# Isolation and partial characterization of lectins of indian varieties of plants

Science, Biology

The word ‘ Lectins’ has been derived from the Latin word which means ‘ I choose’. Because lectins are very specific to the site to which it binds. Lectins are carbohydrate-binding proteins which bind to glycoproteins, glycolipids, and also polysaccharides which mediates various kind of biological processes by binding to different sugar moiety. Lectins act as a bridge and bind to the carbohydrate moieties on two different RBCs and hence give rise to the ‘ clumping of erythrocytes’. The specificity of the lectin is due to its affinity to bind to a specific carbohydrate present on the plasma membrane of erythrocytes. Most lectins in plant species are not ABO blood type specific and only a few edible plants contain lectins that are specific for blood group antigens. Lectins were characterized for their agglutination properties with erythrocytes of human and other animals, is the easiest and most convenient method of detection of lectin activity. Lectins are also called agglutinins because when it binds to cell surfaces results in agglutination reactions. Lectins are highly diverse in structure, molecular weight, composition, and number of sugar binding sites present per molecule. Lectins are well-known proteins which have highly specific carbohydrate-binding. Lectins have non-immune origin and can binds to oligosaccharides, glycoproteins, glycolipids and different polysaccharides without changing their covalent structure. The lectins were first described by Stillmark in 1888 when he was working with castor bean extracts and showed agglutination reaction.

Lectins are generally classified into five major groups according to their affinity for reversible interactions with different carbohydrates: (i) glucose / mannose, (ii) galactose and N-acetyl-D-galactosamine, (iii) N-acetyl

glucosamine, (iv) L-fucose and (v) sialic acids. Lectins are widely distributed in nature and found in all forms of life including plant products such as fruits, vegetables but nuts, grains, beans and seeds contains high lectin amount.

Researchers have great interest and lectins has been studied and isolated from various sources including plants, animals, fungi, lichens and bacteria. It has been reported that lectins have been found mostly in seeds of Legumes and other plant species. Within the plant body, lectins play an active role in transport of carbohydrates and in the formation of symbiotic associations with rhizobia to facilitate the formation of root nodules. The interest on plant lectin study is due to their high specificity on carbohydrates. Lectins have also been isolated from vegetative tissues of plants like leaves, stems, barks, and roots. Lectins are also suited for analysis and isolation of animals and human glycocojugates. The mature seed contains about 3% of the weight of it. The plant lectins are stable proteins which can be characterized without affecting their sugar binding properties. The banana lectin has been isolated from Musa paradisiaca and characterized in 1990.

The dimeric structure of lectin was shown to be mannose-specific. The snail Helix pomatia, contains large amounts of a lectins which agglutinates with human type A erythrocytes. It has been reported that this lectin, which aggregates in the snail albumin gland, plays a major role in the protection of eggs as well as developing embryos against bacterial and fungal infections. The lectins from legume and cereal has altered the microflora present in the gut, causes inflammation and increases the intestinal permeability which also helps in the translocation of gut pathogens to the periphery. When

kidney bean lectin (PHA) given in high doses to conventional rats proved lethally toxic, but is nontoxic for the germfree animals. Lectin activity has been demonstrated in wheat, barley, oats, maize. Maize, like wheat, alters intestinal epithelial structure as well as function.

The biological activities of cereal lectins are highly similar because they are closely related to one another both structurally and immunologically. The root extract of Arachis hypogea (groundnut) and its seed lectin were found to stimulate the synthesis of exopolysaccharide and capsular polysaccharide of the micro symbiont cowpea Rhizobium strain. When lectins of Abrus was treated with rabbit erythrocytes and injected in the peritoneal cavity of mice showed agglutination reaction. The biological activities like anti-tumor, anti-proliferative, immune potentiating, antibacterial, antifungal, anti-insect, and antiviral activities have been found in lectins. Microbes carry lectins, which help them for attachment to the host cells. The human body contains lectins at various places such as, on the vascular endothelial linings(selectins) in order for blood cells to escape into the tissues; in to capture microorganisms, and as substances called opsonins, that coat foreign antigens, making them more susceptible to phagocytosiss. The screening of number of breast cancers against lectins shows different specificities. Lectin associated haemagglutination assay and the ability of different oligosaccharides to act as inhibitors was determined by the microtitre plates by using rabbit erythrocytes. The lectins consumption disturbs normal growth in humans as well as in other animals. It has been reported that the lectins influences the nutrient intake. Lectins cause morphological injury in the small intestinal

mucosa due to its adhesion to the mucosal surface. But the injury can be prevented by the simultaneous administration of saccharides having specific affinity for the lectins or by treatment of the foods containing lectins with heat. Lectins are found commonly in most legumes and their toxic effects have been seen.

Pusztai et al. reported that beans having higher content of lectins causes most serious damages to the luminal surface of intestine in rats compared to those having lesser lectin contents. An inhibitory effect of lectins on the activity of peptidase as well as disaccharidase of enterocytes has also been reported. Besides playing a role in innate immunity mannose binding lectin (MBL) helps in cellular defenses such as phagocytosis, and pattern-recognition receptors that activates pro-inflammatory signaling cascades. Lectins isolated from bean species has influenced the intestinal structure and function negatively leading to diseased situations. Some lectins show anticancer property in vivo as well as in vitro, as a result they can be used as therapeutic agents for tumor inhibition as it causes apoptosis. Lectins have affinity to bind with ribosomes as a result it inhibits protein synthesis. Lectins can decrease the telomerase activity and suppresses angiogenesis. Distinction between a malignant cell and a normal cell has been done by using lectins. Lectins has the property which modify the cell cycle by inducing non-apoptotic G1-phase accumulation mechanisms, which arrests G2/M phase cell cycle and do apoptosis and also has the ability to activate the caspase cascade. Plant lectins have the capacity in cell separation and bone marrow transplantation.

Lectins can be used as probes for the characterization and isolation of simple and complex sugars. Lectins can be used in immunological studies as a tool. Dietary lectins can cross the gastrointestinal barrier and enters the circulation intact, and also be able to interact with synovial tissues directly. Lectin has the tendency of alternating interleukin production which affects the body immune system. Various plant lectins have the tendency to bind with the intestinal mucosa which disturbs the functions of intestine and may causes enlargement of pancreas. Plant lectins plays a vital role to defence itself from the predators is not new. Lectins are used in the activation of lymphocytes and for induction of proteins like enzymes, interleukins or cytokines. To determine the 3-dimensional structure of carbohydrate binding site of lectins NMR and XRD are used. Lectins have many applications starting from identification of microorganisms to cancer research. Mitosis (cell division) can be enhanced with pokeweed lectin (PWA). Lectins have been used as carriers in drug delivery such as delivery of chemotherapeutic agents.

The lectins isolated from different plant species often varies greatly in their molecular structure and specificity. Many legume species contain proteins which are clearly related to the lectins lacking carbohydrate binding activity. Well-known examples of this group of proteins are the Phaseolus vulgaris arcelins and the a-amylase inhibitor. Biochemical, cellular, evolutionary, molecular, and physiological arguments indicate that lectins have a role in plant defence. The toxic nature of plant lectins and its effects on animals and humans have been obtained from feeding experiments with purified PHA and

also observed from accidental poisoning of humans by taking raw or insufficiently cooked beans.