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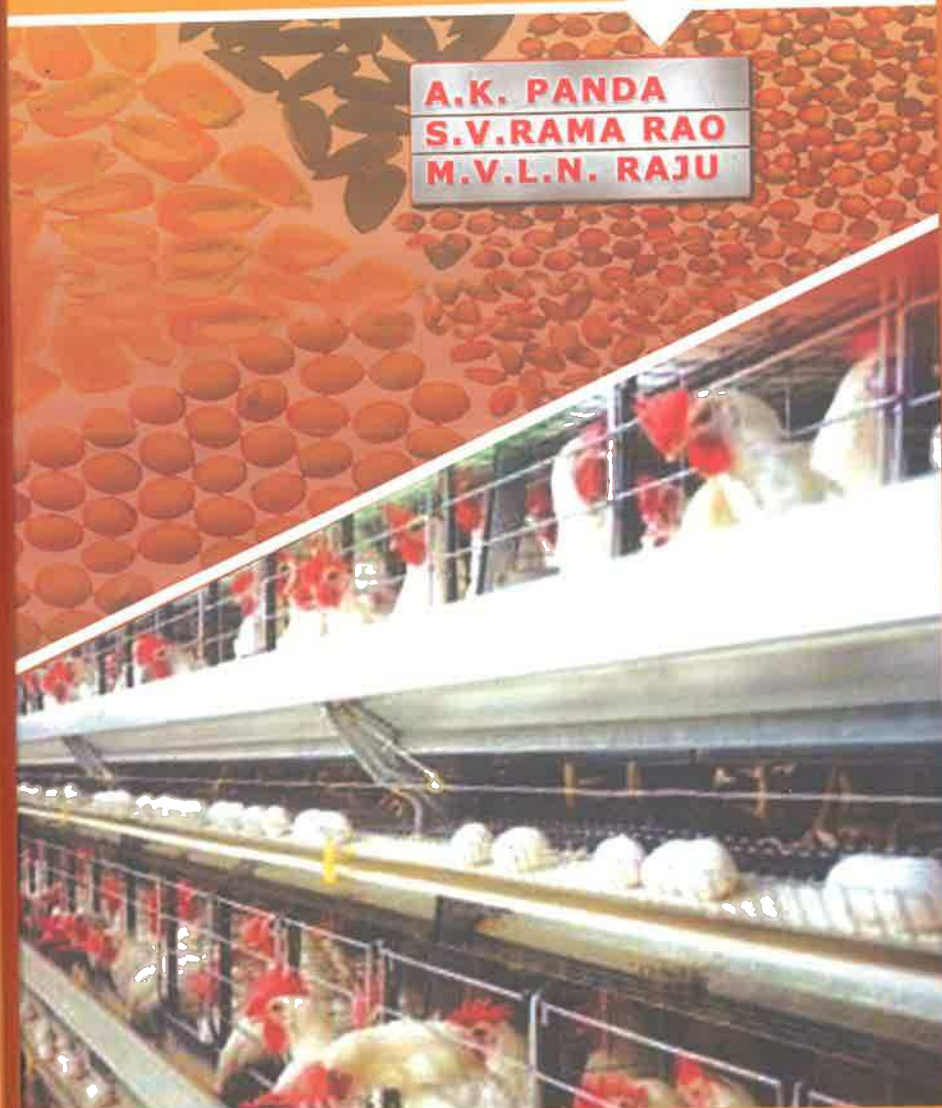
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COMMERCIAL CHICKEN NUTRITION

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A.K. PANDA
S.V.RAMA RAO
M.V.L.N. RAJU



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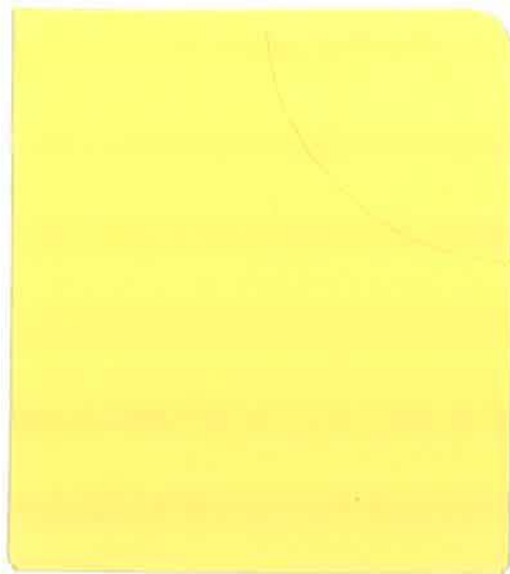
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**COMMERCIAL
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NUTRITION**

By
**A.K. Panda
S.V.Rama Rao
M.V.L.N. Raju**

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Preface

Indian Poultry Industry has made a spectacular growth during the last three decades. Its development is not only been in size but also in productivity, sophistication and quality. Availability of high yielding layer and broiler varieties together with standardized package of practices have contributed to spectacular growth in both egg and meat production. Success in poultry production rests primarily on the quality of the bird employed, proper environment and provision for good feed, the last being most expensive of all other inputs, deserves befitting attention. The major cost of production in poultry rearing is feed which accounts for 70-80% of the production cost. Balanced feed is therefore, important in modern broiler and layer rearing to exploit their genetic potential for optimum meat and egg production. Chickens employed in organized production system grow much faster and lay at higher rate than ever before. Such birds require highly specialized packages of feeding practices. Besides a liberal supply of well-balanced feed, its effective utilization by bird is equally important. Any improvement in performance that can be related to the feed inevitably has a profound effect on profitability.

Nutrition is the science that integrates knowledge of biochemistry and physiology into a unifying concept of the relationships between an organism and its food supply. It encompasses the procurement, digestion, absorption, and metabolism of food items. Besides a liberal supply of well-balanced feed, its effective utilization by bird is equally important. Any improvements in performance that can be related to the feed inevitably have a profound effect on profitability. For the preparation of balanced and economic feed detailed knowledge on the nutrient contents and availability in the feed ingredients used to formulate the diet is a basic requirement. Lot of research has been conducted on in chicken in an effort to determine its critical nutritional needs for maximizing the production efficiency.

The objective of nutrition is to provide all essential nutrients in adequate amounts and in optimum proportion. Poultry is one of the most fastidious of all animal species and scientific nutritional research of it is achieved by the knowledge gained from basic to applied research. Poultry products such as egg and meat supply high quality readily digested protein and, energy and are a compact source of readily available micronutrients. Poultry producers, nutritionists and geneticists are aware of the challenges being made to the poultry industry. Of the poultry, chickens dominate poultry production and hence received considerable attention in research, planning and development process in India. The book is divided into 20 chapters with an attempt to provide comprehensive information on nutrition in chicken for the benefits of poultry farmers, feed manufacturers, students, teachers, researchers and all those associated with poultry enterprises.

Introduction

Chicken rearing has a history of over 5000 years in India. Red jungle fowl, the wild native chicken is believed to be the basic source of all the modern breeds, reared through out the world. Poultry farming was confined to rearing of few chickens and ducks in the back yards till early 1960s and egg and chicken meat production was insignificant. The per capita availability of eggs in 1960 was only 0.3 kg. Realizing the importance of eggs and chicken meat in human nutrition and the increasing requirements of growing human population, efforts were initiated for increasing poultry production in the country. The R&D efforts initiated on pure lines in the public sector laid the foundation, which was subsequently consolidated by importation of high yielding grandparent and parent stocks by the private sector. Availability of high yielding layer (320-300 eggs) and broiler (2.2-2.4 kg at 6 wks) varieties together with standardized package of practices on nutrition, housing and management and disease control have contributed to spectacular growth rates in egg production (5-7% per annum) and broiler production (10-12% per annum) in India during the past 3-4 decades. The contributions of the private sector in this regard are quite impressive and praise worthy. Today, almost all the best known international layer and broiler stocks are available in the country. The necessary veterinary support and training for ensuring high standards of rearing are imparted by the State Agricultural Universities and specialized training institutes set up in the private and Govt. sectors.

Indian poultry sector has recorded a phenomenal growth and today India stands at 3rd position among the nations in the world in egg production and 5th in chicken meat production. The per capita availability of eggs has increased from 10 to 49 eggs, while that of chicken meat from 0.3 kg to 2.1 kg per annum during the last four decades. However, it far behind the recommended consumption of 180 eggs and 10.8 kg poultry meat per person per year. The mismatch in production and consumption is more in the rural areas of the country. The popularity of chicken meat is on the rise during the last two

decades. It is presently accounting for about 27% of the total meat consumed and is the most popular meat from any single livestock species. Chicken dominates the poultry production in India. Nearly 95% of the total eggs are produced by chickens and the rest is contributed by ducks. India is the home for many breeds of native chicken like Aseel, Kadaknath, Miri, Nicobari, Kalahasthi etc., which are still popular among the rural and tribal areas for back yard free range farming. For the commercial farming, high yielding crosses developed and supplied by the private sector like Babcock, Bovans (egg type) and Cobb, Ross, Hubbard (meat type) are being used. The crosses developed under the public sector like Krishi layer, Krishibro (multicolored broiler etc.) are popular in certain areas and rural varieties like Vanraja and Gramapriya are popular for rural poultry farming.

Nutrition is the science that integrates knowledge of biochemistry and physiology into a unifying concept of the relationships between an organism and its food supply. It is necessary to supply in the food not only the chemical compounds used as precursors of the metabolites which the animal can synthesize but also supply in ready to use form all those metabolites which the animal is incapable of synthesizing. It involves various chemical reactions and physiological processes which transform foods into body tissues and activities. It involves the ingestion, digestion, and absorption of various nutrients, their transport to all body cells and the removal of unusable elements and waste product of metabolism. It is utmost important to understand the basic functioning of the nutrients in the animal system and also the interrelationship between various nutrients before one can use the practical scientific use of knowledge of nutrition. The objective of nutrition is to provide all essential nutrients in adequate amounts and in optimum proportion.

Poultry is one of the most fastidious of all animal species. Scientific nutritional research of the poultry is achieved by the knowledge gained from basic to applied research with starting, growing, laying and breeding stocks. The chicken is also economically important for production of nutritious food; therefore, much effort has been paid to determine its critical nutritional feeds. The chicken is a monogastric animal with relatively small intestinal tract and contribution of nutri-

ents synthesized from the gastrointestinal tract is very little. So, most of the nutrients are supplied through the diet in adequate amounts in optimum ratio to each other and in available form for optimizing the efficiency. At least 40 essential nutrients are required in chicken which must be present in their diet for eliciting optimum performance. Chicken dominates the poultry production in India; therefore, most of the research has been concentrated in chicken to determine its critical nutritional needs for maximizing the production efficiency. As, the young chicks is an experimental animal for fundamental nutrition studies, it has also used by many research laboratories engaged in basic studies on nutritional requirements and metabolism of nutrients.

Feed accounts for major cost of poultry production (65-70% of broiler and 75-80% of layer production cost). Therefore feeding of adequate amount of balanced and wholesome feed is important for optimum production. Feed of broilers and layers are formulated to contain optimum nutrient concentration obtainable at reasonable cost for maximum growth, production and efficiency of feed utilization. For the preparation of balanced and economic feed detailed knowledge on the nutrient contents and availability in the feed ingredients used to formulate the diet is a basic requirement. The objective of feed manufacturing is to produce feed that should meet the intended specifications both in nutritional composition, palatability, and desired medication level and is free of contaminants. Nutritional evaluation of feedstuffs includes the many physical, chemical and biochemical techniques in vitro and digestibility and metabolic studies in vivo. Quality begins with a balanced ration that is being prepared to meet the target species nutritional requirements. Production of quality feed involves the procurement of feed ingredients that met specified physical and nutritional targets, correct sampling and evaluation to ensure that ingredients meet, exceed or fall short of purchasing specifications. Thus, the plan to sample and evaluate incoming ingredients is a critical step in manufacturing quality feed. For these the laboratory must be equipped with standard laboratory equipments and chemicals, and well trained personnel. Further the test methods should have been approved by standard organizations.

The most widely method of expression of nutritive value of a feedstuff is 'proximate analysis' developed by the research workers at the Weende Research Station in Germany. In this method feeds and other biological materials are partitioned into moisture, crude protein (NX6.25), ether extract or crude fat, crude fibre, nitrogen free extract and ash. Energy present in the feed is utilized for the body processes and to form the non-proteinous organic matter of the tissues and secretions. It is said that birds eat for energy. Once their energy requirement has been met, they will not consume any more feed even if the requirement for other nutrients like proteins, vitamins or minerals have not been met. This makes necessary for the nutritionist to know the relationship between energy and protein content of the diet. Measures of feed energy are important for expressing the energy needs of the chicken in feeding recommendation. When a substance is completely burnt to its final oxidation products like carbon dioxide and water, the amount of heat liberated is gross energy (GE). It is also known as heat of combustion and is usually determined by a bomb calorimeter. The portion of GE which can be absorbed by the animals depends on many factors and parts of the GE are excreted in faeces and urine (ME), and losses through heat increment (NE). In poultry both the faeces and urine voided together, therefore, metabolizable energy (ME) is the common denominator in poultry diet formulation. In poultry, dietary requirement of protein are actually requirement for the amino acids contained in the dietary protein. Therefore, amino acid rather than total protein requirement is the primary consideration of the nutritionist in formulating poultry rations. Several factors influence the amino acid composition feed ingredients. For balance and economical feed formulation, it is desirable to know the amino acid composition of ingredients to be used in the diet. Knowledge of the availability of amino acids in feedstuff is also important in formulation of diets. The amounts of amino acids that is available to the animal are often much lower than the quantity contained in feedstuffs. Many factors affect the availability of amino acids. Anti nutritional factors such as tannins in sorghum and trypsin inhibitors in soybeans reduce the availability of amino acids. Much of the latter adverse effect is due to increase in endogenous amino acid losses. Therefore digestible amino acids are superior to total

amino acids in feed formulations. Analysis of ileal contents rather than excreta is a more reliable method for assessing amino acid digestibility in poultry.

The harmful substances (anti-nutritional factors, toxins, contaminants, etc.) may be present in the feedstuffs naturally or acquired during processing, handling or storage. Different livestock species vary in their reaction to these toxic or anti-nutritional factors. When present in more than prescribed levels these substances are harmful to the livestock productivity. While formulating the It is therefore, more important for the nutritionist to take a decision on the upper or lower level of inclusion of these ingredients. Many efforts have been made to develop to detoxify these feedstuffs by either completely removing or denaturing the toxic substances or by reducing their concentration to such an extent that theses may be tolerated by the livestock.

Once the feed is digested, the hydrolysis products of digestions are absorbed through the alimentary tract into the blood stream and distributed to the cells of the body where they undergo chemical changes. Blood takes part either directly or indirectly in all biochemical processes of the body. The immune system is a network of interacting cells and soluble factors, which work together to produce immune response to kill and remove the pathogens. Nutrition is the major decisive factor which determines the expression of genetic potential of bird in terms of growth and immunity. Nutrients also influence the magnitude of antibody response and in the maturity of immune system. Interactions among various nutrients, imbalances or toxicity of nutrients lead to disturbance in normal physiology of bird and leads to growth depression and immunosuppression in chicken. Further for achieving high level of economic efficiency, poultry are raised under intensive production system in densely populated colonies or flocks during which the birds are stressed by several factors such as transportation to the growing site, overcrowding, vaccination, etc. In the modern feeding practices, feed additives are assuming a position of prime importance in poultry nutrition. Feed additives are generally added in the feed to alleviate such adverse effects, which consequently resulted in enhanced productivity.

Technologies have advanced significantly during the last decade. In the recent years the fusion of biochemistry, cell biology and microbiology to form molecular biology has led to spectacular advances in the understanding and control of biological processes. The influence of dietary nutrients (mostly amino acids) in gene and protein expression has become an important area of research. It has been shown that under conditions of amino acids under-nutrition certain genes are consequently expressed aiming to regulate amino acid homeostasis. The availability of 'omics' technologies are transforming scientific approaches to physiological problems from a reductionist viewpoint to that of a holistic view point. This is of profound importance in nutrition, since the integration of multiple systems at the level of gene expression on the synthetic side through to metabolic enzyme activity on the degradative side combine to govern nutrient availability in tissue. Protein activity is central to the process of nutrition from the initial absorption of nutrients via uptake carriers in the gut, through to distribution and transport in the blood, metabolism by degradative enzymes in tissues and excretion through renal tubules exchange proteins. Therefore, the global profiling of the proteome, defined as the entire protein complement of the genome expressed in a particular cell or organ or in plasma or serum at a particular time offers the potential for identification of important biomarkers of nutritional state that respond to alterations in diet.

Nutrition is the quantitative science that describes the process of providing the cells of the body with simple and complex molecules obtained from the external environment at the appropriate rates and ratio to optimize health, growth, production and reproduction. It encompasses the procurement of digestion, absorption and metabolism of nutrients. Quantitatively precise information on the nutrients, their digestion, absorption and transport to the cells, nutritional requirements of the poultry and nutritional value of the feedstuffs, is the subject of the book. The information provided in the publication is based on the theoretical knowledge as well as the information generated from the research conducted by the author or elsewhere for the benefit of the users.

Nutrients in Feeds and Their Functions

1

Nutrient is required for growth, maintenance and reproductive process of the body. A nutrient is a substance that an individual needs to live and grow or a substance used in an organism's metabolism which must be taken in, from its environment. Nutrients are the substances that enrich the body. They build and repair tissues, give heat and energy, and regulate body processes. The nutrients are arranged into six groups according to their chemical nature, functions they perform and the case with which they are chemically determined. The nutrients required by the chicken are

- ★ Water
- ★ Energy
- ★ Protein
- ★ Essential fatty acids
- ★ Minerals and
- ★ Vitamins

All the above nutrients are supplied to the chicken through a mixture of feedstuffs and certain supplements, i.e. the feed which are essential for optimizing growth and egg production and maintaining sound health of the birds.

I. Water

Water is the most essential nutrient. It acts as vital medium for various metabolic functions in the body. Water is a major component of blood, intercellular and intracellular body fluids and it controls homeostasis in the body regulating osmotic pressure, electrolyte concentrations and body temperature. Water plays an important role