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Published in final edited form as:
Curr Top Microbiol Immunol. 2008; 322: 249-289.

Escherichia coli biofilms

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Abstract
E. coli is a predominant species among facultative anaerobic bacteria of the gastrointestinal tract. Both its frequent community lifestyle and the availability of a wide array of genetic tools contributed to establish *E. coli* as a relevant model organism for the study of surface colonization. Several mechanisms, including the formation of biofilms, have been shown to regulate surface colonization and their expression and activity are finely regulated, both in space and time, to ensure productive interactions between the bacterial cell and its environment. This review focuses on the molecular mechanisms underlying biofilm development in both commensal and pathogenic *E. coli*.

Keywords
Biofilms, growth & development, Escherichia coli infections, microbiology, Escherichia coli K12, physiology, Humans

Introduction

The description of a biological association between bacteria and surfaces dates back to the dawn of microbiology when, in the seventeenth century, Antonie Van Leeuwenhoek observed "animalcules" on his own dental plaque surface. Since then, however, what we now know to be a biofilm was considered as a mere aggregation of individual cells in suspended single-celled planktonic cultures. It is currently admitted that we have explored only a very specific aspect of bacterial biology since, in most ecological niches, bacterial interactions with other microorganisms and with their environment are much more complex than those of the planktonic uncultured bacterial communities known as biofilms. Biofilm physiology is characterized by the ability of the bacterial cells to form a self-reinforcing protective structure (see Fig. 1A; Anderson and G.A. O'Toole, this volume) and the immunological defense, which is at the heart of the immune system (see Fig. 1B; see also Fig. 2). The formation of biofilms and the negative impact of biofilm development on human activities has stimulated research aimed at providing clues for combating detrimental biofilms. More recent studies conducted on genetic mechanisms underlying biofilm development have made a large selection of model bacteria, including *Escherichia coli*.

Although current knowledge of bacterial biology owes much to work done on *Escherichia coli*, the study of the formation and development of biofilms in vivo and *in vitro* is still in its infancy. Indeed, *E. coli* is a predominant species among facultative anaerobic bacteria of the gastrointestinal tract, where it thrives in an environment with specific characteristics of a multicellular biofilm (Costerton et al. 1995; Poblet and Gibson 2002).

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Immunology Notes

■ Immunology

Def'n: the branch of biomedical science concerned with the response of the organism to **antigenic challenge**, the recognition of self from non-self, and all of the biological (*in vivo*), serological (*in vitro*), and physical chemical aspects of immune phenomena

• **defence mechanisms** include all physical, chemical and biological properties of the organism which reduce its susceptibility to foreign organisms, material, etc.

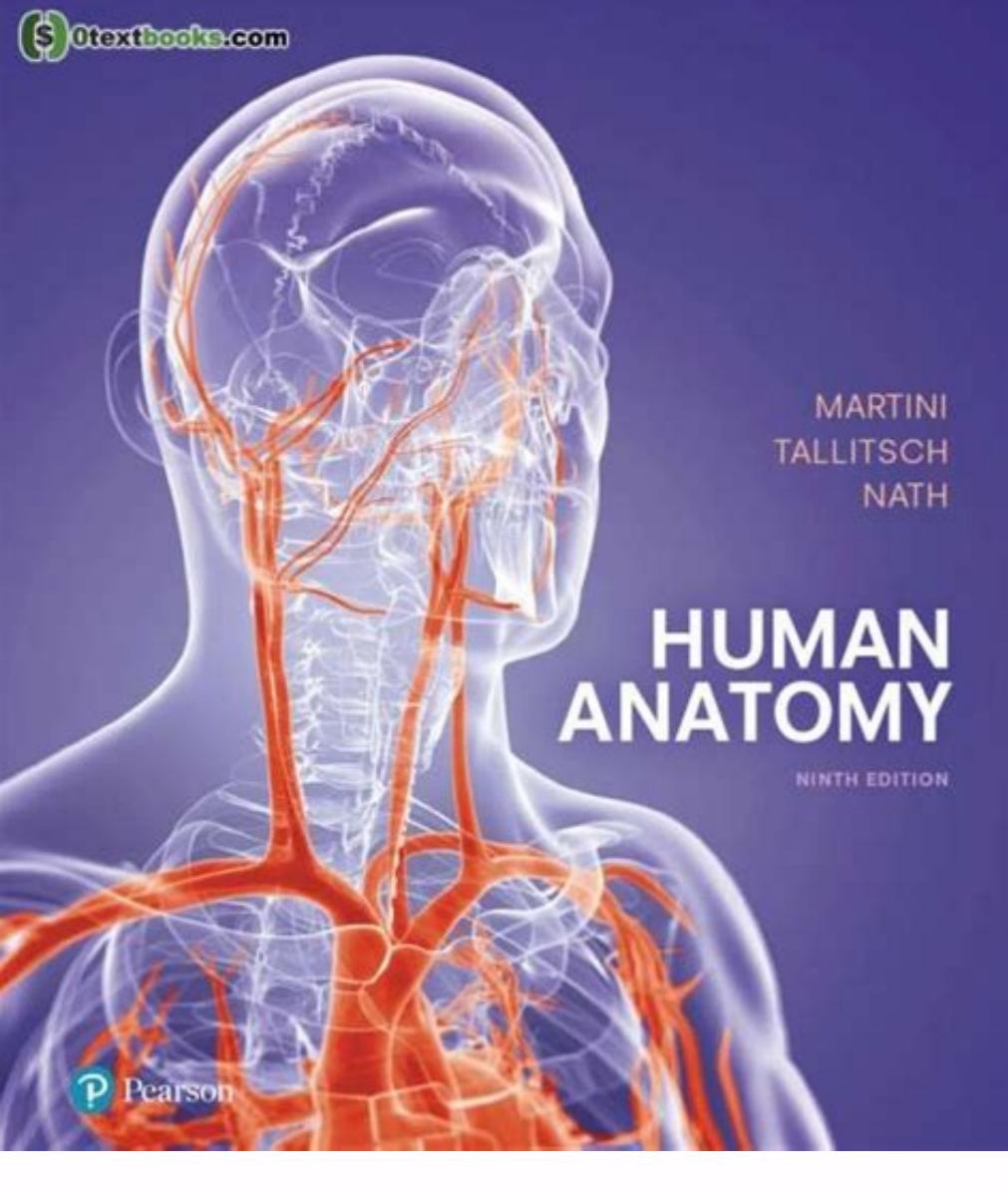
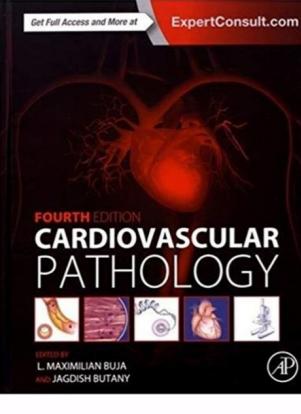
• functionally these may be divided into those which are static, or **innate** to the organism, and those which are responsive, or **adaptive** to a potential pathogen or foreign substance

■ Functional Division

1. **innate system**
 - evolutionary older system
 - first line of defense
 - non-specific
 - resistant static, i.e. doesn't improve with repeated exposure, **no memory**
 - often sufficient to prevent disease
 - i. physical defenses
 - skin & epithelial surfaces, cilia
 - commensal flora
 - acidic gastric contents
 - fever
 - ii. biochemical defenses
 - soluble
 - lysozyme, acute phase reactants
 - complement, fibrinogen, interferon
 - cellular
 - natural killer cells, RES phagocytes

2. **adaptive system**
 - second line of defense
 - activated once the innate system has been penetrated/overwhelmed
 - is **specific** to the infective agent
 - exhibits **memory** with an enhanced response to subsequent challenge
 - i. soluble factors
 - ii. cellular factors

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