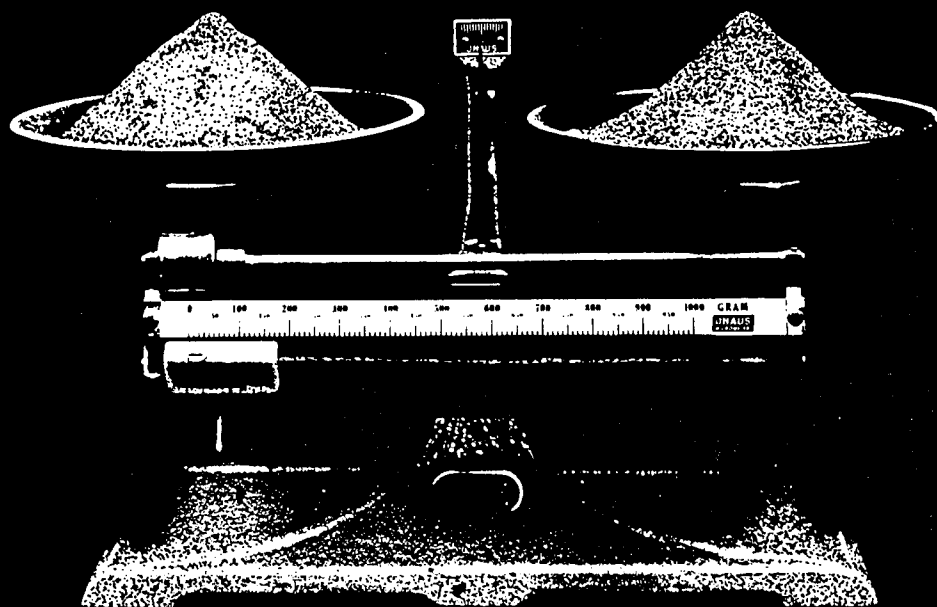


Enzymes for Measuring Quality

Which one is better for you?

One of these samples of sweet potato flour has twice as much protein as the other. Food scientists are using enzymes to tell the difference quickly and accurately



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As the volume of processed and extended shelf-life foods grows, it is important to have suitable, rapid, inexpensive methods for measuring protein quality. New applications of immobilized enzyme technology develop by researchers in the Department of Food Science at NCSU give quicker and more accurate results than traditional methods.

Protein quality has two aspects which must be evaluated separately. The first problem is to determine what essential amino acid building blocks are in a protein. The second is to determine whether they are digestible and available for absorption into the body.

Processing and storage may cause changes in the chemistry or the structure of amino acids and alter their bio-availability. The new techniques measure these effects as well as the total amino acid content and digestibility.

Determining Protein Quality

Protein quality depends, in part at least, on what amino acids are present. Humans depend upon their food to supply the eight essential amino acids which our bodies cannot manufacture. Vegetable proteins are often low in one or more of the essential amino acids, which limits the ability of that food source alone to meet the body's needs.

The standard method for determining which amino acids are present is an acid hydrolysis method which breaks a protein into its amino acids. This method, however, may destroy some of the most important amino acids. Furthermore, this method shows only how much of an amino acid is present, it does not distinguish between forms which are biologically useful and those which are not.

To overcome these problems and get a more accurate amino acid "score," a combination of enzymes can be used instead of strong acid to cut the peptide bonds in a protein to isolate amino acids. By immobilizing microbial and animal proteinases and peptidases within a single reactor, we have obtained complete hydrolysis of a number of proteins. Since this technique preserves all of the amino acids, scores obtained are better indications of the protein quality than results of the standard procedure.

Enzymes are immobilized by chemical attachment to porous glass beads, so that a single reactor can be used repeatedly for six to twelve months with little loss of activity, permitting easy standardization of assay methods and comparison of results. In addition such a system allows enzymes that are difficult to obtain or expensive to be used economically.

The immobilized enzyme technique also enables us to detect amino acids which are no longer biologically available. Browning, crosslinkage and racemization (see Figure 1) cause changes in amino acids which are not revealed by standard hydrolysis. Lysine, for example, reacts with sugars such as glucose, fructose, or lactose and becomes biologically unavailable, lowering the nutritional quality of the protein. By the standard method, this lysine would appear as available, whereas the immobilized enzyme method shows it to be unavailable.

Digestibility

Many of the structural changes affect digestibility which, in turn, affects amino acid availability. A standard digestibility test has been developed using another immobilized enzyme system containing a combination of gastric, pancreatic and intestinal enzymes, which mimics the action of the digestive tract.

A number of plant and animal proteins have been tested with this system and digestibility values were the same as those obtained when the proteins were fed to humans. This 24-hour test tube method, used in conjunction with the immobilized enzyme method for determining amino acid "score," will be explored as a possible alternative to 28-day rat feeding trials which are the presently accepted, but not very accurate, method for assessing nutritive quality of proteins for humans.

A Two-minute Test

In addition to the immobilized enzyme methods, we have developed a rapid, sensitive fluorometric method for determining available lysine. Lysine is frequently regarded as a limiting amino acid in vegetable protein. Lysine reacts readily with sugars in foods to become unavailable. This quick reading of available lysine gives a preliminary

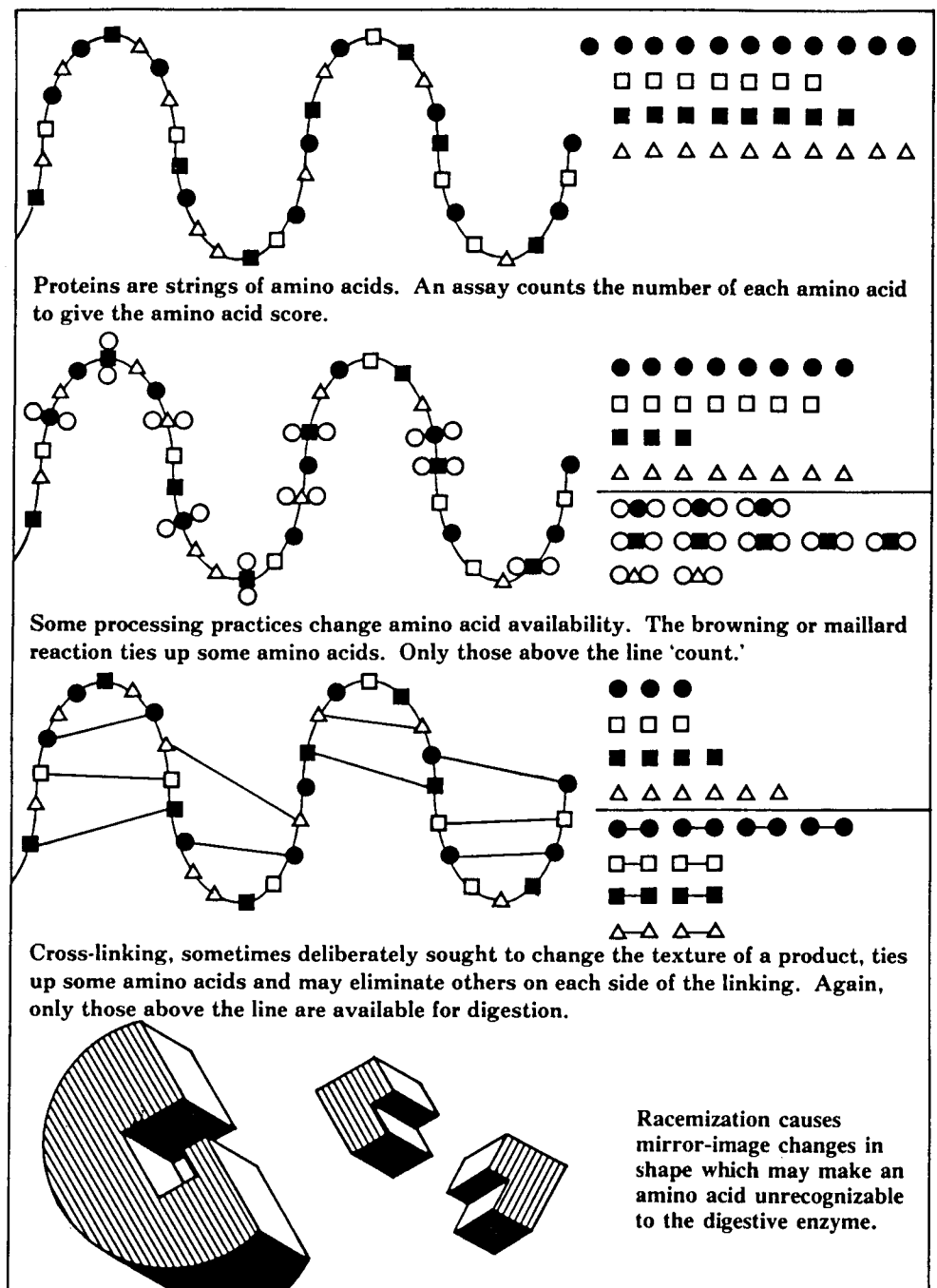


Figure 1. Nutritional value depends on amino acids present and available for digestion.

estimate of overall protein quality. With new processing techniques used for familiar proteins, and new sources of protein being tried for innovative foods, this inexpensive 2-minute test will offer distinct advantages over the current 48-hour test which requires some elaborate and expensive equipment.

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