

Preface

The challenges in animal genetics for today's students and instructors are to cope with the fast growing body of information related to genetics research, to gain basic skills of problem solving, to make use of genetic knowledge in real life applications, and to deal with the ethical and social aspects of genetics research. The aim of this book is to provide students and instructors with up-to-date knowledge to meet these challenges. Recent developments in high throughput technologies (e.g., next-generation sequencing) has had an enormous impact on our understanding of molecular and quantitative genetics. These new technologies require that both molecular and quantitative skills are needed to deal with the challenges of animal genetics research. Genetics is one of the most dynamic topics in biology in terms of flow of new information on a daily basis.

The electronic format of this book (ebook) will allow frequent updates with new genetic information. Importantly, with the ebook, readers can easily download specific chapters, search for any information in the book, resize fonts, and access different web sites through the links, in addition to many other advantages. The 29 chapters of the book were contributed by 34 authors representing 20 different institutions from the USA, Sweden, Turkey, and Australia. Chapters were peer-reviewed by 41 reviewers. The topics of Molecular and Quantitative Animal Genetics have been chosen to help students understand the concepts, principles, and models of animal molecular and quantitative genetics and to learn to apply these concepts for improving the health, production, and well-being of animals.

The changing environment of twenty-first-century teaching and learning is a challenge faced by both students and instructors. What is the role of the instructor in the era of massive internet information available to the students? What is the role of students in the learning process? What is the difference between teaching and learning? These questions and others are discussed in 1 which provides an overview of teaching vs. learning and discusses the fundamental ways by which learning occurs. The first section "Quantitative and Population Genetics" focuses on the statistical and quantitative aspects of animal genetics. Included in this section are inbreeding and inbreeding depression, genomic selection, crossbreeding, basic genetic model for quantitative traits, heritability and selection, heritability and repeatability, and

applications of statistics in quantitative traits. Section 2 "Applications of Genetics and Genomics to Livestock and Companion Animal Species" deals with genetic improvement programs for beef cattle, sheep, dairy cattle, and pigs. It also describes the recent research developments of genetics and genomics of the horse, dog, sheep, and goats. The genetics of color and genetic defects in horses, domestication of dogs, the dog genome, current status of the sheep genome, genetics and domestication of goats, and new genetic technologies are discussed in detail in this section.

Bioinformatics tools in animal genetics research, genome-wide association studies, high throughput technologies, mapping and identifying single genes in animal breeding, genetics of coat color, genetics-nutrition interactions in ruminants, and nutritional epigenomics are covered in Section 3 "Molecular Genetics of Production and Economically Important Traits". Section 4 "Genetics of Embryo Development and Fertility" focuses on the genomics of sex determination, chromosome X inactivation and dosage compensation, chromosome X defects, functional genomics of gametes and embryos, transcriptomics and proteomics of embryos, genetics of in vitro-produced embryos, and genetic screening of embryos. The last section "Genetics of Animal Health and Biotechnology" describes the genetic diversity of the major histocompatibility complex proteins and immunoglobulins, genetics of infectious disease susceptibility, applications and challenges of genetic selection for livestock health, genetic advancement and assessment of animal welfare, genetic selection in animal welfare, animal biotechnology, cloning and genetically-engineered animals, and intellectual property rights and animal resources.

The book is designed to serve students at both undergraduate and graduate levels and readers interested in molecular and quantitative genetics.

I wish to acknowledge the authors for their collaboration and the many colleagues who volunteered to review the book chapters (see lists of contributors and reviewers). Finally, I thank my family (Hanan, Karam, Rawi, and Haya) for being patient with me during evening hours.

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