Microbial Lectins and Agglutinins: Properties and Biological Activity

Edited by David Mirelman

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A scene can be readily visualized in which David Mirelman or whoever it was who actually did the work of finding willing contributors to this book, one of the Wiley Series in Ecological and Applied Microbiology, paces up and down over strewn copies of Current Contents muttering: "but there must be somebody, somewhere working on marine invertebrate lectins"; because whatever else one might say about this volume, it has to be admitted that it covers the ground. Not a single important microbial class has escaped with its skirt unlifted and its sugar-binding proteins (lectins) unexposed. Reading from cover to cover you will plod sequentially from viruses in chapter 2 to the above mentioned sea beasties in chapter 19 via sections on hairy bacteria, gonococcal pili, cholera and diphtheria toxins, the slime mould saga (again), protozoan pastes, fungal fixatives and much, much more. Incidentally according to this evolutionary progression, the editor obviously feels that mycoplasma are more advanced than myxobacteria. To save you scurrying off for the microbiological dictionary: the latter are the ones who wander round their soil environment in swarms (or hunting packs as the authors of that particular chapter ramboistically put it) looking for a lone yeast or nematode to mug; whereas the former, the smallest and simplest wall-free prokaryotic cells known, stay peaceably single but nonetheless manage to irritate the tissue culture people no end by sticking to and growing on the surface of their precious cell lines.

This collection of reviews is an almost exclusively American-Israeli-Swedish affair. This does not, I am sure, reflect the formation of a new exclusive trans-Atlantic club for books and symposia to counter a possible thrust from the Pacific Basin but may say something about the availability of funds supporting pure and unfettered science in those countries. After all, lectinology is not a research area exactly bursting with applications as yet. And perhaps this is the major problem. Several chapters include an apology from the authors that they had in fact so little to tell the reader with regard to the major questions and a somewhat desperate plea for more work to be done.

However a few glens in this black lectin forest have been cleared and certain rules are emerging from the gloom. It is becoming increasingly plain that there are at least 3 main types of lectin in the non-plant world: (1) the lumbering great aggregation factors, much beloved of sponges and fungi, which are secreted from and act as a species-specific adhesive glue between cells; (2) the glycoprotein lectins which are firmly attached to the outer cell surface by a bonding that does not include the sugar-binding site and which play a role in cell-cell and cell-ligand recognition and adhesion; and (3) the small protein-only lectins (mini versions of the familiar plant lectins but almost invariably galactose specific) which start out as cytoplasmic molecules and are only released later in the cellular life cycle by an unknown mechanism not involving signal peptides. What they do after that is a question and a half, as Snow's old Gay would have said. The most familiar and certainly the most studied examples of this class are the slime mould lectins, discoidin and pallidin, and an overwhelming weight of evidence now exists against them acting directly in specific cell-cell adhesion. Similar molecules exist in mammalian systems and there too no such rule can be established.

With all this in mind, it was disappointing to say the least that chapter 1, the keynote contribution intended to set the scene, comprised a mere three and a half pages of text with no attempt at the

above clarification. The discerning will have noted that there is no mention of the infamous sugar-binding bacterial toxins in the guide lines quoted. This is because they are not in fact lectins according to the definition layed down by Goldstein et al. in 1980 (another surprising and maybe significant omission from the introduction). The welcome fact that they were included in this edition is an indication that man's attempt to pigeonhole molecules in his own little boxes was not taken too seriously by the editor. By the way, there is absolutely no truth in the rumour that the Goldstein definition has been engraved upon stone in the catacombs of the Weizmann and that new postgrads are taken down there to gaze reverently and learn it by heart.

Scanning through the notes made while reading the book, it is quite evident that there are 3 principal areas where substantial progress is being made and the chapters describing these are the ones to xerox... I mean concentrate on: viral adhesins and bacterial fimbriae and toxins. However in the virus chapter, a strange fact comes to light. As every college biology student knows: X-ray diffraction studies have shown that each haemagglutinin spike on the surface of the influenza virus is made up of three lectin polypeptides intertwined. But here we are told that whilst the flu virion has about 500 HA spikes, which like most other viral adhesins bind to host cell surface sialic acid, only 950 molecules of lectin can be detected. So where is the third man? A case for Miss Marple? This chapter is also plagued with mysterious acronyms; the JEVs and VAPs abound (no JAPs of course) and if you slide over their first mention or want to dip in here and there for reference: hard luck! As far as could be ascertained, the letters NA and HN are never overtly decoded; NA we know, but HN in relation to viruses? Have neuraminidase will travel?

And in the section concerned with how bacterial gut and urinogenital pathogens get their hooks, or rather, their fimbriae into us, among all the gene cloning discoveries (up to 8 genes in a cluster required to code for, transport, 'polymerize' hundreds of lectin subunits (pilins) to form a single fimbrial hair and to anchor this into the outer membrane of these gram-negatives), I came across the answer to a question that always arises when lectins are involved in infection, namely: since most of the cells of a given host bear the same set of sugars at their surface, how does the infecting particle get beyond the first mouth or nasal mucosal cell it encounters? How does it travel to the point at which we know, or think we know, the infection commences? The answer of course lies in the genes. The promoter governing the fimbrial gene cluster can be turned on and off very readily, though they do not as yet know how, and fimbriae negative clones are common especially in the excreted cells which of course go on to carry the disease to other animals.

There was nothing much new to read in the story of the ups and downs of the slime mould lectins in their early much vaunted role as species-specific cell-cell linkage molecules. Steven Rosen, whose seminal observations at Cornell in 1972 founded the whole field, lovingly went through it all again (never in the pages of human literature have so many reviews been written about so small a research area with so many turnovers) and after having fairly described the dubious nature of the positive evidence and listed all the damning negative evidence which has accumulated (I quote from his concluding section: "Despite 12 years of intensive study, however, their function remains elusive"), he could not resist inserting a forlorn note added in proof that yet another paper claiming a role for the lectins in slime mould amoebae aggregation had just been published. Beautiful ideas die hard in the heart of their creator.

Because of the professional and erudite way the authors have tackled their respective topics – and any criticisms made above are not intended to detract from that conclusion – this is not a book for the faint hearted. You are plunged with the minimum of waffle into critical and detailed accounts of the experimental evidence. The state of affairs in the microbial lectin world of 1984 (the latest references are of this age) is revealed, warts and all, and as such, it is an excellent springboard into the current literature. But I have to admit that my copy will be chiefly treasured for the exhaustive 10 page list of all known microbial lectins (*E. coli* alone has now acquired 16 of them would you believe?) and their properties, kindly and no doubt laboriously provided in chapter 1. Thank you David!

C.J. Chesterton