



Animal Nutrition

Organized by

Mediterranean Agronomic Institute of Zaragoza

Animal Nutrition

Jointly organized by: **CIHEAM-IAMZ, University of Zaragoza (UZ) and Spanish Foundation for the Development of Animal Nutrition (FEDNA)**

Scientific coordinators: **Prof. Dr. José Antonio Guada, Prof. Dr. Gerardo Caja**
IAMZ coordinator: **Dr. Armando Occón**

The Master on Animal Nutrition provides a two-year programme for graduates who wish to specialize in the subject, and professionals interested in updating their knowledge.

In the first year participants follow the Postgraduate Specialization Course. Formal lectures are complemented by laboratory practicals, computer practicals, technical visits, tutored personal work and a professional training stage.

In the second year, students who have successfully completed the first year develop an individual work of initiation to research or to professional activity on a chosen topic of the specialization, leading to a Master of Science Degree.

The programme is held every two years. Next edition starts in October 2009.

Participants must hold a university degree in agronomy, veterinary sciences, animal sciences, biology or any related field. Knowledge of biology, physiology and statistics is required.

The working languages are English, French and Spanish. Lecturers may teach in any of the three languages. Simultaneous translation into Spanish is provided when lecturers speak English or French, therefore participants should prove knowledge of Spanish at the start of the course. From the beginning of July to the end of September IAMZ organizes an intensive course of Spanish for those who require it. Participants can answer the exams in Spanish, French or English. In the selection of candidates, knowledge of English and French is valued, as part of the documentation distributed may be written in either of these languages.

This Master is also an official Master of the Spanish University system.

Objectives

The objective of the first part of the Master programme (Postgraduate Specialisation Course) is to enable participants to: (i) update the scientific bases and fundamental mechanisms of animal feeding and nutrition; (ii) gain experience in the application of the most advanced methods and techniques and in the formulation of specific feeding strategies of the main species of interest in animal husbandry; (iii) be capable of planning, developing and managing nutrition programmes aimed at obtaining safe and high-quality feed; and (iv) exchange experiences and points of view, enhanced through a programme developed in a highly international and interprofessional context.

Through the work carried out in the second part of the programme (Master Thesis), participants complete their training by making a critical application of the knowledge, methods and techniques acquired during the first year of specialization and develop their competence in: (i) analysis of problems; (ii) definition of objectives; (iii) acquisition and treatment of data in compliance to a pre-established research protocol; (iv) analysis of results; and (v) elaboration of conclusions that may contribute to clarify and find a possible solution to problems.

Part 1

Postgraduate specialisation course

Training is organized in 7 sections (60 ECTS)

Section/unit 1 **PRINCIPLES OF ANIMAL NUTRITION**

This section provides the scientific foundations of animal nutrition and feeding. Chemical composition and physical properties of feed components are first reviewed. The digestion process and the metabolism of nutrients are then dealt with, followed by the study of feed evaluation methodologies. Finally, nutrient requirements and feed intake are treated, considering their control mechanisms and estimation methodologies. Learning outcomes are: (i) to update the scientific foundations and fundamental mechanisms of feed digestion and nutrient metabolism; (ii) to know the factors determining feeding quality and to gain experience in the evaluation of energy and protein conversion; (iii) to be able to estimate nutrient requirements and nutrient balances in different growth and production stages; and (iv) to apply the adequate methodology to estimate feed intake and to predict its variation.

Section/unit 2 **FEEDSTUFFS AND FEED TECHNOLOGY: COMPOSITION, QUALITY AND SAFETY**

This section gives a broad picture of different feed sources, their composition and values, as well as of the processes used in feed manufacturing and their economic implications. Feed quality and safety are stressed by dealing with their standards, assessment, and communication to users. Learning outcomes are: (i) to characterize different feed categories and their components; (ii) to gain experience in assessing feedstuff nutritive values and in the elaboration and use of feed composition tables; (iii) to acquire a deep knowledge on the technology used for feed manufacturing and on the economic implications of such production; (iv) to analyse feeds and feedstuffs quality standards and be competent in the use of current methodology used to evaluate such standards; and (v) to apply safety control methods for feeds and feedstuffs, measurement techniques and evaluation methods.

Section/unit 3 **ANIMAL FEEDING, AND FOOD QUALITY AND SAFETY**

After an introduction on the general aspects of quality and safety related to nutrition, appropriate feeding strategies for different livestock species and their economics are reviewed, considering their particular needs, the diverse production systems and the factors influencing product quality. Learning outcomes are: (i) to determine the optimal feeding systems considering the species, their biological cycle, the type of production and the production system; (ii) to gain practical experience in feed formulation and in the development of feed strategies; (iii) to identify factors related to nutrition that influence the quality of animal products, and to be able to modify this quality according to market requirements; (iv) to master aspects linked to food safety and to the implementation of quality assurance and product traceability systems; (v) to develop skills in the detection of contaminants and pathogens in animal products; and (vi) to value the economic implications of the different nutrition strategies.

Section/unit 4 REPERCUSSIONS OF NUTRITION ON THE ENVIRONMENT AND ON ANIMAL HEALTH AND WELFARE

This section increases participants' awareness of the close relationships among nutrition and animal health and welfare, and emphasizes the necessity of maintaining a balance between feed resources and animal feeding requirements in order to maximize the recycling of nutrients and minimize the release of undesirable emissions. Learning outcomes are: (i) to analyse nutritional aspects that influence animal health and welfare; (ii) to apply alternative nutrition systems that reduce the risk of diseases, guaranteeing at the same time the safety of animal products; (iii) to minimize stress risks and to improve animal welfare applying adequate nutrition strategies; (iv) to know the influence of animal nutrition management on the environment and the production system sustainability; (v) to quantify the impacts of nutrition on intensive and extensive production systems, and to identify feed resources and management strategies that minimize these impacts; (vi) to be aware of the role that grazing has on landscape management and conservation; and (vii) to consider of the possibilities offered by alternative production systems such as organic production and other farm-assured systems.

Section/unit 5 MATHEMATICAL AND STATISTICAL METHODS IN ANIMAL NUTRITION

The section focuses on the statistical principles underlying the design of experiments and the analysis of the data generated, also introducing participants to meta-analysis principles, and highlighting the use of modelling as a tool on animal nutrition. Learning outcomes are: (i) to know the statistical bases relevant to data analysis and experimental design in animal nutrition programmes; (ii) to become familiar with the computer software used for these programmes; (iii) to gain practical experience in data mining and analysis using the appropriate software; (iv) to integrate and analyse data originated from large series of experiments on animal nutrition topics; and (v) to assess the potentiality of models and aid-to-decision systems in animal nutrition, and to practise their use.

Section/unit 6 INDIVIDUAL PROJECT

Throughout the Course, participants carry out an individual project either on an innovative topic related to animal nutrition or on the design of a feeding programme for a species of their choice, applied to a specific farming system and the conditions of their country of origin. Learning outcomes are: (i) to apply the principles and methodology presented during the Course; (ii) to gain experience in finding technical and scientific information, as well as to learn how to make selective treatment of such information; (iii) to make a critical assessment of different alternatives for optimum and sustainable nutrition of the species chosen considering the determined environmental and socio-economic conditions and the pre-established production objectives; (iv) to be able to define and integrate the different components that interact in the design of a nutrition programme and in its application planning; and (v) to acquire experience in the preparation of oral communications and in their presentation and defence in public.

Section/unit 7**PROFESSIONAL TRAINING STAGE RELATED TO ANIMAL NUTRITION**

The last month of the course is devoted to putting into practise the knowledge acquired in previous sections. A professional stage carried out in feed industries, modern farms or other type of institution related to animal nutrition or agro-food products allows participants to better understand the whole process and the day to day problems, as well as to develop skills in the use of current methods and techniques. Learning outcomes are: (i) to acquire experience in a real professional environment; (ii) to develop skills in the analysis of situations, in the decision making process and in the management of real problems; (iii) to favour the exchange of ideas with the professionals of the sector directly involved in development activities; (iv) to value actions carried out by the host institution, increasing their analysis ability and their critical sense; and (v) to be competent in the elaboration of synthetic reports characterizing the host institution, its strategies and activities concerning animal nutrition, and assessing the personal and professional training value of the work carried out during the stage.

TRAINING SEQUENCE

Section/unit 1

(10 ECTS)

Dates: from 1 October to 9 November 2007.

PRINCIPLES OF ANIMAL NUTRITION

Subunit 1 – Feed composition, nutrient digestion and metabolism,

Subunit 2 – Feed evaluation,

Subunit 3 – Nutrient requirements,

Subunit 4 – Feed intake.

Section/unit 2

(10 ECTS)

Dates: from 12 November to 21 December 2007.

FEEDSTUFFS AND FEED TECHNOLOGY: COMPOSITION, QUALITY AND SAFETY

Subunit 1 – Feed components and feed categories,

Subunit 2 – Feed technology,

Subunit 3 – Raw material and compound feed quality,

Subunit 4 – Feed safety.

Section/unit 3

(15 ECTS)

Dates: from 7 January to 22 February 2008.

ANIMAL FEEDING, AND FOOD QUALITY AND SAFETY

Subunit 1 – General aspects about animal product quality and safety,

Subunit 2 – Feeding for milk production: cattle, sheep and goats,

Subunit 3 – Feeding for meat production in ruminants: cattle, sheep and goats,

Subunit 4 – Feeding for meat production in monogastrics: pigs, poultry and rabbits,

Subunit 5 – Feeding for egg production.

Section/unit 4

(6 ECTS)

Dates: from 25 February to 4 April 2008.

REPERCUSSIONS OF NUTRITION ON THE ENVIRONMENT AND ON ANIMAL HEALTH AND WELFARE

Subunit 1 – Health and nutrition,

Subunit 2 – Welfare and nutrition,

Subunit 3 – Animal production and environmental interactions,

Subunit 4 – Reducing environmental impact in intensive systems through nutritional management,

Subunit 5 – Livestock/environment interactions in extensive systems,

Subunit 6 – Environmentally-friendly production systems.

Section/unit 5

(5 ECTS)

Dates: from 7 to 25 April 2008.

MATHEMATICAL AND STATISTICAL METHODS IN ANIMAL NUTRITION

Subunit 1 – Data analysis and experimental design,

Subunit 2 – Meta-analysis of experimental data,

Subunit 3 – The use of modelling as a tool in animal nutrition.

Section/unit 6

(7 ECTS)

Dates: from 1 October 2007 to 9 May 2008.

INDIVIDUAL PROJECT

Section/unit 7

(7 ECTS)

Dates: from 12 May to 6 June 2008.

PROFESSIONAL TRAINING STAGE RELATED TO ANIMAL NUTRITION

Comprehensive oral or written examination

Participants take 1 written examination for each Section, except for Section 3 where they take 2. Each unit is independently graded.

Written exams consist of a set of questions that require a concise answer. Some of the questions are multiple choice. Lengthy questions are avoided.

Participants may retake failed exams once.

For the evaluation of Section 6, participants must elaborate a written document that is presented and defended orally before a jury for its assessment.

For the evaluation of Section 7, participants must present a report assessing the work carried out in the host institution and valuing the professional and personal contribution of this training stage to their education.

Analytical syllabus

Section/unit 1 PRINCIPLES OF ANIMAL NUTRITION

Subunit 1 – Feed composition, nutrient digestion and metabolism

Chemical composition and physical properties of feed components. Microbiology of the digestive tract: ruminants and monogastrics. Comparative digestion: processes, end products and efficiency. Intermediate metabolism: gut and liver. Tissue metabolism: bones, muscle, adipose tissue, reproductive tract and mammary gland. Nutrigenomics. Practical work is carried out at the laboratory on proximate analysis and cell-wall fractioning of feed, physical characteristics of feed components and NIR analysis.

Subunit 2 – Feed evaluation

Quality criteria and methodology. Energy evaluation systems. Protein evaluation systems. Mineral and vitamin availability. Practical work is carried out at the laboratory on *in vitro* and *in situ* methods and on enzymatic methods. To complement practical work, two case studies are developed dealing with digestibility and energy balance and with estimation of feeding value.

Subunit 3 – Nutrient requirements

Estimation and expression of nutrient requirements. Nutrient balance and body reserves. Maintenance, activity and thermal regulation. Growth and development. Reproduction, pregnancy and lactation. As practical work, two case studies are developed dealing with estimation of nitrogen balance and urea excretion and with cost estimation of energy expenditure, activity cost and critical temperature.

Subunit 4 – Feed intake

Control mechanisms. Estimation methodologies. Variation factors and prediction. As practical work, two case studies are developed based on estimation of feed intake in grazing animals and with the estimation of fill value and substitution rate.

Section/unit 2 **FEEDSTUFFS AND FEED TECHNOLOGY : COMPOSITION, QUALITY AND SAFETY**

Subunit 1 – Feed components and feed categories

Raw material and compound feed production and trends in international trade. Pastures, forage crops and their preserved products. Straws and stubbles. Shrubs and forage-trees. Agro-food by-products. Energy concentrates: cereal grains, roots, tubers, fats and oils. Protein concentrates: oil-seeds and pulses. Feeds of animal origin. Minerals, vitamins and other micro-ingredients. Feed additives: classification and related regulations.

As practical work, two case studies are developed dealing with the prediction of nutritive value from composition data and with the elaboration and use of feed composition tables.

As practical work, two case studies are developed dealing with the prediction of nutritive value from composition data and with the elaboration and use of feed composition tables.

Subunit 2 – Feed technology

On-farm processing: harvesting, conditioning, storage and transport. Raw material reception and sampling. Grinding, mixing and pelleting. Other mechanical and heat treatments. Liquid handling. Control of technological aspects. Feed hygiene issues. Consequences of processes on feed value. The economics of feed production. Several technical visits to feed industries complete this subunit.

Subunit 3 – Raw material and compound feed quality

Quality standards. Sampling protocols. Methods for assessing quality standards: chemical and microscopy analysis, NIR, etc.

A technical visit is organised to a quality control laboratory. Practical work in the laboratory is carried out on feed microscopy.

Subunit 4 – Feed safety

Detection, limits, prevention and control of microorganisms and undesirable substances in feedstuffs and feeds: mycotoxins, toxins of plant origin, pesticides, industrial contaminants, animal residues and microorganisms. Specifications and control of GMOs in animal feeds. Risk analysis and HACCP methods in the feed industry. Good manufacturing practices and ISO standards. Methods for assessing safety standards. International standards and regulations: Codex Alimentarius and others. Labelling and traceability. Detection of GMOs in raw materials: NIR techniques.

A technical visit to a feed mill is organized for risk analysis and HACCP demonstration. Practical work in the laboratory is carried out on feed microbiology and on the detection of GMOs in raw materials using molecular techniques.

Section/unit 3 ANIMAL FEEDING, AND FOOD QUALITY AND SAFETY

Subunit 1 – General aspects about animal product quality and safety

Animal products and human health. Functional compounds in animal products. Quality criteria: nutritional, sensorial and cultural aspects. On-farm hygiene. Safety issues: transfer of contaminants from feed to food, maximum limit of residues, biotic agents, prevention and control. Quality assurance systems. Traceability in the food chain. Facing a food-safety crisis.

Practical work in the laboratory is carried out on detection of contaminants in animal products and on identification of biotic agents in animal products.

Subunit 2 – Feeding for milk production: cattle, sheep and goats

Biological cycles and production systems in ruminants. Lactation curve, milk yield and milk composition. Modification of milk quality and dairy products through nutrition. Feeding strategies and rationing for young and adult animals. Prevention of digestive and metabolic disorders. Economic considerations.

Practical work is carried out for the use of rationing software. A technical visit is organized to a dairy cattle farm with a milk processing unit, whose feeding strategies must be evaluated by the participants. Another technical visit for cheese quality assessment is also arranged.

Subunit 3 – Feeding for meat production in ruminants: cattle, sheep and goats

Biological cycles and production systems. Non-nutritional factors influencing carcass and meat quality. Modification of carcass and meat quality through nutrition. Feeding strategies and rationing for young and adult animals. Prevention of digestive and metabolic disorders. Economic considerations. Practical work is carried out for the use of rationing software and for carcasses and meat evaluation. A technical visit is organized to a sheep farm, whose feeding strategies must be evaluated by the participants.

Subunit 4 – Feeding for meat production in monogastrics: pigs, poultry and rabbits

Production systems. Non-nutritional factors influencing carcass and meat quality. Modification of carcass and meat quality through nutrition. Feeding strategies and rationing for young and adult animals. Prevention of digestive and metabolic disorders. Economic considerations. Practical work is carried out for the use of feed formulation software and for the assessment of meat and product quality. Technical visits are organized to pig and rabbit farms.

Subunit 5 – Feeding for egg production

Production systems. Egg production performance and biosynthesis of egg components. Modification of egg quality through nutrition. Feeding strategies and rationing for young and adult animals. Prevention of digestive and metabolic disorders. Economic considerations.

Practical work is carried using feed formulation software and assaying egg quality. Technical visits are organized to pig and rabbit farms.

Section/unit 4 REPERCUSSIONS OF NUTRITION ON THE ENVIRONMENT AND ON ANIMAL HEALTH AND WELFARE

Subunit 1 – Health and nutrition

Immunonutrition: nutrition, disease and performance relationships. Use of probiotics and nutraceuticals. Alternatives to the use of antibiotics in animal feeding. Bioactive forages to reduce parasite burdens. Avoiding anti-nutrient derived toxicity.

As practical work, a case study on control of parasites through grazing management is carried out.

Subunit 2 – Welfare and nutrition

Definition and assessment of welfare. Welfare implications of hunger and malnutrition. Nutritional management under thermal stress. Nutritional stereotypes. Appropriate trace element supplementation.

Subunit 3 – Animal production and environmental interactions

Sustainable animal production and farming systems. The role of livestock in maintaining rural areas. Legislative framework. Gaseous emissions. Excreta. Water use. Grazing impacts. Environmental impact of the feed industry, including the use of GMOs.

As practical work, a case study on energy and nutrient balances in the assessment of gas emissions and effluents is carried out, as well as laboratory analysis of water contaminants.

Subunit 4 – Reducing environmental impact in intensive systems through nutritional management

Optimizing nutrient capture by ruminants: synchronization of protein/energy supply to the rumen, enhancing nutrient utilization. Modification of rumen fermentation to reduce gaseous emissions. Optimizing nutrition of pigs and poultry to reduce the environmental impact. Farm budgets for phosphorous and nitrogen. Impacts of trace element supplementation.

Subunit 5 – Livestock/environment interactions in extensive systems

Impact of grazing on vegetation structure and composition. Carrying capacity of rangelands: overgrazing. Using livestock as tools for land management. Livestock-wildlife interactions. Side effects on invertebrates and birds.

A technical visit to illustrate landscape management and grazing is organized.

Subunit 6 – Environmental-friendly production systems

Animal nutrition in organic production. Other farm-assured systems.

A technical visit to an organic farm is organised.

Section/unit 5 MATHEMATICAL AND STATISTICAL METHODS IN ANIMAL NUTRITION

Subunit 1 – Data analysis and experimental design

Basic statistical principles. Data mining and analysis: variance and covariance, regression, repeated measures and non parametric methods. Experimental design in animal nutrition studies.

Practical work is based on statistical analysis and experimental design using statistical packages.

Subunit 2 – Meta-analysis of experimental data

Basics of meta-analysis are dealt with, complemented with practical work on a case study on meta-analysis.

Subunit 3 – The use of modelling as a tool in animal nutrition

Basics for empirical and mechanistic models. Modelling digestion processes. Growth modelling. Decision support models and software for rationing. Practical work is based on the use of modelling software.

Section/unit 6 INDIVIDUAL PROJECT

Section/unit 7 PROFESSIONAL TRAINING STAGE RELATED TO ANIMAL NUTRITION

Part 2

The Master of Science thesis

Project (10 month duration, 60 ECTS)

This part of the programme is carried out in well-recognized institutions (universities, research centres or firms), generally throughout Spain or in the participant's country of origin, under the scientific supervision of a thesis director that must be a doctor of renowned prestige. Participants choose the topic according to their interest of training, which is approved by a Committee. If the participant so requires, the organizing institutions advise on the choice of the most appropriate thesis director and institution to carry out the desired project, and likewise propose topics related to their research activities or other topics of interest previously accorded with other institutions.

This is the first edition of the Master, and that is the reason why the experience related to this discipline comes from a previous Master on Animal Production that was held at IAMZ from 1979 to 2006, in which animal nutrition was one of the three main areas studied. In the previous Master, the theses related to nutrition dealt mainly with the study of the effects of diet composition and additives on nutrient absorption, production performance and reproductive parameters; others studied nutritional needs and feed value of different products and by-products. So, a wide range of research topics available for Master of Science theses is foreseen, considering these traditional topics and other more innovative subjects introduced in the new Master, such as nutrition/food quality relationships, the influence of nutrition on the environment or the consequences of nutrition in animal health and welfare.

The participant, with the support of the thesis director, should inform the organizing institutions periodically on the development and progress of the research work. This part concludes with the writing of a thesis to be defended in public before an examining board convened by the organizing institutions. The jury is composed of representatives of the organizing institutions and at least three external members selected in each case for their expertise and prestige in the field of the thesis.

INDICATIVE MASTER THESES REALISED WITHIN THE AREA OF ANIMAL NUTRITION DURING THE PREVIOUS MASTER ON ANIMAL PRODUCTION HELD FROM 1979 TO 2006

Title: The effect of diet on vitamin E concentration, colour shelf life and lipid oxidation during simulated retail display in beef steaks from different production systems (2007)

Author: Virginia Resconi, Agronomist, Argentina

Place of realization: Departamento de Producción Animal y Tecnología de los Alimentos, Facultad de Veterinaria, Universidad de Zaragoza (Spain) and Division of Farm Animal Science, University of Bristol (UK)

Thesis directors: M. M. Campo and R.I. Richardson

Title: Protection of soy bean flour proteins through a combined treatment of malic acid and heat. *In vivo* trials (2007)

Author: Luis Felipe Fernandes, Agronomist, Portugal

Place of realization: Departamento de Nutrición Animal, Escuela Técnica Superior de Ingenieros Agrónomos, Universidad Politécnica de Madrid (Spain)

Thesis directors: J. González Cano and C.A. Rodríguez Cortés

Title: Livestock-vegetation interactions in pastures of the Natural Park of Sierra y Cañones de Guara. Implications for the management of this natural protected area (2004)

Author: José Luis Riedel, Natural Resources Engineer, Argentina

Place of realization: Unidad de Tecnología en Producción Animal, Centro de Investigación y de Tecnología Agroalimentaria, Diputación General de Aragón, Zaragoza, Spain

Thesis directors: Alberto Bernués and Isabel Casasús

Title: Effect of adding urea to the ration in the pre-mating period on the reproductive yield of 'Rasa Aragonesa' sheep (2003)

Author: Rachid El Bouyahiaoui, Agronomist, Algeria

Place of realization: Unidad de Tecnología en Producción Animal, Centro de Investigación y Tecnología Agroalimentaria de Aragón, Zaragoza, Spain

Thesis directors: J. Folch and J. Donato Andueza

Title: Evolution of the size and number of adipocytes from different fatty depots in calves belonging to Spanish autochthonous breeds slaughtered at different weights (2002)

Author: Gregorio Indurain, Biologist, Spain

Place of realization: Departamento de Producción Agraria, Escuela Técnica Superior de Ingenieros Agrónomos, Universidad Pública de Navarra, Pamplona, Spain

Thesis director: José Antonio Mendizabal

Title: Study of the possible negative effect of the addition of hydrolyzable tannins on lamb fattening feeds (2001)

Author: Miguel Raso, Veterinarian, Argentina

Place of realization: Estación Agrícola Experimental, Consejo Superior de Investigaciones Científicas, León, Spain

Thesis directors: Francisco Javier Giraldez and Pilar de Frutos

Title: Evaluation of zinc methionine as a feed supplement for improving milk quality in dairy goats (2001)

Author: Ahmed Salama, Agronomist, Egypt

Place of realization: Departamento de Ciencia Animal y de los Alimentos, Facultad de Veterinaria, Universidad Autónoma de Barcelona, Spain

Thesis directors: Gerardo Caja and Xavier Such

Title: Use of ultra sound scanning in real time to study the udder and the effect of different milking intervals on the milk production of the dairy cow (2000)

Author: Moez Ayadi, Agronomist, Tunisia

Place of realization: Unidad de Patología y Producción Animal, Facultad de Veterinaria, Universidad Autónoma de Barcelona, Spain

Thesis director: Gerardo Caja

REFERENCES OF THE MAIN ACADEMIC STAFF TEACHING WITHIN THE M.SC. PROGRAMME

Some 90 invited lecturers from about 8 countries participate in the M.Sc. programme of which, 61% come from Higher Education Institutions, 25% from Research Centres, 10% from Private Companies, 3% from International Centres and 1% from Administration Services. Considering their implication in the programme, the following academic staff is taken as reference:

- José Antonio **GUADA**, Scientific coordinator, Univ. de Zaragoza, Departamento de Producción Animal y Ciencia de los Alimentos, Zaragoza (Spain)
- Gerardo **CAJA**, Scientific coordinator, Univ. Autònoma de Barcelona (UAB), Departament de Ciència Animal i dels Aliments, Bellaterra-Barcelona (Spain)
- Juan **ACEDO-RICO**, Consultant, Burgos (Spain)
- François **BOCQUIER**, Ecole National Supérieure Agronomique, Chaire de Sciences Animales, Montpellier (France)
- Emilio **CARBONELL**, Instituto Valenciano de Investigaciones Agrarias (IVIA), Unidad de Biometría, Valencia (Spain)
- Daniel **CHAISEMARTIN**, World Organisation for Animal Health (OIE), Paris (France)
- Carlos **DE BLAS**, Univ. Politécnica de Madrid (UPM), Departamento de Producción Animal, Madrid (Spain)
- Peter **DENNIS**, Univ. Wales, Institute of Rural Sciences, Aberystwyth (UK)
- Michel **DOREAU**, Institut National de la Recherche Agronomique (INRA), Unité de Recherches sur les Herbivores, Clermont-Theix (France)
- Alan **DUNCAN**, Macaulay Land Use Research Institute (MLURI), Animal Ecology in Grazed Ecosystems Group, Aberdeen (UK)
- Ilias **KYRIAZAKIS**, Scottish Agricultural College (SAC), Animal Nutrition and Health Department, Edinburgh (UK)
- Raul E. **MACCHIARELLI**, Univ. Puerto Rico, Department of Agronomy and Soils, Mayagüez (Puerto Rico)
- Juan F. **MEDRANO**, Univ. California, Department of Animal Science, Davis (US)
- François **MESCHY**, Institut National de la Recherche Agronomique-Institut National Agronomique Paris-Grignon (INRA-INA PG), Unité Physiologie de la Nutrition et Alimentation, Paris (France)
- John **MILNE**, Deer Commission for Scotland, Inverness (UK)
- Tom **MISSELBROOK**, Institute of Grassland and Environmental Research (IGER), North Wyke Research Station, Devon (UK)
- Pierre **MORAND-FEHR**, Institut National de la Recherche Agronomique-Institut National Agronomique Paris-Grignon (INRA-INA PG), Laboratoire de Nutrition et Alimentation, Paris (France)
- Cándido **POMAR**, Agriculture and Agri-Food Canada, Dairy and Swine Research and Development Centre, Lennoxville (Canada)
- Nacif **RIHANI**, Food and Agriculture Organization of the United Nations (FAO), Animal Production and Health Division, Roma (Italy)
- Pedro **RONCALÉS**, Univ. Zaragoza, Departamento de Producción Animal y Ciencia de los Alimentos, Zaragoza (Spain)
- Marc **ROUX**, Etablissement National d'Enseignement Supérieur Agronomique de Dijon (ENESAD), Département Productions Animales, Dijon (France)
- Gerardo **SANTOMÁ**, Trouw Nutrition, Barcelona (Spain)
- Bernard **SÈVE**, Institut National de la Recherche Agronomique (INRA), Unité Mixte de Recherches sur le Veau et le Porc, Saint-Gilles (France)
- Leo **VAN RAAMSDONK**, RIKILT-Institute of Food Safety, Wageningen (the Netherlands)
- Bill **WEISS**, Univ. Ohio, Department of Animal Sciences, Wooster (US)