# Preface

In recent years, the role of the microbial ecosystem in both human and animal health has become more prominent (Finegold 2008; Ley et al. 2006; Murphy 2004; Turnbaugh et al. 2009; Turnbaugh et al. 2006; Xu and Gordon 2003). The "microbial organ" is at last getting its due as a playing a part in health as well as production parameters (Lyte 2010). Though much of this research has focused on the effects of the microbial communities and cross-communication with the host in and on humans, increasing amounts of research has delved into the microbial organ of animals (Freestone and Lyte 2010). A new hypothesis has recently been advanced by Dr. Mark Lyte that probiotics may function as a drug as a delivery mechanism for neuroactive and bioactive compounds that affect the host.

In light of these changes in our understanding of intestinal microbial ecology based on new molecular and older culture-based methods, a revised vision of the role of Direct fed Microbials and prebiotics in animal agriculture was necessary. With this in mind, an American Dairy Science Association DISCOVER conference was held in 2009 on "Probiotics in Animal Agriculture: Science and Mechanisms of Action". Following discussions with Dr. Gilliland and others at that conference, it was decided that a "state of the art" book needed to be produced for the animal and DFM industries.

The practice of supplementing direct fed microbial and prebiotic additives to domestic animals during growth is becoming more widespread in food animal production. Beneficial effects particularly in cattle, pigs and poultry including improved general health, foodborne pathogen reduction, more efficient food utilization, faster growth rate and increased milk and egg production continue to be reported. The success associated with direct fed microbial and prebiotic applications in multiple species ensures their continued commercialization and widespread use of such additives. However, several fundamental questions remain. It appears that early establishment and retention of an ecological balance in the gastrointestinal tract is an important first step for an external biological additive to be effective in young animals. Therefore, it is possible that the effectiveness of direct fed microbials and prebiotics in some animal species may only be an indirect consequence of speeding up the establishment of the dominant microflora characteristic of the adult gastrointestinal tract. Consequently an understanding of the key processes during establishment of microflora in the gastrointestinal system that lead to the subsequent fermentation characteristics and ecological balance exhibited by the highly protective microflora is needed. Identifying these processes should lead to continued improvement in the effectiveness of available commercial products. Several additional areas of future research directions are also likely needed for further development and implementation of these biologicals.

A critical area that is now becoming possible is the rapid identification *in vivo* of characteristic microbial profiles to confirm successful establishment. Such techniques involve incorporation of molecular fingerprinting of both externally introduced cultures as well as the indigenous gastrointestinal microflora. This may also potentially help to achieve a better understanding of the mechanism(s) required for successful selection and optimization of direct fed microbials and prebiotics. In addition, this will provide insight into environmental factors that may play a role in the ability of direct fed microbials to limit pathogen transmission. Other arenas in which direct fed microbials and prebiotics may be important are in limiting establishment of pathogens in older animals which possess a more mature and developed gut microflora and need removal of pathogens already colonized in animal gastrointestinal tracts. Here success will be dependent on a much more complete picture of gastrointestinal microbial ecology and may include organisms which have been overlooked when typical direct fed microflora have been identified and characterized. In addition, modeling of microbial interactions in the gastrointestinal tract may be important to identify common factors within the complex matrix of the microbial consortium which help to serve as a barrier to prevent pathogens from coexisting with these microorganisms. Continued research on direct fed microbials and prebiotics in general should markedly expand their commercial applications.

## Definitions

In this book, we use an overarching definition for **probiotics** as “a preparation or a product containing viable, defined microorganisms in sufficient numbers, which alter the micro-flora (by implantation or colonization) in a compartment of the host and by that exert beneficial health effects in this host”(Schrezenmeir and De Vrese 2001). **Direct-fed microbials** (DFM) are a category of probiotics that are used in the animal industry in the United States (Fuller 1989; Schrezenmeir and De Vrese 2001). Typically, DFM as a category includes: traditional “probiotics” (live bacterial, fungal or yeast cultures), non-viable bacterial, fungal or yeast cultures, or end-products of bacterial, fungal or yeast fermentations. Some of these products include cultures that utilize a mechanism of action similar to **Competitive Exclusion Cultures**, but are not included in that FDA definition (CVM 1997). **Prebiotics** are defined as non-living compounds that can be degraded by the intestinal microflora, and are often considered a “colonic food”(Collins and Gibson 1999; Crittenden 1999; Schrezenmeir and De Vrese 2001). Many of the yeast products (DFM) used in the animal industry contain endproducts of fermentation that are prebiotics, or prebiotic like, which can explain some of the effects of those products on the microbial population of the intestinal tract.

College Station, TX, USA Todd R. Callaway
Fayetteville, AR, USA Steven C. Ricke

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