



ENZYME RESEARCH GROUP

The Effect of Plant Form Protease's on Viruses

Viruses and viral diseases have been with us since the dawn of recorded history. Archeological artifacts dating back thousands of years B.C., suggest that such familiar diseases such a polio and smallpox now known to be caused by viruses were no strangers to the ancient world.

Smallpox, influenza, chicken pox, measles, mumps, herpes viruses from the common cold to rabies have all been a major cause of human misery and death throughout history. In 1939, using an early electron microscope, researchers were able to "see" a virus for the first time. Like other microorganisms, viruses typically gain entry to the body through epithelial surfaces, usually the:

- ❑ Skin
- ❑ Mucous membrane of respiratory tract
- ❑ Gastrointestinal tract
- ❑ Genital tract
- ❑ Conjunctiva (Mucous membrane lining on the inside of the eyelid and outside of the eyeball).

If a virus manages to make it through these physical barriers, it encounters a second line of defenses. These defenses are engaged against anything the body recognizes as foreign. They include phagocytes (literally, "cell eaters"), white blood cells whose job it is to engulf, ingest and eliminate foreign particles, of course, viruses before they can infect any of the body's cells. Perhaps a billion strong, they constantly circulate throughout the body in the blood and lymph systems.

Many white blood cell types can act as phagocytes, but most important to our story are the macrophages. Macrophages (Greek for "big eaters") may be mobile, circulating through the blood and lymph fluid, or attached to a particular type of tissue. They devour everything, including viruses and bacteria, as well as dead body cells, dead neutrophils and other debris. Other cells called natural killer cells wander through the blood and lymph fluid looking for abnormal cells, particularly those that are infected by viruses or are cancerous. When they find an abnormal cell, they kill it.

How Viruses Differ From Bacteria

Most of us have the sense that viruses are unique in some way and that the viral infections are not as readily treatable as those caused by bacteria. The key differences between viruses and bacteria are size and structure. Viruses are the smallest known form of life, ten to 100 times smaller than an average bacterium. Bacteria are large enough to carry their own synthetic machinery, and thus can live and reproduce independently of a host cell. Viruses, in contrast, are obligate intracellular parasites (that is, they can replicate only inside a host cell). Viruses carry their genetic information either as RNA or as DNA, but bacteria use only DNA.

Viral Structure

The structure of a virus is an exercise in simplicity. The most basic viruses have just two components: a core of genetic material and a protein coat called a capsid. In addition to these components, common to all viruses, some viruses have an outer envelope, consisting of a combination of lipids, proteins or carbohydrates. A complete, fully developed viral particle that contains both genetic material and a capsid coat is called a virion. This economical little structure is capable of doing a great deal of harm by invading and replicating within host cells.

The viral genome (genetic material of all living cells) is contained within chemical structures known as nucleic acids. In human cells, deoxyribonucleic acid (DNA) is used to store genetic information. DNA is organized into segments called genes, each of which contains "instructions" for manufacturing a particular protein, which in turn helps determine cell structure and function. Human cells also contain another nucleic acid, ribonucleic acid (RNA), which helps carry out the instructions encoded in the DNA.

In contrast to human cells, the viral genome can be written in either RNA or DNA. A virus can have either RNA or DNA but never both. The nucleic acid of a virus can be single or double-stranded. The type of nucleic acid and number of strands in a viral genome are ways we classify viruses.

Viral nucleic acids are recognized by human intracellular mechanisms involved in DNA and RNA replication and transcription. Thus, the viral genome can "hi-jack" the host cell's replication process, a *modus operandi* that lies at the heart of a virus' infectivity.

Viral Envelopes

In some viruses, such as herpes viruses, the capsid is also surrounded by an envelope, similar in lipid structure to cell membranes and, in fact, derived from membranes of the host cell in which the virus was replicated. Viruses with such envelopes are termed enveloped; those with no envelope are termed naked.

The envelope of certain viruses is covered by protein-carbohydrate spikes that protrude from the surface of the envelope, giving the virus something of appearance of a medieval mace. These spikes contribute to the infectious properties of the virus helping the virus attach to host cells or causing red blood cells to clump together.

An enveloped virus and a non-enveloped, or naked virus are contrasted. The envelope itself consists primarily of lipids and is similar in composition to cell membrane. In fact, enveloped viruses derive their envelopes from membranes of the host cells they infect.

Surface Proteins

Glycoproteins on the surface of viruses apparently act as “recognition factors” that enable the virus to recognize and attach to only those cells within its host range (the range of organisms and cell types it infects). In the case of naked viruses, these glycoprotein recognition factors occur on the capsid itself; in enveloped viruses, they protrude through the envelope to the surface of the virus.

Many viruses, however, encode proteins, which specifically bind either antibody or complement (a complex system of proteins found in normal blood serum that combines with antibodies to destroy pathogenic bacteria and other foreign cells) with viruses, and these may provide protection against attack during the intracellular phase. There is some evidence that these provide protection against direct neutralization.

Protein Coat

The protein coat or capsid is made up of a series of repeating subunits known as capsomeres. These consist of one, or very few types of proteins coded by the viral nucleic acid. The type and arrangement of these capsomeres is what gives each virus its characteristic architecture. These capsomeres demonstrate how “economical” the virus is in its structure and function. While human cell membranes have hundreds of different structural elements, the viral capsid consists of just a few proteins, repeated again and again. Thus, relatively little of the virus’ genetic material is devoted to coding for these structural proteins allowing the virus to carry a minimum of genetic material.

Proteases & The Protein Coat

Protease is a classification of a group of enzymes which act on protein molecules and assist by catalyzing reactions. These reactions, in effect help to change the molecular structure, or breakdown the protein molecules. Based on clinical studies, it is known that proteases are able to hydrolyze almost all proteins as long as they are not components of living cells or are in an environment that stabilizes their confirmation. Normal living cells are protected against lysis by the inhibitor mechanism. Parasites, fungal forms, and bacteria are protein. Viruses are cell parasites consisting of nucleic acids covered by a protein film. The introduction of oral proteases, presents the ability of those enzymes to act upon the protein coating of viruses. Enzymes can also break down undigested food protein, cellular debris, and toxins in the blood, sparing the immune system this task. The immune system can then concentrate its full action on the bacterial or parasitic invasion.

Protease will hydrolyze various forms of protein that have lost their native stability in the system (waste). The enzyme action it produces can adapt to meet the current digestive or metabolic needs of the body. It should be noted that some proteases when taken on an empty stomach is readily taken up into the mucosa cells of the intestine and passed into the blood circulation. Clinical observations (manuscript in preparation) have noted that upon high intake of oral proteases, heavy metal concentrations have been significantly decreased in the blood.

Oral proteases taken on an empty stomach have been shown to be absorbed and carried into the blood stream where they are bound to alpha-2 macroglobulin. The binding of the alpha-2 macroglobulin to proteases does not inactivate the proteolytic activity of the protease. However, the complexing of the alpha-2 macroglobulin ensures the clearance of the protease from the organism. Several studies have indicated that oral proteases bound to the macroglobulins hydrolyze immune complexes, proteinaceous debris, damaged proteins, and acute phase plasma proteins in the blood stream. It is suggested that oral proteases may help hydrolyze and remove extracellular proteins damaged by free radicals. This is based on the absorbability of the protease into the circulatory system, their hydrolytic activity and ability to remove proteinaceous debris in the blood and extracellular fluid, and their susceptibility due to their unfolding and other conformational modifications from their native state.

To simplify this explanation: *It is being suggested that once a virus has been "tagged" by the immune system for elimination from the body, the combination of protease and alpha-2 macroglobulin are able to assist the immune system in breaking down and removing the virus from the s*