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0521616131 - Physiological and Clinical Aspects of Short-Chain Fatty Acids

Edited by John H. Cummings, John L. Rombeau and Takashi Sakata

Frontmatter

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This is the first comprehensive volume to look at the importance of short-chain fatty acids in digestion, the function of the large intestine and their role in human health. Short-chain fatty acids are the major product of bacterial fermentation of dietary carbohydrates in the human and animal large intestine. Through their absorption from the caecum and colon they provide a means whereby energy can be salvaged from carbohydrates not digested in the upper gut. It is now increasingly recognized that they may have a significant role in protecting against large-bowel diseases and in metabolism in other tissues. This volume has been prepared by an international team of contributors who are at the forefront of this area of research. The volume will be an essential source of reference for gastroenterologists, nutritionists and others active in this area.

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# PHYSIOLOGICAL AND CLINICAL ASPECTS OF SHORT-CHAIN FATTY ACIDS

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## Preface

In both the forestomach of ruminants and the hindgut of many animals, including man, short-chain fatty acids are produced from the breakdown of dietary carbohydrates. Thus, many species are able to obtain energy through symbiosis with anaerobic bacteria. The principal substrates that contribute to the production of short-chain fatty acids are the polysaccharides of the plant cell wall, starch, oligosaccharides, some sugars and mucus. Short-chain fatty acids may also be produced from amino acids arising from the degradation of proteins of dietary or endogenous sources. The process of breakdown of these substrates is collectively known as fermentation and the products, apart from short-chain fatty acids, include branched-chain fatty acids from amino acids, lactate, ethanol, hydrogen, methane, carbon dioxide and stimulation of the increase in bacterial biomass.

It has been known for more than 100 years that short-chain fatty acids exist in the gut. In animal nutrition they have been frequently studied, since they are the major energy source, especially for ruminants. Consequently, there is a substantial literature on this subject. Their role in human health, however, is only just emerging. It was not until the 1960s that short-chain fatty acids first became a focus for study in man. The literature on short-chain fatty acids covers many species and we therefore now have considerable knowledge of the bacterial metabolism necessary for the production of short-chain fatty acids, their epithelial transport, cellular metabolism, effects on cell growth and differentiation, and subsequent uptake by liver and muscle. Already, clinical uses for short-chain fatty acids have been suggested and their effects on lipid metabolism, glucose and insulin, the control of cellular proliferation and health of the colonic and other epithelial tissues have been observed. There are likely to be other effects both within and distant from the gut. These findings are of relevance to the cause of large-bowel cancer and management of ulcerative colitis and diversion colitis. It is also evident



that fermentation may provide a route for salvaging energy from undigested carbohydrates in man which could be of vital importance for the nutrition of developing countries.

The term 'short-chain fatty acid', as used throughout the book, and as defined by Oliver Wrong and Michiko Fukushima in the opening chapters, refers to saturated unbranched alkyl monocarboxylic acids of 2–4 carbon atoms. Many of the contributing authors also refer to other organic acids produced during fermentation, including C5 (valerate) and C6 (caproate) in addition to formate, lactate and succinate. Moreover, fatty acid isomers of C4–6 are also recognized products of bacterial fermentation from the branched-chain amino acids, valine, leucine and isoleucine. However, the convention that most authors have adopted in the book is to use the term 'short-chain fatty acid' for acetic, propionic and butyric acids.

Thus, the study of short-chain fatty acids is an emerging field of great importance to human health. The literature is very scattered and research is currently being carried forward by investigators in many disciplines, including veterinary and animal scientists, human physiologists, biochemists, cell biologists and clinicians. It is our intention, therefore, in this book, to draw together into a scholarly, comprehensive and authoritative reference source the literature and current thinking on this subject. We hope that, from it, readers will be able to integrate observational and mechanistic studies, and ultimately develop a fuller understanding of the role of short-chain fatty acids in human and animal health.

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