Preface

In modern-day nutrition research, there is a distinct division between the nutrition of humans and animals. Even within animal nutrition, there are clear demarcations between those involved in nutrition research for pigs, poultry, ruminants, fish, and companion animals (dogs, cats, and horses). This discrimination between species may seem logical from a practical point of view as there are distinct physiological and biochemical differences between humans and terrestrial animals, as well as between animals. However, there are far more aspects of nutrition which all species have in common. In academia, research, and even industry, animal and human nutrition appear as two separate worlds, each with its own scientific approaches and foci. Human and animal nutrition departments exist side by side in many organizations (e.g., universities, companies), more often than not, living within their own world with cooperation between these departments being, unfortunately, rather the exception than the norm. Over recent years, the concept of OneHealth has been (re)introduced. Within this concept, a multiple-discipline approach is taken to provide the best health for people, animals, and our environment.

A recent example of a OneNutrition approach can be found in the area of protein quality evaluation of human foods. Whereas in the past the protein digestibility corrected amino acid score (PDCAAS) system was used for the evaluation of protein quality of human foods, the recent FAO approach has been to capitalize on the decades of methodology development in pig nutrition (ileal digestibility) and adopt the digestible indispensable amino acids score (DIAAS) system. Where the previous PDCAAS values were hindered by (often major) inaccuracies from a correction by rat fecal nitrogen digestibility values, the new DIAAS system utilizes state-of-the-art standardized ileal digestibility values of individual amino acids of an animal species more similar in digestive physiology to humans. Although ultimately such measurements should be conducted on the species of interest, in this case humans, until more accurate methodologies are developed, a OneNutrition approach will provide more accurate data.

The OneNutrition concept also provides an excellent approach in our understanding of the nutrition of individual species. Differences (and similarities) in anatomy and digestive physiology as well as specializations (or adaptations) of species in their metabolism of nutrients as a result of diet-induced evolutionary adaptations, can provide insights into species-specific nutrition. For example, the spatial localization of alanine:glyoxylate aminotransferase 1 (AGT1), responsible for the removal of glyoxylate which is involved in hyperoxaluria, seems to be species dependent. In carnivores and insectivores, AGT1 is mainly present in mitochondria of liver cells, while in humans, Old World monkeys (macaques, baboons), rabbits, and guinea-pigs, AGT1 is almost exclusively located in the peroxisome. The mitochondrial localization of AGT1 is seen in carnivorous and insectivorous species of different genera (mammals, birds, reptiles), indicating

that AGT1 localization in the mitochondrion might be required when consuming high-protein, low-carbohydrate diets. In rodents (rats, mice, hamsters) and marmosets (New World monkey), AGT1 is distributed approximately equally between both organelles. These species differences in intracellular localization of hepatic AGT1 provide clear indications of dietary selection pressure during evolution and hence guidance to the nutrition of individual species.

An area in which there appears to be little overlap between human and animal nutrition, research is in the application of enzymes. The use of enzymes in human food production dates back to 6000 BC or earlier, first as a product of microbial fermentation, for example in the production of beer, wine, cheese, and yogurt. For decades, industrially produced, more or less pure, enzymes have been used in the production of bread and lactose-free milk, to mention a few, to improve quality (bread) or make nutritious milk accessible to lactose-intolerant people. Most enzymes used in human nutrition are, however, used during food production/processing. Very few enzymes are used as such, meaning they are consumed (as a small pill or a few drops) to act within the gastrointestinal tract where they should degrade specific unwanted factors. Current examples are enzymes to degrade lactose and gluten for lactose- and gluten-intolerant people, respectively.

In contrast, apart from enzymes produced during fermentation processes as in the production of silage, enzyme application in animal feeds is only a relatively recent phenomenon. In the 1980s, the first enzyme products gaining commercial importance entered the feed market. These first enzymes mainly degraded fiber; xylanase and β-glucanase. In 1991, the first commercial viable phytase entered the feed market, which rapidly changed the entire landscape. Nowadays, most poultry and pigs feeds contain specific enzyme products. They are active in the stomach and intestines and degrade antinutritional factors or improve the nutritional value of the feed for the animal.

Obviously, the OneNutrition approach can also be applied to enzymes. Unwanted (antinutritional) factors in animal feeds are very likely also unwanted in the diet of humans, and vice versa. What are such common unwanted factors? Which compounds can be broken down to improve the nutritional value for animals and could also improve the nutritional value for humans? This could be either by degradation of unwanted factors (similar to lactose and gluten), or by increasing the digestibility and availability of (relatively) scarce nutrients. Examples are increasing the availability of some amino acids for athletes, sick, or elderly people, and of specific minerals in populations of people with deficiencies. Improving the nutritional value of foods in general is a clear objective for feeding undernourished people. And, vice versa, can enzymes that are presently used in food production be applied to improve the nutritional value of animal feeds?

This book reintroduces the once (pre-1970) common approach to nutrition, that of OneNutrition by posing these questions and thoughts. The editors, Prof. Dr. Carlos Simões Nunes and Assistant Professor Dr. Vikas Kumar, realized that enzymes are important in both animal and human nutrition and that by bringing our current knowledge in these, hitherto, two separate areas into one book, the

reader is able to develop new insights for applications of enzymes in foods and feeds. The authors of the various chapters have a wealth of knowledge in various aspects of enzymes for feed and food. After chapters dealing with more general aspects of enzymes, phytase is discussed in detail. The direct application of phytase has been extensively investigated in pigs and poultry, but has also been investigated for use in humans. Although for humans the improved digestibility of phosphorus may be less important than for animals, its effect on micro-minerals such as iron and zinc may be of great importance for many people.

In 10 chapters, depolimarizating enzymes are discussed, both from a food and feed perspective. The multitude of applications of such enzymes is amazing, and we are only at the beginning of our understanding of how these can be used more effectively. Increased understanding of vegetable cell wall composition and morphology, and of their effect within the gastrointestinal tract will ultimately result in the development of more specific enzymes to break down or modify these complex structures. In combination with currently used enzymes such as xylanases and cellulases, they will not only enable the more complete use of potential food/feed energy, but also induce specific effects on the gut wall and the gut microflora, resulting in improved gut health (for both humans and animals). Lately, the importance of the microbiota in human diseases such as obesity has been described. The production of prebiotics by a specific (combination of) enzyme(s) may promote a favorable microbial balance, and thus promote health.

In the third part of the book a number of different enzymes and some direct microbials are discussed. I was especially triggered by the chapter on chitinases. Given the future predicted protein shortage and our focus on the use of insects in feed and food, this enzyme may prove to be of great importance. Protein digestibility of many insects is limited because of the presence of chitin, but may be greatly improved by effective application of chitinases.

The final area of focus of the book deals with important technological issues related to enzyme use and production: formulation and analysis, the continued discussion of regulatory aspects, and the overall questions regarding economy. The final chapter of the book contains a great review regarding the potential of enzymes for both humans and animals, discusses general perspectives, and provides conclusions.

The editors should be complemented on bringing together many experts in the field of enzyme use in feeds and foods and achieving the OneNutrition approach in the use of enzymes in nutrition. We have to look into each other's kitchens and silos more often! This book allows the reader to look into those silos and kitchens, and be able to develop new insights and understanding of the application of enzymes in food and feed.

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