About the book

The book has been written specifically to cater the needs of undergraduate students of Veterinary Science by providing all the needed information comprehensively as per the VCI regulations, on Applied Animal Nutrition subject at a single source. **"Complete information in a comprehensible way" is the watchword of the book.** The book consists of 15 chapters providing a structured approach to learning by covering all the topics in a uniform, systematic format. ***The topics have been carefully designed to conform to the latest VCI syllabus.***

The book deals with feeding experiments, evaluation of feeds and feeding standards, feeding of ruminants (cattle, buffaloes, sheep and goats), non-ruminants (swine and horse), poultry, rabbits and laboratory animals. The perspectives on utilization of unconventional feeds (chapter 6) and efficiency of feed conversion to animal products (chapter 11) are dealt elaborately.

The book is useful to postgraduate students of Animal Sciences and Veterinary Sciences, teachers and scientists of animal production and health disciplines, personnel of feed industry involved in feed manufacturing and marketing, field veterinarians, animal husbandry extension workers and progressive animal farmers and animal lovers.

About the author

Dr. D. V. Reddy is Professor and Head, Department of Animal Nutrition at Rajiv Gandhi Institute of Veterinary Education and Research, Pondicherry.

Recognizing his contributions towards the advancement of the profession, Dr. Reddy was conferred with 'Fellow Membership diploma (FUWAI)' by United Writers' Association, Chennai in 1998, Fellow of National Academy of Veterinary Sciences (India) (FNAVS) in 2006 and Fellow of the Animal Nutrition Association (FANA) in 2006 and Achievement Award in 2014 by CLFMA of India. His biography was published in "Marquis Who's Who in the World" (14th Edition) first time in 1997 and updated in the latest 31st Edition (2014), "Marquis Who's Who in Asia" (1st Edition)-2007 and "Marquis Who's Who in Science and Technology" (10th Anniversary Edition) 2008-2009 for his intellectual and creative accomplishments.

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APPLIED NUTRITION Livestock, Poultry, Rabbits and Laboratory Animals

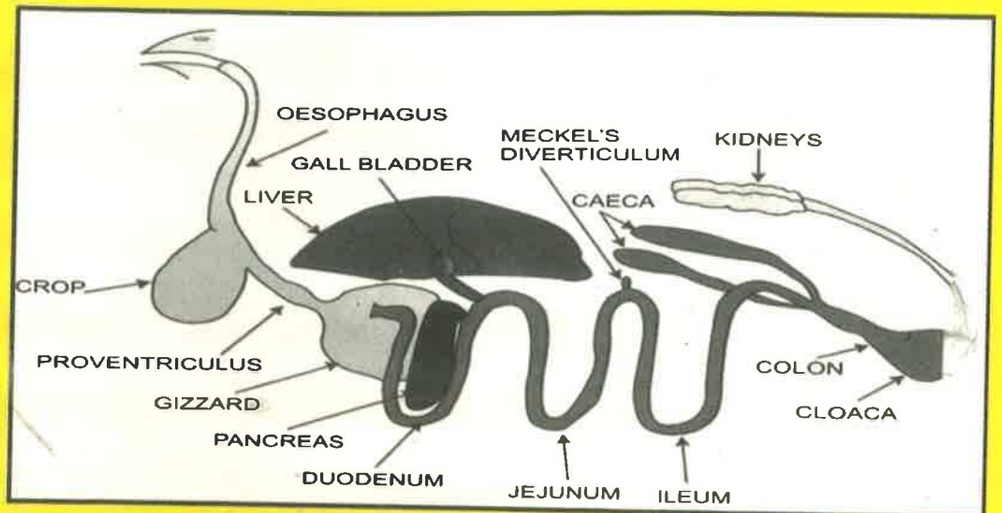
D.V. REDDY

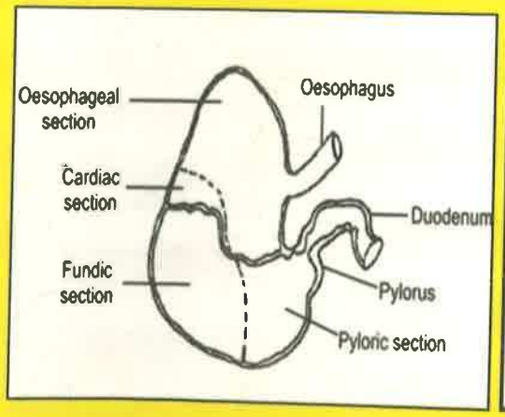
OXFORD & IBH

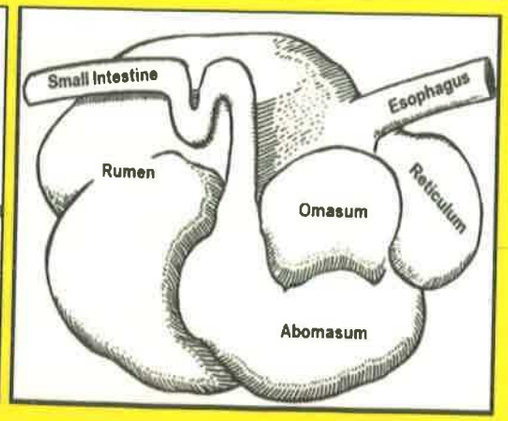
Third Edition

APPLIED NUTRITION

Livestock, Poultry, Rabbits and Laboratory Animals







D.V. REDDY

Third Edition

Applied Nutrition

Livestock, Poultry, Rabbits and Laboratory Animals

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Preface to the Third Edition

The third edition consists of 15 chapters. With the publication of textbook ***Applied Nutrition: Cats Dogs Wild animals & Birds*** in 2014, chapters on Cat and Dog nutrition, therapeutic diets, and preservation of foods are omitted in this edition. This edition updates the requirements of cattle, buffaloes, sheep, goats, poultry, pigs, horses and rabbits based on recent research and a need to consider higher levels of productivity by larger and improved genotypes. BIS specifications, ICAR (2013) requirements and NRC requirements have been updated.

New information has been added in several chapters for quick grasp, comprehension and to make the textbook reader-friendly. Text is enriched with flow charts and illustrations. These include conduct of metabolism trial and example on calculation of digestibility, illustrations of ruminant stomach, gastrointestinal tract of horse, equine stomach and avian digestive tract and flow charts depicting the occurrences in the rumen. All these efforts have been made to meet the objective: "Complete information in a comprehensible way".

No one person can write a book on Applied Animal Nutrition (dealing with feeding of domestic ruminants, poultry, pigs, horses, rabbits and laboratory animals) and claim both expertise and original thoughts in all the areas. The same applies to me. When and where possible, I have provided pertinent references. During my 33 years of service as a teacher / researcher / extension worker at various institutions and at various levels to deliver to diversified audience, I have developed the habit of making notes while reading or attending professional meetings. Indeed even as a UG student my evenings are spent in library on week days. This habit of documentation as a way of life helped me to author the book.

I am indebted to my students: to my undergraduates who have shared in my experiments with nutrition syllabuses and my postgraduates who

motivated me to deliver on contemporary thoughts on the subject. For the same reasons I am indebted to my colleague teachers / researchers / extension workers in several institutions spread over the Indian Union. I give my heartfelt thanks. I thank my colleague teachers in the department Dr. C.M.Tiwari and Dr.D.Uma Maheswari for their feedback.

I extend my sincere appreciation to Dr.N.Elanchezhian (a colleague in the department) for the balanced diet charts in the chapter on Poultry Nutrition (including those in the Appendix) and Dr.R.Ganesan (Dept of AGB) for updates on experimental designs in the chapter 1. I am thankful to the publishers for meticulous planning and publication of the book. Above all, I thank God for His guidance and inspiration.

December 2014

Duvvuru Venka Reddy

Preface to the Second Edition

Response to Feedback Request and Action Taken

Response to my request letters for feedback by post as well as by email had been quite substantial and satisfying, from all Veterinary Colleges and majority Animal and Veterinary Research Institutes of India. I am extremely grateful to all those of my colleagues and students who have offered numerous helpful suggestions. Accordingly, Horse Nutrition has been added (chapter 10), Rabbit Nutrition (chapter 16) has been thoroughly revised, and new useful information has been provided in Appendix II and in several chapters in an effort to make a more complete text on Applied Nutrition. I take this opportunity to express my gratitude to the publishers for meticulous planning and intelligent publishing of the books.

June 2009

Duvvuru Venka Reddy

Preface to the First Edition

There are several textbooks on Animal Nutrition and Feeding written by eminent teachers and scientists. But no single textbook caters the needs of undergraduate students of Veterinary Science by providing all the needed information comprehensively on Animal Nutrition subject at a single source. As per the Veterinary Council of India (Minimum Standards of Veterinary Education Degree Course-BVSC & AH) Regulations, 1993, Animal Nutrition courses encompass principles of animal nutrition, evaluation of feedstuffs and feed technology and Applied nutrition covering feeding of livestock, poultry, human beings, pet, rabbit and laboratory animals. The examination system comprises an internal assessment (50%) at the end of each semester and an external assessment (50%) conducted by an annual board appointed by the university at the end of the academic year. The new syllabus and the examination system make the student and the teacher as well, to run to different sources for procuring the needed information for each of the four Animal nutrition courses (ANN 211, ANN 212, ANN 221 and ANN 222). Being in the teaching line since 1981 and specifically teaching Animal Nutrition as per the new syllabus since its introduction from 1995, I have prepared the manuscript. It will be published as two books: 1. Principles of Animal Nutrition and Feed Technology and 2. Applied Nutrition (Livestock, Poultry, Human, Pet, Rabbit and Laboratory Animal Nutrition).

Each textbook consists of two sections (Part I & II) and thus the four sections correspond to the four courses. Each section provides a structured approach to learning by covering all the topics in a uniform, systematic format. This (section – or) course-wise topic-led organization is a distinct advantage of these books since they meet the needs of the students for each course of Animal Nutrition Semester-wise. Some of the topics have been detailed beyond the syllabus level to enlarge the knowledge of the readers because of their importance in applied feeding practice, for example feed

additives. These books are designed to give students rapid, easy access to all the material in a course wise format which benefits them prepare for the internal examinations and external examinations economically and ensure exploit their potential to a greater extent. The topics are detailed in a straightforward and hopefully lucid manner. "Complete information in a comprehensible way" is the watchword of the books.

A list of suggested reference books are given at the end of the textbooks. Scientific names of food and fodder crops, popular varieties of fodder crops, metabolic body size figures for body weights, very useful conversion factors and others are furnished in the appendix.

These textbooks are also useful to teachers and scientists of department of Animal Nutrition, personnel of feed industry involved in feed manufacturing and marketing, postgraduate students of Animal Sciences i.e. Animal Nutrition, Avian Production and Management, Livestock Production and Management and Animal Husbandry Extension. Further, they are useful to field veterinarians, extension workers of departments of Animal Husbandry and Dairying and Rural Development, Progressive Animal farmers and Animal lovers. I take this occasion to express my gratefulness to Dr. K.V.S. Reddy, a modesty personified, for providing moral support from time to time. I appreciate the contribution of my wife, Prasuna and children, Amar and Vamsee for providing me cheerful environment and allowing me to spend many hours with drafts of manuscripts rather than with them. Above all I thank God for His guidance and inspiration.

February 2001 **Duvvuru Venka Reddy**

Suggested Reference Books

1. **Animal Nutrition**
   by L.A. Maynard, J.K. Loosli, H.F. Hintz and R.G. Warner, 7th edition, 1979.
2. **Animal Nutrition**
   by P. McDonald, R.A. EDWARDS AND J.F.D. GREENHALGH, 5th edition, 1995.
3. **Feeds and Principles of Animal Nutrition**
   (Revised edition of Animal Nutrition) by G.C. Banerjee, 1st edition, 1988. Reprint 1998, 1999.
4. **Vitamins in Animal Nutrition** (Comparative Aspects to Human Nutrition) by L.R. McDowell, 1st edition, 1989.
5. **Minerals in Animal and Human Nutrition**
   by L.R. McDowell, 1st edition, 1992.
6. **Animal Nutrition**
   by J.W. Lassiter and H.M. Edwards, Jr. 1st edition, 1982.
7. **Trace Elements in Human and Animal Nutrition**
   by E.J. Underwood, 4th edition 1977, 5th edition by Walter Mertz, 1987.
8. **The Mineral Nutrition of Livestock**
   by E.J. Underwood and N.F. Suttle, 3rd edition, 1999.
9. **The Rumen and its Microbes**
   by R.E. Hungate, Ist edition, 1966.
10. **Advanced Animal Nutrition for Developing Countries**
    edited by U.B. Singh, 1st edition, 1987.

11. **Advances in Dairy Animal Production**
    by V.D. Mudgal , K.K. Singhal and D.D. Sharma, 1st edition, 1995. 2nd edition 2003
12. **Commercial Poultry Nutrition**
    by S. Leeson and J.D. Summers, 1st Indian reprint, 1993.
13. **Applied Animal Nutrition**
    by E.W. Crampton and L.E. Harris, 2nd edition, 1968.
14. **Livestock Feeding**
    by S.N. Ray; 1st edition, 1978.
15. **Animal Nutrition in the Tropics**
    by S.K. Ranjhan, 4th edition, 1997.
16. **Agroindustrial Byproducts and Nonconventional Feeds for Livestock Feeding**
    by S.K. Ranjhan, 1st edition, 1990.
17. **Chemical Composition and Nutritive Value of Indian Feeds and Feeding of Farm Animals**
    by S.K. Ranjhan, 1st edition, 1991.
18. **Nutritive Value of Indian Cattle Feeds and Feeding of Animals**
    by K.C. Sen, S.N. Ray and S.K. Ranjhan, 6th edition, 1978.
19. **Textbook of Feed Processing Technology**
    by N.N. Pathak, 1st edition, 1997.
20. **Nutrient Requirements of Livestock and Poultry**
    by S.K. Ranjhan, 2nd revised edition, 1998.
21. **Feeding of Poultry**
    by B. Panda, V.R. Reddy, V.R. Sadagopan and A.K. Shrivastav, 1st edition, 1984.
22. **Dictionary of Animal Nutrition and Feed Technology**
    by K.K. Singhal, 1st edition, 1992.
23. **Clinical Nutrition of the Dog and Cat**
    by J.W. Simpson, R.S. Anderson and P.J. Markwell, 1st edition, 1993.
24. **The Waltham Book of Clinical Nutrition of the Dog and Cat**
    by J.M. Wills and K.W. Simpson, 1st edition, 1994.
25. **Nutritive Value of Indian Foods**
    by National Institute of Nutrition, Indian Council of Medical Research, 1989.

26. **Nonconventional Feed Resources and Fibrous Agricultural Residues - Strategies For Expanded Utilization**
Proceedings of a Consultation held in Hisar, India, 21-29 March 1988, Edited by C. Devendra, IDRC and ICAR.

27. **AFRC (1993) Energy and Protein Requirements of Ruminants**
An advisory manual prepared by the AFRC Technical Committee on Responses to Nutrients. CAB International, Wallingford, U.K.

28. **Small Ruminant Production in India By the year 2000 - Strategies for development**
Proceedings of the National Seminar held in Tirupati (AP), India, 13-17 November 1990, Edited by G.V. Raghavan, M.R. Reddy and N. Krishna, APAU, ICAR and IDRC.

29. **Small Ruminant Production and Post-Production Systems - Current Status and Development**
Proceedings of the workshop held at CLRI, Chennai, India, 4-6 December 1996, Edited by N. Krishna, A. Subbarama Naidu and D. Chandramouli, CLRI, ANGRAU, IDRC.

30. **Principles of Animal Nutrition and Feed Technology 2nd edition 2010** (ISBN 978-81-204-1752-6, xx plus 431 pages) by D.V. Reddy.

31. **Advanced Animal Nutrition 2011** (ISBN 978-81-204-1756-4, x plus 507 pages) by D.V. Reddy.

32. **Applied Nutrition: Cats, Dogs, Wild Animals and Birds 2014** (ISBN 978-81-204-1774-8, xv plus 285 pages) by D.V. Reddy.

33. **Fodder Production and Grassland Management 2nd edition 2014** (ISBN 978-81-204-1772-4, 200 pages) by D.V. Reddy.

Contents

Applied Nutrition I
(Ruminants)

Applied Nutrition II
(Non-ruminants, Poultry, Rabbits and Laboratory Animals)

Vitamin C	Citrus fruits: orange (kamala), mosambi (sathkudi); cabbage-type vegetables, dark green vegetables, tomatoes, potatoes with skin, fruits: papayas, guava, mango
Calcium	Milk and milk products, small fish with bones, legumes, tofu (soybean curd), broccoli, cauliflower.
Phosphorus	All animal tissues: meat, fish, poultry, eggs, milk; plant protein supplements, cereal brans
Magnesium	Nuts, legumes, whole grains, dark green vegetables, carrots, seafood, chocolate, cocoa
Sodium and chloride	Table salt, soy sauce, moderate amounts in meats, milk, vegetables; large amounts in many processed foods
Potassium	All whole foods; meats, milks, fruits: banana, vegetables, grains, legumes
Sulphur	All protein-containing foods: meats, fish, eggs, milk, legumes, nuts
Iodine	Indized salt, seafood
Iron	Red meats, fish, poultry, shellfish, eggs, legumes, dried fruits
Zinc	Protein-containing foods: meats, fish, whole grains, pulses, vegetables; oysters, crab meat
Copper	Meats, drinking water
Fluoride	Seafood, drinking water
Selenium	Seafood, meat, grains
Chromium	Meats, unrefined foods, fats, vegetables oils
Cobalt	Foods of animal origin: meats, milk and milk products
Molybdenum	Legumes, cereals, organ meats
Manganese	Widespread in foods

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