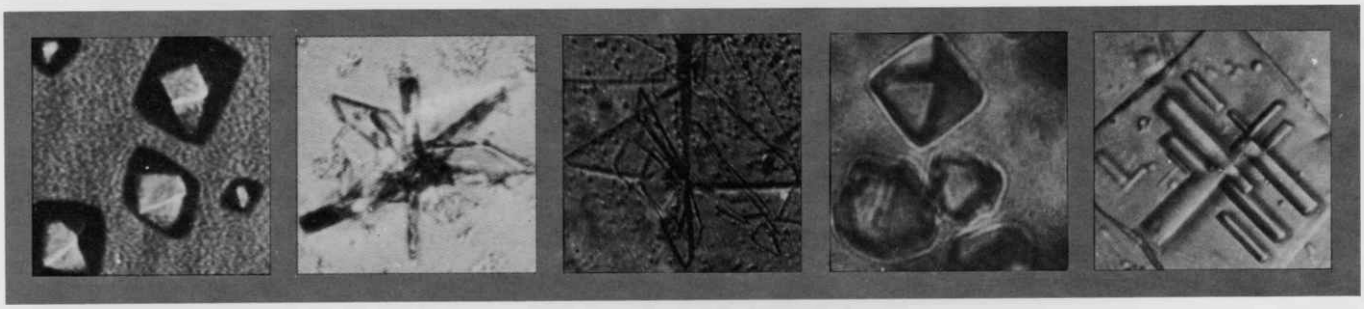

# Richest Protein Supply Unbound From Green Leaves

Wouldn't it be nice if the most abundant type of protein in the world were also one with a near-perfect balance of the nine amino acids essential to human nutrition?

It is. It also has other qualities that make it attractive as a nutritious added ingredient in all kinds of foods, from soda pop to meatloaf. Its first commercial use is expected in 1984.

This protein is found in every type of green plant that has been tested for it. Until recently, though, there was no practical way to separate it from the undigestible components of the plants.

Now, Dr. Don P. Bourque, a University of Arizona biochemist, extracts pure, white protein crystals from the green leaves of many plants, including tomatoes, alfalfa and cotton. The crystals have no taste, and dissolve easily in water. That makes them desirable for unobtrusive protein-fortification of prepared foods, either junk foods or foods that are already nutritious.

Photographs: Micrographs of fraction-I protein crystals from different plants: (left to right) potato, corn, tomato, spinach and tobacco. (Photos courtesy of Don Bourque.)

This protein is already crucial to life on earth in another role. It acts as a catalyst in photosynthesis, allowing green plants to turn solar energy into food energy. It is almost identical in every green plant.

Fraction-I protein is the simplest of several names for Bourque's protein crystals. The name refers to one process for extracting the protein from crushed and pressed leaves. The protein's formal name is ribulose 1,5-biphosphate carboxylase/oxygenase.

Before coming to Arizona in 1973, Bourque worked in California with Dr. Samuel G. Wildman, who first isolated fraction-I protein in 1947. Wildman had crystallized the protein from tobacco leaves, but the same methods did not work for other plants.

Bourque spent several years here developing the extraction and crystallization methods for fraction-I protein from a variety of plants. Crystallization ensures the protein's purity. Bourque has purified samples from leaves of spinach, alfalfa, cotton, corn, potato, tomato, tobacco and several common weeds.

Next, Bourque scaled up his extraction process 1,000-fold, using a wooden Italian wine press to squeeze juice from pounds of fresh alfalfa. It still took several weeks to produce just a few ounces of the protein crystals, but that was enough for testing by a major food company that had become interested in fraction-I protein.

"Currently, we're planning to produce large amounts working with a commercial facility that produces leaf extracts from alfalfa," said Bourque. Most of the alfalfa products are used in animal feeds, but the fraction-I protein could be separated for other purposes.

"I expect we'll isolate several tons of it by mid-year 1984, which will help us evaluate its potential market and possible uses," he said.

Fraction-I protein has advantages over other protein powders such as fish and yeast proteins, which have not caught on widely as food fortifiers. "The lack of flavor and color and the solubility are important," said Bourque. Nutritionally, fraction-I protein offers easy digestibility as well as a balance of essential amino acids.

The food company that tested a sample of fraction-I protein "found it has several useful properties, including its gelling properties," said Bourque. The ability to form a stable gel might give the protein uses in whipped toppings or egg substitutes.

"The beverage industry has been and still is very interested in a soluble protein that could be used as an additive, and this one could meet that need," said Bourque. "Also, a major vitamin company is interested in packaging it as protein pills."

Medical uses have also been proposed. Kidney-disease patients and people with deficiencies in amino acid metabolism often have strict requirements for the type and quantity of protein in their diets, and fraction-I protein in measured amount might fit their needs. The protein might become useful in formulas for infants allergic to milk. Soy protein, slightly lower in essential amino acids, is now used in those formulas.

Its solubility, digestibility and amino acid balance could make fraction-I protein favored for burn victims and other patients who must be

fed through stomach tubes.

On another track, Bourque's crystallized fraction-I protein is already furthering scientists' understanding of photosynthesis. His samples are being analyzed for determining the protein's structure and for the presence of metallic co-factors. "These studies may lead to identifying factors that might affect plant productivity," he said.

The food applications are drawing the most attention, though, partly because the protein is so plentiful worldwide.

Bourque expects the first applications to be in specialized food products in this country, but he talked about the eventual possibilities for easing protein deficiencies in underdeveloped countries.

He noted that many developing countries are in tropical areas that have plants with large leaf-weight to total-weight ratios. "For example, cassava is a plant that is grown for its root, but its leaves are rich in protein that is not used," said Bourque. "The extraction procedures are simple enough. I can imagine a package for sending to developing countries that would have the equipment they would need and instructions for extracting the protein. It would be guaranteed high-quality protein."

For many crops traditionally grown for their fruits, seeds or roots, such as tomatoes, peas or potatoes, Bourque said, "more plant protein is wasted by destruction of leaves than is actually obtained from the parts that are harvested."

Left: Don Bourque prepares a minute sample of fraction-I protein for biochemical analysis.
Right: John Walden, Bourque's research assistant, works on extraction of the protein from other leaf material.