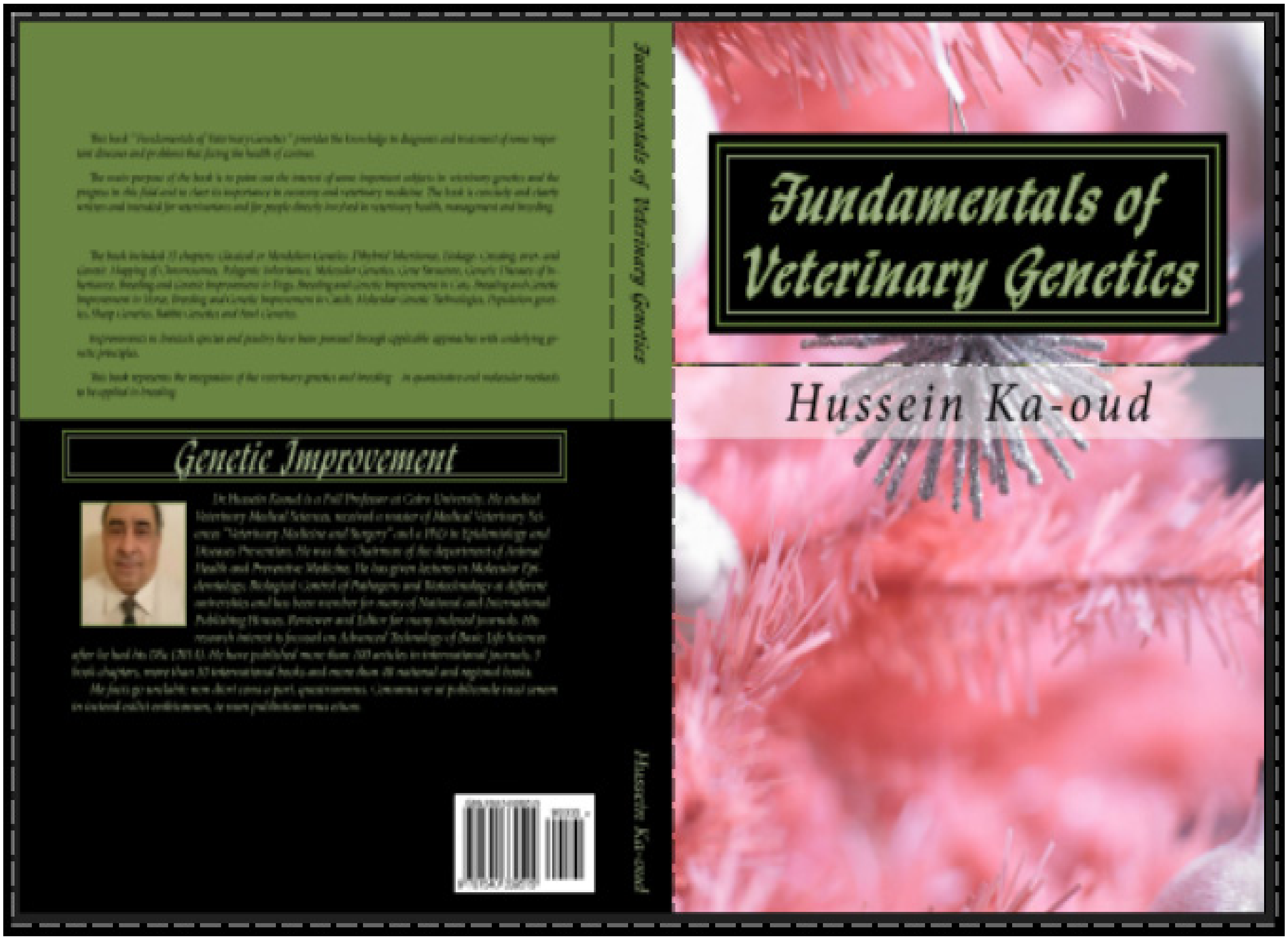
Fundamentals of Veterinary Genetics
Hussein Ka-oud
Genetic Improvement
Fundamentals of Veterinary Genetics
Hussein Ka-oud

Fundamentals of Veterinary Genetics

Dr. Hussein Abdelhay Elsayed Kaoud

Full Professor of Animal, Poultry, Aquaculture Health
and
Environmental Pollution

Faculty of Veterinary Medicine
Cairo University

Contents

Preface

Genetics is the study of heredity.

There are three main branches of modern genetics

1. Classical or Mendelian Genetics, which is the study of heredity at the whole organisms level by looking at how characteristics are inherited. This method was pioneered by Gregor Mendel (1822-1884). It is less fashionable today than molecular genetics, but still has a lot to tell us.
2. Molecular Genetics, which is Molecular Biology the study of heredity at the molecular level, and so is mainly concerned with the molecule DNA. It also includes genetic engineering and cloning, and is very trendy. This unit is mostly about molecular genetics.
3. Population Genetics, which is the study of genetic (differences within and between species, including how species evolve by natural selection).

Forward genetics

The starting point of **forward genetics** is to treat cells of the normal *wild-type* form of the organism with some agent such as X rays or certain chemicals that causes mutations. Then descendants of these cells (usually organisms growing from them) are screened for abnormal manifestation of the function in question.

For example, if we are interested in the biological function "color" and the wild type is purple, then we might look for mutations producing any other color (blue, red, pink, and so on) or even the absence of color (white). The first question asked, are these properties inherited as a single mutated gene? That question can be answered by crossing each presumptive mutant organism to a wild-type organism, then inspecting the ratios of wild-type to mutant progeny in the subsequent generations of descendants. The ratios indicating single-gene inheritance were originally established by the "father of genetics," Gregor Mendel, in the 1860s. A gene discovered in this way can be mapped or isolated, often leading to its DNA sequence.

The next step is to determine the function of each gene that has been identified. Returning to our example, we would ask, how does that gene act to influence flower color? The biochemical properties of each mutant obtained are studied at the molecular level and the defective protein encoded by that gene deduced an important step in piecing together the overall system of reactions responsible for color. Hence, overall forward genetics can be represented by the Sequence, Mutation, Gene discovery, DNA sequence and Function

The relatively new field of genomics has facilitated this approach: once a gene for a specific property has been mapped in the genomic sequence, then that gene's sequence is known, and if that gene has been studied in experimental organisms, then because of evolutionary homology, it is very likely that a function is already known for it. For example, human genes for proteins that promote transcription have been identified by their homology with the genes of fruit flies and yeast. Many heritable disorders have complex inheritance (heart disease, diabetes, and cleft palate are some examples) involving several genes; genomic analysis has begun identifying these genes too.

Reverse genetics

The **reverse genetics** approach starts with a gene sequence (probably learned from a genome sequence) that has no known function and then attempts to find that function. As in forward genetics, an important step is to obtain mutations in that gene. Several experimental approaches exist that can target mutations to an individual gene. These approaches are generally termed *directed mutagenesis.* One such approach is to completely knock out the gene's function by eliminating the gene and then to look for the effects on the organism's functioned. Alterations in the function of the mutant gene reveal aspects of the gene's biochemistry when fulfilling its normal role. (The technique works well for genes that are found as only one copy. It has been discovered from genomics that some genes are present in more than one copy, and in such cases it is possible to knock them all out.) Reverse genetics can be summarized by the Sequence Gene (DNA sequence) **,** Mutation and Function.

This book **" Fundamentals of Veterinary Genetics "** provides the knowledge in diagnosis and treatment of some important diseases and problems that facing the health of canines.

The main purpose of the book is to point out the interest of some important subjects in veterinary genetics and the progress in this field and to clear its importance in economy and veterinary medicine. The book is concisely and clearly written and intended for veterinarians and for people directly involved in veterinary health, management and breeding.

The book included 15 chapters: Classical or Mendelian Genetics ,Dihybrid Inheritance, Linkage-Crossing, over- and Genetic Mapping of Chromosomes, Polygenic Inheritance, Molecular Genetics, Gene Structure, Genetic Diseases of Inheritance, Breeding and Genetic Improvement in Dogs, Breeding and Genetic Improvement in Cats, Breeding and Genetic Improvement in Horse, Breeding and Genetic Improvement in Cattle, Molecular Genetic Technologies, Population genetics, Sheep Genetics, Rabbit Genetics and Fowl Genetics.

Improvements in livestock species and poultry have been pursued through applicable approaches with underlying genetic principles.

This book represents the integration of the veterinary genetics and breeding in quantitative and molecular methods to be applied in breeding.

Dr. Hussein A.Kaoud
Professor of Animal, Poultry, Aquaculture Health
Faculty of Veterinary Medicine
Cairo University

Chapter 1

Classical or Mendelian Genetics

Classical or Mendelian Genetics is the study of heredity at the whole organisms level by looking at how characteristics are inherited. This method was pioneered by Gregor Mendel (1822- 1884). It is less fashionable today than molecular genetics, but still has a lot to tell us.

Mendelian Genetics

Gregor Mendel (1860's) discovered the fundamental principles of genetics by breeding garden peas.

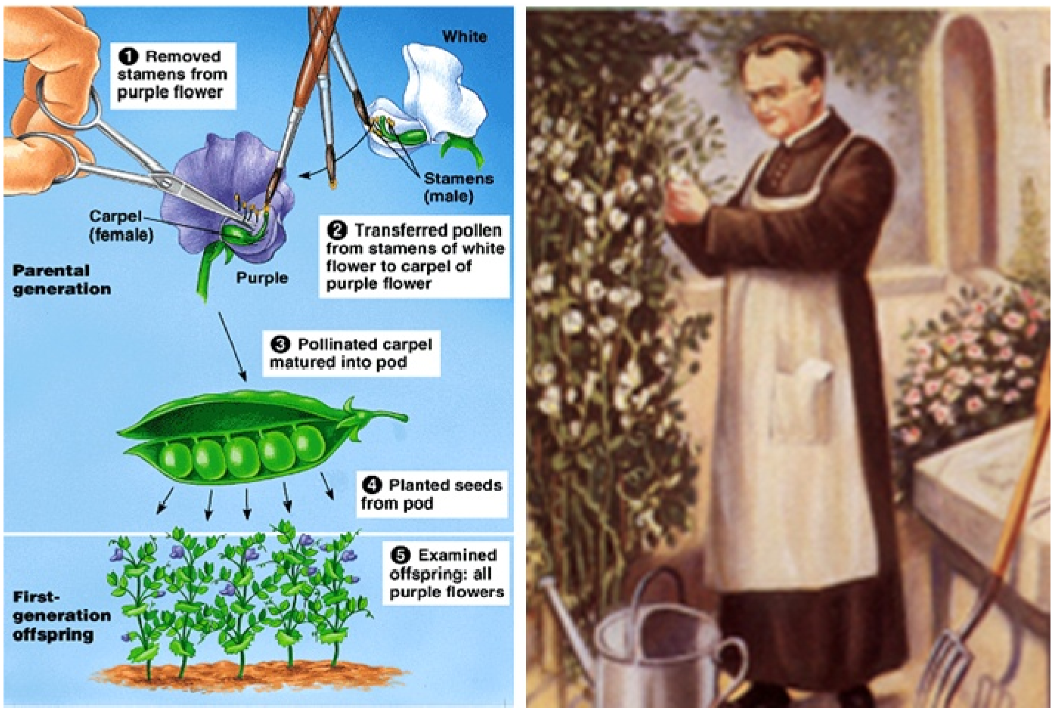

Fig.1: Gregor Mendel (1860's) discovered the fundamental principles of genetics by breeding garden peas.

Monohybrid inheritance

In the introduction we noted that early attempts to determine fundamental genetic mechanisms frequently failed because investigator tried to examine simultaneously all discernible traits. We saw that Mendel's success in preparing the groundwork of our modern understanding lay in (1) concentrating on one or a few characters at a time, (2) making controlled crosses and keeping careful records of the results, and (3) suggesting "factors" as the particulate causes of various genetic .patterns. If we wished, for instance, to learn something of the inheritance of vestigial wings in the fruit fly, Drosophila (Fig. 2-1), we would cross an individual having normal,