Studies in Natural Products Chemistry: Chapter 10. Chemico-Biological Aspects of Plant Lectins with a Preference to Legume Lectins

Fatima Clement John, Khatija Tabbasum, Chebrolu P. Rao

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The discovery of lectins, a class of carbohydrate-binding proteins, dates back to 1888 when Stillmark first noticed a hemagglutinating factor in castor bean extracts. Ever since, the field of lectins has been steadily growing as new lectins with unique binding specificities are being discovered from various sources. Moreover, newer technologies and synthetic approaches have helped unravel unknown aspects of lectins that have potential for the use of these proteins in biomedicine and biomaterial sciences. Lectins are, by the new definition, proteins with the presence of at least one noncatalytic domain that binds reversibly to a specific carbohydrate. The ability of lectins to bind carbohydrate moieties of glycoprotein and glycolipid cell-surface receptors often results in important biological events. They also bind various glycoses and/or glycoconjugates, including certain drugs, a potential that can be used in prophylaxis of disease. As a result of these findings, studies on lectins have escalated from both chemical and biological points of view, and it is difficult to keep track of the new discoveries and developments in this field in order to reap their benefits and develop the science and the emerging technology from them. Therefore, this review deals with the new discoveries and key developments in the field of lectins, especially with reference to their isolation, structure elucidation, and their chemico-biological applications including those in drug discovery and medicine. Lectins have been isolated from various sources, including plant, viral, bacterial, fungal, and animal. However, the most well-studied class of lectins is the plant lectins, followed by fungal ones. Plant lectins have been shown to possess antitumor and anticarcinogenic activity. Like the antitumor drugs that trigger the apoptotic death of tumor cells, plant lectins have also shown cytotoxic effects mediated via apoptosis. During the last decade, there has been a growing interest in lectins, which exhibit anticancer activities. A few kinds of plant lectins have been identified that induce apoptosis activity in tumor cells, for example, mistletoe (Viscum album L.). Interaction of lectins with cells is also known to induce mitogenicity. As lectins are specific to certain carbohydrates, they are very often able to distinguish between normal and cancer cells and can be used in targeted delivery of organic or inorganic drugs to certain cancer cells and bring about their destruction, a potential that needs to be exploited to its fullest extent. Therefore, this chapter attempts to put into meaningful perspective the latest information available on lectins, which includes practical aspects of isolation, structure elucidation, and lectin–drug interactions, and the structure–activity relationship of lectins that helps us to understand how their activity can be optimized. Many lectins studied to date have numerous biological activities, of which some may have applicability in the biomedical industry. Advancements in computational and bioinformatics studies, and efficient screening mechanisms available in the pharmaceutical industries to pick out the most efficient of these proteins and turn them into drugs for medical use, have all led to a renewed interest in lectins in drug discovery.

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