RICH'S

"Enzymes + Intestinal Flora"

A comprehensive formula of Enzymes and Intestinal Flora designed to enhance proper nutrition!

Rich's "Digest-All" contains plant derived food enzymes and aerobic bacteria to assist in the break down and digestion of consumed food. The enzymes break down the Carbohydrates, Fats, Fivers, and Proteins into the essential building blocks of life. The intestinal bacteria provides increased resistance to infectious diseases, reduces the duration of diarrhea, can reduce blood pressure & serum cholesterol concentrations, provides a reduction in allergies, modulation of cytokine gene expression, regressions of tumors, and reductions in carcinogen or co-carcinogen production.

Each capsule contains:

Protease…………..……………22,400 HUT
Amylase…………………………..6,600 DU
Lipase……………………………..2,870 LU
Cellulase…………………………..2,560 CU
Lactase…………………………....400 LacU
Maltase………………………………250 DP
Sucrase……………………………..600 IAU
Marshmallow Root…………………..50 mg.
Slippery Elm Bark…………………...50 mg.
Magnesium Citrate…………………..25 mg.
Calcium Citrate……………………...20 mg.
Bifidobacterium Bifidum….115 million org.
Bifidobacterium Intantis…..115 million org.
Bifidobacterium Logum…..115 million org.
DDS-1 Acidophilus……….115 million org.
Enterocococcus……………115 million org.
Lactobacillus Acidophilus…115 million org.
Lactobacillus Bulgarium…..115 million org.
Lactobacillus Casei………..115 million org.
Lactobacillus Plantarum…..115 million org.
Lactobacillus Rhamnosus…115 million org.
Lactobacillus Salivarius…..115 million org.
Pediococcus Acidilacticii…115 million org.
Streptococcus Thermopilus.115 million org.

This product is not intended to diagnose, cure, or prevent any disease.

RE: THE NEED FOR LICENSURE OF DIETITIANS IN VIRGINIA

TO: Ms. Elizabeth A. Carter, Ph.D.
Deputy Director of the Virginia Department of Health Professions
Virginia Department of Health Professions
6606 West Broad Street, 4th Floor
Richmond, Virginia 2320

It has come to my attention that there was some recent confusion in a hearing regarding licensure of dietitians in Virginia, regarding the oral efficacy of supplemental enzymes. The question as it was relayed to me was in essence, "Can the oral consumption of enzymes be responsible for claimed health benefits?" The answer to this question **is** a carefully qualified but absolute yes!

The study of digestive physiology and the nature and characteristics of enzymes will clarify the answers to our questions regarding the oral use of enzymes, once and for all. We will take this one step at a time and logically, scientifically reach our conclusions.

First we need to define "enzymes" and differentiate the different types of enzymes we will be discussing. Enzymes are organic catalysts, produced by living cells, that produce chemical changes in other substances or substrates. In essence, they are the "workers" in all physiological processes. In fact, they are the essence of physiological life itself. As stated by doctors Lopez, Williams, and Miehlke in the 1994 book, ENZYMES: THE FOUNTAIN OF LIFE, "Enzymes serve as the body's labor force to perform every single function required for our daily activities and are required to keep us alive. They are responsible for all of the functions of every organ system in our bodies."

That should remind us of the word **metabolism** which has been defined as "the sum total of all chemical reactions that take place within the human body." Therefore, in one sense, since all of the chemical reactions that take place in the human body are catalyzed by enzymes, all of the enzymes could be defined as "metabolic" enzymes. However, it is generally recognized that there are three broad categories of enzymes. In reference to the human body, two would be referred to as endogenous enzymes, and the third and final category as erogenous enzymes. Digestive enzymes, the first category which the body produces (endogenous) are secreted by the body to aid in the digestion of food. These enzymes would include the salivary enzymes, gastric enzymes, pancreatic enzymes, and enzymes produced in the small intestines. Metabolic enzymes (also endogenous), the second category, are responsible for all of the other work and chemical reactions in the body besides digestion. All together, researchers have specifically identified over three thousand different enzymes out of an estimated eighty thousand to one hundred thousand enzyme systems in the human body. Food enzymes, the third category, are the erogenous enzymes. Overwhelming research has demonstrated that they are, at least, just as important to good health as the enzymes that our bodies produce.

Perhaps the human race has come "full circle". Having begun on raw enzyme rich foods, we then learned to cook and destroy the enzymes in various ways, and as a result we also learn to experience the complexities of degenerative diseases very prematurely. Anyone doubting this conclusion is simply not aware of the exhaustive research done by Dr. Edward Howell, Dr. Francis Pottenger, Dr. Weston Price, Dr. Max

Wolf, and Dr. Karl Ransberger, just to name a few. ENZYMES: THE FOUNTAIN OF LIFE, 1994, by Dr. Lopez, Dr. Williams and Dr. Miehlke has brought us full circle by bringing some of this research to our attention and shining the light of truth and success upon the darkness of our past unawareness.

My own personal unawareness has cost me a lifetime of unnecessary, suffering from an inefficient body, which was catastrophically damaged in 1970. I was nineteen years old, six foot one inches tall, and weighted one hundred and sixty five pounds. January 16, 1970, I was "killed" in a car wreck in the San Fernando Valley, California. Actually, a second opinion sent me to a trauma center in Van Nuys, instead of the morgue. At the trauma center it was determined that I was simply in a coma, with massive cerebral hemorrhage, a collapsed lung, broken sternum, bruised heart, broken nose, jaw, face, compound fracture of the left femur and not likely to survive. After a few days the doctors told my parents, who had been unable to recognize me, that I could end up a vegetable and lose my left leg as well. On the fourth day I came out of the coma and woke up to "hell". Blood and spinal fluid continued to hemorrhage for another six days. Then they started setting broken bones. I spent six months in a hospital bed, received thirty seven pints of blood, had thirty six hours of surgery, and my body weight had dropped to ninety pounds before I stabilized. I spent about six months in a wheel chair, then got on crutches, a cane, and then walked with a limp from a "drop foot". Through the years I have had many injuries and never seemed to quite heal from them and spent an unfortunate amount of time "suicidally depressed" when things flared up.

My true healing began in 1989 when I "discovered" enzymes. It was like discovering postage stamps after a lifetime of returned mail.

One of the main objections to supplementary, erogenous enzymes has been: "Enzymes are proteins, and as such will be digested in the acid environment of the stomach." Yes, that is probably true for some enzymes, which are not designed to function in that environment. Let's return to our physiology review. The salivary enzymes will work in a pH from 6.5 to 7.5 but may become inactive in the "resting" pH of the cardiac stomach, which normally has a pH of 5.0 to 6.0. During the first hour while the pyloric portion of the stomach acidifies to around 1.5 to 3.0, some salivary digestion can continue depending on how much the ingested food raises the pH of the cardiac portion of the stomach. Since there are no parietal cells in the cardiac portion of the stomach, and the peristaltic waves begin in the pyloric portion of the stomach, the cardiac portion allows for an hour of predigestion if appropriate enzymes are present. After the first hour, the pyloric portion of the stomach should be at a pH from 1.8 or 2.0 to 3.0 or 3.5. The lower range being harder to achieve and maintain due to the diluting presence of the food and liquid ingested. Still the pH is low enough to change the pepsinogin (secreted by the chief cells), into pepsin. Pepsin is well known to have a pH activity range of 1.0 to 5.0, and a peak activity range of 1.8 to 3.5. Is pepsin not an enzyme? Is pepsin not a globular protein? Is pepsin not as happy as a duck in the water in the acid environment of the pyloric portion of the stomach? Yes! Yes! Yes! Because that is precisely what it is designed to do.

The partially digested food called chyme, leaves the pyloric portion of the stomach as each successive peristaltic wave of muscle contractions, every fifteen to twenty **five** seconds, pushes about two to five milliliters of chyme through the pyloric valve into the duodenum with each peristaltic wave. The pH of the chyme can easily be within a range of 2.5 to 4.5, depending upon the biological age of the person involved, and that stomach's ability to concentrate hydrochloric acid, as well as any diluting factors involved. As soon as the acid chyme comes into contact with the wall of duodenum, hormones are released into the blood that cause both the gall bladder and the pancreas to secrete their alkaline secretions: Bile (pH 5.5 to 7.7) and hydrelatic secretion (pH 8.4 to 8.9). It is absolutely necessary for the small intestines to be alkalized, because the pancreatic enzymes are well known to work only in a pH range of 7.2 to 9.0, with a peak activity range of 7.8 to 8.3. If pancreatic and biliary secretion is inadequate in alkalinity (bicarbonate), then the pancreatic enzymes will not function since they are out of their pH activity range. If alkalinization is adequate or hopefully optimal, the pancreatic enzyme function will also be optimal in the small intestines.

It may be obvious by now that enzymes have pH activity ranges and peak pH activity ranges as well. If they are not in the appropriate pH range environment, then they will be inactive and not function. If conditions are extreme enough they may even be denatured and hydrolyzed into amino acids. Obviously pepsin will not function in the pH range of the small intestine, and pancreatic enzymes will not function in the pH range of the stomach. So pancreatic enzymes are normally and wisely enterically coated to protect them from the inappropriate pH environment of the stomach.

Current research has conclusively shown that HCL and pepsin supplements aid digestion in the pyloric portion of the stomach. Enterically coated pancreatic enzyme supplements have been shown to be effective in the small intestines, when alkalinization is sufficient. Both aid in the digestion of food in their respective stages of the digestive system.

So what about the pH ranges and efficacy of the enzymes that are present in food or in food enzyme supplements? Some plant enzymes function in a pH range of 3.0 to 9.0 and some function in a pH range of 2.0 to 12.0. These enzymes can function the same whether we consume them in raw foods or in premium quality enzyme supplements. They have the capacity to do work in the pH range and environment of the mouth, the cardiac portion of the stomach, the pyloric portion of the stomach, and in the small intestines as well. Are they enzymes? Are they globular proteins? Are they happy ducks in the water in the digestive system? Do they work and aid in digestion of food? Yes! Yes! Yes! Yes! Even at the lowest pH of the pyloric portion of the stomach, they merely become inactive until they reach a more comfortable pH range in the small intestines. The works listed in the list of references establish these facts beyond any reasonable doubt.

Beyond these well-established facts, enzymes have been and are being used therapeutically. They are very effective and safe. They are absorbed in the small intestines and circulate throughout the body acting upon their appropriate substrates. I personally know of six people who have completely eliminated all inflammation from inflamed or abscessed teeth within two to five days. Six cases attempted, six cases completely successful. The book ENZYME THERAPY by Dr. Wolf and Dr. Ransberger is filled with research and studies and success. The previously noted book ENZYMES: THE FOUNTAIN OF LIFE is likewise overwhelmingly persuasive and well documented. Regarding enzyme absorption it authoritatively states, "According to the older text books 'absorption of intact enzymes into the rest of the body is not possible.' The sooner we correct these books the better!"

As to the safety and efficacy of enzymes, ENZYMES: THE FOUNTAIN OF LIFE clearly says, “Just read the long list of contraindications, adverse effects, concomitant symptoms, interactions, notifications and warnings for any drugs said to be safe. ‘It will then be clear that there are scarcely and drugs as harmless as such enzyme preparations’.” This is clearly due to the fact the enzymes are not drugs, but are foods to the human body. It is necessary for us all to examine all of the facts regarding any issue under consideration. My own openness and willingness to cast aside my own unawareness has brought me the freedom and healing from what I would not have otherwise survived. I do not work with belief systems or traditions, but rather with those methods that meet scientific standards. It either works or it doesn’t. I very much appreciate your consideration of this hurried, rough draft to address this issue. It you have any questions or comments they are welcome.

Sincerely,

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Amylase Enzymes

PHYSIOLOGICAL ACTION: Amylase enzymes hydrolyze or digest large polysaccharide molecules, commonly known as carbohydrates, into small disaccharide molecules, which are eventually reduced to the monosaccharide, glucose, before reaching the cell. Glucose is one of the primary raw materials used by the body in the production of energy. The mitochondria in the cells transform glucose into Adenosine Triphosphate (ATP), a high-energy compound that releases its energy to facilitate cellular function. Therefore, when the body is deficient in amylase enzymes, it is also deficient in its main source of energy, glucose.

According to the Gell and Coombs classification of hypersensitivity reaction, Type I reactions result from the release of pharmacologically active substances such as histamine, serotonin, slow reacting substance of anaphylaxis (SRS-A) and eosinophilic chemo tactic factor of anaphylaxis (ECF-A) from Igesensitized basophiles and mast cells after contact with a specific antigen. These released substances cause vasodilation, increased capillary permeability, smooth muscle contraction and eosinophilia. This inflammatory response is usually manifested in those organ systems of the body, which come in contact with the outside world, most notably the respiratory tract and the skin. Some of the clinical conditions in which Type 1 reactions play a role include seasonal allergic rhinitis (hay fever), extrinsic asthma, atopic dermatitis and urticaria/angicedema. Inflammation caused by the release of histamine and similar substances can also be triggered by trauma and acute or chronic infections. The pharmacologically active substances that cause an inflammatory response are stored in the granules of mast cells or basophiles until a stimulus prompts their release. Neurohormones modulate the release of these substances. The function of these neurohormones is controlled by cAMP and cGMP systems within the cells.

The intracellular concentration of camp is a principal determinant of both the inhibition of the release of several chemical mediators, such as histamine, and the relaxation of smooth muscles. The production of cAMP and cGMP requires adequate ATP as a precursor. Therefore, when there is a deficiency of ATP in the cell, insufficient cAMP and cGMP will be produced causing imbalances in the neurohormone control of inflammation. In a study reported in Health and Longevity, a significant number of patients exhibiting skin conditions, such as dermatitis, were found to have low blood levels of amylase. High-potency amylase enzymes taken between meals will be absorbed into the bloodstream to affect the digestion of carbohydrates, providing glucose for the production of ATP and its subsequent conversion to camp and cGMP.

In addition, amylase enzymes in the bloodstream may contribute to the immunological attack on certain myxoviruses, which are enveloped in a coat composed principally of glycoproteins (proteins bound to carbohydrates). These myxoviruses are known to cause acute respiratory conditions and skin eruptions.

Cellulase Enzymes

PHYSIOLOGICAL ACTION: Cellulase enzymes hydrolyze cellulose fibers into smaller fragments ultimately releasing glucose. The human digestive system does not secrete enzymes capable of breaking down cellulose, so dietary fiber moves through the digestive tract essentially intact unless the enzyme, cellulose, is present in the diet. Cellulase is found naturally in all raw fruits, vegetables and whole grains but is missing in those that are cooked or processed. Even if these raw foods are consumed with cooked or processed vegetables or grains, there will not be adequate cellulose available to completely digest the fiber in the meal. Fiber fragments can result and be absorbed into the body. Human animal studies have provided irrefutable evidence that enzymes can and are absorbed intact from the gastrointestinal tract into the blood stream under normal conditions. Thus, exogenous cellulose can help the body utilize fiber fragments in the extra-cellular fluids. Cellulase deficiencies are often overlooked, yet a lack of cellulose can mean poor digestion plant foods and less than optimal absorption of nutrients in the intestines.

Dietary fiber consists of cellulose fibrils cemented together with a matrix of other substances (soluble fiber) including hemicelluloses (non-cellulosic polysaccharides), pectin, lignin and gums. Exogenous cellulose enzymes help release these beneficial components from dietary fiber. Of particular interest, pectins tend to bind heavy metals and organic toxic substances reducing their absorption into the body. This property can reduce the effects of food allergies and metal toxicity. In addition, studies have shown that hemicelluloses increase the bulk, softness and transit time by increasing their ability to bind water.

Lipase enzymes

PHYSIOLOGICAL ACTION: Lipase enzymes hydrolyze neutral fat (triglycerides) into diglycerides, monoglycerides and, finally glycerol and free fatty acids. If fats are not properly digested, they cannot be used by the body to:

- **Provide a source of energy.** Forty to forty-five percent of the calories in the average American diet are derived from fats, which is about equal to the calories derived from carbohydrates. Therefore, properly digested dietary fats are needed as a source of immediate energy for basal metabolism and to maintain stored energy for future metabolic events. When carbohydrate metabolism is inadequate, the body relies primarily on the metabolism **of** fat to supply its energy requirements. This takes place in starvation and following a high-fat meal when carbohydrate availability is reduced. Using triglycerides as an energy source also occurs in cases of diabetes because insulin deficiency impairs glucose transport into the cells. Triglyceride metabolism results in the formation of ketone bodies, which cannot be properly oxidized in the absence of carbohydrates. Excessive ketone bodies in the blood can have an extremely acidifying effect and may overwork the body's homeostatic excretion mechanisms resulting in kidney and circulatory failure. Enhanced digestion of dietary triglycerides can reduce the metabolism of stored fat thus lowering serum ketones. Triglycerides, composed of three fatty acids attached to glycerol, offer an immediate replacement source of energy. Glycerol is a short-chained carbohydrate, which is easily converted to glucose and absorbed into the bloodstream to supply energy, sparing some of the body's fat reserves and reducing the production potentially harmful ketone bodies.
- **Prevent cholesterol deposits on arterial walls.** Although the exact cause of cholesterol deposits on arterial walls is unclear, there is overwhelming evidence that it is associated how effectively dietary fat is metabolized. Proper digestion dietary fats can have a beneficial effect on cholesterol and triglyceride metabolism. Short chain fatty acids are absorbed directly into the blood and transported throughout the body attached to blood protein. Long chain fatty acids, monoglycerides and diglycerides are reconverted into triglycerides in the intestinal wall and surrounded with protein to form chylomicrons and Very Low Density Lipoproteins (VLDLs). These large transporter molecules carry the fat through the lymph and blood circulation to the liver for metabolism. Cholesterol is also incorporated into the chylomicrons and VLDLS. VLDLs are potentially converted in the blood to Low Density Lipoproteins (LDLs), the molecular complex responsible for depositing cholesterol in the tissues, of major concern, the arteries. Therefore, thorough digestion of dietary fats into free fatty acids reduces the VLDL and subsequent LDL levels in the blood. In addition, proper digestion of foods containing the Omega-3 and Omega-6 oils is important in order to obtain essential fatty acids, especially linolenic acid. This fatty acid is the precursor for Prostaglandins in the E3 series (PGE-3). PGE-3 are hormone-like substances that have been shown to reduce serum cholesterol and triglyceride levels as well as platelet aggregation and thrombosis. Older persons who are

more prone to hardening of the arteries were found to have lower lipase levels and hence poor fat absorption from the intestine.

- **Maintain resilience and lubrication of all cells and tissues in the body.** Fatty substances combine with protein to form the lipid bilayer of cell membranes and internal fatty tissue serves as insulation against heat loss and as a protective cushion for many tissues and organs. In addition, up to 20% of the solids in fecal matter is derived from the fat in sloughed epithelial cells. When dietary fat is poorly digested, it will not be absorbed into the epithelial cells of the digestive tract. Consequently, the stool loses some of its natural lubrication from discarded epithelial cells which, when compounded by low fiber in the diet, may contribute to constipation.
- **Facilitate the metabolism of essential nutrients.** Fat-soluble vitamins A, D, E and K need dietary fat to be absorbed and transported. Properly digested fats work with these and other nutrients to perform life-supporting functions in the human body.

Today's "fast-food", refined diet is essentially devoid of high-fiber foods. They have been replaced with foods higher in fat, a trend increasingly associated with serious health problems. Dietary fiber consists of cellulose fibrils cemented together with a matox of other substances including hemicelluloses, pectin, lignin and gums. Studies have shown that hemicelluloses increase the bulk, softness and transit time of stool; pectins reduce the amount of fat the body can absorb reducing blood fat levels; lignins bind excess bile acids produced in response to a high-fat diet preventing their metabolism into toxins by colon micro flora; and certain gums reduce the rate of glucose absorption helping to pace the postprandial rise in blood sugar levels. In the digestive process, exogenous cellulose enzymes help release these beneficial components from dietary fiber. Only modest amounts of cellulose are included in this formula because the additional glucose obtained from complete digestion of cellulose would not be desirable in cases of poor sugar and/or fat metabolism. In addition to **lipase** and **cellulose, protease** and **amylase** are provided in Formula #1 8 to help utilize other important food nutrients.

<u>Protease Enzymes</u>

PHYSIOLOGICAL ACTION: Protease enzymes hydrolyze large protein molecules into smaller polypeptides and amino acids. Human and animal studies have provided irrefutable evidence that proteolytic enzymes, preferably taken on an empty stomach, can and are absorbed intact from the gastrointestinal tract into the bloodstream under normal conditions. These proteases increase the proteolytic activity of the blood helping the body dispose of undesirable and often detrimental protein factions in the extra-cellular fluids. In particular, this increased proteolytic activity has been found to help reduce the effects of acute inflammation. When there is cellular injury, insoluble fibrin clots develop at the periphery of the inflamed area, enclosing the damaged tissue preventing the migration of disease-causing agents or toxins to other areas of the body. During the reparative process, serum proteolytic enzymes, known as plasmins, begin breaking down the fibrin clots into smaller, soluble peptides and amino acids. Although the immediate fibrin deposit is one of the most important defense mechanisms in the body, an imbalance between the number of fibrin clots formed and the amount of plasmin present to dissolve the clot has been found to cause exaggerated inflammatory symptoms such as more extensive edema; more pain; complete stoppage of circulation to the area a delay of the phagocytic stage of inflammation; and delayed healing with excess scar formation. Proteolytic enzymes given to human subjects suffering from inflammation have experienced a dramatic resorption of the edemic fluid and relief of the heat, redness, swelling and pain. Protease supplementation has been shown to be beneficial for acute inflammation involving soft tissue (sports injuries), bones, respiratory tract or the ears, nose, throat, and /or gums.

Adequate proteolytic activity in the bloodstream is vital to a healthy immune system. Human lymphocytes have proteolytic enzymes bound on the surface of their cell membranes, which are capable of digesting the protein components of various pathogens. In addition, lymphocytic proteases have an increased affinity for infected cells due to the presence of foreign proteins in the cell membrane. Immunological studies have shown that oral administration of protelytic enzymes increases antibody and lymphocyte production and so aid the immunological response. Exogenous proteases exhibit a unique selectivity for foreign non-living proteins. Normal, living cells are protected against lysis by an inhibitor mechanism. Viruses are cell parasites consisting of nucleic acids covered by a protein film, which do not show any of the characteristics of life until after a successful cellular invasion. In vitro studies have found that, during their extra-cellular phase, the viral envelope can be hydrolyzed or at least inactivated by proteolytic activity leading to a loss of infectivity. Elevating the proteolytic activity of the blood and plasma with exogenous proteases has been shown to inhibit the infectivity of several types of viruses in man including six different influenza Type A viruses and cold viruses. Although bacteria and parasites cannot be inactivated directly by exogenous proteolytic enzymes (due to the protective mechanism in their cell membranes), these enzymes can break down undigested protein, cellular debris and toxins in the blood. For example, proteases can hydrolyze undigested dietary protein that enters the blood through openings made in the intestinal wall by the toxins and mycelia Candida yeast. Supplementation of high-potency proteases allows the immune system to focus its full attention upon the bacterial or parasitic invasion.

The inability to properly digest protein can negatively affect many metabolic processes of the body. Protease supplementation helps the body utilize protein to produce hormones and to carry calcium to structural tissue and the nervous system. In a healthy nervous system, calcium and protein are integrally involved in the release of neurotransmitters, which propagate transmission of nerve impulses. Magnesium concentrations in the extra-cellular fluids determine how much calcium may enter a nerve cell. When extra-cellular levels of protein, calcium and magnesium are low, irregular nervous reactions or anxiety can result. Magnesium also plays a vital role in maintaining mental and emotional balance by regulating the formation of the brain neurotransmitter dopamine and by promoting the formation of beneficial Prostaglandins. Proper protein, calcium and magnesium assimilation is imperative to the improvement of the irritability, anxiety and other psychological imbalances associated with PMS and menopause. In addition, studies have shown that people suffering from fungal infestations such as Candidiasis tend to be deficient in magnesium.

Calcium ions initiate and control muscle fiber contractions. A decrease in ionized serum calcium results in severe intermittent spastic contractions of the muscle known as tetany. As protein utilization is improved, more calcium ions are bound by circulating proteins thus reducing the extra-cellular calcium ion concentration. To avoid the possibility of a titanic response, it is necessary to supplement calcium when taking high-potency protease enzymes. Readily soluble Calcium and Magnesium Gluconate are included in Formula #419 to prevent the complications that could result from a deficiency of dietary calcium and/or magnesium.

Sucrase, Lactase and Maltase Enzymes

PHYSIOLOGICAL ACTION: Ideally, the mucosal cells lining the small intestine secrete three digestive enzymes: sucrase, lactase and maltase. These enzymes, collectively know as disaccharidases, render dietary carbohydrates small enough to pass through the wall of the small intestine into the bloodstream to be used by the body as a source of energy for metabolic processes. Sucrase primarily digests sucrose (refined sugar) into glucose and fructose. Lactase digests lactose (milk sugar) into glucose and galactose. Maltase digests maltose, a product of starch digestion, into glucose. A deficiency of one or more of these disaccharide-splitting enzymes may be due to genetic influences, irritation or abnormality of the intestinal wall, and/or exhaustion of the body's ability to produce the enzyme(s). Disaccharidase deficiencies are generally characterized by intestinal distress following ingestion of foods containing the offending sugar or starch. Diarrhea is due to the increased number of un-split disaccharide molecules remaining in the intestinal lumen, which are osmotically retaining fluid. Bloating and flatulence are caused by the production of gas (CO, and H,) from the bacterial fermentation of the disaccharide residues in the lower small intestine and colon.

Lactase deficiency has received the most attention of the disaccharide – splitting enzyme deficiencies. Most mammals, including humans, have high intestinal lactase activity at birth. But, in some cases, this activity declines to low levels during childhood and remains low in adulthood. The low lactase levels cause maldigestion of milk and other foods containing lactose. It is estimated that approx. 70% of the world's population is deficient in intestinal lactase with more than one-third of the U.S. population presumed to be unable to digest dairy products. Although not as well recognized as lactase deficiencies, sucrase deficiencies may explain the increasing inability of many people to handle the sucrose in their diets frequently exhibited as mental/emotional problems. The excessive amount of sucrose in the modem, refined diet can exhaust the body's ability to produce sucrase enzymes as well as the body's supply of nutrients needed for carbohydrate metabolism. Chronic constipation in individuals consuming a highly refined carbohydrate diet may be at least partially explained by the absorption of excess sucrose into the bloodstream pulling water with it from the intestinal tract to maintain osmotic balance. Adding disaccharidase enzymes to the diets of those individuals suffering from a sucrase, lactase and/or maltase deficiency can help them more fully realize the nutritional benefits from carbohydrate-containing foods.

The human digestive system does not secrete enzymes capable of breaking down cellulose, so dietary fiber moves through the digestive tract essentially intact unless the enzyme, cellulose, is present in the diet. Cellulase deficiencies are often overlooked, yet a lack of cellulose can mean poor digestion raw plant foods and less than optimal absorption of nutrients in the intestines. Cellulase digests cellulose into glucose and is naturally found in raw fruits, vegetables and whole grains. Many starches and other nutrients in these uncooked foods are coated with cellulose. Unfortunately, most people do not chew raw food thoroughly enough to activate the cellulose and, therefore, cannot be fully utilized by the body. In addition to improving intestinal absorption of nutrients, supplemental cellulose enzymes can enhance the body's utilization of fiber to normalize bowel activity.

Many people who cannot tolerate carbohydrates in their diet turn to protein as their primary source of energy as 56% of protein intake is converted to glucose. Since high protein diets rarely contain the full spectrum of nutrients, many vitamins and minerals are depleted in the body's attempt to metabolize excessive am9ounts of protein resulting in multiple nutritional deficiencies.

REFERENCE LIST

1. Guyton, Arthur C., Textbook of Medical Physiology, Eighth Edition, Philadelphia, Penn., W.B. Saunders Co., 1991.
2. Tortora, Gerard J., Principles of Human Anatomy, Third Edition, New York, N.Y., Harper and Row, 1983.
3. Donovan, Edward W., Essentials of Pathophysiology, New York, N.Y., Macmillan Publishing Company, 1985.
4. Morter, M.T., Jr., Corrective Urinalysis, Rogers, Ark., Best Research, Ind., 1987.
5. Johnson, Leonard R., ed., Gastrointestinal Physiology, Fourth Edition, Saint Louis, Mo., Mosby Year Book, 1991.
6. Lopez, D.A., M.D., Williams, R.M., M.d., Ph.D., Miehlke, M., M.D., Enzymes The Fountain of Life, Charleston, S.C., The Neville Press, 1994.
7. Wolf, Max, M.D., Ransberger, Karl, Ph.D., Enzyme Therapy, Los Angeles, Cal., Regent House, 1977.
8. Howell, Edward, M.D., Enzyme Nutrition, Wayne, NJ., Avery Publishing Group, Inc.
9. Howell, Edward, M.D., Food Enzymes for Health and Longevity, Twin Lakes, Wis., Lotus Press, 1994.
10. Price, Weston A., D.D.S., Nutrition and Physical Degeneration, La Mesa, Cal., Price-Pottenger Nutrition Foundation, Inc., 1970.
11. Pottenger, Francis M., Jr., M.D. Pottenger's Cats, A Study In Nutrition, Price-Pottenger Nutrition Foundation, Inc., 1983.