



Editorial news and events

Book review

Equine nutrition - INRA Nutrient Requirements, Recommended Allowances and Feed Tables

edited by William Martin-Rosset; Wageningen Academic Publishers, Wageningen, the Netherlands, 2015, Hardcover, 691 p., Price: 94 €; 139 US\$; Hardback ISBN: 978 90 8686-237-5; EAN: 9789086862375

The number of horses and other equines is growing more and more in some countries. Many of these animals are kept individually, on small equine farms or in zoological gardens. The adequate feeding of these equines is an important prerequisite for their health, longevity and required performance in reproduction, work, tourism and sport.

Intense research dealing with feed evaluation and feeding of working horses was carried out during the last two centuries in France, but also in other countries. In the very early 1970s, the National Institute of Agricultural Research (INRA) in France initiated a long-term research programme in equine nutrition. Research was conducted on digestion using digestibility trials and fistulated horses. Further research focused on the metabolism of equines. Many studies were done in the fields of feed science and equine feeding.

Based on these studies and on an extended review of the international literature published between the late 19th and the early 21st century, William Martin-Rosset formed a team to summarize all this knowledge and to publish the INRA nutrient requirements, recommended allowances and feed tables as 'Equine nutrition'. The book was published in 2012 in French and now translated into English. It includes the 6th revised edition of the NRC (2007) and new nutritional systems developed in Germany.

The last recommendations on the energy and nutrient requirements of horses by the Society of Nutrient Physiology (Germany, 2014) were published after publication of the present book and therefore could not be considered by the authors.

William Martin-Rosset works as the head of the Equine Nutrition Department at the INRA (National Institute for Agricultural Research in the Research Centre of Clermont-Ferrand, France). He studied agriculture and biology, is head of the Equine Nutrition Unit and president of the Equine Commission at INRA. Furthermore, he is the chairman of the Committee on Feeding Standards in France. Since 1979, he has been a member of the Horse Commission at the European Association of Animal Production (EAAP), later he was chairman of the nutrition working group and president of the Horse Commission of the EAAP. W. Martin-Rosset is author and co-author of numerous scientific papers in the field of equine nutrition (see Chapter 'Further reading' in this book). He is editor of the *Journal for Equine Nutrition*, and serves as a board member and reviewer for the main international journals in this field.

The editor asked 28 colleagues, mainly from INRA-Institutes, but also from French universities and other research institutions, to support him in writing this new INRA edition of nutrient requirements. The editor of the book is the first author of 10 chapters, and co-author of five further chapters of the book. The lists of contributors and the institutes are given at the beginning of the book.

After the table of contents, the editor introduced the topic of the book with a Preface (4 pp.). The work is structured in 16 chapters. All contributions follow a similar format: introduction, main topics, conclusions and references.

Chapter 1 (74 pp.) deals with 'Nutritional principles of horses'. Based on the energy and protein

expenditures and requirements, the authors explain feed intake and digestion and principles of energy, protein, mineral and vitamin nutrition. Finally, major health problems of horses are mentioned.

'Diet formulation' is the title of Chapter 2 (24 pp.). The authors describe the principles of diet formulation, beginning with choosing of feeds and calculating the amounts of feeds to be offered to the animals to provide all the nutrients they require depending on maintenance and production (growth, milk, work including sports) of various breeds. All calculations were done on the basis of INRA-data, but also NRC (USA) and Canadian requirements for horses are considered.

In Chapter 3 the authors deal with the keeping and feeding of 'The mare' (36 pp.). They describe the annual reproduction cycle, the nutrient requirements for maintenance, pregnancy, lactation and recommend allowances for all stages of the reproductive cycle. The second part of this chapter gives recommendations for practical feeding depending on the body weight of the mares (450–800 kg). This chapter also contains annual management cycles of racing breed mares, competitive sport mares and other types of activities.

Chapter 4 deals with 'The stallion' (12 pp.). More than 6000 stallions are used for reproduction in France. Characteristics of the reproduction cycle, nutritional requirements and recommended nutrient allowances during the stallions' annual breeding cycle, practical feeding and prevention of nutritional problems are the main topics in this chapter.

'The growing horse' is the title of Chapter 5 (48 pp.). The growth period of horses lasts from 3 to 5 years. This period represents a large management and financial investment and influences performance and longevity. During this 'risk' period, nutritional requirements and balances must be met to guarantee an optimal development of the growing horse. Growth and development, nutritional requirements, recommended allowances and practical feeding are the main section of Chapter 5. Special attention is paid to the feeding of foal before and after weaning.

Chapter 6 is headlined 'The exercising horse' (57 pp.). The authors estimate the number of working horses to be between about 120 000 to 150 000 animals in France. About 15% are racing on race tracks, 85% are used for sports and leisure, and a low percentage is devoted to agriculture work and mainly forestry. The authors describe in the first section the physiological and metabolic consequences of exercise followed by the nutritional expenditures of different exercises and the recommended allowances. Kinetics of allowances for exercise, other

particular situations and particular nutritional supplements for exercising horses are described in the last paragraphs. The supplements are divided into so-called ergogenic aids (non-essential additives such as L-carnitine, creatine, ubiquinone (or Q10), carnosine, sodium bicarbonate, ribose), antioxidants, vitamins and other supplements. Such substances are considered as 'supplementary feeding stuffs' and the authors discuss their eventual effects in relation to energy and nitrogen metabolism. In most cases there is no evidence that the additives have shown additional effects on the performance of horses. Finally, the authors added a short section entitled 'Feed contaminants and doping', dealing with completely different issues. The authors make proposals for better analysis of contaminants and clear rules for prohibited substances.

The short Chapter 7 (11 pp.) deals with 'Fattening horse for meat'. Horse meat is consumed in several European countries, in France 0.3 kg per inhabitant (18 000 t) and year. The authors describe different production systems, nutrient requirements and allowances, ration formulation and practical feeding of horses for meat production.

'Ponies, donkeys and other cases of interest' is the title of Chapter 8 (17 pp.). Requirements, allowances (depending on body weight, work, physiological stage and other physiological stadiums) and husbandry conditions (outside, critical temperatures, etc.) are given.

The title of Chapter 9 is 'Feeds, additives and contaminations' (32 pp.). The authors distinguish between feeds in roughages (forages (fresh and conserved), roots, tubers and their by-products, crop by-products), concentrate feeds (cereal grains, grain by-products, legume seeds, oilseed by-products, industrial protein sources, fruit and fruit by-products and by-products of animal origin), as well as compound feeds. The processing of feed materials and compound feeds as well as dietetic feeds and nutritional supplements are the next subheadings. Finally the authors deal with feed additives such as technological additives and substances influencing the health and performance of horses (e.g., enzymes, probiotics, yeasts, prebiotics, organic minerals, glucosamine, fatty acids, antioxidants, ergogenic aids, growth factors, herbal preparations). They also address feed contamination from doping substances and plant poisoning, and feed-related poisoning, such as plant toxins, mycotoxins and bacterial toxins. All substances are discussed briefly, and in some cases repeated to Chapter 6.

'Pasture' (37 pp.) is the headline of Chapter 10. For the horse as herbivore, pasture grass is an essen-

tial part of the diet for between six and ten months of the year. The authors describe the management of prairie ecosystems used for pasture, the use of grass by horses, feeding systems which include pasture grasses, and parasitism associated with eating grass. The chapter also included recommendations for pasture management.

Chapter 11 deals with the 'Harvest and pre-secretion of forages' (20 pp.). The horse is fed with stored forage for a long part of the year. Conserved forages cover between 25 and 85% of the energy requirements and 20 to 95% of protein requirements. Various techniques and technologies to produce hay, silage and wrapped round bales as well as problems of harvesting and preservation of forages are described. Finally the authors analyse the effects of harvesting and storage on the chemical composition and feeding value of forages.

'Nutritive value of feeds' is the title of Chapter 12 (50 pp.). This chapter is based on the INRA system. Much attention is paid to the energy and protein values of feeds including chemical composition, digestibility of nutrients, the net energy value of feeds (the UFC-system; 'Unité Fourragère Cheval' or the 'Horse feed unit', demonstrated in many examples) and the protein value of feeds (the MADC system; *Matières Azotées Digestibles Cheval* or the *Horse digestible crude protein*). Minerals, vitamins and feed intake are further sections in this chapter.

'Formulating a ration' is the title of Chapter 13 (25 pp.). The authors describe a graphic and an informational method to formulate the composition of a diet and the amount of feed to meet the energy and protein allowances of horses. Calculations are shown after an explanation of both methods. Some attention is paid to the calculation of mineral and vitamin supplementation. Finally, formulas for ration calculations are mentioned.

Chapter 14 shows the 'Environmental impact of horses' (23 pp.). The objective of this chapter is to discuss both the impact of horses on biodiversity and how to monitor it, as well as managing emissions from horses. The first part deals with the impact of pasturing horse on plant and animal biodiversity of pastured environments. Data on the impact of horse grazing on the biological diversity of grasslands are still limited. A variable mode of grazing promotes the coexistence of a large number of plant and animal species in the ground cover. Available studies are often too short to evaluate the long term impact of equine grazing (see also Chapter 10).

The second part of Chapter 14 deals with all excretions by horses (gases, urine and manure). The methane emissions of horses are much lower than those of ruminants. The authors calculated an average methane emission of 20.7 kg per horse and year (for lactating mares: 29.7 kg per year). The total enteric methane emissions from equids in relation to all farm animals in France accounts for 1.5% compared to 90% for ruminants. Furthermore, the authors analyse the nitrogen and mineral excretion of horses and their environmental consequences. Alternatives to use manure for mushroom growing, composting or energy production are discussed.

'Behaviour and behavioural management during rearing and stabling' is the title of Chapter 15 (8 pp.). Observed behaviours are described and explanations for such behaviour are given in this short chapter. Practical recommendations are given to optimise the behavioural management of adult as well as young horses.

The last chapter (16; 55 pp.) shows tables of chemical and nutrient composition of 169 roughages and 71 concentrates. The data were derived from digestion trials on horses and measurements of voluntary feed intake for most of the forages. The authors describe the construction of the tables and explain the use. Tables of feedstuffs contain information about dry matter, net energy (UFC) and protein content (MADC), all energy levels, organic matter, crude protein, lysine, four fibre fractions, ether extract, starch and for three minerals (P, Ca and Mg). Some trace elements and vitamins of feeds are given in additional tables.

The book contains a list of abbreviations, acronyms and units (4 pp.), a glossary (11 pp.), a section entitled 'Further reading' (97 pp.) and an Index (13 pp.) to find all terms used in the book.

The authors implement a new concept of scientific exchange in the large 'Further reading' section. Research in equine nutrition at INRA has a long history. Results of this research have already been published in scientific journals. All of these references are classified in three categories: 1. Books, synthesis and proceedings (4 pp.), 2. Fundamental knowledge (energy, protein, minerals, vitamins, water and watering, intake, feeds and feed processing, feed analysis, digestion, evaluation, prediction, feed additives, dietetic feeds, nutritional supplements; 30 pp.) and 3. Applied knowledge of horse nutrition (pasture, grazing, behaviour, mare and foal, stallion, growing horse, fattening horse, exercising horse, pony, donkey, aged horse, health, environments, regulations; 48 pp.).

The authors try to connect various chapters in order to avoid repetitions. They combine theoretical deductions with practical recommendations for horse feeding. Feed science and feeding of horses are very important parts of the book. The book is an excellent example to combine new scientific knowledge with practical horse feeding. It gives insight in updated feed evaluation systems in equines, based on net energy, amino acids, minor nutrients, feed intake and nutrient requirements for all categories of equine. Tables of recommendations are provided for all nutrients and all species and categories of equines on the base of long term feeding trials.

This book is recommended as an excellent source on equine nutrition for scientists, teachers and their students in animal and veterinary science, advisers, professionals and all those working with or interested in equines.

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