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Advances in sustainable dairy cattle nutrition

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Book Review

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Some readers will be familiar with the expression 'does exactly what it says on the tin', that tin being a brand of paints sold in the UK and Europe. Can the same be said of this book? As Editor, Alexander Hristov has gathered together some scientifically excellent contributions from a very select group of eminent animal nutrition experts to create an up to date, readable and comprehensive account of dairy cow nutrition. So, where there have been '*Advances*' I am confident they will have been covered. Talking to colleagues, enthusiasm was expressed for the quality of the research covered, and I have little doubt that this book will find a place on many bookshelves. But there are some negatives as well, which need to be clearly stated from the outset. Before doing so, I should mention that throughout my research career I avoided getting too close to nutrition, considering it an oversubscribed research area, and in recent years I have become rather concerned about the often indiscriminate use of the term 'sustainable'. So, whilst I have a great deal of respect for what the publishers (Burleigh Dodds) have achieved in disseminating agricultural knowledge, I do worry that 59 books concerned with 'sustainability' in one way or another (and three specifically with Sustainable Production of Milk) might be excessive, and I approached this volume with that concern in mind. Regrettably, those concerns were vindicated. I described the author list as 'very select' and this is true in two senses, namely expertise (excellent) and geography (disappointing). The book is in four parts dealing with nutritional requirements, plant-extract based dietary supplements, direct-fed microbials/other supplements and co-product based alternative feeds. Three of those sections contain a total of nine chapters, all first-authored from the USA. The exception is part two, focused on plant-based dietary supplements. This section starts with a discussion (from Spain) of effects of essential oils on the rumen and beyond, for which there is considerable *in vitro* evidence that requires to be exploited in practical husbandry. Next, a Swiss contribution considers the potential of tannins to mitigate emmisions of nitrogen and methane, and the palatability problems that such compounds introduce. This concludes with a figure describing the *anticipated* effects of an optimal inclusion, so it is implicit that such an optimum has not yet been identified. The final chapter of this section is from Canada and deals with saponins, comprehensively describing their ability to modify the rumen microbiome and functionality. In its introduction, this chapter also emphasises the desire (amongst consumers? It is not defined) for a move away from chemical and antibiotic feed additives to 'natural' alternatives, again, the implicit belief being that this would benefit sustainability. The European Union went a long way towards enforcing that move twenty years ago, with a ban on the antibiotic growth promoters that are still used in the USA. Scientifically, the contributions made by American authors to this book are excellent, starting (in part one) with discourse on nutritional requirements for carbohydrate, protein and lipid. A sensible place to start in many ways, but I miss any preamble or overview of what is meant by nutritional sustainability for ruminants, which by definition requires some appreciation of the sustainabiltiy of fodder production and the intricacies of rumen metabolism (the rumen figures prominently throughout, of course, but an introductory chapter would have been useful). Moving on to part three (direct-fed microbials and other supplements) was the point at which I seriously began to wonder whether the book's North American focus was itself sustainable. The first of four chapters in this section deals with microbial supplements other than yeast, the argument being (understandably) that yeast supplements have been extensively reviewed over many years. Probiotic supplements and their effects on the rumen and large intestine are catalogued and there is discussion of possible effects beyond the digestive tract (immunity, mastitis, heat stress) but the chapter concludes (rightly) with an honest assessment of limited practical applicability to date, the cost-effectiveness of those products that are available having not been properly evaluated. Attention then moves to exogenous enzymes, from where I quote '*Exogenous enzymes can be a cost-effective way to increase feed efficiency….but results…have been equivocal*'. The chapter describes the possible preingestive and postingestive effects of different classes of fibrolytic enzymes (cellulases, xylanases) as well as amylases and proteases, fungal enzymes and the expansins (which by relaxation of the cell wall can enhance the activity of other enzymes). Again, the conclusion is far from positive and I am convinced by the second part of the quote, but not by the first. I would not regard amino acids as 'supplements', but they are the subject of the next chapter in this section and a convincing argument is made for future dietary formulation models to include amino acid composition so as to enable an overall reduction in the amount of protein fed whilst maintaining output and enhancing health.

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Part three then concludes by switching from input-based discussion to output-based, the output in question being methane. This is a good chapter, out of place. Had this chapter began with the missing description of sustainabiltiy and led on to the pivotal importance attached to mitigating methane emissions it would have provided the much needed introductory first chapter. As it stands, the scientific description of the various mitigation strategies that have been tried is excellent, so please do not overlook it. The book concludes (part four) with two chapters dedicated to the use of by-products, first as alternative fibre sources and then as alternative protein sources. The first of these is written from the perspective of an animal nutritionist, whilst the second deals at some length with the processing mechanics of generating the protein by-product. Both are scientifically commendable within these constraints, and do give brief mention to the 'circular bioeconomy' concept. Neither really do it justice. This underlines the scientific success of the book as an account of ruminant nutrition, and (for me at least) its societal failing as a driver of greater sustainability. I am left to speculate that the USA, a powerhouse of agricultural research, is not yet fully committed to the need.

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