

## Tropical Legumes in Animal Nutrition

Ed J.P.F. D'MELLO and C. DEVENDRA. Published by CAB INTERNATIONAL, Wallingford, Oxon, UK, 1995. 350 pp. Price £55. ISBN 0 85198 926 8.

The major research effort currently directed towards evaluating and extending the role of legumes in the tropics is a natural reflection of the poor animal performance inherent in this region, and the potential of legumes through their high quality attributes to make significant improvements in this productivity. Compilation of a book dedicated to defining the impact of tropical legumes on animal nutrition is overdue. Most major publications in the past have concentrated on agronomic and botanical aspects, which reflects where the major emphasis in research on tropical legumes has been placed, namely in identifying, selecting, breeding and evaluating plants with the capacity to grow, survive, and persist under variable grazing regimes in an often hostile environment. In the editors' own words, the book is aimed at research workers, field officers, undergraduate and postgraduate students. Based on the title of the book these readers should expect a modernistic evaluation, using current nutritional wisdom and principles as detailed in the various feeding standards, on how legumes impact on the nutrition of animals in the tropics, and how this translates to improved animal performance.

Tropical legumes are used in a large and diverse range of situations and for widely varying purposes within the tropical region, and in compiling this volume, the editors have ambitiously attempted to cover this diversity of usage. Consequently, all major groupings of leguminous plants are represented, namely the pasture and browse legumes and legume grains, and these are considered in relation to their contribution to the nutrition of large and small ruminants as well as non-ruminants. The editors have contributed from their own vast experience in the field, (together they contribute to 6 of the 11 chapters), and have recruited other experienced authors to assist in their coverage of the subject matter.

The first chapter by L.R. Humphreys succinctly sets the scene by documenting the enormous genetic diversity within this group of

plants, by providing key examples of the production increases recorded using legumes both as pasture plants and as components of farming systems, and by discussing their adaptation to the widely varying environmental conditions existing throughout the tropics. In his conclusion, however, the author stresses the need to maintain efforts to provide the appropriate technologies to exploit these plants, and to continue to identify new plants, in order to realise their potential to improve animal production and satisfy the other potential uses.

Several chapters are devoted to describing the composition and nutritional attributes of pasture and browse legumes and legume grains, and their impact on the nutrition and productivity of both large and small ruminants. B.W. Norton and D.P. Poppi commence by discussing and reviewing aspects of the composition and nutritive value of pasture legumes, and do so by initially defining the important components that constitute nutritive value, namely feed intake and the efficiency with which nutrients are extracted for absorption during digestion. Furthermore, they stress the poor predictive relationship between chemical composition and nutritive value, since the former provides no information about the composition of absorbed nutrients. While these principles should be considered universally accepted, it is still appropriate that they were introduced early in the discussion. There remains a widespread perception, even in sections of this volume, that the high content of various nutrients (e.g. crude protein) in legumes means that they will significantly improve animal performance. The authors provide an updated inventory of the chemical composition of a wide variety of pasture legume species, often relating it to that of tropical grasses, and offer some predictions as to the likely 'adequacy' of various nutrients in relation to the animal's needs for production. Protein content is discussed in terms of its components, *i.e.* rumen degradable and undegraded dietary protein, as is the approach of current feeding standards, although the relative lack of information on the degradability of protein in tropical legumes is highlighted as a deficiency in

knowledge. Nevertheless, the authors indicate that, in the absence of tannins, it appears that much of the additional protein in legumes compared with grasses is degraded in the rumen and thereby provides little additional by-pass protein. The chapter concludes with some suggestions for future research.

By comparison, the following chapter (Chapter 3) by C. Devendra on the composition and nutritive value of browse legumes is disappointing, and, on reflection, a far more cohesive coverage would have resulted by combining the two chapters to reduce repetition in relation to defining terminology, to standardise the approach and to provide a convenient avenue for comparing the composition and potential nutritive value of the two legume types. Chemical composition is discussed in out-dated terminology, for instance digestible crude protein, and the value of legumes in the nutrition of herbivores is adjudged on the high protein content of the browse plants without apparent cognisance of the importance of the composition of that protein component (see above). This chapter is followed by one (S.K. Arora) describing, sequentially and in some considerable detail, the composition of several prominent legume grains and concludes that this is an under-exploited feed resource for livestock.

The following two chapters provide a detailed and comprehensive account of the anti-nutritional factors in forage legumes (Chapter 5; R. Kumar and J.P.F. D'Mello) and legume seeds (Chapter 6; D'Mello). The diligence of these authors in covering a wide scope of anti-nutritional factors, including tannins, in considerable detail in Chapter 5, as well as cyanogens, saponins, non-protein amino acids, alkaloids and others, and in compiling an extensive bibliography, has provided a most valuable reference source for workers in this field of science.

In Chapter 7 on the intake of tropical legumes, Poppi and Norton take up where they left off in their previous section (Chapter 2) by reviewing the role legumes have in influencing dietary intake, a major determinant of nutritive value. Most significantly, they challenge several common assumptions: firstly, that legumes will always promote increased total intake; and secondly, that they will always lead to an increased supply of protein to the intestines for absorption purely on the basis of their higher nitrogen content than the companion grass. Both

issues have important implications for animal production. The authors also allude to another often-overlooked constraint to increasing intake, that relating to the difficulty of mechanically harvesting the legume material, the more nutritious leaf component.

Chapter 8 by D.B. Coates and Chapter 9 by Devendra review the production of, respectively, large and small ruminants as influenced by tropical legumes. As such, they should represent a logical transition between principles established in the previous chapters relating to nutritive value of this plant resource and their translation into production benefits for ruminant livestock. Chapter 8 covers a wide array of issues, including adaptation of plants to environment, production by both cattle and buffalo in terms of growth, fertility and milk output from pasture and browse legumes, and grazing strategies and recommendations for practical and commercial use of legumes for these larger ruminants. In this respect, the author is to be commended; the reference list alone will prove a useful and up-to-date information source for students. With regards to production responses, the author has compiled an inventory of annual liveweight gains from various legume-inclusive grazing systems, often overlaid with fertiliser and stocking rate treatments, but it is often difficult to assess the response to the legume as no comparative information is provided on the performance of animals from 'unimproved' systems (see Table 8.3), or alternatively, no indication of expected performance from such systems is provided. However, the disappointing aspect is that there has been no attempt to analyse how legumes are contributing nutritionally to this improved animal performance across seasons. There is no indication of the nutrients they are providing which alleviate deficiencies of specific nutrients, for instance low energy intake or deficiencies of rumen degradable or undegraded dietary protein. The author briefly refers to the potentially deleterious effects of high stocking rates in terms of long-term pasture stability and land degradation, one of the few references to this important topic in the book.

The following chapter provides much less detail on the effects on small ruminants, partly in response to the paucity of information available for these species relative to their larger counterparts. Where experimental data have been reviewed, the response has merely been described as a liveweight response without reference to the

extent of same. The author has provided an interesting discussion, based on experimental results, on the extent to which both forage and browse legumes can replace costly concentrate sources without jeopardising production.

The following two chapters, both written by D'Mello, are concerned with non-ruminants and the role of alternative protein (and energy) sources which could potentially reduce the demands for more conventional protein meals, which are both costly and in limited supply in developing countries. Chapter 10 describes the role of leguminous leaf meals in non-ruminant nutrition, in terms of their composition and nutritive value, their effect on animal performance and the constraints limiting their utilisation, primarily their high fibre and low energy content and the presence of anti-nutritional factors, as well as potential processing methods to overcome these constraints. The author concludes that this food source has an important but limited role as a source of nutrients, primarily as a partial dietary replacement for conventional protein meals.

The final chapter is a comprehensive review on what the author describes as the role of under-utilised legume grains in non-ruminant nutrition, and follows a similar structure to the previous section. The major legume seeds are discussed, with particular emphasis on groundnut. Amino acid deficiencies and the presence of toxic and anti-nutritional substances pose the main constraints to their extended use, although methods to ameliorate these constraints are discussed in some detail. An excellent table outlining recommendations for use of these legumes by various non-ruminant species and classes, including processing method, maximum inclusion level and suggested dietary additives, will be most valuable for all working in this area.

Most of the chapters in this book are written in a clear and easily readable style. However, a few

tend to be presented in catalogue style, whereby individual plants, legume seeds or anti-nutritional factors are discussed in great detail sequentially. This reflects the large volume of material reviewed and these chapters will be extremely valuable as reference material. The chapters are presented in a logical, sequential order with good cohesion between adjoining chapters in most cases, and where appropriate. In widening the scope of the book to include both ruminants and non-ruminants, there is the danger that it be seen as too general by those devoted to either field alone. However, the information presented is in sufficient detail for both groups, so that it represents a useful reference for all those working in the field of tropical legumes. Pasture agronomists, in particular, should benefit from exposure to issues presented with a nutritional bias.

This book presented a wonderful opportunity to critically evaluate tropical legumes from a nutritional point of view. In this regard, the book has been successful in challenging some long-held concepts about the role of legumes in increasing nutrient supply to the grazing ruminant, but much remains to be known about which specific nutrients are limiting under different circumstances and the extent to which legumes can meet these requirements. If the book has a shortcoming, it is that this avenue was not adequately pursued, or in the absence of critical information, that it was not highlighted as a deficiency in the knowledge. This understanding is paramount if the full potential of tropical legumes is to be realised, and if new opportunities for their use are to be identified.

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