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Price : PB Rs. 760/-, USD 40

ISBN. No. : 978-93-83397-10-0

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Saroor Nagar, Hyderabad - 500 035, India.

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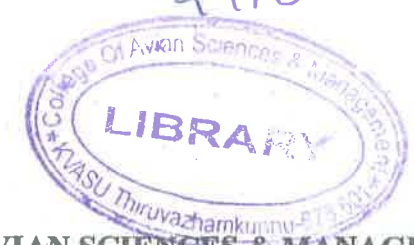


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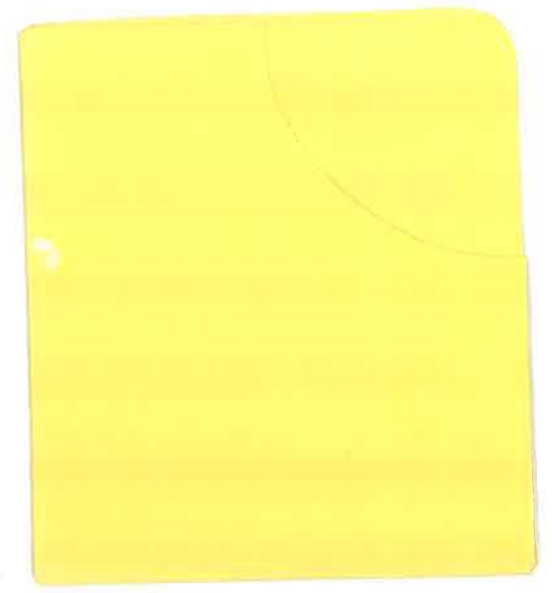
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Edited by
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Published By
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Website : www.hindpoultry.com

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HIND PUBLICATIONS

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Saroor Nagar, Hyderabad - 500 035, India.
Phone : 040-24042046, Mobile : 09391378805, 9440837109
E-mail : hindpoultry@hotmail.com ,
Website : www.hindpoultry.com

First Edition : 2014

Price Rs. 760/-

ISBN. No. : 978-93-83397-10-5

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Designed by :

Akshaya Graphics
Chikkadpally, Hyderabad.

Printed at :

Akruthi Offset Printers
Chikkadpally, Hyderabad.

Preface

Poultry sector in India has made tremendous growth and transformed itself from the age-old backyard farming into a dynamic agri-based industry. India is the third largest producer of eggs and fifth largest producer of poultry meat in the world, producing 70 billion eggs and about 3.45 million tons of poultry meat annually. Indian poultry sector has been growing at around 8-10% annually over the last decade with broiler meat volumes growing at more than 10% while table egg at 5-6% driven by increased domestic consumption. Consistent with increase in productivity, the annual per capita availability also increased to 61 eggs and 3.1 kg of meat. The production capacity has responded with increased integration and large scale implementation of contract poultry farming. The poultry industry has been supported by advancements in genetic capabilities, veterinary health, feed, equipment, and processing sectors. The demand for poultry products such as meat and egg is rapidly increasing due to changing food habits, higher purchasing power, urbanization, increasing health consciousness towards protein rich diet, preferred meat due to religious preferences, etc over the years.

Consumer's demand for animal protein and breast meat has made broiler chicken production as one of the fastest growing segment of the livestock industries around the world. Due to the progress and advances in genetic selection, modern-day commercial broilers have fast growth rate and high feed conversion. The broiler chicken have gained about 700-800 g more weight (about 1600-2000g in 1990's and 2400-2600g today) and about

0.4-0.5 point's improvement in feed efficiency (about 1.9-2.2 in 1990's and 1.6-1.7 today) during the last two decades. Such improvements poses a challenge to all those concerned with poultry industry to fully exploit the genetic potential. Several new approaches have surfaced to optimize the performance of the broilers and also to optimize the profitability out of it. This includes manipulation right from the embryonic stage and continues to the age of marketing. The purpose of the book is to educate the researchers, academicians, students and entrepreneurs on the new developments happened in the poultry, especially in the broiler sector.



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INTRODUCTION

Poultry rearing, the world over is either for meat or egg production. Broiler is a class of poultry for meat production. Indian broiler 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 broiler varieties together with standardized package of practices have contributed to spectacular growth in meat production. This could be the reason that broiler industry is growing at 8 to 12% annually. Today, India is proud to be the 5th largest producer of poultry meat in the world. The broiler meat production in India was less than 1 million tonnes in 2000 and has reached 3.4 million tonnes during 2012. This is an increase of 350% over the last 10 years. However, the per capita availability is still 3.2 kg against the suggested requirement of 11 kg poultry meat. So broiler industry has to grow three fold to meet the requirement. Different estimations stated that broiler meat production in India will reach 6 million tonnes in 2015, but a more realistic figure would be 4.4 million by 2020.

Success in poultry production rests primarily on the genetic potentiality of the bird. Management, Health and Nutrition should be proper to express the genetic potentiality. Nutrition is the key player as 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 rearing for optimum meat production. In case of broiler the main thrust is to improve growth. Today broilers chickens grow to 2.4 kg by 40 days of age with almost 50 folds growth

compared to 45-50g day old body weight. Thus broiler chickens employed in organized production system grow much faster and thus 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.

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. 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. The digestion and absorption of nutrients is important in poultry because of relatively small gastro-intestinal tract which requires less passage time for the nutrients to travel through the tract. It takes only 4 hours for the food to travel down from the mouth to the colon. Within this short span, the nutrients have to be broken down and absorbed effectively. The objective of nutrition is to provide all essential nutrients in adequate amounts and in optimum proportion. 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. Lot of research has been conducted on chicken in an effort to determine its critical nutritional needs for maximizing the

production efficiency. Poultry producers, nutritionists and geneticists are aware of the challenges being made to the poultry industry.

In India, more than 60% of broilers are produced in 5 states (Andhra Pradesh, Karnataka, Maharashtra, Punjab and West Bengal). The challenges for Indian broiler industry are multiple. Availability of raw materials and prices are major issue. Considering about 1 kg of maize required to produce 1 kg of broiler (based on feed conversion ratio of 1.65 and 60% maize in diets), an additional 1 to 3 million tonnes of maize is required, for broiler industry only. Similarly, soybean meal requirement is 3.6 million tonnes for broiler industry in India (considering 25-30% inclusion in broiler feed). The cost of soybean meal has increased considerably over the years which possess a major threat to the progress of poultry industry. Global compound feed production is estimated around 900 million tonnes, out of which more than 30% are in Asia. Today Indian broiler industry requires about 12 million tonnes of feed. Indian feed and meat businesses have to face serious challenges if the expansion of 8 to 12% will continue due to its vast population (India counts about 1.22 billion citizens and 17.5% of total world's population) and shrinking arable land (India occupies only 2% of world's total land, and slightly more than 7% of the arable land available). Thus it is high time that Indian agriculture must be more efficient (production per unit area should increase).

Significant development in the genetic selection of the meat type chickens has led to fast growth, improved feed efficiency and attaining the market weight in a shorter period. Decreased age to market of commercial broilers, thus, increased the importance of the incubation period

and makes it larger percentage of the overall growth period. It is expected that anything that supports or limits growth and development during the incubation period will have a marked effect on overall performance and health of poultry. The development of an embryo inside the chicken egg is a fascinating process of transformation of chemical components into a living organism in 21 days. Many factors influence the development and viability of embryos and hatchlings. Incubator temperature that is currently used (37.5°C) may promote oxidative stress and lipid peroxidation in the fast-growing broiler chick embryo with a high metabolic rate. The increase in oxidative stress may promote lipid peroxidation and may compromise antioxidant status of the embryo and hatchling. Therefore, reducing oxidative stress during embryogenesis through thermal manipulation and diet may compromise antioxidant status of the developing chick embryo. During chick embryo development, there exists an antioxidant balance in tissues which supports normal embryonic development and post hatch chick viability. Chick viability is an important factor in determining post hatch health and profitability. The days immediately before and after hatch is a critical period for the development and survival of commercial chickens. Approximately 2-5% of hatchlings do not survive the critical post hatch adjustment period and many survivors exhibit stunted growth, inefficient feed utilization, reduced disease resistance or poor meat yield. These limitations can be alleviated by the administration of nutrients in the amnion of the late embryo (*In Ovo* Feeding) or by administration of nutrients in the hatchery immediately post-hatch (Early Nutrition). Since the modern broiler increase its body weight by 50 fold (2.4 -2.6 kg) from

hatch until market age (42 days), the first few days of adjustment have a great impact on overall growth and well-being of the bird.

Nutrition plays an important role in expressing genetic potentiality of the bird. A good start is critical to achieve optimum potential in broiler chicks. To achieve the genetic potential, the neonate must quickly adapt to efficiently digesting and utilizing nutrients from relatively exogenous dietary sources. The nutrient requirements are very high during first few weeks of life, whereas the capacity to digest the feed and absorb and transport nutrients is limiting. The nutrient at this stage should be designed to stimulate early gut development, promotion of gut micro flora and immune system development. Of all the dietary components, the most expensive and critical are energy and essential amino acids which accounts for over 90% of the total feed cost. Provision of adequate amount of balanced and wholesome feed is important for optimum production. The nutrient requirement of broiler chickens varies according to the stages of growth (pre starter, starter, grower and finisher). During rearing, broilers are allowed to consume feed on an ad libitum basis to ensure speedy development to market size. In commercial nutrition and in research studies, metabolizable energy (ME) is the standard measure of energy used in describing energy requirements and diets for poultry. Protein and amino acids (AA) are one of the most expensive nutrients in broiler feed and formulating the diets with the correct level of AA is important for optimizing the broiler production. Besides formulating the diet with the balanced protein and AA, the quality of such proteins and AA are important. Rapid development in biotechnology has provided new opportunities to enhance

the productivity and efficiency of livestock and poultry through development of a number of feed additives. Feed of broilers should be formulated to contain optimum nutrient concentration obtainable at reasonable cost for maximum growth and efficiency of feed utilization.

Maize and soybean meal form the major source of energy and protein in the diet of broiler chicken. Assuming the continuation of current growth of poultry sector in India, the gap between supply and demand will fuel the prices and there will be need for technology adoption and imports to fulfill the gap between the demand and supply. This increase will surely increase the cost of production of meat and reduce the profitability. In the coming times, poultry has definitely to look beyond maize and soybean meal because of its availability, cost and also maize-soybean production cannot keep pace with the ever-increasing poultry production. The advancement of knowledge in molecular genetics has opened new window for improving broiler production performance both through application of genomics selection for genetic enhancement and through nutrigenomics research to optimize the nutrient utilization efficiency in broilers. It is now realized that identifying the unique interaction between nutrition, physiology, genetics, immunology, environment and health and the changes that occur at molecular level will further help in understanding the mechanism and identifying potential methods for applying this research for profitable poultry production. Nutragenomics, which is the study of interaction between dietary nutrients and gene expression, is one such important area in poultry production. This is an exciting time for the biological scientists as the omics era continues to evolve and shape our lives in the future.

Poultry meat supply high quality and readily digested protein and energy and they are a compact source of readily available micronutrients. Today, consumers are more interested about the nutrient content of foods and how this impacts their health. Thus food products enriched with beneficial components, which can prevent or ameliorate disease progression process, are the need of the day. Thus, interest in modifying the nutrient composition of meat has been extended beyond production to design high quality food for healthy human system. The major emphasis has been focused on omega-3 (ω -3) fatty acids, conjugated linoleic acid, α -tocopherol, and selenium. Incorporation of health promoting nutrients to chicken meat could lead to novel products development (functional food) that influence one or more functions of the consumer in a favorable way, exceeding the effects of normal adequate nutrition. Value added functional foods can be produced through the modification of the conventional production systems and usually by modifying the bird's diet.

Heat stress is one of the major stressors for broiler production in tropical countries like India. This rapid growth and increased productivity in broilers have created a greater physiological strain on the bird, encouraging metabolic diseases like Sudden death syndrome, Pulmonary hypertension syndrome (Ascites), and Skeletal disorders. For optimal performance of broilers placement of lights in the poultry house is important. Mycotoxin contamination of poultry feed is more concern in developing countries like India due to lack of proper agricultural practice, storage and processing conditions. Public concerns over food safety from the food of animal origin is a cause of global concern in the recent years

due to problems such as bovine spongiform encephalopathy (BSE), dioxin and melamine contaminations, microbial resistance to antibiotics and outbreak of food borne bacterial infections (food poisoning). Thus, several challenges are being surfaced in the broiler industry, today. An attempt has been made in the book to provide comprehensive information on the advances made in the field of broiler chicken nutrition for the benefits of poultry farmers, feed manufacturers, students, teachers, researchers and all those associated with poultry enterprises. The information provided in the publication is based on the theoretical knowledge as well as the information generated from the research conducted by the various author or elsewhere for the benefit of the users.



Embryonic Development and Antioxidant Defense System in Chicken

1

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Commercial broiler breeding programme are aiming at getting maximum healthy chicks with high growth rate. Continuous genetic selection of broilers for fast growth has resulted in shortening the marketable age from 42 to 35 days of age. Thus, modern broiler chickens spend more than 30% of their total life span inside the egg (Hulet et al., 2007). Anything that affects growth and development during embryonic period can have a marked effect on overall performance during the post hatch period. Thus, understanding the changes that occur during embryonic development and factors that can enhance its development and function is essential to trigger better performance in young chickens. The development and viability of embryos are limited by the nutrient content of the egg needed for the development of the embryo and body reserves through to hatch.

The development of an embryo inside the egg is a fascinating process of transformation of chemical components into a living organism in 21 days. The increase rate of surviving at the end of the incubation period is very important for poultry