomes domesticated. The peppers afford a good opportunity, for they have been subjected to detailed study by some of my students and me. The ancestral form, one of the bird peppers, was originally considered a separate species but now that its close relationship to the domesticated peppers has been demonstrated it is recognized only as a variety (*C. annuum* var. *glabriusculum*). It has very small berries, red in color, extremely pungent, readily deciduous and borne erect. In the domesticated peppers we find an increase in size of the berry, various mature fruit colors in addition to red, pungent and non-pungent, persistent on the stalk, and either erect or pendent. Several of these changes largely eliminate the dispersal of the fruit by birds so that the berries are always available to people. At the same time the plants became dependent on people for their perpetuation. In other parts of tropical America other wild species were brought into domestication, one of which, *C. frutescens*, is cultivated in the United States and is the source of the well-known sauce, Tabasco.

There are several other minor food plants in the family, but it is now time to turn our attention to the drug and medicinal members, most of which are extremely poisonous and several of which have been used as hallucinogens. Our earliest record of these comes from the Old World. Although now little used in medicine, the most notorious is the mandrake (*Mandragora officinarum*). The root of the plant was thought to resemble the human figure, and for this reason many superstitions grew up around the plant. It was a cure all and served as a love potion, an aphrodisiac, and for knock-out drops; we know that it functioned effectively at least for the last use. The plant is mentioned in both the Bible and Shakespeare, and Machiavelli's play, *La Mandragola*, is still being produced.

Two other Old World plants of which we find early uses, henbane (*Hyoscyamus niger*) and the deadly nightshade (*Atropa belladonna*) are sources of hyoscyamine and

atropine, both widely used in medicine. The latter is the only antidote known for a number of toxic substances.

The genus *Datura* is perhaps better known to you than the other medicinal plants in the family, for one species, the Jimson weed or thorn apple, *D. stramonium*, said to be native to Asia, is a fairly common weed in Indiana. At one time this species was fairly widely used in medicine. Another species, the angel's trumpet, *Datura inoxia*, is sometimes grown as an ornamental in this state. It was a sacred plant among southwestern Indians and was used ceremonially. The tree Daturas of Central and South America, now placed in the genus *Brugmansia*, were widely used as hallucinogens by the native people. One of these, *B. sanguinea*, whose seeds were used as a narcotic, has recently been brought into cultivation in Ecuador for the production of scopolamine.

Solanum also provides us with drug plants. One of the newer ones is *S. marginatum*, a native of Africa, which became well established as a weed in the Andes. A few years ago an Ecuadorian chemist, Alfredo Paredes, found that it was a rich source of steroids, and recently it has been brought into cultivation in Ecuador for the production of solasodine, which is being used to make anti-inflammatory drugs and birth control pills. It will be interesting to observe the changes in *B. sanguinea* and *S. marginatum* as they become converted from wild to domesticated plants. Most of our domesticated plants are of very ancient origin, so we do not have exact records of the changes that have taken place.

There are other medicinal plants in the family including some of those previously mentioned as food plants. For example, the red peppers at one time were rather extensively so used and still have a minor role. Tobacco is another plant that one time was thought to have medicinal value. It was difficult for me to know how to work this plant into a talk on the contributions of the family to human welfare, for there are few plants that cause more harm—the connection of tobacco with cancer and other health problems in humans is well documented. It is, in fact, difficult to find anything good to say about the plant, but it does kill insects as well as humans and has been employed in pesticides. The plant was used ceremonially by the American Indians. Columbus himself saw the plant, and it was to spread more rapidly around the world after the discovery of the Americans than any plant with the possible exception of corn. Nearly all of the tobacco cultivated around the world today is *Nicotiana tabacum*. The Indians, however, domesticated a second species, *N. rustica*, that was widely cultivated in Mexico and the eastern United States. In fact, this species was the first one cultivated in Virginia, and it wasn't until the English obtained seeds of *N. tabacum*, apparently smuggled in from the Spanish colonies, that tobacco growing began to thrive in Virginia, which, I am sorry to say, it still does today.

The final contribution of the family is a great number of ornamentals. Sometimes these are overlooked in ethnobotanic surveys, but the appreciation of plants for their aesthetic value apparently goes back to prehistoric times, and, of course, the production of ornamentals is a multi-million dollar business today. Many of the genera already discussed have furnished us a number of ornamentals, some of which are appreciated for their fruits rather than their flowers—thus we have the Jerusalum cherry (*Solanum pseudo-capsicum*), the Chinese lantern plant (*Physalis alkekengi*) and the ornamental peppers (various cultivars of *Capsicum annuum*). For their flowers we have the flowering tobaccos (several species of *Nicotiana*), *Solanum wendlandi*, and several species of *Datura* and *Brugmansia*. More widely grown than any of these is the petunia (*Petunia hybrida*), certainly one of the most appreciated of our garden ornamentals, not only for its beauty but for the fact that it is so easily grown. Our petunia is of hybrid origin, involving two or more species native to southern South America. From here also have come two other favorites, *Salpiglossis sinuata* and *Schizanthus pinnatus*. The latter is known under the common names of butterfly flower and poor man's

orchid. Like many of the other common names, the latter is rather misleading, but the flower does have a slight resemblance to an orchid and certainly the plants cost less than most orchids.

This concludes the survey of the family which, I think you will agree, is of considerable importance. One word of caution perhaps is in order, however. A few years ago Childers and Russo (1977) brought together a large number of testimonials from people who claimed that by giving up the eating of solanaceous plants their arthritis had been improved or eliminated. However, until definite proof is forthcoming I shall continue to eat potatoes, tomatoes and chili peppers with enjoyment.

Literature Cited

1. CHILDERS, N.F. and G.M. RUSSO. 1977. The Nightshades and Health. Somerset Press, Somerset, N.J.
2. D'ARCY, W.G. (ed.). 1984. Biology and Systematics of the Solanaceae. Columbia University Press, New York.
3. HAWKES, J.G., R.N. LESTER and A.D. SKELDING (eds.). 1979. The Biology and Taxonomy of the Solanaceae. Academic Press, London.
4. HEISER, C.B. 1969. Nightshades, the Paradoxical Plants. W.H. Freeman, San Francisco.
5. ____. 1984. The Ethnobotany of the neotropical Solanaceae, in G. Prance and J. Kallunki (eds.), Ethnobotany in the Neotropics. New York Botanical Garden, New York.
6. ____. 1984 (in press). Of Plants and People. University of Oklahoma Press. Norman OK.