

The Probiotic Nature of Normal Microflora*

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ABSTRACT: *The normal microflora of humans consists of bacteria, yeasts, fungi and possibly viruses. Recent studies are revealing that many of their actions are like those of the normal microflora present in the intestinal tract and on the skin and mucous membranes. This chapter focuses on some similarities between probiotics and normal skin microflora.*

The skin and mucous membranes of healthy individuals maintain normal functions with naturally occurring microorganisms on them. The numbers and types of these microorganisms depend on moisture level, pH, nutrient availability, the presence or absence of inhibitory materials and the immunological tolerance of different sites of the body. Microorganisms generally found on skin, on mucous membranes and in the gastrointestinal (GI) tract of healthy individuals constitute the normal microflora, meaning they are normally present and do not cause problems in healthy individuals. People would have continual microbial infections—boils, abscesses, inflammation, diarrhea and intestinal gas/bloating—if they did not live in harmony with their normal microflora.

For over 50 years, it has been widely believed that the presence of microorganisms on the skin is part of a natural defense because the normal microflora helps protect against pathogenic microorganisms.

*This chapter is adapted from a seminar presented by the author in November 2007 at the College of Pharmacy at the University of Cincinnati.

This dogma has been accepted without a great deal of scientific support. Billions of bacteria inhabit the GI tract. The mucous membranes of the nose, mouth and vagina may have large numbers of microorganisms. There are few reported studies directed at understanding the benefits of microorganisms normally present compared with the number of studies conducted to understand mechanisms by which pathogenic microorganisms cause infections, or to determine which antimicrobial agent(s) are most effective in treatment.

In recent years, there has been a dramatic increase in the popularity of probiotics in the United States. Probiotics are dietary supplements containing potentially beneficial bacteria or yeasts. These products generally have been marketed as food supplements and as dairy products. Promotion of probiotics is based on clinical studies demonstrating the benefits to intestinal health and laboratory studies demonstrating mechanisms by which probiotics achieve those benefits. The laboratory studies indicate that these microorganisms and/or their metabolites interact with intestinal epithelial cells to prevent adherence of undesirable bacteria and to down-regulate the intestinal immune system.

It is likely that the mechanisms by which probiotics affect mammalian cells are similar to mechanisms used by normal microflora in other parts of the human body. The goals of this chapter are to introduce readers to the normal microflora in several regions of the body, with emphasis on the skin microflora; to discuss probiotics and touch on their therapeutic activity and cellular microbiology; and to show some similarities between probiotics and skin microflora. It is hoped that this information will serve as the basis for studies to better understand mechanisms by which the human normal microflora maintains homeostasis with epithelial and mucosal cells so that formulators can apply this information to personal care products designed to maintain the health and beauty of the skin.

The Paradox

It is amazing that billions of bacteria inhabit an individual's GI tract and high concentrations of microorganisms reside on specific skin sites and on mucosal surfaces, yet people are neither sick nor

covered with infections. The intriguing question is: Why not?

Normal Microflora

The skin, mucous membranes and GI tract are constantly in contact with the environment and they become colonized by bacteria, yeast, fungi and viruses. In healthy individuals, the types of microorganisms generally colonizing skin and mucous membranes are a few yeasts and fungi, but bacteria predominate. Aly and Maibach¹ investigated the aerobic microflora of the axilla, groin, finger web and toe web. They found average counts per square centimeter of 1.3×10^7 for nonlipophilic diphtheroids, 3.0×10^6 for lipophilic diphtheroids, 1.3×10^5 for micrococci and 8.6×10^3 for *Staphylococcus aureus*. Of the four sites tested, the axilla had the highest average number of Gram-negative rods (3.8×10^2). Todor² recently published more extensive information on the predominant bacterial microflora of humans (see **Table 1.1**).

Bacteria, yeasts and fungi have adaptive survival strategies that enable them to deal with adverse conditions.³ This is why microorganisms can still cause problems, in spite of all the body's natural defenses. The interaction between individuals and their resident microflora is thought to be dynamic and generally beneficial:

- Enteric bacteria produce and secrete vitamins K and B12.
- Lactic acid bacteria produce and secrete B vitamins.
- Resident microorganisms prevent colonization by other bacteria and pathogens by competing for attachment sites and essential nutrients, by producing fatty acids, by lowering the pH in microenvironments, by producing peroxides and specific bacteriocins that kill or prevent growth of other bacteria, and by stimulating epithelial cells to produce defensins, cathelicidins and other small antimicrobial peptides.
- Intestinal microorganisms stimulate the development of certain tissues (e.g., caecum and Peyer's patches in the GI tract).²
- Microorganisms stimulate the immune system (skin immune system and gastric associated lymphoid tissue) and induce the production of antibodies.