# "TO STUDY THE EFFECT OF FEEDING DIFFERENT LEVEL OF ENERGY AND PROTEIN IN VANARAJA STRAIN OF BROILER"

# THESIS

SUBMITTED TO THE

**BIHAR AGRICULTURAL UNIVERSITY**

(FACULTY OF POST-GRADUATE STUDIES)

SABOUR (BHAGALPUR) BIHAR

IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF

MASTER OF VETERINARY SCIENCE

(Animal Nutrition)

*By*

**DR. SHAHLA PERWEEN**

Registration No. M/ANN/74/BVC/2012-13

**Department of Animal Nutrition**

BIHAR VETERINARY COLLEGE

PATNA (BIHAR)

**2014**

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**2014**

# DEPARTMENT OF ANIMAL NUTRITION

## BIHAR VETERINARY COLLEGE, PATNA - 14

**Bihar Agricultural University, Sabour (Bhagalpur)**

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## CERTIFICATE - I

This is to certify that the thesis entitled "**To study the effect of feeding different level of energy and protein in *Vanaraja* strain of broiler**" submitted in partial fulfillment of the requirements for the Degree of Master of Veterinary Science (**Animal Nutrition**) of the faculty of post-graduate studies, Bihar Agricultural University, Sabour, Bhagalpur, Bihar is the record of bonafide research work carried out by **DR. SHAHLA PERWEEN,** Registration No. **M/ANN/74/BVC/2012-13,** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

It is further certified that the assistance and help received during the course of this investigation and preparation of the thesis have fully acknowledged.

**Endorsed**

28/5/2014
(.......................................)
Chairman / Head of Department

Kaushalendra Kumar 28/05/2014
**(Dr. Kaushalendra Kumar)**
Major Advisor

# DEPARTMENT OF ANIMAL NUTRITION

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# CERTIFICATE - II

We, the undersigned members of the Advisory Committee of **DR. SHAHLA PERWEEN,** Registration No. **M/ANN/74/BVC/2012-13**, a candidate for the Degree of Master of Veterinary Science with major in **Animal Nutrition** have gone though the manuscript of the thesis and agree that the thesis entitled **" To study the effect of feeding different level of energy and protein in *Vanaraja* strain of broiler "** may be submitted by **Dr. SHAHLA PERWEEN** in partial fulfillment of the requirements for the degree.

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# DEPARTMENT OF ANIMAL NUTRITION

## BIHAR VETERINARY COLLEGE, PATNA - 14

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## CERTIFICATE - III

This is to certify that the thesis entitled " **To study the effect of feeding different level of energy and protein in *Vanaraja* strain of broiler**" submitted by **DR. SHAHLA PERWEEN**, Registration No. **M/ANN/74/BVC/2012-13,** in partial fulfillment of the requirements for the Degree of Master of Veterinary Science **(Animal Nutrition)** of the faculty of post- graduate studies, Bihar Agricultural University, Sabour, Bhagalpur, Bihar was examined and approved on 11/7/2014

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Dedicated

To

My Respected

Parents
&
Teachers

# ACKNOWLEDGEMENT

*To investigate the role of different level of energy and protein on the performance of vanaraja strain of broilers and its presentation in form of thesis was a challenging and very exhaustive task. In the completion of this work I have received invaluable suggestions, encouragement, co-operations and help from different sources.*

*It is my sincere duty to express my deep sense of gratitude to those who cooperated me in the presentation of this manuscript.*

*I acknowledgement my profound indebtness to my esteemed and major advisor Dr Kaushalendra Kumar, Asst. Professor , Deptt of Animal Nutrition, Bihar veterinary College, Patna for his intellectual and academic support, continuous guidance, constructive suggestion, close supervisions, keen interest and healthy criticism, during the period of study, culminating in the completion of this work, without his effort this thesis will never be done.*

*I express my deep sense of gratitude and obligation to Dr. Chandramoni, chairman, Deptt. of Animal Nutrition, Bihar Veterinary College, Patna for his keen interest, invaluable suggestions and immense help during the period of investigation.*

*I am also thankful to other members of advisory committee, Dr. Amitabh Dey, Hea and Principal Scientist, RCER, ICAR Complex, Patna, Dr. Satyadeo Kumar, University Professor, Department of Livestock Production and manegement, Dr. Manoj Kumar Astt. Professor, Deptt. of Veterinary Microbiology, Bihar Veterinary College, Patna, and Dr. S. Samantaray, University professor & Chairman and dean PGS nominee*

Department of Parasitology, Bihar Veterinary College, Patna for their guidance.

I am also highly obliged to Dr. Sanjay Kumar, Asstt. Professor, Deptt. of Animal Nutrition, Bihar Veterinary College, Patna for providing invaluable cooperation during the period of experiment.

I would like to express my deepest gratitude to Dr. Ajeet Kumar and Dr. Anil Gattani, Asstt. Professor, Deptt. of Biochemistry, Bihar Veterinary College, Patna for their immense contribution and moral support in conducting this work.

I am also highly obliged to Dr. K.G. Mandal, Assoc. Professor, Department of Animal Breeding & genetics, Bihar Veterinary College, Patna, Dr. Sushma Kumari, Asstt. Professor, Department of LPT, Bihar Veterinary College, Patna, Dr. S.R.P Sinha, University Professor, Department of Veterinary parasitology, Bihar Veterinary College, Patna, Dr. Ajit Kuamr, Asstt. Professor, Department of Veterinary parasitology, Bihar Veterinary College, Patna, Dr. Raviranjan, Asstt. Professor, Department of LPM, Bihar Veterinary College, Patna.

My appreciation goes to respected Dr. M.K. Chaudhary, Principal, Bihar Veterinary College, Patna, for invaluable support during the course of my studies.

My sincere thanks also go to Dr. R.P. Sharma, Ex-Director, Poultry Directorate Project, Hyderabad, who helped me in various ways during the period of experiment.

I am also indebted to staff of ILF,BVC, Patna for providing facilities to conduct this investigation.

*Also, deeply grateful to non-teaching staffs of Deptt. of Animal Nutrition , who gave me their time and energy to help during the experiment.*

*I express sincere gratitude to every member of my family for their affectionate inspiration and everlasting endurance, sacrifice and moral support during my study.*

*Lastly, I express my deep sense of gratitude to Almighty God , whose kindness and favor helped me to complete this challenging task.*

**Date :** 11/7/14

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**Place : B.V.C., Patna** **(SHAHLA PERWEEN)**

# ABBREVIATION

| | | |
|---|---|---|
| Ab | : | Antibody |
| Ad - lib | : | Ad libitum |
| AGPT | : | Agar gel precipitation test |
| ALT | : | Alanine Transaminase |
| ANOVA | : | Analysis of variance |
| AOAC | : | Association of Official Analytical Chemist |
| ARC | : | Agriculture Research Council |
| BIS | : | Bureau of Indian Standards |
| B. wt. | : | Body weight |
| Ca | : | Calcium |
| C : P | : | Calorie : protein |
| CP | : | Crude Protein |
| d.f. | : | Degree of freedom |
| D P V | : | Days post vaccine |
| DM | : | Dry matter |
| DROB | : | Deoiled rice bran |
| E | : | Energy |

| | | |
|---|---|---|
| e.g. | : | For example |
| EDTA | : | Ethylene diamine tetra acetate |
| EE | : | Ether extract |
| FCR | : | Feed conversion ratio |
| GDP | : | Gross Domestic Product |
| HA | : | Haemagglutination |
| Hb | : | Haemoglobin |
| HDL | : | High Density Lipoprotein |
| IBD | : | Infectious bursa disease |
| IBDV | : | Infectious bursal disease virus |
| IU | : | International Unit |
| J | : | Joule |
| Kcal | : | Kilo calorie |
| Kg | : | kilogram |
| Kcal | : | Kilocalorie |
| Lb | : | Pound |
| LDL | : | Low density Lipoprotein |
| ME | : | Metabolisable energy |
| MT | : | Metric ton |
| P | : | Protein |
| PBS | : | Phosphate buffer saline |

| | | |
|---|---|---|
| PCV | : | Packed Cell Volume |
| PI | : | Performance Index |
| P | : | Phosphorus |
| SPSS | : | Statistical Packages for Social science |
| T | : | Treatment |
| TG | : | Triacyl glycerol |
| VLDL | : | Very low density lipoprotein |
| % | : | Percent |

# CONTENTS

# LIST OF TABLES

# CHAPTER -1

# INTRODUCTION

# INTRODUCTION

In present scenario poultry farming is gaining strength with fast pace of development both in developed and developing countries, especially in India where 67% of the population is dependent upon agriculture and its allied for their livelihood security. Poultry farming promises a great scope to mitigate the challenges of poverty alleviation, women empowerment, income generation, employment generation, improvement in standard of living, employment to unskilled, illiterate women, landless farmer, small land holding farmers and laborers, respectively.

India has one of the world's largest and fastest growing poultries industries, ranking third in hen production and fourth in broiler meat production (ICRA - 2011). According to annual report 2011-2012, Department of Animal Husbandry, Dairying and fisheries, Ministry of Agriculture, Government of India , poultry population in India is 648.9 million with annual growth rate 7.33% and contribution of poultry industry to GDP is 6.4% annually. It is the one and only industry to meet the ever growing demand of human population in our country for nutritious food product like meat and egg.

As per ICRA, 2011 report, Indian poultry sector has been growing at around 8-10% annually over the last decade and at more than 15% in last three years. India's per capita consumption of poultry meat and eggs are estimated at around 3 kg per annum and 51 eggs per annum respectively. Broiler meat production in India is around 3 million metric tons while broiler meat market is estimated around Rs. 30,000 crore.

Industry estimates suggest that broiler meat consumption will double by 2014-15 (Global Agricultural Information Network (GAIN) Report 2011).

According to Bihar Basic Animal Husbandry statistics 2012, poultry population estimated to 14 million and ranked 6th among other state of India. In egg production its rank is 15th and in per capita availability of eggs it is 26th in position and only 8 eggs /head/annum are available, where as Andhra Pradesh and Tamilnadu are leading producer of chicken egg. Bihar is lagging behind in poultry census in India. Poultry production in Bihar is going momentum of popularity and population has increased up to fourteen million in Bihar.

The traditional diet of the majority of rural people is moderate in energy and low in protein, because of more use of cereals and restricted use of costly food items like fish, meat and egg are restricted. The vegetable protein sources used by the village households are deficient in critical and, essential amino acids like lysine and methionine which in turn can cause protein malnutrition in them. Feeding of diets deficient in quality protein sources like chicken egg, meat and other products of chicken origin exposes them particularly pregnant women, feeding mother and growing children to many common diseases. Backyard poultry farming can perform well in village conditions to improve the nutritional status and economic condition of rural poor. Eggs and birds can be used at home level, as well as it can be sold in premium prices even in urban market where considerable demand for backyard produced egg and birds. The backyard breed namely *Vanaraja* developed by Project Directorate of Poultry (PDP), Hyderabad are very well acclimatized to village climate with good growth and moderate egg production as per the performance study conducted in our research unit as well as in farmer's field. Because of their attractive feather colour they looks like desi bird but their growth and egg productions are far better than desi local breeds. Particularly these backyard breed is resistant to some common poultry diseases also. A desirable character i.e. long shank introduced in this breed helps them for faster movement to escape from predators in the backyard condition; the parents of Vanaraja are selected for higher general immunity.

Vanaraja strain of broiler gaining popularity among farmers in Bihar because of low requirement, however, there is no systemic study in Bihar on this strain for different level of energy and protein. Vanaraja strain of broiler is introducing in Bihar to promote backyard poultry farming among the landless and marginal farmers. Backyard poultry farming is going wider importance and acceptance among rural people as a source of income generation and supplementary livelihood activity. Net profit to the farmer is also higher because Vanaraja strain of broiler needs low input rearing. The two essential components like protein and energy costs about 90% of the total feed cost which should be utilized most efficiently for the shake of desired economy of broiler production and formulation of poultry ration. These two requirements are influenced by age, strain, breed and season. Earlier work indicated that the metabolizable energy requirement of Vanaraja chicks during 1 to 42 days of age was much lower than for commercial broiler/layer chicks (Rama Rao et al., 2005). The protein and energy requirement of these birds for the same periods are however not known. So, keeping in view, the present study was undertaken to investigate the effect of different level of protein and energy sources on Vanaraja chicks during 1 to 56 days of age with following objective.

(i) To study the effect of feeding different dietary level of energy and protein on growth performance and feed efficiency in Vanaraja strain of broiler.

(ii) To study the carcass characteristic of broilers fed with different level of protein and energy.

(iii) To study the immune status of broiler fed with different level of protein and energy.

(iv) To study the effect of feeding of different level of energy and protein on hematology and lipid profile in blood of Vanaraja broiler.

(v) To study the effect of feeding of different level of energy and protein on economics of broilers production.

# CHAPTER -2

# REVIEW OF LITERATURE

# *REVIEW OF LITERATURE*

The position of poultry meat and egg supply has relatively increased in the recent year. It is expected that major part of increased demand for animal product in the future has to be met by increased poultry supplies. Presently the major contributor of poultry meat are broiler. *Vanaraja*, a dual purpose chicken developed at Project Directorate on Poultry (PDP), Hyderabad can grow well under backyard / free range condition with low input. Backyard poultry farming is going wider importance and acceptance among rural people as a source of income generation and supplementary livelihood activity among the landless and marginal farmers .

From the various studies under taken in our country it has been observed that feed formed the single largest component of poultry production. As indicated by Parthasarthy (1996) that the next major item of cost in broiler was chick which accounted about 25 to 30%,while these approaches were found to be beneficial pullet but the performance of growing *Vanaraja* strain of broiler is different and needs low input. Since, no definite and separated standard recommendations for the requirement of growing *Vanaraja* strain of broiler, only a few works has been reported in the literature are available on the basis of individual experiment. From the available limited information indicate that the growth rate and feed efficiency could be improved by providing lower nutrient level to the existing rations usually fed to broiler.

The subject will be reviewed under the following heading.

A. Requirement of energy and protein and their ratio for optimum performance.

B. Nutritional effect on carcass yield

C. Miscellaneous

## A. Requirement of Energy & Protein & ratio for optimum performance

Requirements of energy and protein could be expressed as independent absolute units of the diets or as the requirement of dietary available energy carrying protein as its function (ME:CP ratio).The latter view holds good .Concept of feeding high energy diet to broiler originate with the reports of Scott *et al.*(1947). They demonstrated that both growth rate and feed efficiency were improved by feeding diets high in digestibility and energy concentration. Sunde (1956) found depressed growth rate and feed efficiency on low energy and high protein ratio which could be improved through increase of energy such diet. Hill & Dansky (1954) found that over a wide range of dietary energy concentration chicken tended to eat in order to satisfy their energy requirement. At very low energy concentration the chicken may not meet its energy requirement and at high energy concentration consumed more feed than its required for maximum growth and the excess may be deposited as fat ( Donaldson,1955). However, and excess of production energy in relation to the amount of protein in the diet depresses the growth and decreases the efficiency of feed utilization. Sibbald (1962) reported that as the ME consumption increases the weight gain of birds will increase in protein consumption. contrary to these findings Spring and

Wilkingson (1957) fed 22, 25 and 28% diet having1200,1350 and 1550 kcal ME/lb and observed as the dietary energy was increased there was effect on gain while increasing protein level had no effect of gain. these observation suggest that such variation in body weight gain should have been associated with the differences in calorie protein ratio in various diet .Summer *et al* (1963)confirmed that the utilization of protein increased with the level of energy in diet. Fisher and Wilson (1974) have shown that the ME/kg broiler show linear response in weight gain, feed intake, feed conversion efficiency and energy intake.

Farrel *et al.*(1973) fed high diets to broilers having ME concentration ranging from 2.3 to 3.36 M cal/kg diet. birds on a diet with medium energy concentration (3.1 M cal/kg) require slightly less ME than those on other diet and reached the required live weight earlier. They conclude that feed intake was found to be inversely related to the energy concentration but the ME required to reach a given live weight was quite similar. Moran(1971) found that 1400 kcal ME/lb gave better results in terms of growth, feed utilization of the ratio having 1200 and 1000 kcal /lb.

Virk *et al.*(1976) evaluate energy requirement at constant protein level (22%) with ME ranging from 2300 to 3800 kcal ME/kg. Their results indicated a requirement of 2900 kcal ME/kg diet in summer and 3200 kcal. ME/kg in winter and increasing ME beyond this level gave lower body weight gain. Explanation of this view was given that chicken performance better lower dietary energy level in tropic because of high environmental temperature which probably calls for lower energy need to maintain basal metabolism. Chicken depend mainly on protein for building tissue. The sources of protein and energy its content in the diet are important consideration in determining the exact percentage required.

Reports are available that higher level of protein are of advantage and conversely that satisfactory performance may be achieved with lower levels of protein. It is desirable to relate the level of protein to that energy of the ration if protein and adequacy is to be assured. According to Spring and Wilkinson (1957) increasing dietary level 22% to 28% had no effect on gain, on the other hand Sibbald et al. (1962) reported increase in weight gain of birds with the increase in protein consumption which may be due to different in calorie protein pattern. Reports are available that the efficiency of protein utilization was improved at constant energy level as the protein content of diet decline. Han(1970) observed a better weight gain when 21% protein was fed in starter diets than 19% protein in finisher diet. According to Wisman and Beane (1966) increased protein level improved the feed efficiency but cause a decreased in protein utilization based on body weight.

From the experiment conducted by various scientists it has been observed that the protein requirement for poultry increases as the energy content of diet increases and that the requirement can no longer be expressed as percentage of die but be expressed as energy protein ratio. Birds on low energy ratio consume more of feed to satisfy the energy requirement and thus take more of the protein also which is used up for energy purpose instead of actual deposition in body. Due to imbalance in feeds having too wide energy and protein ratio, the growth rate is affected. It is, therefore very important to balance the energy protein ratio in the formulation of poultry ration in such a way so as to get maximum production with less wastage. It is generally accepted now that for each type of bird at each stage or phase of production, there is optimum dietary C:P ratio. Work of Hill and Densky (1954) illustrated that need for expressing nutrient requirement (including that of protein) is largely determined by energy concentration.

Studies also indicated that as the concentration of ration was increased the percentage of protein required for feed efficiency of growth also increased. Reddy *et al.* (1972) employed various dietary protein levels ranging from 19 to 22% with a constant C:P ratio 132Kcal ME/ kg and concluded that 20% protein level was adequate for layer type starter chicks. Malik et al.(1966) conducted investigation under tropical condition to study the different levels of energy and two level of protein( 20.5 and 24.5%) in white leghorn chicken. An ME and P ratio of 130 at 24.5 % level was found to be optimum when both the growth rate and feed efficiency were taken into consideration.

Sadagopan *et al.* (1971) observed that growth response of laying type starter chicks was improved as the level of protein was increased from 19 to 21% while 21% dietary protein level at 2717 Kcal ME/kg with a ratio 1:123 gave the maximum weight. Widening the ratio beyond this protein level showed slight depressing effect on growth at 8th weeks.

Information's about the exact requirement of protein and energy. No standard recommendation pertaining to dietary protein and ME requirement of these birds for profitable meat production are available as not much work has been done with eggs type chicks. The energy and protein required for egg type chicks( 0-6weeks) should be 2900 kcal ME/kg and 20% CP respectively as recommended by NRC (1971), ISI (1968) and Panda (1972), have recommended 20% protein in chick ration. The optimum C:P ratio ranged from 138 to 145.2:1 for chicks as recommended by Malik (1966). High energy and high protein diet had positive effect on growth rate and feed efficiency Sibbald *et al.* (1961) O' Niel *et al.* (1962) observed that the excess of protein in relation to energy did not adversely affect either growth rate or feed efficiency but resulted in wastage of protein Haque and Agarwal (1975) employed different energy protein ratio (171.8 :1, 137.5 : 1, 128.2 : 1 and 114.4:1) at 4 level of protein (16, 20, 22, 24%) for 8th weeks in egg type chicks to determine the optimum energy and protein ratio. They obtained greater body weight gain with ration containing 23% protein having energy and protein ratio 128.2. They noticed no significant difference in feed consumption but improvement in feed efficiency with increased protein level and decreased energy and protein ratio of ration. Sheriff *et al.*(1981) studied the effect of feeding different dietary level of crude protein and ME on performance and economics of white leghorn male chicks. They formulated diets to contain 20% crude protein with 2400, 2500 and 2700 ME/kg of feed and 23% and 26% crude protein with 2400 and 2500 ME/kg of feed for a period 0-10 weeks of age. Birds reared on 27% CP and 2470 Kcal/kg had highest body weight gain and best feed efficiency. They concluded from their results that birds reared on 21% to 24% CP with 2400 to 2500 Kcal ME/kg at 10weeks of age were economical. They also suggested that the diet with high protein and low energy (28% CP with 2470 ME/kg) may be fed when the prevailing cost of protein supplement will be lower.

Okosum (1987) recommended 21% CP 2700 Kcal ME/kg for the growing cockerel in tropics. Bomgbose (1999) endorsed the recommendation as given by Okosum (1987) by feeding cockerel chicks a diet with 21% and 2700 Kcal ME/kg by replacing meat meal with maggot meal.

Sudhakar *et al.* (1988) studied the comparatively economics in production of broiler and W.L. cockerel fed two different C.P.(20 and 22) and two energy (2700 and 2900 Kcal ME/kg) level up to 8th week of broiler up to12th week of cockerel. They reported from their results, that the broilers males gained 108% more than W.L.cockerel and also consumed 40% more than cockerel. They recommended a dietary protein of 22% with 2900 Kcal ME/kg was necessary for optimum performance for both broiler and cockerel. They further noticed that the variable cost increased with age in broiler and fixed cost decreased with age. However, age did not influence the variable and fixed cost in cockerel.

Eruvbetine *et al.* (1996 ) while including cassava as an energy source in cockerel diet, found that cockerel fed diet having 19% C.P. obtained a body weight about 575g at 6th weeks and 1170g at12th week with a feed efficiency 2.77 and 4.43 respectively. Butala and Rajagopal (1991) formulated cockerel diet based on boiled rice bran with the graded levels of tallow with a protein content of about 25% and energy from 2600 to 2900 Kcal ME / kg obtained the maximum live weight gain (902)g at 12th weeks of age with feed efficiency ratio of about 3.5:1.

Morris and Njuru (1990) compared the responses on male broiler chicks and male chicks of an egg laying stocks on different diet containing different levels of protein ranging from 16.0 to 25 % and ME content 13.0MJ/ kg .They concluded from the experiment that male layer chicks needed at least 18.8% crude protein to maximize their live weight gain. The maximum efficiency of conversion of food to live weight were achieved with a diet containing 23% crude protein . The efficiency of protein utilization was found to be same in both male broiler chicks and male chicks of layer strain.

Vala *et a*l. (1996 ) fed rations containing 20% crude protein and 2700 Kcal ME /kg to day old male chicks of laying strain for a period of 7th weeks. During that period the cockerel achieve a body weight gain of 680g with a feed efficiency of 1:30 and average gain per week was found to be 97.09 gram. They advocate that cockerels which are considered as unproductive in the commercial hatcheries can be made productive and valuable by poultry keeper .

Elangovan *et al.* ( 1996) conducted a balance study to evaluate the response of 9th weeks old chicks from three genotype viz. A high laying strain of WLH and indigenous breeds Ascel and Kadaknath to utilize nutrients from high or low nutrient density (20% CP and 11.71 MJ ME /kg and 15% CP and 10.00 MJ ME /kg ) . The mean daily feed intake in both type of diet did not differ but a higher body weight gain and feed conservation ratio were obtained on the diet with a higher nutrient density .

Gheisari and Gollian (1996) used varied energy and protein level in diet during rearing period in layer strain of chicks containing there level of energy 2900,2700 and 2500 Kcal ME/kg and three level of protein (80%,100%and 120% of NRC recommendation) .An improvement in feed consumption ,energy and protein intake ,daily gain and feed conversion ,was observed a consequence of protein increases in ration .

Pathak and Netke (1996) studied the effect of maize verses sorghum on utilization of ME in WLH male and broiler chicks at a period of 7 - 21 and 21-42 days of age . The ME used for maintenance was found to be much higher in WLH chicks as compared to broilers.The type of diet did not influence the performance of WLH chicks and these chicks tended to divert lesser quantity of surplus energy of fat deposition than that of broiler. This is an advantage to those health conscious consumers who prefer lesser fat in meat of poultry .

Ulmek *et al.*(1996) studied the growth performance of make chicks of strain with broiler starter ration and broiler finisher ration .They obtained an average body weight of cockerel at 10 week of age as 1026 g with an overall feed conservation ratio of 1 :3.69 .

Fan and ye (1997) in a study on growth curve and maximum profit from egg type cockerels obtained the body weight of growing cockerel around 750 g at 9th week of age by a diet which provided 11.0 MJ ME /kg and18.5% crude protein from day old to 6th weeks of age and from 6th weeks onwards on a diet containing 11.55 MJ ME / kg of ME and 16.0% crude protein . They also indicated that allow a large number of surplus growing cockerels chicks could be made profitable by equating growth curve, feeding cost and market price of layer type cockerel chicks .

Thus it is advisable that the cockerel which is at present regarded as unproductive by poultry keeper should be paid more attention by devising the way for its improvement in growth rate in order to attain marketable weight at shortest possible time which will enable this rejected lot to a profitable one .

**B.Natritional effects on carcass yield and quality**

The progressively increasing demand for chicken of uniform size and composition has stimulated the formulation of rations to give specific weights and body composition at marketing. Trends are in a way to produce chicken with less body fat and more lean meat as excessive body fat can pose waste management problem. Thus it has now become increasingly important to consider not only weight gain and feed efficiency of meat type chickens but also their carcass composition.

Marked changes in body composition can be achieved by altering protein and energy levels in the ration (Donaldson, *et al.*, 1956). Dansky and Hill , (1952) indicated that birds fed a high energy ration deposited more fat on the carcass than did birds on a moderate energy ration. As the content of both protein and energy was reduced the carcasses became progressively poorer in fleshing and finish. In an earlier experiment (Donaldson , *et al.* 1955) observed that ratio of pE and crude protein in ration influenced percentage of water and ether extract in carcass. When ration ranging from 35.7 to 48.6 calories pE /1b for each percentage crude protein were fed to chicks up to weeks the moisture content carcass ranged from 70.6- 67.2 % and ether from 5.6 - 9.4 % despite no increase in growth rate . In other words the carcass quality could be influenced in the absence of alteration of gain. Leong *et al.* (1955) found an increase in weight of visceral depot fat in broilers as the energy content of the diet was increased. Harms (1955) observed that birds receiving a diet containing 6.3 % stabilised yellow grease had a greater deposition of abdominal fat than did those birds receiving no supplemental fat. In a later experiment Harms, *et al.* (1957) found that as the energy level of the diet was increased from 793 Kcal to 978 Kcal pE/ Ib feed ,a significant increase was obtained in percentage of eviscerated yield. Further they observed that birds receiving high energy diets had a greater percentage of drippings and significantly lowered cooking losses due to evaporation. Hill, *et al.* (1956) reported that body composition was influenced by altering the calorie : protein ratio primarily through its effect on appetite. Rand, *et at*(1957) showed on diets varying in protein, fat and energy content that increased protein consumption reduced the percentage of fat in carcass. The amount of fat in carcass was found to be inversely correlated with protein : energy ratio. Spring and Wilkinson , (1957) showed that increasing the dietary protein from 22 to 28 % had no effects on gain but increased dietary energy from

1200 to 1500 Cal/lb decreased body protein and water and increased body fat both at 2 weeks and 8 weeks of age , respectively.

Hizikura and Morimoto (1962) reported that low energy high protein diet reduced the percentage of carcass. However ,Summers, *et al.*(1963) reported a leaner carcass if the energy level was kept constant and protein level was increased. They further observed that carcass protein was increased and decreased in a linear manner with increasing levels of dietary protein(Summers, *et al.* (1965). Conversely, increasing levels of dietary energy resulted in decreased carcass protein and increased carcass fat. With practical diets, little or no improvement in weight gain was achieved by increasing the problem level beyond 20% but marked changes in carcass composition were noted.

Combs, (1961) reported that with widening of C:P (M/p) ratio from 35-49 there was no effects on rate of gain although 68% more fat was deposited in carcass of chicks fed low as compared with high protein diets. The positive correlation between C:P ratio (wide ratio) and body fat content suggests that at low protein level the chick may increase its energy intake to consume amount of protein to a limited extent and is somewhat influenced by the source of energy in ration. But when protein deficiency stress could not be reserved by the increased feed intake the difference in growth rate was observed .

Essary , *et al.* (1965) formulated rations to give C : P ratio (ME/lb CP) ranging from 35.7 - 50.1 and fed these to broiler chicken. Warm eviscerated yields were not appreciably affected by the different levels of protein and fat in diet. Birds fed rations containing high levels of fats in relationship to the level of protein\(wide ratio and high PE levels) deposited significantly more fat while ration containing low level of fat in relationship to percentage of protein (C : P ratio from 35.7 - 42.8) resulted in no significant difference in fat deposition . Thus it appears that the level of fat and protein in diet influenced for larger percentage of weight of live - birds fed the high energy ration than those fed the low energy one. Voluntary energy consumption increased in relation to energy needs as the protein level was reduced. This was accomplished by progressive increase in percentage body protein and water (Combs, *et al.*,, 1964).

Han,(1970) observed that in carcass of 6 weeks old chicken protein content increased with the increase of dietary protein but there was no difference at 12 weeks . Fat content of the carcass directly reflected energy value of the diet. Computer formulated least cost ration of progressively lower nutrient concentration were observed by Gooch, *et al.* (1972) to produce broilers carcass having poor fleshing and finish grade. Kiclanowski,(1972) indicated that in the more rapidly growing birds the lean body mass to protein ratio in the weight gains declined at a faster rate than in the slow growing ones and that only protein deposition but also deposition of fat was greater in birds fed at a higher level . Prasad,(1976) found no marked difference in dressing percentage and carcass composition when ME : protein ratio was reduced from 134 to 122 at 23 % protein and 153 to 144 at protein for starter and finisher ration, respectively.

Moran, (1980) pointed out that under normal circumstances , protein became marginal in relation to dietary energy and a simple reduction of dietary protein in the finishing ration for the broiler chicken affect both in production and quality loss. However , protein above requirement does not benefit performance nor alter carcass quality in a way that is meaningful to the consumer . Inadequate protein increase finish because calories in excess of need are consumed. Combs, *et al.*

(1964) suggested that birds would "over consume" diets low in protein and high in energy thus resulting in increased body fat. 33In a similar situation, Lipstein, *etal.*(1975) have shown that marginal dietary levels for broilers caused an over consumption of feed which they believed was an effort to satisfy requirement. (Levielle, *et al* 1975). Thus it appears that percent body fat will decrease as the calorie : protein ratio decreases. However the mechanism by which this occurs and the magnitude of the effete may depend on whether the calorie : protein ratio is alerted via changes in the concentration of dietary energy, dietary protein or a combination of the two.

Lowering energy - protein concentration (5% and 10% of normal) in broiler finisher ration led to reduced gains even though amino acid availability, balance and relationship to the ME calorie was kept constant (Moran, 1980). Concurrently, the percentage of chilled carcass to live weight was not decreased but increased when the ration change was moderate (3200 Kcal to 2875 Kcal/kg, i.e 5% reduction). Failure to obtain an additional yield improvement by a more extensive dietary modification (from 3035 to 2875 Kcal/kg, i.e 10% reduction) was due to stimulated development of gastrointestinal system. Robbins, (1981) obtained increased body fat content of male broiler when dietary crude protein crude protein was increased in direct proportion with dietary energy (constant C : P ratio) or when dietary energy was increased in iso nitrogenous diets (Variable C : P ratio ) Haskanson, (1978) has shown that 2500 Kcal ME/ kg broiler ration promoted a large intestine, gizzard and liver with less eviscerate3d abdominal fat than if a 3000 Kcal/kg feed were given.

Janky, *et al.*(1976) have shown that reducing dietary energy with boiler chicken lowers yield upon processing . However, Pejon *et al.*(1980) reported to the contrary. Breast and drumstick are the only parts appreciably alerted by the pattern by growth during finishing period. Halvorson and jacobson, (1970) noted that net meat increase of the broiler chicken between 5 and 8 weeks of age was largely the consequence of breast muscle growth. Dawson, *et at.* (1957) studied the relationship between meat type score and percentage of edible meat in broilers . The average yield of edible meat ranged from 47.51 to 51.05% cooking losses from 22.72 to 24.54 % bone from 21.16 to 23.85% in terms of ready to cook weight . Their results also indicated that a pound of ready to cook meat could yield approximately 50% edible meat, 22%bone, 23%loss, due to cooking and 5% loss due to separating.

Chemical composition of thigh and breast muscles estimated by Raina (1974) indicated that with an increase in dietary energy , an increase in ether extract content and a decrease in moisture content resulted. Sheriff *et al* (1993) conducted experiment on white leghorn male chicks from 0-10 weeks on 7 different dietary protein and energy level on performance and ready to cook yield . Their results revealed no significant differences in ready to cook yield with giblets either among treatment or ages and the value obtained for this parameter ranged from 70.21 to 71.51 % at 8$^{th}$ week and 69.7 to 72.89 at 10$^{th}$ of age. In a later experiment Sheriff *et al.*(1983) while studying the effects of dietary protein and energy level on male white leghorn chicken found a decrease in fat % as energy level in feed was an increased while the increasing of dietary protein level result a higher protein content of carcass with proportionate reduction in fat % .

Mahapatra *et al.*(1984) studied carcass characteristics and meat availability under two dietary regimen 927.7% and 2800 Kcal ME/kg and 24.4% protein and 3000 Kcal ME/kg ) up to 8 weeks of age . Diet did not influence pre slaughter eviscerated weight , giblet weight and total yield. The percent of moisture protein, ether extract and ash content of whole carcass varied from 73.27 to 75.08, 19.05 to 19.72 to 2.99 to 4.88 and 0.94 to 1.21 respectively were not significantly different among dietary among dietary treatment .

Toyormizu, M.*et al.* (1984) studied the responses of metabolisable energy on body protein gain in white leghorn male chicks and reported that body protein gain was not very much affected by the calorie ratio of dietary carbohydrate to fat.

Butala *et al.* (1990) incorporated different level of dietary, tallow in the rations of W.L.H. male chicks to study the carcass characteristics and meat quality for a period of 12 weeks. Result revealed no significant differences in slaughter characteristics as well as carcass composition. They obtained on an average meat-bone ratio of 12 : 1.

Holsheimer and Veerkamp (1991) studied the effects of dietary protein and energy on performance and yield in two strains of male broiler chicks .Dietary energy and protein level affected the slaughter characteristics and carcass yield in which higher energy level gave high carcass yield while normal CP gave the best over all yield.

Butala and Rajagopal (1991) prepared diet containing graded level of tallow (0,2,4 and 6%) with boiled rice bran as an ingredient for 12 weeks in WLH chicks. It was observed that the carcass protein decreased significantly and carcass fat increase significantly with inclusion 6% tallow in the diet having 3280 kcal ME/ kg than other level of ME (2290 kcal ME/kg to 2840 kcal ME/kg).

Nagra and sethi (1993) employed 20,22 and 24% protein level with 2500, 2700 and 2900 Kcal ME/kg in broiler ration in order to determine the energy and protein requirements . The abdominal fat deposition , meat to bone ratio and dressing percentage increased significantly with each increment in the energy content while no significant effect of protein level in these parameters was recorded .

Bamgbose (1999) investigated the effect of feeding cockerel chicks with maggot meal with or without methionine on a ration containing 21% C P and 2700 Kcal ME/kg for a period of $8^{th}$ week. Results showed slight variation in dressing % (65.35 to 71.03%) meat bone ratio ( 1.85 to 2.01) among treatment.

**(C) Miscellaneous :**

In view of the shortages in the availability of broiler chicks rearing is now gaining importance. Several worker studies the economics of broiler production [Heady et al (1961)], Kothandraman and Narari (1982) and Singh et al (1987). However, the studies on the economics of cockerel production are scarce.

Sheriff *et al* (1983) calculated the economics of rearing white leghorn male chicks on different dietary energy and protein levels on 20% crude protein with 2400, 2550, 2700 kcal ME/kg of feed and 22 and 26% crude protein with 2400, 2550 ME/kg of feed at eight week and 10 week of age. They obtained highest profit margin of Rs 1.55 with 27% CP and 2470 kcal ME/kg followed by 24% CP and 2470 kcal ME/kg, 28% CP and 2600 kcal ME/kg 21% CP and 2430 kcalME/kg diet . They suggested white leghorn male chicks could be profitable reared on diets containing 21 to 24 % CP with 2400 to 2500 kcal ME/kg up to weeks of age.

Shudhakar *et al* (1988) studied the comparative economics of sexed broiler and white leghorn cockerel at two energy level up to 8 week of broiler and up to 12 weeks in cockerel. White the variable cost expressed as percent of total cost was highest in cockerel (86.77%) followed by broiler (70.78%) the reverse was in the trend of the fixed cost which was lowest in cockerel. Since the cockerel decreased while chicks cost was much lower as compared to broiler , the fixed cost of cockerel decreased while proportionally the variable cost increase. Age did not influence the variable and fixed cost in cockerel. The total cost of production per bird basis was least for cockerel and highest in broiler. Low energy and other protein level resulted in the lower cost/kg live weight in both broiler and cockerel . The average cost of production per kg live weight of cockerels and broiler were found to be 16.6 and 14.0 respectively.

Mohan *et al* (1990) studied the economics of cockerel production in and around Namakal . The total cost per bird was found to be Rs. 9.45 of which fixed and variable cost constituted 86 and 14%, respectively. Among variable cost of feed accounted 65.4% of total cost while cost of chicks accounted for 6.36%. The income from sale of one live bird worked out to be Rs. 36.62 at the rate Rs. 60/kg and the cost of production was found to Rs. 14.00 with a net income was about of Rs.22.00 and benefit cost could be reared as substitute for broiler at places where the consumers prefer light meat and shortage in the availability of broiler chicks.

Bertechini et al (1991) observed in a 3x3x2 factorial design (starter energy value x finisher energy value x sex ) 504, Hubbard chickens were given from 1-day-old diets based on maize, soyabean oil meal, wheat meal and vegetable oil with minerals and vitamins to supply metabolizable energy (ME) 2800, 3000, and3200 kcal/kg with a constant energy: nutrient ration. With increase in ME intake, there. Energy content of the starter diet had no significant effects on \performance in the finishing period (26 to 56 days old). Feed conversions were improved linearly with increase and energy value in starting and finishing periods. There was no difference in body fat, protein and water among the treatments.

Bertechini et al (1991) experimented 20 days , 216 male and female Hubbard chickens initially 28 days old were given diets to supply metabolized energy (ME) 2800,3000, and 3200 kcal/kg with a constant energy : nutrient ration. With increase in ME intake . Energy content of the starter diet had no significant effects on performance in the finishing period (26 to 56 days old ). Feed conversions were improved linearly with increase and energy value in starting and finishing periods. There was no difference in body fat, protein and water among the treatments.

Bertechini *et al* (1991) experimented 20 days, 216 male and female Hubbard chickens initially 28 days old were given diets to supply metabolizable energy (ME) 2800, 3000, and 3200 kcal/kg and were kept in batteries at environmental temperature of $17.1^0$, $22.2^0$ and $27.9^0$ C. Diets were composed of maize, soya bean oil meal, wheat bran and vegetable oil with mineral and vitamins and had constant energy : nutrient ration. When energy intake increased, and feed intake and fed conversion decreased . There was linear decrease ($p<0.05$) in weight gain, Feed intake and ME intake. Feed conversion was best at $22.2^0$c ($P<0.05$) with a difference between values at $17.1^0$c & $27.9^0$c. Weight gain , feed intake, ME intake dressed carcass yield and abdominal fat were greater in males than in females ($P<0.05$).Chicks attained greater body weight gain a ration containing 23% protein and having energy : Protein ratio of 128.2:1. Chicks exhibited improved feed efficiency with increased protein level and decreased energy, protein ratio of the ration. However, there was no significant difference in feed consumption among different groups. The ration containing 23% protein and 128.2:1 ratio of energy protein was found economical.

A. Ahmed, Chatterjee,and Bhattacharya *et al.* (2008) This experiment was undertaken to investigate the performance of *Vanaraja* chicks subjected to high altitude conditions (Arunachal Pradesh) and energy feeding at different levels. 990 *Vanaraja* chicks (one day old) procured from a single hatch and having identical body weights (38.2+or-5 g) were randomly divided into three groups (T1, T2 and T3) of 330 birds each. The chicks were further subdivided into three replicates containing 110 chicks each. Three types of rations were prepared using conventional feed ingredients: ration I (high energy, HE) - 2900 kcal ME/kg diet (maize, rice polish, groundnut cake, soybean meal, fish meal and vegetable oil);ration II (medium energy, ME) - 2800 kcal ME/kg diet (maize, rice polish, groundnut cake, soybean meal and fish meal); and ration III (low energy, LE) - 2700 kcal ME/kg diet (maize, rice polish, groundnut cake, soybean meal and fish meal). The body weights at 6 weeks and cumulative feed conversion efficiencies were 802.82+or-6.72 and 2.52+or-0.08, 722.72+or-5.82 and 2.85+or-0.08 and 689.82+or-10.39 and 3.02+or-0.09, respectively, for the groups fed with rations I, II and III. The mortality percentage was higher than the normal range in all the groups. Significantly higher body weight ($P<0.05$) and better feed conversion efficiency ($P<0.05$) were observed in group fed with the HE diet. Feed consumption was inversely proportional to the energy content of the diet.

H.Al-Khalif and A. Al- Nasser et al (2012) they observed during the feeding of three different levels of dietary protein

18%,21%,22%,.variables measured include body weight ,feed consumption and feed efficiency,. Result showed that there was no significantly different levels indicating that using a diet with 18% protein level is as satisfactory as those 21% and 22% .therefore a lower protein level can be possibly fed reducing the cost feed. In conclusion feeding a diet treatment with 18% protein in recommended for the Arabi chickens.

Rao S.V Rama *et al.*(2005) A study was conducted to evaluate the effect of varying dietary energy concentration on performance of *Vanaraja* chicken during juvenile phase of life. For this he created 7 treatment group of 9 replicate with 315 a day old chicks. Chicks in each of the 7th group were fed one of diet containing ME from 2200 to 2800 kcal ME/kg for 1-42 days of age. He observed body weight reduced significantly ($P<0.05$) in group fed diet containing ME below 2400 kcal/kg diet and FCR was significantly with energy level and was comparable among the dietary groups containing 2600 to 2800 kcal ME/kg diet. Reducing level of ME adversely affect FCR. With reduce of energy level weight of gizzard, intestine and fad deposition decreases. The weight of Bursa and spleen were comparable among all the dietary groups.

Rao S.V Rama *et al.*(2006) A study was conducted to evaluate the effect of dietary protein level on performance of *Vanaraja* chicks during juvenile phase. For this he created 6 group of 10 replicate with six chicks in each. Each treatment groups offered one the six iso-caloric (2.6 Mcal/kg) diets containing 14.5 to 22% with an increment of 1.5% from 3 to 49 days of age. The weight gain was significantly ($p<0.05$)low at 14.5% CP as compare to higher protein level. No significant difference in feed efficiency was evident among the dietary groups containing 16% or higher protein during the experiment . The relative weight of liver, gizzard, giblet, intestine and fat were significantly higher in bird fed 14.5 CP.

Mohammed A. Ahmed *et al.*(2013) An experiment was conducted to study the nutritional value of yellow maize when it substitutes sorghum grain as source of energy at levels 0, 25, 50, 75 and 100% in broiler rations. One hundred and forty unsexed one day old (Ross) broiler chicks were randomly assigned to five approximately isocaloric and isonitrogenous diets labeled as follows: Diet (S0) containing sorghum 100% (control, 60% of the diet), diet (S1) 75% sorghum 25% maize, diet (S2) 50% sorghum 50% maize, diet (S3) 25% sorghum 75% maize and diet (S4) maize (100%) (without sorghum). Each treatment had four replicates with 7 birds/replicate. The experiment lasted for 6 weeks. Feed intake and body weight gain had been recorded weekly. The results showed significant increase ($P < 0.01$) in feed intake (3847.7, 3817.68 and 3734.06gram) and body weight gain (2189.58, 2203.04 and 2078.98gram) for birds fed diets S0, S1 and S2 respectively. No significant differences were observed in feed conversion ratio among all dietary treatments. Moreover, protein efficiency was greater for birds received diet S0 (2.65) and diet S1 (2.62) and lowest for birds received diet S4 (2.45). Birds fed diet S3 and S4 recorded significantly ($P < 0.01$) lowest hot and cold carcass weights (1420.83, 1479.17gram) and (1395.84, 1458.34gram) respectively than other groups. Broiler chicks supplemented with diet S1 and S2 recorded significantly ($P < 0.05$) higher carcass hot dressing percentage (73.66 and 73.36) respectively than those fed diet S0 (72.60) and S4 (72.60) while those fed diet S3 (71.92) recorded the lowest one. The highest serum glucose level was obtained by chicks fed diet S1 (176.33) while those fed on the other four diets were statistically similar. Serum total protein was found to be higher for chicks fed diet S0 (3.10), S1 (3.66) and S4 (3.42) while the lowest level was observed by chicks fed diet. S3 (2.31). All the treatments had no significant ($P > 0.05$) effect on cold carcass dressing percentage, liver and abdominal fat weights, serum cholesterol, serum calcium and inorganic phosphorus levels. The cost of production decreased by increasing level of maize.

Irfan Akram Baba *et al.*(2014)a experiment was conducted to study the effect of some climatic parameters on the performance of *Vanaraja* birds reared under intensive and backyard systems. Performance of *Vanaraja* (dual purpose) birds under the environmental conditions such as temperature, relative humidity and Temperature Humidity Index (THI) was studied in summer in Jammu region of Jammu and Kashmir. 120 birds were equally distributed and reared for eight weeks in two groups: intensive (inside shed) and semi intensive (outside shed). Each group was having four replicates of 15 birds each. Based upon average daily dry and wet bulb temperatures, THI values for outside and inside the shed were calculated. The overall average temperature, relative humidity, THI, mortalities, water intake, weight gain, feed consumption, and feed conversion ratio by the birds in intensive (inside shed) and semi intensive (outside shed) systems up to eight weeks of age were; 37.02 and 37.63 , 62.18 and 66.61 %, 84.5 and 83.85, 2.4 and 1.7, 1300.3+6.77 and 1055.92± 7.32 ml, 173.27 ± 6.78 and 170.84 ± 5.21 g, 398.02 ± 5.66 and 327.90 ± 7.11 g, 2.24± 0.112.0 and 2 ± 0.12 respectively. THI values for outside and inside the shed suggested that the birds were in stress during the experiment. It was concluded that during the extremes of temperature and relative humidity the performance of the *Vanaraja* birds was less.

R.Buragohhain ,M.K Ghosh *et al.*(2005) *Vanaraja*, a dual-purpose bird, has adaptability and potentiality to provide economic benefit and uplifting the socio–economic condition of the rural poor. For optimizing the growth and productive performance, adequate levels of dietary protein and energy are the prime necessity. In the present study, an attempt has been made to study the effect of dietary protein and energy levels on growth performance of Vanaraja birds in high altitude areas of Arunachal Pradesh. About two hundred day-old chicks received from PDP, Hyderabad were distributed randomly into four groups with two replicates in each and housed under deep litter system of management in the experimental sheds of National Research Centre on Yak (ICAR), Dirang, Arunachal Pradesh situated at an altitude of about 5200 ft. above . Four experimental rations were prepared with decreasing levels of dietary protein i.e. 23 to 20% CP and increasing levels of energy i.e. 2800 to 3100 Kcal ME/kg, designated as Ration-I (23% CP, 2800 Kcal/kg), Ration-II (22% CP, 2900 Kcal ME/kg), Ration-III (21% CP, 3000 Kcal ME/kg) and Ration-IV (20% CP, 3100 Kcal ME/kg) respectively and fed up to 6 th weeks of age. The chicks were dewormed and vaccinated as per schedules. During the experimental period, daily feed intake, body weight gain at weekly interval and mortality of the chicks were recorded. The average daily feed consumption ranged from 57.40 +5.22 g to 65.56 +4.50 g per bird per day. No significant difference (P>0.05) was observed between the groups in daily feed intake, however, feed intake was inversely proportional to the dietary energy levels in the rations. The final body weight gain was observed to be highest with Ration–II with 22% CP and 2900 Kcal ME/kg (954.17 +26.44 g) followed by Ration I (945.83 +46.29 g), Ration III (905.38 +29.79 g) and Ration IV (882.31 +31.56g). However, no significant difference was observed between the groups in weekly body weight gain. Feed conversion ratio was recorded as, 1.31

+0.16, 1.32 +0.13, 1.25 +0.12, and 1.27 +0.13 with Ration I to IV. Thus, it is apparent from the present study that with increasing the energy levels in the diet, no significant difference was observed in respect of body weight gain or overall feed conversion ratio between the groups. However, considering the performance in terms of body weight gain or overall feed conversion efficiency, 22% CP and 2900 Kcal ME/kg may be considered as optimum for growth performance of *Vanaraja* birds up to 6 th weeks of age in high altitude areas of Arunachal Pradesh. Further studies with more nos. of birds for longer duration are necessary to get absolute requirements of protein and energy in high altitude areas for optimum productivity of *Vanaraja* birds.

A. Golian *et al(* 2010) was study the effect of four levels of energy (2900,3000, 3100,3200 kcal/ kg ) and four levels of protein (17,20,23,and 26%) on PI and humoral immune responses of chickens. Lymphoid weight and lever weight were determined at 10,15,20 d. five birds were i/m injected with 1ml/chick SRBC 15% suspension in PBS at days 15(primary injection) and 25 (secondary injection) of age. Blood sample were collected 5 and 10 days after each injection and then evaluate for total immunoglobulin, $I_g$ M, $I_g$G, and anti -SRBC titers. Chicks BW and FCR improved as dietary energy and protein increased chicks feed intake was not influenced by dietary protein level. He found broiler fed low level of protein had heavier liver weight than those fed diets with high levels. Total $I_g$G anti-SRBC antibody titers were rose in bird fed low energy dietary energy content did not influence birds anti-SRBC antibody titers. Protein energy diets are equally for early growth and feed effeciency but rapid growth decrease immune responses. This mean that birds were selected for rapid growth but not for enhanced immune responses.

H. Enting, *et al.(*2007) An experiment of 60 week of age was conducing to study the effect of low density broiler breeder diets on performance and immune status of their offspring. He conducted that low density broiler breeder diets can improve offspring growth rate, reduce mortality & reduce & increase immune response depending upon breeder age and egg weight.

J.Nasr, F kheiri *et al (*2011) : An experiment of 42 days was conducted to evaluate the performance and carcass yield of broiler fed diet with different level of lysine requirement , very high lysine (120% NRC), high lysine(110%NRC), standard (100%NRC), and low lysine (90%NRC) in a completely randomize experimental design. During the study he observed that increasing lysine level in diet significantly increase carcass percentage and abdominal fat, gizzard, and heart weight compare with standard group.

# CHAPTER -3

# MATERIALS AND METHODS

# *MATERIALS AND METHODS*

The present study was designed with a view to investigate the influence of various level of energy and protein on the performance, carcass traits, immune response, lipid profile and economics of production at *Vanaraja* strain of broiler for a period of eight weeks at Poultry Nutrition Research unit of Animal Nutrition Department, Bihar Veterinary College, Patna.

**Experimental techniques:** The study was planned to see the effect of feeding different level of energy and protein in *Vanaraja* strain of broiler. A 600 day old chicks of Vanaraja strain were procured from PDP, Hyderabad during early winter season and temperature was approximate 32°C. The chicks were vaccinated against Ranikhet and Gumboro diseases. The crippled chicks and those with extreme body weights were discarded from study. The experimental birds were given only crushed maize on first day and then given standard ration. On sixth day, 540 chicks were selected, wing banded, weighed and randomly divided into nine experimental groups of 60 chicks in each group replicated twice with 30 chicks in each replicate. The chicks were reared on electrically heated brooder in early age under different treatment groups.

**Duration of experiment:** The experiment was conducted for the period of 56 days. All the standard managemental practices were followed during experimental period including vaccination schedule.

**Housing:** Chicks were reared on deep litter system. Bedding material used was saw dust. Litter was kept 3-4" thick. The litter was raked weekly to prevent any cake formation in rearing pens. Chicks were served fresh clean drinking water ad libitum through fountain system. Poultry chicks were reared under uniform condition of housing including brooding, feeding, watering, lighting and other managements. During early periods of growth chicks were provided with artificial light.

**Hygienic measures:** The cages, feeding and watering troughs were cleaned and disinfected. Fresh water bath with phenol solution, which was changed every morning, was maintained at the entrance of the experiment room throughout the experimental period as one of the hygienic measures

**Dietary treatment:** The whole birds were divided into nine treatment groups. The birds in $T_9$ treatment group serve as control fed diet containing 21% crude protein and 2800 kcal ME/kg energy.

| | | |
|---|---|---|
| $T_1$ | : | 17% crude protein 2600 kcal ME/kg |
| $T_2$ | : | 17% crude protein 2800 kcal ME/kg |
| $T_3$ | : | 17% crude protein 3000 kcal ME/kg |
| $T_4$ | : | 19% crude protein 2600 kcal ME/kg |
| $T_5$ | : | 19% crude protein 2800 kcal ME/kg |
| $T_6$ | : | 19% crude protein 3000 kcal ME/kg |
| $T_7$ | : | 21% crude protein 2600 kcal ME/kg |
| $T_8$ | : | 21% crude protein 3000 kcal ME/kg |
| $T_9$ (control) | : | 21% crude protein 2800 kcal ME/kg |

**Feed formulation:** The feed ingredient were procured in one lot before the start of experiment. All the ingredients were analyzed for proximate principles (AOAC, 1975) along with calcium and phosphorus using the method modified by Talapatra *et al.* (1940) and are presented in Table-1. Based on the analyzed value of crude protein and standard published value of metabolizable energy. Nine different experimental rations were formulated with three levels of protein viz. 17, 19 and 21 percent each with three level of energy (2600, 2800 and 3000 kcal/ME/kg) in a 3 x 3 factorial arrangement. The above formulated rations were again analyzed for their proximate principles in Animal Nutrition laboratory. The composition of experimental ration and analytical values were presented in Table -1 and Table -2.

**Table 1. Percentage chemical composition and metabolizable energy of feed used in experiment (on dry matter basis)**

| Ingredients | DM | CP | EE | CF | TA | AIA | NFE | Ca | P | ME (kcal/kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| Yellow Maize | 91.0 | 9.50 | 3.35 | 2.08 | 2.80 | 0.20 | 82.27 | 0.08 | 0.36 | 3330 |
| Soyabean Meal | 92.0 | 45.0 | 0.82 | 5.85 | 7.05 | 1.03 | 41.28 | 0.23 | 0.58 | 2450 |
| Wheat Bran | 89.5 | 14.0 | 3.6 | 11.50 | 6.60 | 1.40 | 64.30 | 0.21 | 1.18 | 2000 |
| De-oiled Rice Bran | 92.5 | 13.0 | 1.78 | 13.25 | 6.40 | 2.70 | 65.57 | 0.07 | 0.98 | 1800 |

**Table 2. Percentage composition of different experimental diets**

| Ingredients (%) | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| Yellow Maize | 50.50 | 60.00 | 67.00 | 48.00 | 59.00 | 68.00 | 46.00 | 61.00 | 54.00 |
| Soya bean meal | 19.00 | 21.00 | 22.00 | 25.00 | 27.00 | 27.50 | 31.00 | 33.50 | 32.00 |
| Wheat bran | 13.50 | 7.50 | 3.00 | 11.00 | 5.00 | 0.00 | 10.50 | 0.00 | 5.00 |
| Deoiled rice bran | 13.50 | 7.50 | 3.00 | 12.50 | 5.00 | 0.00 | 9.00 | 0.00 | 5.00 |
| Soya oil | 0.00 | 0.50 | 1.50 | 0.00 | 0.50 | 1.00 | 0.00 | 2.00 | 0.50 |
| Common salt | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Calcite | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Mineral mixture | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| Premix | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 |

**Calculated value**

| Attributes | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| CP (%) | 17.05 | 17.10 | 17.15 | 19.04 | 19.20 | 19.15 | 21.08 | 21.19 | 21.10 |
| ME (kcal/kg) | 2607 | 2815 | 3009 | 2624 | 2810 | 3019 | 2609 | 3012 | 2814 |
| Ca (%) | 1.20 | 1.21 | 1.22 | 1.21 | 1.23 | 1.11 | 1.21 | 1.20 | 1.21 |
| Av. P (%) | 0.54 | 0.53 | 0.54 | 0.52 | 0.54 | 0.51 | 0.54 | 0.54 | 0.54 |

**Composition of mineral mixture (Agrimin forte):**

Vitamin A (7,00,000 I.U.), Vitamin $D_3$ (70,000 I.U.), Vitamin E (250 mg), Nicotinamide (1000 mg), Cobalt (150 mg), Copper (1200 mg), Iodine (325 mg), Iron (1500 mg), Potassium (100 mg), Magnesium (6000 mg), Manganese (1500 mg), Selenium (10 mg), Sodium (5.9 mg), Sulphur (0.72 %), Zinc (9600 mg), Calcium (25.5%) and Phosphorus (12.75%).

## PARAMETERS OBSERVED DURING THE EXPERIMENT

The following recording and sampling procedures were adopted during the experimental period.

### (A) GROWTH PARAMETERS

#### (i) Feed consumption:

Feed consumption is the amount of feed consumed every week. It was calculated for each treatment group at weekly basis. At the end of the week, the residual amount of feed was weighed and subtracted from the weight of feed offered at the beginning of week. Difference in weight was divided by the total number of birds.

#### (ii) Body weight and body weight gain:

During the initial phase of the experiment, body weight of individual chicks was recorded. Thereafter, body weight change was observed at weekly interval up to eight weeks. Live weight gain was calculated by subtracting the live weight at the beginning of the week from the live body weight of the next week and whole body weight gain at the end of $8^{th}$ week from the initial body weight.

#### (iii) Feed conversion ratio (FCR) and performance index (PI):

Feed conversion ratio (FCR) was calculated every week as the amount of feed consumption per unit of body weight gain. Performance index was also calculated at weekly interval.

FCR was calculated by using the formula;

$$\text{FCR} = \frac{\text{Feed consumed (g)}}{\text{Body weight gain (g)}}$$

PI was calculated by using the formula (Bird, 1955);

$$PI = \frac{\text{Body weight gain (g)}}{\text{Feed consumed (g)}} \times 100$$

**(B) Balance study of nutrients:**

After end of the experiment, a five days metabolic trial was conducted to observe the balance of major nutrients such as protein, energy, calcium and phosphorus.

In each trial four birds from each group were randomly selected and transferred to metabolic cages. Preliminary feeding was given for adaptation of broilers to the new system of housing. Polythene sheets of appropriate size were spread over the dropping trays for the collection of mixed excreta. The chicks were offered a weighed amount of experimental ration at a fixed morning hour everyday during the trial period. The mixed droppings were also quantitatively collected at the end of 24 hrs at fixed hours and pooled to know the total amount of excreta voided for five days. Daily feed intake was collected after deducting weight of feed residue left from the feed offered. Representative feed samples were drawn from the bulk, finely ground and stored in bottles for proximate, Ca and P analysis in laboratory. Aliquots from dropping after thorough mixing with the help of spatula was drawn for dry matter and follow up analysis for nitrogen estimation. Aliquots of five days were pooled together for nutrient analysis.

**(C) Carcass study:**

At the end of eight week, four birds from each group and two from each replicate were randomly selected for slaughter and processing. The birds were starved 24 hours before slaughter without withdrawing of drinking water. Each bird was weighed twice, just prior to starvation and again immediately before slaughter. The birds were bled by clean incision at the base of ear lobes and allowed to bleed. The birds were emerged in hot water (70° C) for 30 second (hard scalding). The scalded birds were hand plucked to remove body feathers perfectly. The head was removed by severing cutting between the first cervical vertebra and optical bone. The feet and shank were cut at the tibio-tarsal joints , wings tips was removed and dressed weight of the carcass was recorded. The birds were then eviscerated by removing the crop , gullet , trachea and viscera. The lungs were scrapped off. The giblets (heart, liver and gizzard) were removed from the viscera. Gall bladder was removed from liver, gizzard was opened the contents were washed out and lining was pulled off and the contents were washed. The heart was free from blood clot and adhering vessels. The weight of the carcass along with giblets was recorded as eviscerated weight. The dressing percentage and eviscerated percentage were calculated on the basis of pre-slaughter live weight at 8$^{th}$ week of age.

The neck of carcasses were removed as closely to the clavicles as possible, weight of neck and giblet were recorded separately. The weight of heart, liver and gizzard were recorded and expressed as percentage of live weight.

$$\text{Dressing percentage} = \frac{\text{Dressed weight}}{\text{Pre slaughtered weight}} \times 100$$

$$\text{Giblet percentage} = \frac{\text{Weight of giblet}}{\text{Dressed weight}} \times 100$$

**Collection of blood:**

At the end of the experiment blood samples were collected from three broiler bird per replicate, making six samples per treatment. Blood was collected in two set of vial, one with without anticoagulant and other with anticoagulant EDTA, from the wing vein using insulin syringes.

Blood without anticoagulant allowed to clot, and centrifuged for 15 min at 1500 rpm to separate the serum. The serum sample were stored at -20° C for the analysis of serum for cholesterol, triglyceride, HDL,VLDL, LDL, total protein and glucose. Blood samples with EDTA used immediately for haematological tests such as packed cells volume (PCV) and haemoglobin (Hb).

**(D) Serum biochemical analysis:**

**(I) Lipid profile of serum:**

Total cholesterol, HDL, and Triglyceride were estimated by using commercial test kit (AUTOSPAN liquid gold, Cogent) at 505nm wavelength in spectrophotometer 106.

$$\text{(i) Total cholesterol (mg/dl)} = \frac{\text{Absorbance of test}}{\text{Absorbance of standard}} \times 200$$

$$\text{(ii) HDL cholesterol (mg/dl)} = \frac{\text{Absorbance of test}}{\text{Absorbance of standard}} \times 50 \times 2^{*}$$

*(2 = dilution factor, as sample was diluted 1:1)

(iii) Triglycerides (mg/dl) = $\frac{\text{Absorbance of test}}{\text{Absorbance of standard}} \times 200$

(iv) LDL cholesterol = Total cholesterol – $\frac{\text{Triglyceride}}{5}$ – HDL cholesterol

(v) VLDL Cholesterol = $\frac{\text{Triglyceride}}{5}$

**(II)Total protein of serum:**

The collected samples of serum from each group were examined for total protein by using commercial test kit (AUTOSPAN liquid gold, Cogent) at 578 nm wavelength using spectrophotometer 106.

Total protein (g/dl) = $\frac{\text{Absorbance of test}}{\text{Absorbance of standard}} \times 6.5$

**(III) Glucose of serum:**

The collected samples of serum from each group were examined for Glucose by AUTOSPAN liquid gold (Glucose) test kit at 505 nm using spectrophotometer 106.

Total glucose (mg/dl) = $\frac{\text{Absorbance of test}}{\text{Absorbance of standard}} \times 100$

**(E) Whole blood analysis:**

**(i) Haemoglobin:**

Haemoglobin (Hb) was estimated as per cyanmethemoglobin (Drabkin, 1932) method. In this method hemoglobin is oxidized to methaemoglobin by potassium ferricyanide; methaemoglobin in turn combines with potassium cyanide to form cyanmethaemoglobin. The standard absorbance was read before the start of the procedure. 0.02 ml of the test sample was added to 4.0 ml of Drabkin's solution. The diluted sample was allowed to stand for 10 minutes, it was then transferred to a cuvette and the optical density was observed at 540 nm against a blank of Drabkin's solution. The result was calculated from formula given below;

$$\text{Hb (g/dl)} = \frac{\text{Absorbance of sample}}{\text{Absorbance of standard}} \times \text{concentration of std.}$$

**(ii) Packed cell volume:**

Packed cell volume (PCV) was estimated by micro haematocrit method (Campbell, 1995). Packed cell volume (PCV) was measured as micro-haematocrit with 75 x 16 mm capillary tubes. Capillary tube was filled with two-thirds to three-quarters full with well mixed blood. The one end of capillary tube was sealed with sealing wax. Filled capillaries were placed in the micro-hematocrit centrifuge, with the plugged end away from the centre of the centrifuge and centrifuged at 3000 rpm for 5 minutes. PCV reading was taken with the help of PCV reader express as percentage.

**(F) Efficacy of different level of energy and protein on immune response of *Vanaraja* strain of broiler:**

**Antigen:** Poona strain of IBD virus, being maintained in Department of Microbiology, Bihar Veterinary College, Patna in the form of 50% bursal homogenate was used as a reference antigen throughout this study.

**Antiserum:** The hyper-immune serum against a vaccine strain virus is obtained from Department of Veterinary Microbiology. This serum was inactivated at 56°C and stored at 0°C.

**Vaccine:** Cell culture adapted live invasive intermediate IBD virus vaccine ($EID_{50}$) available in freeze dried form (Venkateshwara hatcheries Pvt. Ltd., Pune) was used. The vaccine was reconstituted in diluents supplied with vial and used within few hours after reconstitution.

**F- strain Ranikhet disease virus vaccine:** A commercially available F-strain vaccine (Venkateshwara hatcheries Pvt. Ltd., Pune) was used for vaccination of chicken after proper reconstitution at 7$^{th}$ days of age. F-strain virus was further used as antigen in Haemaggultination (HA) test and Haemagglutination inhibition (HI) test after propagation in embryonic egg by allantoic route.

**Chicken red blood cells:** 1.0 % suspension of chicken RBC in phosphate buffer saline (PBS) was used for HA and HI tests.

**Red blood cell suspension:** Three adult chickens were used as donor of blood. The blood was collected from each bird in Alsever's solution (1 : 1) and centrifuged at 500 rpm for 10 minutes. The supernatant was removed and packed cells were washed three times with PBS. Finally 1.0 percent RBC suspension was made in PBS and stored at refrigerator temperature. This suspension was used only for four days after preparation and thereafter the fresh suspension was prepared.

**Buffer:**

(i) Agar Gel Precipitation Test (Aziz, 1985):

**Solution A :**

| | |
|---|---|
| $Na_2 HPO_4, 2H_2O$ | 1.4 gm |
| Double distilled water | 100 ml |

**Solution B :**

| | |
|---|---|
| $Na H_2 PO_4$ | 1.4 gm |
| Double distilled water | 100 ml |

**Composition of the agar gel:**

84.1 ml of solution A

15.9 ml of solution B

8.0 g of sodium chloride

1.0 g of agarose HI Media

0.01 g of sodium azide

The mixture was steamed for 10 minutes at 15 lb pressure.

(ii) Phosphate Buffer Saline (Aziz, 1985):

| | |
|---|---|
| NaCl | 2.0 g |
| KCl | 0.05 g |
| $Na_2 HPO_4, 2H_2O$ | 0.14 g |
| $KH_2PO_4$ | 0.05 g |
| Double distilled water | 250 ml |

$P^H$ ranged between 7.2 to 7.4

This solution was autoclaved at 15 lb pressure for 15 minutes and stored at refrigerator temperature till used. This buffer was used for reconstitution and preparation of antigen.

**Alsever's solution:**

| | |
|---|---|
| Dextrose | 2.05 g |
| Sodium citrate | 0.90 g |
| Sodium chloride | 0.42 g |
| Citric acid | 0.055 g |
| Distilled water | 100 ml |

It was sterilized by autoclaving at 10 lb pressure for 15 minutes.

***Methods***

**Preparation of antigen:** Poona strain of IBDV antigen was obtained and tested for the presence of IBDV antigen by agar gel in the Department of Veterinary Microbiology and used for Agar Gel Precipitation Test (AGPT). Then it was distributed in small aliquots prepared in the same manner served as negative antigen control. Hyper-immune serum raised against IBDV antigen, was obtained from the Department of Veterinary Microbiology.

**Procedure for collection of serum samples from chickens:** The blood was collected from wing vein with 5 ml sterilized syringe using 22 gauze needles at the end of 7,14,21,28 days. From each bird one to two ml of blood was drawn and immediately transferred to sterilized test tube which were kept in a slanting position and the blood was allowed to clot. The serum samples were collected and inactivated at 56° C for 30 minutes and finally stored at -20° C until use.

**Agar gel precipitation test (AGPT):** This test was carried out as per the procedure of Hirai *et al.*, (1972) with some modifications. The glass microscopic slides (75 mm x 25 mm) were pre-coated by dipping them in 0.3 percent agar solution and dried in open air. The slide were placed on a horizontal level surface to obtain uniform gels. Four ml of the gel was poured on each slide with a pre warmed glass pipette and allowed to set. After setting, the slides were kept at 4° C for few hours to facilitate punching of gels. With the help of a template, a hexagonal well pattern consisting of a central well surrounded by six peripheral wells were made, each well being 3.5 mm in diameter and the centre to centre distance between the wells being 8 mm.

The central well was charged with the antigen, and one of the peripheral wells with the reference antiserum. The remaining five wells were used for test sera. The slides were kept in a humidified chamber at room temperature and observed daily for three days for the appearance of any precipitin band.

**Haemagglutination inhibition (HI) test:** The HI test was performed in perspex plate as per the method suggested by Beard (1980). Four HA units of virus antigen (Charan *et al.*, 1981) and 1.0 per cent chicken RBC suspension were used in the test. Using 0.25 ml of serum sample, two fold serial dilution were made in PBS. To each serum dilution 0.25 ml (4 HA units) of virus antigen was added. After a reaction time of 20 minutes at room temperature, 0.5 ml of 1.0 per cent RBC suspension was added to each well containing serum virus mixture were also included as control. The result were read after 40 minutes. The reciprocal of the highest serum dilution showing complete inhibition of haemagglutination was taken as the HI titre.

**Statistical analysis:**

All the data were analysed statistically using Statistical Packages for Social Sciences (SPSS) Software, version 17.00. The recorded data were set into 3 × 3 (CP and ME) factorial arrangement and analyzed in completely randomized design. One-way analysis of variance (ANOVA) with the post hoc Duncan's multiple comparison tests, means were separated using LSD was used to evaluate statistical significance of differences among the control and experimental groups according to Snedecor and Cochran (1967). The results are given as means, standard error and $P<0.05$ was considered as statistically significant difference.

**(G) Economics of production:**

The economics of broiler production was calculated on the cost of feed per kg live weight gain. The economics is thus dependent on the cost of different feed ingredients used in the experiment along with feed efficiency of various treatments. Actual cost of feed was calculated on the basis of rates on which the different feed ingredients were purchased from the local market.

(i) Total output/bird : Total weight of bird (kg) × sale price / kg

(ii) Total input/bird : Cost of feed + Cost of chicks + Cost of medicine + Vaccine etc.

(iii) Net profit / bird : Total output / bird - Total input / bird.

CHAPTER -4

# RESULTS AND DISCUSSION

# *RESULTS AND DISCUSSION*

Poultry production in our country is gaining momentum in present scenario but to facilitate it in rural areas a poultry breed *Vanaraja* developed by Project Directorate on Poultry (PDP), Hyderabad. The main aim for introducing this breed that which is well adopted in backyard poultry farming and it can reared with low input. In this way *Vanaraja* breed is helpful in improvement of standard of living by enhancing income of rural peoples. Hence the present study was undertaken to study the effect of feeding different dietary level of energy and protein on the performance of *Vanaraja* strain of broiler. Systemic work in this field is the need of time. In this study different parameter like feed intake, body weight gain, feed conversion ratio, performance index, blood serum profiles, immune response of broiler and carcass quality were observed, respectively.

## GROWTH PARAMETER

### Feed intake:

The effect of different dietary level of protein and energy on feed intake at weekly interval and 8$^{th}$ week of age in *Vanaraja* strain of broiler (Table – 3) showed significant effect on feed intake in experimental bird. The average feed intake during the experiment varied from 2872.04 g in $T_5$ to 3129.66 g in $T_8$ group. Week wise feed intake varied from 86.00 to 112.00 g in $T_8$ and $T_2$ group at first week, where as it ranged from 133.00 to 154.00 g in $T_9$ and $T_3$ group at 2$^{nd}$ week of age. The data of feed intake ranges from 234.50 to 281.00 g in $T_7$ and $T_2$; 336.68 to 390.60 g in $T_5$ and $T_2$; 382.00 to 476.28 g in $T_5$ in $T_3$; 473.50 to 523.00 g in $T_6$ and $T_1$; 553.26 to 634.00 g in $T_3$ and $T_8$ in 3$^{rd}$, 4$^{th}$ , 5$^{th}$ , 6$^{th}$ , 7$^{th}$ and 8$^{th}$ weeks, respectively. A good fluctuation was observed in feed intake in every week among the different treatment groups.

The analysis of variance for the effect of treatment on feed intake in *Vanaraja* was found to be significant (P<0.05). Average feed intake at the end of first week in $T_2$ group was found to be highest (112.00 g) and significantly (P<0.05) more than $T_1$, $T_3$, $T_4$, $T_5$, $T_6$, $T_7$, $T_8$, $T_9$ groups, respectively. In second week feed intake of $T_9$ group was found to be significantly (P<0.05) lower than $T_1$, $T_2$, $T_3$, $T_4$, $T_5$, $T_6$ groups, respectively. However, in third week feed intake in $T_7$ (234.50g) was found to be significantly lower than $T_1$, $T_2$, $T_3$, $T_4$, $T_5$, $T_6$, $T_8$ and $T_9$ groups, respectively, whereas no significant (P>0.05) difference was noted among $T_4$, $T_5$, $T_8$ and $T_9$ groups. In fourth week of age, feed intake in $T_5$ (336.68 g) was found to be significantly lower than $T_1$, $T_3$, $T_4$, $T_6$, $T_7$, $T_8$ and $T_9$ groups, respectively, whereas feed intake is $T_2$ group was found to be highest among groups during different weeks.

However, in fifth week age, feed intake in $T_5$ was found to be significantly (P<0.05) lower as compare to $T_1$, $T_2$, $T_3$, $T_4$ ,$T_6$, $T_7$, $T_8$ and $T_9$ group, where as $T_3$ (476.28 g) group was found to be highest among all the treatment groups. In sixth week, feed intake in $T_6$ (473.50 g) was found to be significantly (P<0.05) lower than $T_1$, $T_2$, $T_3$, $T_4$, $T_6$, $T_7$, $T_8$ and $T_9$ groups, respectively, whereas value of $T_8$ (554.50 g) was found to be highest among the different groups. In seventh week of feed intake in $T_4$ (526.50 g) was found to be significantly (P<0.05) lower as compare to $T_1$, $T_2$, $T_3$, $T_6$, $T_7$, $T_8$ and $T_9$ groups, respectively, whereas, value of $T_7$ was found to be highest among all the groups. However, in eighth week, feed intake in $T_3$ (543.40 g) was found to be significantly (P<0.05) lower than $T_1$, $T_2$, $T_4$, $T_5$, $T_6$, $T_7$, $T_8$ and $T_9$ groups, respectively. Feed intake during the entire experimental period, ranging from 2872.04 to 3129.66 g, which was significantly influenced by dietary treatment and level of protein and energy.

*Vanaraja* broiler reared on 19 percent crude protein with 3000 kcal ME/kg showed lower feed intake than the treatment group fed with 17 percent crude protein, either increasing energy level. However, there was a significant difference in feed intake by broiler, reared on $T_1$, $T_2$, $T_3$, $T_4$, $T_6$, $T_7$, $T_8$ and $T_9$ groups, respectively.

The above results indicated that broiler reared on higher level of protein and energy consumed less feed than the diet having lower level protein, which affects the feed intake than level of energy. The present result agreed well with the finding of Sheriff *et al.* (1981) who also obtained lower feed consumption in broiler fed 22% and 2670 kcal ME/ kg ration containing low level of crude protein and ME showed higher feed intake. Result of feed intake obtained in this study also corroborates the finding of farrel *et al.* (1975) who concluded that the feed intake was inversely related to energy concentration in the diet. In contrary to our finding, Haque and Agarwal (1975) obtained numerical higher feed intake in chicks fed ration with higher level of protein and energy. The variation in feed intake could be due to energy content that associated with increase dietary energy concentration. Bamgbose (1999) obtained a significant reduction in daily feed intake in chicks, when the energy concentration of the ration was increased by incorporating high fat contain maggot meal at the level of 8% in the diet. Thus a proper calorie protein ratio is needed in the ration for optimum intake of nutrient through feed consumption.

**Body weight:**

Result of body weight at weekly interval in broilers is presented in Table - 4. The average body weight varied from 90.80 ± 0.85 g in $T_1$ to

113.04 ± 1.29 g in $T_8$ at 1st week, where it ranged from 181.44 ± 1.63 g in $T_1$ to 226.60 ± 2.78 g in $T_9$ at 2nd week. In 3rd week it ranged from 267.56 ± 1.60 g in T1 to 349.88 ± 2.34 g in $T_8$ and in 4th week it varied from 358.16 ± 2.34 g in $T_1$ to 500.00 ± 5.57 g in $T_8$. In 5th week it ranged from 511.44 ± 4.83 g in $T_1$ to 664.00 ± 5.59 g in $T_8$. In 6th week it ranged from 685.8 ± 5.97 in $T_1$ to 900.4 ± 6.26 g in $T_8$, whereas, in 7th week it ranged from 864.8 ± 8.23 g in $T_1$ to 1167.8 ± 6.00 in $T_8$ group. However, the range was 1036.4 ± 7.78 g in $T_1$ to 140360 ± 3.91 g in $T_8$ at 8th week of broilers.

The analysis of variance to saw the effect of different treatment on body weight in broiler was found to be highly significant (P<0.05). Average body weight at the end of 1st week in 21% CP, 3000 kcal ME/kg group ($T_8$) was found to be highest (113.04 ± 1.21), however, it was significantly comparable to $T_6$ group fed with 19 % CP, 3000 kcal ME/kg energy and control ($T_9$) group. Similar result was noted during 2nd week of age and the similar trend continued till the end of this experiment, where it was found that higher protein and energy level has positive effect on body weight.

**Body weight gain:**

Result of body weight gain at weekly interval and at the end of 8th week in the V*anaraja* strain of broilers is given in Table - 5. Average body weight gain varied from 54.28±1.04 g in $T_1$ to74.60 ± 1.22 g in $T_8$ during 1st week. In 2nd , 3rd , 4th , 5th , 6th ,7th and 8th week minimum and maximum change in body weight gain ranged from 90.64 g ($T_1$) to 115.4 g ($T_9$), 86.12 g ($T_1$) to 128.04 g ($T_6$), 90.60 g ($T_1$) to 150.12 g ($T^8$), 138.6 g

($T_7$) to 181.16 ($T_2$), 172.52 g ($T_2$) to 236.4 g ($T_8$), 179.0 g ($T_1$) to 273.4 g ($T_6$) and 140.0 g ($T_2$) to 255.20 ($T_6$), respectively. Average body weight gain at the end of experiment varied between 999.88 g ($T_1$) and 1365.16 g ($T_8$), respectively.

The analysis of variable for the effect of dietary treatment on body weight gain in broiler showed significant ($P<0.05$) effect on change in body weight. Average weight gain at the end of 1st week in $T_8$ group was found to be the highest (74.60 ± 1.22 g ) which was significantly higher than $T_1$, $T_2$, $T_3$, $T_4$, $T_5$, & $T_7$ but no significant difference was noted between control and $T_6$ group. Similar trend was seen in 2nd week. However, in 3rd week body weight gain in $T_6$ (128.04 ± 2.10 g) was found to be significantly ($P<0.05$) higher than other group. However, effect of energy and protein on body weight gain was found to be similar in $T_4$ and $T_8$ groups.

Body weight gain in 4th week in $T_8$ (150.12 ± 5.37 g) was found to be highest than other experimental group, whereas, in 5th week $T_2$ (181.16 ± 4.11) was found to be highest but significantly comparable to control, however, similar trend was found in 6th , 7th and 8th week, respectively. The overall body weight gain in $T_8$ group fed diet containing 21 % CP, 3000 kcal ME/kg found to be highest, but it was significantly similar to $T_6$ group i.e. 19 % CP and 3000 kcal ME.

Result of body weight gain indicated that ration containing 19 % and 21 % CP at higher energy that gained maximum growth. The lower level of protein and energy was found to be poor performance on body weight gain. The result are in agreement with Mallik *et al.* (1966), Verma and Pal (1971) findings as high energy and high protein had positive effect on growth rate and was also reported by Sibbald *et al.* (1961), higher than control. In 7th week $T_2$ and $T_3$, $T_4$ and $T_7$ are significantly not differing but lower than control. In 8th week PI of $T_4$and $T_7$, $T_6$ and $T_8$ are significantly not differ but T6 and T8 numerically and significantly higher than control. At the end of experiment PI of $T_6$ and $T_8$ group were significantly ($P<0.05$) higher than control group were as $T_4$ and $T_7$, $T_6$and $T_8$ are comparable.

Thus the study indicate that the higher energy and protein in the diet cause better utilization of feed commensurate with rate of growth. The result obtained also corroborated the finding of Combs *et. al* (1956), Sadagopan *et. al.* (1971), Sheriff *et. al.* (1981), Rama Rao et. al. (2006).

**Table 3. Effect of different level of energy and protein on an average feed intake (g)/bird at weekly interval and 8$^{th}$ week in Vanaraja.**

| Week | T$_1$ | T$_2$ | T$_3$ | T$_4$ | T$_5$ | T$_6$ | T$_7$ | T$_8$ | T$_9$ |
|---|---|---|---|---|---|---|---|---|---|
| 1$_{st}$ | 94.74$^{c}$ ± 1.63 | 112.00$^{e}$ ± 2.00 | 94.40$^{c}$ ± 4.00 | 86.78$^{ab}$ ± 1.50 | 90.86$^{abc}$ ± 0.50 | 102.00$^{d}$ ± 2.00 | 93.00$^{bc}$ ± 1.00 | 86.00$^{a}$ ± 2.00 | 97.50$^{cd}$ 1.5 |
| 2$^{nd}$ | 145.23$^{bc}$ ± 4.78 | 152.50$^{c}$ ± 2.50 | 154.00$^{c}$ ± 4.00 | 153.64$^{c}$ ± 2.00 | 149.00$^{bc}$ ± 1.00 | 145.00$^{bc}$ ± 1.00 | 142.00$^{ab}$ ± 2.00 | 133.50$^{a}$ ± 1.50 | 133.0 ± 3.0 |
| 3$^{rd}$ | 277.28$^{de}$ ± 4.72 | 281.00$^{e}$ ± 1.00 | 271.00$^{cd}$ ± 5.00 | 251.40$^{b}$ ± 1.00 | 246.00$^{b}$ ± 2.00 | 265.00$^{c}$ ± 1.00 | 234.50$^{a}$ ± 1.50 | 246.00$^{b}$ ± 2.00 | 255.5 ± 3.5 |
| 4$^{th}$ | 390.22$^{e}$ ± 4.90 | 390.60$^{e}$ ± 5.00 | 370.84$^{d}$ ± 5.00 | 358.00$^{bc}$ ± 2.00 | 336.68$^{a}$ ± 2.00 | 342.00$^{a}$ ± 2.00 | 365.00$^{cd}$ ± 3.00 | 382.50$^{e}$ ± 2.50 | 353.5 ± 1.5 |
| 5$^{th}$ | 460.06$^{ef}$ ± 7.94 | 452.90$^{de}$ ± 2.50 | 476.28$^{g}$ ± 5.00 | 438.00$^{c}$ ± 2.00 | 382.00$^{a}$ ± 2.00 | 406.50$^{b}$ ± 1.50 | 436.28$^{c}$ ± 2.00 | 466.66$^{fg}$ ± 2.50 | 446.00 ± 2.0 |
| 6$^{th}$ | 523.00$^{e}$ ± 5.00 | 511.00$^{cd}$ ± 1.00 | 503.74$^{bc}$ ± 3.50 | 501.50$^{b}$ ± 1.50 | 501.00$^{b}$ ± 1.00 | 473.50$^{a}$ ± 2.50 | 517.50$^{de}$ ± 1.50 | 554.50$^{f}$ ± 2.50 | 513.5 ± 2.5 |
| 7$^{th}$ | 583.50$^{e}$ ± 7.50 | 578.00$^{de}$ ± 2.00 | 553.26$^{b}$ ± 2.50 | 526.50$^{a}$ ± 1.50 | 569.00$^{cd}$ ± 1.00 | 646.00$^{g}$ ± 2.00 | 565.50$^{c}$ ± 2.50 | 626.50$^{f}$ ± 1.50 | 584.5 ± 3.5 |
| 8$^{th}$ | 602.00$^{e}$ ± 2.00 | 590.00$^{bcd}$ ± 2.00 | 543.40$^{a}$ ± 5.00 | 595.40$^{cde}$ ± 3.00 | 597.50$^{de}$ ± 1.50 | 601.50$^{e}$ ± 1.50 | 586.00$^{bc}$ ± 2.00 | 634.00$^{f}$ ± 2.00 | 582.0 ± 6.0 |
| 1 - 8$^{th}$ week | 3076.0$^{e}$ ± 13.67 | 3068.00$^{e}$ ± 6.00 | 2966.92$^{d}$ ± 1.00 | 2911.22$^{b}$ ± 9.50 | 2872.04$^{a}$ ± 6.00 | 2981.50$^{d}$ ± 1.50 | 2939.78$^{c}$ ± 1.50 | 3129.66$^{f}$ ± 4.50 | 2965.5 ± 5.5 |

$^{abcdefg}$ Values with different superscripts in a row differ significantly ($P<0.05$)

**Table 4. Effect of different level of energy and protein on average body weight (g) at weekly interval in Vanaraja.**

| Week | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| $1_{st}$ | $90.80^{a}$ ± 0.85 | $93.60^{ab}$ ± 0.85 | $95.20^{b}$ ± 1.16 | $96.40^{b}$ ± 0.95 | $105.48^{d}$ ± 1.26 | $110.72^{e}$ ± 1.18 | $100.12^{c}$ ± 1.16 | $113.04^{e}$ ± 1.29 | $111.20^{e}$ ± 1.31 |
| $2^{nd}$ | $181.44^{a}$ ± 1.63 | $188.56^{b}$ ± 2.21 | $190.76^{b}$ ± 1.74 | $197.48^{c}$ ± 1.21 | $216.72^{d}$ ± 2.10 | $220.16^{de}$ ± 1.49 | $200.92^{c}$ ± 1.54 | $223.28^{ef}$ ± 1.12 | $226.60^{f}$ ± 2.78 |
| $3^{rd}$ | $267.56^{a}$ ± 1.60 | $279.36^{b}$ ± 1.76 | $294.60^{c}$ ± 3.05 | $314.00^{d}$ ± 2.87 | $326.16^{e}$ ± 3.03 | $348.20^{fg}$ ± 2.25 | $322.80^{e}$ ± 3.54 | $349.88^{g}$ ± 2.34 | $341.00^{f}$ ± 3.11 |
| $4^{th}$ | $358.16^{a}$ ± 2.34 | $384.64^{b}$ ± 2.51 | $403.80^{c}$ ± 4.22 | $421.20^{d}$ ± 3.89 | $438.40^{e}$ ± 3.20 | $487.40^{g}$ ± 4.18 | $436.80^{e}$ ± 5.47 | $500.00^{h}$ ± 5.57 | $463.20^{f}$ ± 2.63 |
| $5^{th}$ | $511.44^{a}$ ± 4.83 | $565.80^{b}$ ± 4.55 | $565.04^{b}$ ± 1.73 | $572.60^{b}$ ± 3.59 | $603.76^{c}$ ± 4.56 | $645.40^{e}$ ± 2.34 | $575.40^{b}$ ± 3.39 | $664.00^{f}$ ± 5.59 | $631.92^{d}$ ± 4.64 |
| $6^{th}$ | $685.80^{a}$ ± 5.97 | $738.32^{b}$ ± 3.40 | $747.60^{b}$ ± 4.53 | $763.80^{c}$ ± 3.32 | $804.60^{d}$ ± 3.89 | $865.80^{fg}$ ± 2.64 | $770.40^{c}$ ± 2.75 | $900.40^{g}$ ± 6.26 | $840.16^{e}$ ± 5.90 |
| $7^{th}$ | $864.80^{a}$ ± 8.23 | $925.80^{b}$ ± 2.67 | $936.00^{b}$ ± 5.45 | $978.60^{c}$ ± 5.93 | $1059.88^{d}$ ± 6.00 | $1139.20^{f}$ ± 4.57 | $976.00^{c}$ ± 6.38 | $1167.80^{g}$ ± 6.00 | $1104.60^{e}$ ± 4.02 |
| $8^{th}$ | $1036.40^{a}$ ± 7.78 | $1065.80^{b}$ ± 4.91 | $1109.00^{c}$ ± 4.74 | $1149.60^{d}$ ± 10.32 | $1246.40^{e}$ ± 5.16 | $1394.40^{g}$ ± 5.72 | $1147.20^{d}$ ± 8.94 | $1403.60^{g}$ ± 3.91 | $1302.40^{f}$ ± 5.39 |

$^{abcdefg}$ Values with different superscripts in a row differ significantly ($P<0.05$)

**Table 5. Effect of different level of energy and protein on average body weight gain (g) at weekly interval and 8th week in Vanaraja.**

| Week | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| 1st | $54.28^{a}$ ± 1.04 | $56.60^{ab}$ ± 0.80 | $57.64^{ab}$ ± 1.39 | $59.28^{b}$ ± 1.04 | $67.96^{d}$ ± 1.35 | $72.72^{e}$ ± 1.29 | $62.76^{c}$ ± 1.25 | $74.60^{e}$ ± 1.22 | $72.92^{e}$ ± 1.40 |
| 2nd | $90.64^{a}$ ± 1.94 | $94.96^{a}$ ± 2.39 | $95.56^{a}$ ± 1.81 | $101.08^{b}$ ± 1.47 | $111.24^{cd}$ ± 1.82 | $109.44^{c}$ ± 1.23 | $100.80^{b}$ ± 1.94 | $110.24^{cd}$ ± 1.44 | $115.40^{d}$ ± 2.42 |
| 3rd | $86.12^{a}$ ± 2.20 | $90.80^{a}$ ± 2.87 | $103.84^{b}$ ± 3.19 | $116.52^{cd}$ ± 2.66 | $109.44^{bc}$ ± 2.58 | $128.04^{e}$ ± 2.10 | $121.88^{de}$ ± 3.55 | $126.60^{e}$ ± 2.19 | $114.40^{cd}$ ± 2.60 |
| 4th | $90.60^{a}$ ± 2.63 | $105.28^{b}$ ± 3.21 | $109.20^{b}$ ± 3.59 | $107.20^{b}$ ± 4.23 | $112.24^{bc}$ ± 2.93 | $139.20^{d}$ ± 3.67 | $114.00^{bc}$ ± 3.92 | $150.12^{e}$ ± 5.37 | $122.20^{c}$ ± 3.03 |
| 5th | $153.28^{b}$ ± 5.04 | $181.16^{d}$ ± 4.11 | $161.24^{bc}$ ± 4.12 | $151.40^{ab}$ ± 5.55 | $165.36^{bc}$ ± 5.50 | $158.00^{bc}$ ± 3.33 | $138.60^{a}$ ± 6.71 | $164.00^{bc}$ ± 4.13 | $168.72^{cd}$ ± 3.25 |
| 6th | $174.36^{a}$ ± 6.07 | $172.52^{a}$ ± 5.02 | $182.56^{ab}$ ± 4.02 | $191.20^{bc}$ ± 4.89 | $200.84^{cd}$ ± 5.12 | $220.40^{e}$ ± 2.91 | $195.00^{bcd}$ ± 4.45 | $236.40^{f}$ ± 6.34 | $208.24^{de}$ ± 4.19 |
| 7th | $179.00^{a}$ ± 8.46 | $187.48^{ab}$ ± 4.14 | $188.40^{ab}$ ± 7.70 | $214.80^{c}$ ± 7.14 | $255.28^{d}$ ± 4.91 | $273.40^{d}$ ± 3.66 | $205.60^{bc}$ ± 6.96 | $267.40^{d}$ ± 3.60 | $264.44^{d}$ ± 6.98 |
| 8th | $171.60^{b}$ ± 10.07 | $140.00^{a}$ ± 5.14 | $173.00^{b}$ ± 7.99 | $171.00^{b}$ ± 10.09 | $186.52^{bc}$ ± 5.23 | $255.20^{d}$ ± 4.63 | $171.20^{b}$ ± 11.62 | $235.80^{d}$ ± 7.35 | $197.80^{c}$ ± 5.22 |
| 1 - 8th week | $999.88^{a}$ ± 7.84 | $1028.80^{b}$ ± 4.95 | $1071.44^{c}$ ± 4.67 | $1112.48^{d}$ ± 10.27 | $1208.88^{e}$ ± 5.18 | $1356.40^{g}$ ± 5.68 | $1109.84^{d}$ ± 8.94 | $1365.16^{g}$ ± 3.84 | $1264.12^{f}$ ± 5.31 |

$^{abcdefg}$ Values with different superscripts in a row differ significantly (P<0.05)

**Table 6. Effect of different level of energy and protein on FCR at weekly interval and 8th week in Vanaraja.**

| Week | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| 1st | $1.44^{e}$ ± 0.08 | $1.42^{e}$ ± 0.12 | $1.37^{d}$ ± 0.11 | $1.38^{d}$ ± 0.15 | $1.26^{b}$ ± 0.21 | $1.20^{a}$ ± 0.13 | $1.31^{c}$ ± 0.17 | $1.18^{a}$ ± 0.12 | $1.20^{a}$ ± 0.22 |
| 2nd | $1.55^{e}$ ± 0.15 | $1.51^{d}$ ± 0.22 | $1.49^{d}$ ± 0.12 | $1.43^{c}$ ± 0.16 | $1.33^{b}$ ± 0.24 | $1.29^{a}$ ± 0.18 | $1.42^{c}$ ± 0.23 | $1.28^{a}$ ± 0.13 | $1.27^{a}$ ± 0.19 |
| 3rd | $1.90^{h}$ ± 0.05 | $1.83^{g}$ ± 0.09 | $1.78^{f}$ ± 0.14 | $1.65^{e}$ ± 0.11 | $1.55^{c}$ ± 0.09 | $1.46^{a}$ ± 0.15 | $1.60^{d}$ ± 0.19 | $1.46^{a}$ ± 0.08 | $1.51^{b}$ ± 0.12 |
| 4th | $2.26^{g}$ ± 0.09 | $2.14^{f}$ ± 0.19 | $2.08^{e}$ ± 0.12 | $1.92^{d}$ ± 0.18 | $1.78^{b}$ ± 0.17 | $1.67^{a}$ ± 0.08 | $1.85^{c}$ ± 0.11 | $1.67^{a}$ ± 0.16 | $1.78^{b}$ ± 0.07 |
| 5th | $2.52^{f}$ ± 0.16 | $2.30^{e}$ ± 0.13 | $2.31^{e}$ ± 0.17 | $2.15^{d}$ ± 0.06 | $1.94^{b}$ ± 0.11 | $1.88^{a}$ ± 0.15 | $2.08^{c}$ ± 0.12 | $1.86^{a}$ ± 0.14 | $1.96^{b}$ ± 0.09 |
| 6th | $2.71^{f}$ ± 0.18 | $2.46^{e}$ ± 0.21 | $2.48^{e}$ ± 0.13 | $2.31^{d}$ ± 0.16 | $2.09^{b}$ ± 0.08 | $2.04^{a}$ ± 0.13 | $2.25^{c}$ ± 0.11 | $2.04^{a}$ ± 0.09 | $2.10^{b}$ ± 0.12 |
| 07th | $2.85^{g}$ ± 0.13 | $2.57^{f}$ ± 0.07 | $2.60^{e}$ ± 0.12 | $2.42^{d}$ ± 0.19 | $2.21^{b}$ ± 0.11 | $2.14^{a}$ ± 0.23 | $2.38^{c}$ ± 0.20 | $2.13^{a}$ ± 0.16 | $2.22^{b}$ ± 0.18 |
| 8th | $2.95^{e}$ ± 0.18 | $2.71^{d}$ ± 0.11 | $2.70^{d}$ ± 0.16 | $2.52^{c}$ ± 0.08 | $2.31^{b}$ ± 0.12 | $2.21^{a}$ ± 0.14 | $2.50^{c}$ ± 0.12 | $2.22^{a}$ ± 0.21 | $2.31^{b}$ ± 0.14 |
| 1 - 8th week | $2.96^{e}$ ± 0.08 | $2.71^{d}$ ± 0.21 | $2.71^{d}$ ± 0.14 | $2.52^{c}$ ± 0.13 | $2.31^{b}$ ± 0.22 | $2.22^{a}$ ± 0.20 | $2.51^{c}$ ± 0.15 | $2.22^{a}$ ± 0.18 | $2.31^{b}$ ± 0.11 |

abcd efgh Values with different superscripts in a row differ significantly ($P<0.05$)

**Table 7. Effect of different level of energy and protein on PI at weekly interval and $8^{th}$ week in Vanaraja.**

| Week | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| $1_{st}$ | 68.39$^{a}$ ± 0.40 | 71.08$^{b}$ ± 0.17 | 72.34$^{c}$ ± 0.21 | 73.14$^{d}$ ± 0.11 | 79.98$^{f}$ ± 0.07 | 83.96$^{g}$ ± 0.08 | 75.97$^{e}$ ± 0.12 | 85.73$^{h}$ ± 0.09 | 84.31$^{g}$ ± 0.07 |
| $2^{nd}$ | 62.07$^{a}$ ± 0.07 | 64.82$^{b}$ ± 0.23 | 65.66$^{c}$ ± 0.33 | 67.76$^{d}$ ± 0.13 | 74.34$^{f}$ ± 0.12 | 75.53$^{g}$ ± 0.13 | 68.92$^{e}$ ± 0.11 | 76.56$^{h}$ ± 0.09 | 77.73$^{i}$ ± 0.13 |
| $3^{rd}$ | 44.51$^{a}$ ± 0.38 | 47.00$^{b}$ ± 0.12 | 48.90$^{c}$ ± 0.12 | 54.78$^{d}$ ± 0.12 | 56.95$^{ef}$ ± 0.07 | 60.67$^{g}$ ± 0.20 | 56.58$^{e}$ ± 0.14 | 61.41$^{h}$ ± 0.24 | 57.30$^{f}$ ± 0.085 |
| $4^{th}$ | 35.33$^{a}$ ± 0.35 | 38.82$^{b}$ ± 0.20 | 40.01$^{c}$ ± 0.11 | 43.53$^{d}$ ± 0.20 | 46.99$^{ef}$ ± 0.05 | 50.04$^{g}$ ± 0.10 | 45.03$^{e}$ ± 0.09 | 51.55$^{h}$ ± 0.11 | 46.68$^{f}$ ± 0.17 |
| $5^{th}$ | 33.88$^{a}$ ± 0.14 | 38.16$^{c}$ ± 0.17 | 37.22$^{b}$ ± 0.14 | 39.55$^{d}$ ± 0.11 | 43.96$^{e}$ ± 0.05 | 44.56$^{f}$ ± 0.11 | 39.74$^{d}$ ± 0.11 | 44.43$^{f}$ ± 0.07 | 43.60$^{e}$ ± 0.08 |
| $6^{th}$ | 32.73$^{a}$ ± 0.32 | 36.56$^{c}$ ± 0.30 | 35.49$^{b}$ ± 0.16 | 37.85$^{d}$ ± 0.12 | 41.50$^{f}$ ± 0.15 | 42.95$^{g}$ ± 0.08 | 38.42$^{e}$ ± 0.13 | 42.97$^{g}$ ± 0.07 | 41.00$^{f}$ ± 0.05 |
| $7^{th}$ | 31.77$^{a}$ ± 0.39 | 34.81$^{b}$ ± 0.21 | 34.66$^{b}$ ± 0.20 | 37.09$^{c}$ ± 0.09 | 41.09$^{d}$ ± 0.12 | 41.67$^{e}$ ± 0.03 | 36.89$^{c}$ ± 0.09 | 42.05$^{e}$ ± 0.08 | 41.00$^{d}$ ± 0.03 |
| $8^{th}$ | 30.58$^{a}$ ± 0.42 | 32.50$^{b}$ ± 0.36 | 33.54$^{c}$ ± 0.10 | 35.24$^{d}$ ± 0.11 | 38.44$^{e}$ ± 0.11 | 40.95$^{f}$ ± 0.08 | 34.94$^{d}$ ± 0.09 | 40.74$^{f}$ ± 0.08 | 39.04$^{e}$ ± 0.05 |
| 1 - $8^{th}$ week | 33.90$^{a}$ ± 0.17 | 36.48$^{b}$ ± 0.34 | 36.98$^{c}$ ± 0.09 | 39.69$^{d}$ ± 0.05 | 43.55$^{e}$ ± 0.12 | 44.98$^{f}$ ± 0.05 | 39.92$^{d}$ ± 0.10 | 45.26$^{f}$ ± 0.07 | 43.61$^{e}$ ± 0.11 |

$^{abcdefghi}$ Values with different superscripts in a row differ significantly ($P<0.05$)

**Fig.1 Effect of feeding different level of energy and protien on feed intake and body weight at weekly interval and 8th week in vanaraja broilers.**

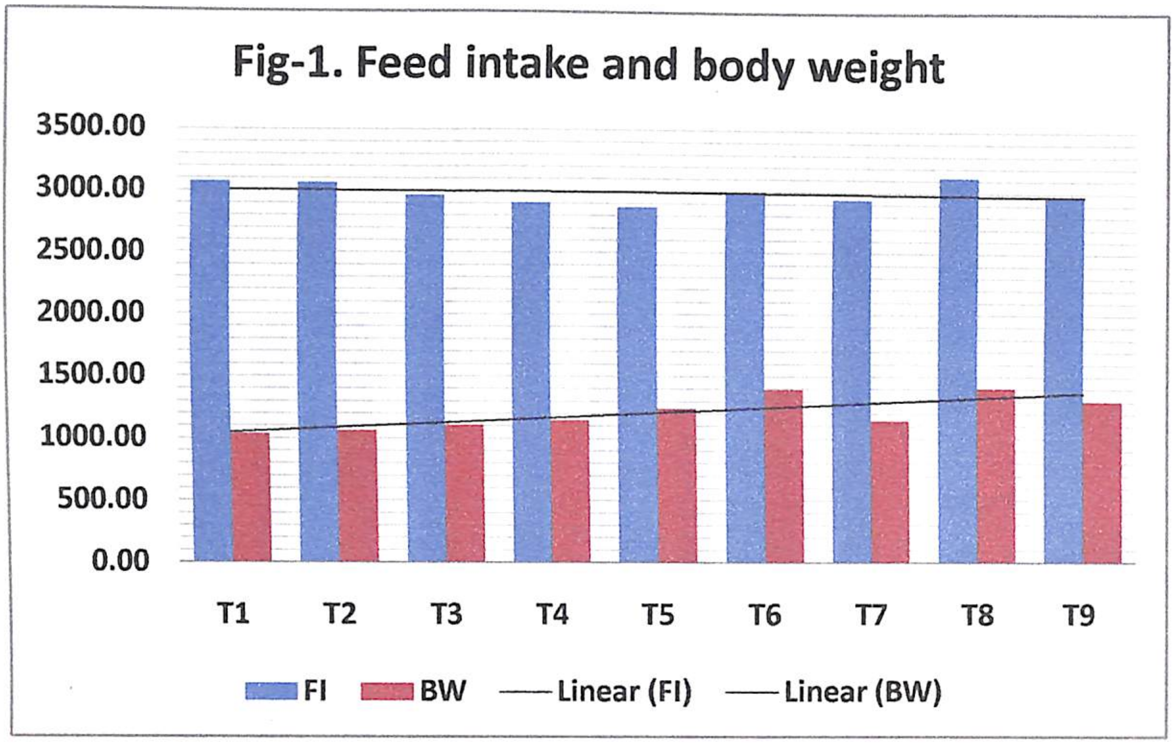



**Fig.2 Effect of feeding different level of energy and protien on Feed conversion ratio at weekly interval and 8th week in vanaraja broilers.**

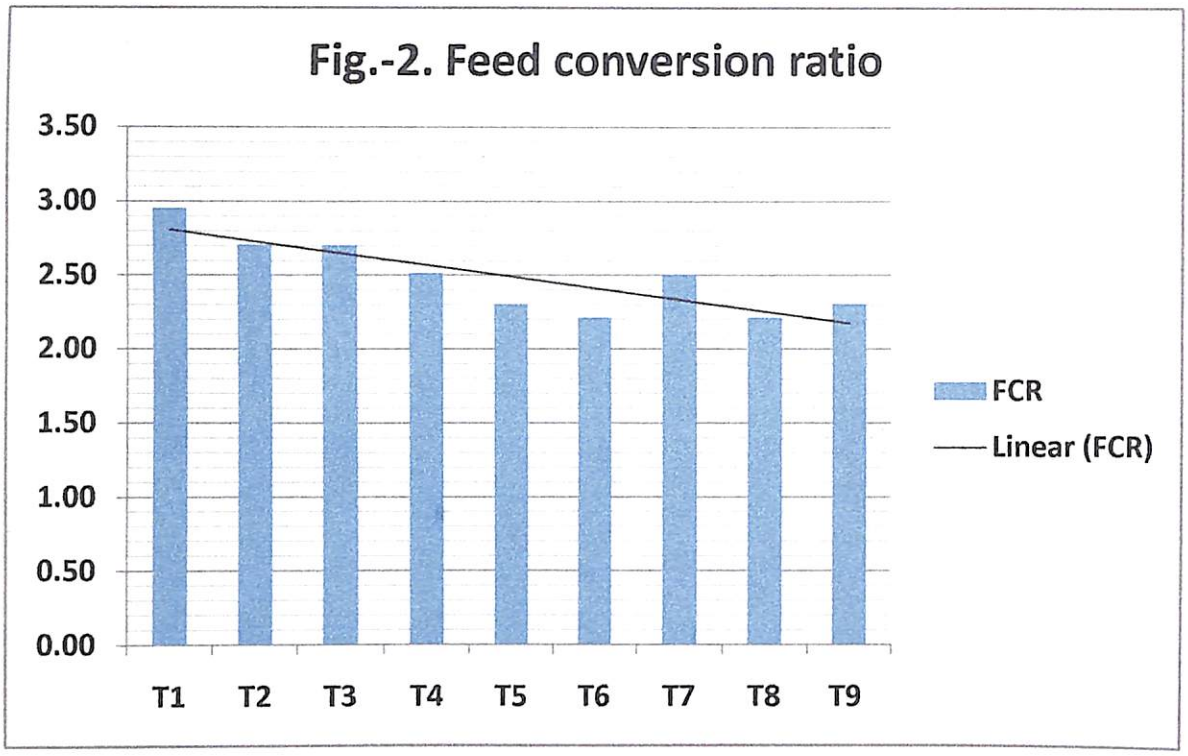
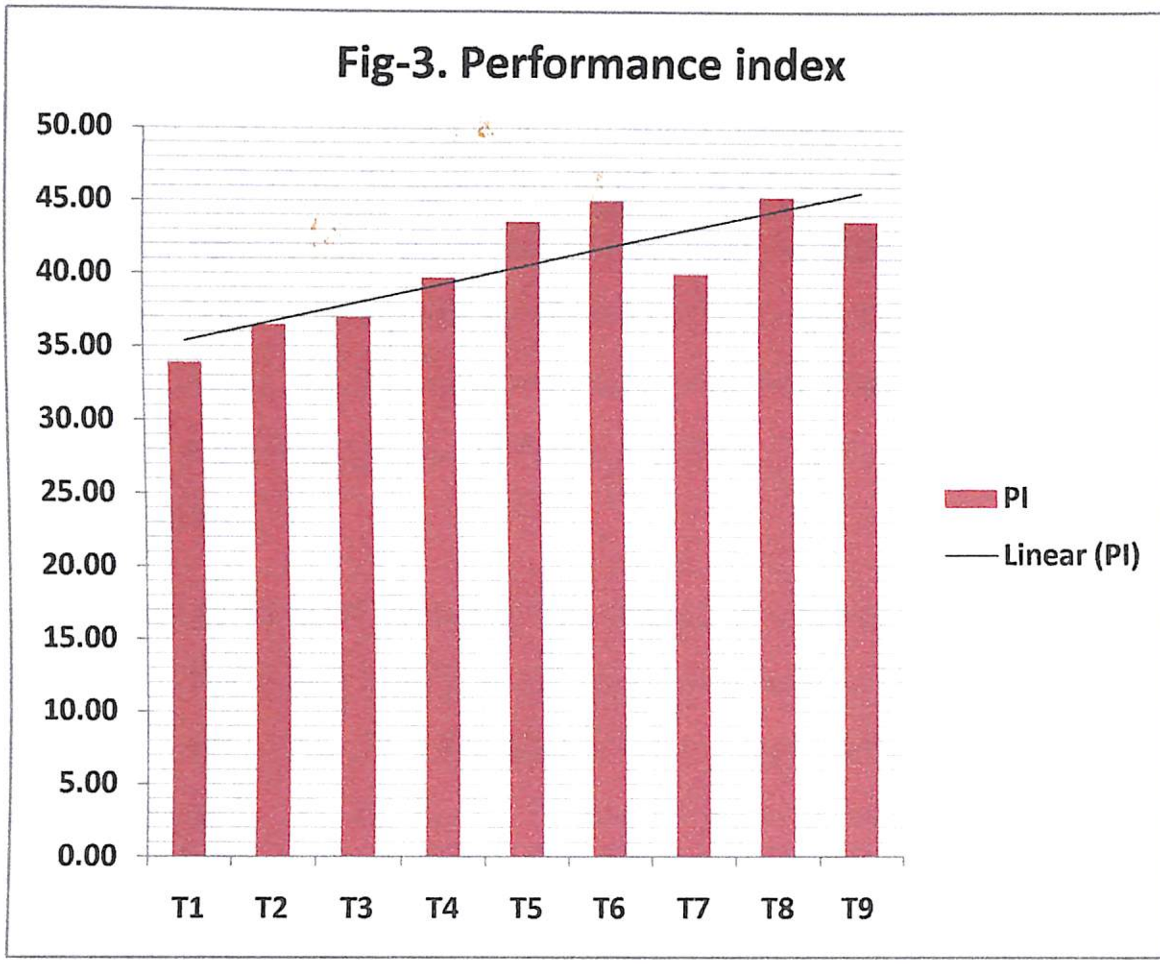


Fig.2 Effect of feeding different level of energy and protien on performance index at weekly interval and 8th week in vanaraja broilers.



## BALANCE OF NUTRIENTS

### Nitrogen Retention:

Nitrogen retention percentage in *Vanaraja* strain of broiler at 8th week of age is given in Table - 8. Nitrogen retention percentage ranged from 50.56 ± 0.67 in $T_1$ group to 54.87 ± 0.87 ± 0.67 in (T9) group. Analysis of variance for the effect of treatment on nitrogen retention in broiler was found to be significant ($P<0.05$), $T_1$, $T_2$ and $T_3$ are significantly comparable to $T_4$, $T_5$, $T_6$, $T_9$ is numerically higher than other treatment groups but significantly no difference among $T_4$, $T_5$, $T_6$,, $T_7$ and $T_8$ treatment groups.

Average nitrogen retention was highest in control ($T_9$) treat group feed with 21% CP and 2800 kcal ME containing ratio and lowest in $T_1$, group fed with 17 % CP, 2600 kcal ME/kg contain ration. The nitrogen retention % in $T_1$, $T_2$, $T_4$, $T_5$, $T_6$, T7 and T8 were found to be as 50.90 ± 0.88, 50.58 ± 1.53, 57.95 ± 0.73, 53.10 ± 1.02, 53.10 ± 0.88, 54.84 ± 0.29, 54.83 ± 83, respectively.

### Energy Metabolizability:

Result of average energy metabolizability of experimental bird during balance study are presented in Table - 8. The analysis of variance for the significant ($P<0.05$), It ranged from 66.00 in $T_7$ group in 0.12 to 71.74 ± 0.66 in $T_8$ group. Energy metabolizability in T8 group was found to be highest followed by group $T_6$, $T_3$, $T_9$, $T_5$, $T_1$, $T_2$ and $T_4$. Result showed the effect of feeding different level of energy and protein had similar effect on energy metebolizability.

**Calcium and Phosphorus Retention:**

Result of calcium and phosphorus retention percentage at 8th week of age are presented in Table - 8. Calcium retention percentage ranged from 51.08 ± 0.90 in $T_7$ group to 52.40 ± 0.72 in $T_5$ group but there is no significantly difference among the treatment groups. As presented in the same table phosphorus-retention percentage ranged from 55.26 ± 1.07 in 07 in $T_1$ to 57.04 ± 1.19 in $T_5$ group. It was found during experiment the phosphorus-retention was numerically higher in $T_5$ group and lowest in $T_1$ group and there was no significant difference among the different treatment groups.

## CARCASS CHARACTERISTICS

In order to observe the effect of feeding different level of energy and protein on carcass characteristic like dressing %, eviscerated %, giblet %, and relative weight of lymphoid organ were also studied.

**Dressing percentage:**

Dressing percentage of broilers fed different level of energy and protein in the present study is given in the Table - 9. Dressing percentage weight of different treatment groups ranged between 67.44 ± 0.31 in $T_4$ group to 71.03 ± 0.65 in control. Dressing percentage was numerically highest in $T_8$ group fed diet with 21% CP 3000 kcal ME/kg but significantly it was comparable to T6 group fed 19% CP 3000 kcal ME/kg and control. As the level of protein and energy in the diet was increased the dressing percentage was also increased.

**Intestine:**

The relative weight of intestine were significantly higher ($P<0.05$) in birds fed 21% CP and it was comparable to $T_7$ and $T_3$ group

**Liver:**

The relative weight of liver is significantly affected with different level of protein and energy in diet. The value of $T_6$ group was significantly comparable to $T_7$, $T_8$ and control.

Spleen and bursa weight was not influenced by dietary protein concentration. The relative weight of gizzard, gibbet intestine and abdominal fat were significantly higher ($P<0.05$) in bird fed 17 % CP in diet as compared to the other dietary groups. Though relative the weight of liver was significantly affected the trend was not clearly evident to attribute the change due to treatment effect the higher abdominal fat content in birds fed 17 % CP in diet might be due to wider ME to CP ration. Compared birds fed other protein level. Decreasing dietary protein (sterling *et al.*, 2000) is known to increase body fat deposition in chicken due to stimulatory effect on hepatic lipogenesis. Higher relative weight of gizzard and intestine in bird fed lowest protein diet might due to increased physical activity in digestive organs. In an effort to digest and absorb nutrients to full fill requirements. Similar changes in structure and function of different visceral organs due to feeding low nutrients and higher fiber diets in broiler have been reported earlier (Dibner *et al.*, 1996, S.V. Rama Rao *et al.*, 2006, 2005).

**Table 8. Effect of different level of energy and protein on nitrogen retention, energy metabolizability, calcium retention and phosphorus retention percentage at 8th week in Vanaraja.**

| ributes | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| Nitrogen etention % | 50.56 [a] ± 0.67 | 50.90 [a] ± 0.88 | 50.58 [a] ± 1.53 | 52.95[ab] ± 0.73 | 53.10[ab] ± 1.02 | 53.10[ab] ± 0.88 | 54.84 [b] ± 0.29 | 54.83 [b] ± 0.49 | 54.87 [b] ± 0.75 |
| Energy tabolizability % | 66.77[ab] ± 1.89 | 69.06[bc] ± 0.83 | 70.67 [c] ± 0.45 | 65.76 [a] ± 0.43 | 69.64 [c] ± 0.47 | 71.47 [c] ± 0.81 | 66.00 [a] ± 0.12 | 71.74 [c] ± 0.66 | 70.22 [c] ± 0.10 |
| Calcium etention % | 51.39 [a] ± 1.06 | 51.59 [a] ± 0.30 | 51.95[a] ± 1.18 | 52.22[a] ± 0.33 | 52.40[a] ± 0.72 | 52.14[a] ± 1.05 | 51.08[a] ± 0.90 | 52.55[a] ± 0.90 | 51.99[a] ± 0.13 |
| Phosphorus etention % | 55.26 [a] ± 1.07 | 55.62 [a] ± 0.50 | 56.14 [a] ± 0.73 | 55.72 [a] ± 1.40 | 57.04 [a] ± 1.19 | 56.48 [a] ± 1.50 | 55.39 [a] ± 1.50 | 56.27 [a] ± 1.29 | 56.99 [a] ± 1.12 |

[abc] Values with different superscripts in a row differ significantly ($P<0.05$)

**Table 9. Effect of different level of energy and protein on carcass traits at 8$^{th}$ week in Vanaraja.**

| Attributes | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| Liver | $3.63^{d}$ ± 0.19 | $2.29^{b}$ ± 0.11 | $2.73^{c}$ ± 0.11 | $2.23^{b}$ ± 0.06 | $1.20^{a}$ ± 0.09 | $2.42^{bc}$ ± 0.04 | $2.30^{b}$ ± 0.03 | $2.43^{bc}$ ± 0.07 | $2.65^{c}$ ± 0.07 |
| Gizard | $2.16^{abc}$ ± 0.10 | $2.52^{e}$ ± 0.11 | $2.24^{bcd}$ ± 0.13 | $2.13^{abc}$ ± 0.07 | $1.97^{a}$ ± 0.09 | $2.06^{ab}$ ± 0.14 | $2.29^{cd}$ ± 0.11 | $2.44^{de}$ ± 0.08 | $2.23^{bcd}$ ± 0.12 |
| Intestine | $5.52^{a}$ ± 0.18 | $6.87^{c}$ ± 0.14 | $8.43^{f}$ ± 0.24 | $7.51^{d}$ ± 0.14 | $6.06^{b}$ ± 0.04 | $6.57^{c}$ ± 0.08 | $8.54^{f}$ ± 0.15 | $8.78^{f}$ ± 0.17 | $7.99^{e}$ ± 0.07 |
| Abdominal Fat | $2.52^{b}$ ± 0.19 | $2.18^{b}$ ± 0.07 | $2.51^{b}$ ± 0.17 | $1.38^{a}$ ± 0.16 | $3.97^{c}$ ± 0.08 | $3.66^{c}$ ± 0.12 | $1.35^{a}$ ± 0.22 | $1.28^{a}$ ± 0.12 | $1.63^{a}$ ± 0.15 |
| Spleen | $0.30^{bc}$ ± 0.14 | $0.32^{c}$ ± 0.21 | $0.33^{c}$ ± 0.13 | $0.23^{a}$ ± 0.11 | $0.24^{ab}$ ± 0.21 | $0.24^{ab}$ ± 0.14 | $0.37^{c}$ ± 0.13 | $0.21^{a}$ ± 0.18 | $0.30^{bc}$ ± 0.22 |
| Bursa | $0.31^{cd}$ ± 0.13 | $0.23^{b}$ ± 0.11 | $0.24^{b}$ ± 0.20 | $0.32^{d}$ ± 0.14 | $0.15^{a}$ ± 0.21 | $0.27^{bc}$ ± 0.18 | $0.30^{cd}$ ± 0.12 | $0.23^{b}$ ±0.08 | $0.25^{b}$ ± 0.11 |
| Giblet | $6.35^{cd}$ ± 0.08 | $5.55^{abc}$ ± 0.15 | $5.47^{abc}$ ± 0.14 | $4.72^{a}$ ± 0.15 | $4.74^{a}$ ± 0.10 | $4.98^{ab}$ ± 0.08 | $6.01^{bcd}$ ± 0.18 | $6.62^{d}$ ± 0.32 | $5.71^{abcd}$ ± 0.17 |
| Dressing % | $68.56^{ab}$ ± 0.55 | $69.22^{abcd}$ ± 0.32 | $68.26^{a}$ ± 0.09 | $67.44^{a}$ ± 0.31 | $70.45^{bcd}$ ± 0.40 | $70.64^{cd}$ ± 0.37 | $68.72^{abc}$ ± 0.65 | $71.03^{d}$ ± 1.05 | $70.63^{cd}$ ± 0.93 |
| Evicerated % | $68.70^{d}$ ± 0.63 | $62.50^{b}$ ± 0.55 | $64.56^{c}$ ± 0.23 | $63.91^{c}$ ± 0.20 | $64.42^{c}$ ± 0.39 | $60.90^{a}$ ± 0.56 | $64.48^{c}$ ± 0.27 | $64.66^{c}$ ± 0.49 | $63.53^{bc}$ ± 0.46 |

$^{abcd}$Values with different superscripts in a row differ significantly ($P<0.05$)

## BLOOD BIOCHEMICAL PARAMETERS

Under this parameter hemoglobin, PCV, serum glucose, total protein, BUN, SGOT, SGPT, total cholesterol, HDL, and triglyceride in experimental birds were studied.

### Blood hemoglobin:

Result of hemoglobin level in serum at 8th week of age in *Vanaraja* broiler in presented in Table - 11. Average hemoglobin level in serum ranged from 11.21 ± 0.24 to gm/dl in $T_2$ group to 12.02 ± 0.59gm/dl in T8. Statistical analysis for the effect of treatment on hemoglobin level in bird was found to be not significantly different. Average level of hemoglobin in $T_1$, $T_3$, $T_4$, $T_5$, $T_6$, $T_7$ and $T_9$ groups were 11.31 ± 0.38, 11.77 ± 0.52, 11.52 ± 0.43, 11.54 ± 0.39, 11.50 ± 0.37, 11.45 ± 0.46 and 12.01 ± 0.54 respectively $T_1$, $T_3$, $T_4$, $T_5$, $T_6$, and $T_7$ are numerically lower value than control but they do not differ significantly.

### Packed cell volume (PCV):

Result of PCV level of serum at 8th week in *Vanaraja* strain of broiler is presented in Table -11. Average PCV level in blood ranged from 24.26 ± 0.8 in $T_1$, group to 26.68 ± 0.56 in T8 group. $T_1$, $T_2$, $T_3$, are significantly not differ but comparable to $T_4$, $T_5$, $T_6$treatment group. $T_8$ group showed higher numerical value but significantly comparable to control.

### Serum Glucose:

The average glucose level ranged between 139.53 ± 2.98 mg/dl in $T_1$ group and 165 ± 58 ± 2.85 mg/dl in T8 group (Table -11). $T_1$ and $T_2$ are not significantly differ.$T_8$ shows higher numerically value than control but significantly there is no difference.

**Total Protein:**

Average total protein level ranged between 3.61 ± 0.23 mg/dl in $T_1$ group and 4.80 ± 0.28 mg/dl in T6 group. Average total protein level was found to be highest in T6 group which is significantly not differ from $T_4$ ,$T_5$, $T_7$, $T_8$, and control. $T_1$, $T_2$, $T_3$ and $T_4$ groups are significantly comparable.

**Blood urea nitrogen:**

Average BUN ranged between 3.11 ± 0.2 in T1 to 4.26 ± 0.16 in $T_8$. During the entire period of experiment it was found that $T_1$, $T_2$, $T_3$ did not shows any significant difference but lower than control. $T_4$, $T_5$, $T_6$, $T_7$, $T_8$ numerically differ but significantly there is no difference.

**SGOT:**

Result of SGOT level of serum at 8th week in *Vanaraja* strain of broiler is presented in table no-11. SGOT among different groups was found to range from 128.81 ± 1.75 mg/dl in T3 group fed with 17 % CP and 3000 kcal ME/kg to 161.96 ± 2.07 in T8 group fed diet with 21 % CP 3000 kcal/ME. The level of SGOT in $T_1$, $T_2$, $T_3$ are significantly similar but lower than control.

**SGPT:**

Result of SGPT level of serum at 8th week in *Vanaraja* strain of broiler is presented in Table - 11. SGPT range from 12.28 ± 0.53 in $T_2$ group fed with 17 % CP 2800 kcal/ME to 18.89 ± 0.57 in T8 group fed with 21% CP and 3000 kcal ME/kg. Statically analysis for the effect of feeding different level of energy and protein on SGPT found to be significant ($P<0.05$). Level of SGPT is $T_1$, $T_2$, $T_3$, $T_4$, $T_5$ are significantly comparable. $T_8$ group shows highest value of SGPT among the difference groups but significantly it comparable to control .

**Cholesterol:**

Result total cholesterol level of serum at 8th week in *Vanaraja* strain of broiler is presented in Table -11. total cholesterol among different group was found to be ranged from 99.45 ± 5.17 mg/dl T1 group fed with diet contain 17 % CP 2600 kcal/ME to 129.39 ± 3.72 is T8 group fed with diet 21 % CP and 3000 kcal ME. Statistical analysis for the effect of feeding of different level of energy and protein on level cholesterol was found to be significant ($P<0.05$) level of cholesterol in group $T_2$, $T_3$, $T_4$ $T_5$, $T_6$, $T_7$ and $T_9$ were 104.68± 6.13 , 117.85 ± 5.38, 100.51 ± 7.20, 115.73 ± 6.60, 124.98 ± 4.36, 110.80 ± 5.03, 117.02 ± 4.59, mg/dl respectively. It was apparent from result the level of total cholesterol increases as the level of energy increasing with corresponding protein. On statistical analysis $T_1$, $T_2$, $T_4$ $T_5$, and $T_7$ are significantly comparable. T6 & T8 are significantly comparable but higher than control group.

**Triglyceride:**

Result of total triglyceride level of serum at 8th week in *Vanaraja* strain of broiler is presented in Table - 11. Total triglyceride among different group was found to be ranged 80.29 ± 3.91 in T2 group to 106.90 ± 2.31 in $T_8$ group which is fed diet contain 21 % CP and 3000 kcal ME/kg and it significantly higher than control, on statically analysis variance there is no significant different among different treatment group except $T_8$.

**HDL:**

The average of HDL level was found to be range from 41.21 ± 0.96 in T4 group (Table - 11) fed diet containing 19 % CP and 2600 kcal ME/kg to 54.13 ± 1.35 in $T_8$ fed diet containing 21 % CP and 3000 kcal ME/kg. $T_1$, $T_2$, $T_3$, $T_4$ and $T_7$ are significantly (P<0.05) comparable to control, whereas $T_8$ is significantly higher than control.

**LDL:**

Result of LDL level in serum at 8th week of age in broiler is presented in Table - 11. Average LDL level in serum ranged from 39.28 ± 5.25 in T1 group fed diet containing 17 % CP and 2800 kcal ME/kg to 55.33 ± 4018 in $T_6$ fed diet containing 19 % CP and 3000 kcal ME/kg. On statistical analysis it was found that there is no significant difference among different treatment group.

**VLDL:**

Result of VLDL level of serum at 8th week in *Vanaraja* strain of broiler is presented in Table -11. Average VLDL ranged from 16.06 ± 0.78 in $T_2$ fed diet containing 17 % CP 2800 kcal ME/kg to 21.38 ± 0.46 in $T_8$ group fed diet containing 21 % CP and 3000 kcal ME/kg. On statistical analysis it was found that there is no significant (P<0.05) difference among different treatment groups.

*Table-10: Effect of different level of energy and protein on serum parameter at $8^{th}$ week in Vanaraja.*

| ributes | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| cose | $139.53^{a} \pm 2.98$ | $146.14^{a} \pm 3.03$ | $148.32^{bc} \pm 2.69$ | $152.18^{bcd} \pm 2.07$ | $155.61^{cd} \pm 3.13$ | $156.97^{d} \pm 2.17$ | $153.48^{bcd} \pm 2.39$ | $165.58^{e} \pm 2.21$ | $164.93^{e} \pm 2.47$ |
| al Protein | $3.64^{a} \pm 0.23$ | $3.82^{ab} \pm 0.21$ | $3.70^{a} \pm 0.26$ | $4.25^{abc} \pm 0.33$ | $4.75^{c} \pm 0.27$ | $4.80^{c} \pm 0.28$ | $4.69^{c} \pm 0.30$ | $4.70^{c} \pm 0.30$ | $4.63^{bc} \pm 0.27$ |
| N | $3.11^{a} \pm 0.20$ | $3.32^{a} \pm 0.21$ | $3.42^{a} \pm 0.20$ | $4.04^{b} \pm 0.19$ | $3.98^{b} \pm 0.24$ | $3.99^{b} \pm 0.16$ | $4.19^{b} \pm 0.13$ | $4.26^{b} \pm 0.16$ | $4.22^{b} \pm 0.09$ |
| DT | $130.52^{a} \pm 2.29$ | $131.65^{a} \pm 2.47$ | $128.81^{a} \pm 1.75$ | $140.71^{b} \pm 1.24$ | $143.53^{bc} \pm 1.49$ | $144.39^{bc} \pm 1.51$ | $147.23^{c} \pm 2.37$ | $161.96^{d} \pm 2.07$ | $157.08^{d} \pm 2.37$ |
| PT | $12.32^{a} \pm 0.56$ | $12.28^{a} \pm 0.53$ | $12.55^{ab} \pm 0.57$ | $13.80^{ab} \pm 0.45$ | $13.39^{ab} \pm 0.49$ | $14.11^{b} \pm 0.19$ | $16.04^{c} \pm 0.79$ | $18.89^{d} \pm 0.57$ | $18.06^{d} \pm 0.71$ |
| lesterol | $99.45^{a} \pm 5.17$ | $104.68^{ab} \pm 6.13$ | $117.85^{bcd} \pm 5.38$ | $100.51^{ab} \pm 7.20$ | $115.73^{abcd} \pm 6.60$ | $124.98^{cd} \pm 4.36$ | $110.80^{abc} \pm 5.03$ | $129.39^{d} \pm 3.72$ | $117.02^{bcd} \pm 4.59$ |
| glyceride | $89.52^{a} \pm 2.32$ | $80.29^{a} \pm 3.91$ | $104.80^{b} \pm 2.11$ | $86.09^{a} \pm 6.68$ | $82.34^{a} \pm 4.15$ | $92.92^{a} \pm 3.51$ | $87.63^{a} \pm 4.20$ | $106.90^{b} \pm 2.31$ | $87.61^{a} \pm 3.66$ |
| L | $42.27^{ab} \pm 1.22$ | $42.04^{ab} \pm 1.49$ | $46.42^{bc} \pm 1.39$ | $41.21^{a} \pm 0.96$ | $47.99^{cd} \pm 1.78$ | $51.07^{de} \pm 2.12$ | $42.23^{ab} \pm 0.75$ | $54.13^{e} \pm 1.35$ | $45.25^{abc} \pm 1.46$ |
| | $39.28^{a} \pm 5.25$ | $46.58^{a} \pm 5.07$ | $50.47^{a} \pm 5.09$ | $42.08^{a} \pm 7.13$ | $51.27^{a} \pm 7.07$ | $55.33^{a} \pm 4.18$ | $51.05^{a} \pm 4.74$ | $53.88^{a} \pm 3.12$ | $54.25^{a} \pm 5.17$ |
| DL | $17.91^{a} \pm 0.46$ | $16.06^{a} \pm 0.78$ | $20.96^{b} \pm 0.42$ | $17.22^{a} \pm 1.34$ | $16.47^{a} \pm 0.83$ | $18.59^{a} \pm 0.70$ | $17.53^{a} \pm 0.84$ | $21.38^{b} \pm 0.46$ | $17.53^{a} \pm 0.73$ |

$^{abcde}$ Values with different superscripts in a row differ significantly ($P<0.05$)

## Table-11: Effect of different level of energy and protein on blood parameter at $8^{th}$ week in Vanaraja.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| emoglobi | $11.31^{a} \pm 0.38$ | $11.21^{a} \pm 0.24$ | $11.77^{a} \pm 0.52$ | $11.52^{a} \pm 0.43$ | $11.54^{a} \pm 0.39$ | $11.50^{a} \pm 0.37$ | $11.45^{a} \pm 0.46$ | $12.02^{a} \pm 0.59$ | $12.01^{a} \pm 0.54$ |
| / | $24.26^{a} \pm 0.68$ | $24.33^{a} \pm 0.60$ | $24.46^{a} \pm 0.54$ | $24.87^{ab} \pm 0.22$ | $24.98^{ab} \pm 0.37$ | $25.63^{abc} \pm 0.26$ | $26.23^{bc} \pm 0.59$ | $26.68^{c} \pm 0.56$ | $25.99^{bc} \pm 0.26$ |

$^{abcde}$ Values with different superscripts in a row differ significantly ($P<0.05$)

## IMMUNE RESPONSE

For assessment of immune status of *Vanaraja* broiler, serum samples were subjected to Haemagglutination Inhibition test at 7, 14, 21 and 28 days of age. Immune response to Ranikhet disease vaccine (F-strain) due to dietary protein energy variation was given in Table - 12. The antibody titre for all observation varied between 0.5 $\log_2$ to 5.0 $\log_2$. During the entire experimental period it was observed that the antibody titre of T6 group fed 19% CP, 3000 kcal ME/kg containing diet was higher but significantly there is no difference among T8 group and control. There was gradual increase in antibody titer against NDV as the level of protein and energy increase. The experiment for a period of 4$^{th}$ week revealed that the bird of T6 group had higher titer value than other treatment groups, but numerically it is comparable to T8 and control group. The serum samples were subjected to agar gel precipitation test (AGPT), a precipitin band on the gel inferred about the antibody conversion to IBDV vaccine.

For estimation of antibody titers to live New Castle Disease virus (NDV) vaccine was used to examine humoral immune response of chicken at different level of protein and energy. The immune response to Ranikhet disease vaccine (F-straitn) due to dietary protein energy variation has been depicted in Table - 12. The perusal of the table reveals that there was a rising trend of antibody titre against Ranikhet disease virus till 28 days of age. Further, the group $T_6$ showed the highest titre for all period of observation, whereas group $T_2$ showed the lowest corresponding value. In general there was a significant rise in sero conversion among all treatment groups as compare to control except the group $T_1$ and $T_2$. The groups ($T_3$, $T_4$, $T_5$, $T_6$, $T_7$, $T_8$) receiving higher energy protein combination also attained higher antibody titre, as compare to control ($T_9$). However, groups $T_1$ and $T_2$ that receive comparatively lower protein and energy showed a relatively lower antibody titre. Golian *et al.* (2010) did not observed any significant changed in antibody titre due to feeding of low energy diet. He further observed that high protein energy diet cause rapid growth and consequently decline immune response. The result was contradictory to the present finding result. Enting *et al.* (2007), however , showed that there was an increase immune response depending upon the breeder age and egg weight. It is speculated that the better body weight gain corroborate health and antibody titre. Moreover, the better immune response recorded in the study might be due to better nutrient utilization and its extension towards the better immune response.

## ECONOMICS OF PRODUCTION

Economics as influenced by different level of protein and energy was shown in Table - 13. Total input cost per bird was calculated on the basis of total feed cost and cost of chicks, medicines and other miscellaneous. As the level of protein and energy increases in diet increased the cost of experimental ration. However, when cost of feed per kg live weight gain was considered it was found maximum in T6 group which was fed diet containing 19 % CP and 3000 kcal ME/kg and minimum in T1 group which was fed with 17 % CP and 2600 kcal ME. Net profit per bird was also found highest in T6 and lowest in T1 group.

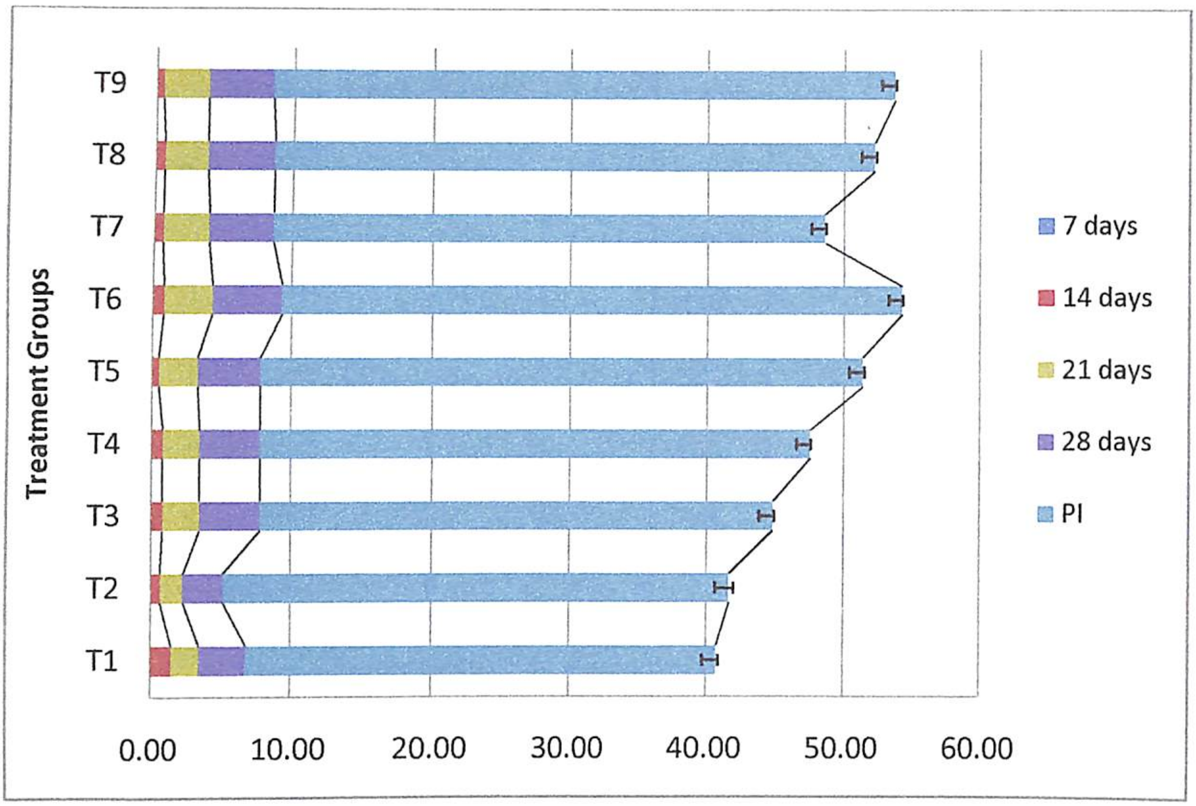
Result of economics also indicated that the profit if margin was found to be more on the ration containing 19% crude protein 3000 kcal ME/kg than other dietary protein energy levels. Previous work related to economics production with energy protein interaction on Vanaraja strain of broiler was not reported. However S.V. Rama Rao *et al* (2006) found that obtained more profit margin in a ration containing16% crude protein.

**Table 12. Immune response to Ranikhet disease vaccine (F-starin) due to dietary protein-energy variation**

| Post IBD ...ation | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | $1.50^{b} \pm 0.34$ | $0.67^{a} \pm 0.21$ | $0.83^{ab} \pm 0.17$ | $0.83^{ab} \pm 0.17$ | $0.50^{a} \pm 0.22$ | $0.83^{ab} \pm 0.17$ | $0.67^{a} \pm 0.21$ | $0.67^{a} \pm 0.21$ | $0.50^{a} \pm 0.22$ |
| | $2.00^{ab} \pm 0.26$ | $1.67^{a} \pm 0.21$ | $2.67^{bc} \pm 0.21$ | $2.67^{bc} \pm 0.21$ | $2.83^{cd} \pm 0.17$ | $3.50^{d} \pm 0.22$ | $3.33^{cd} \pm 0.21$ | $3.17^{cd} \pm 0.31$ | $3.33^{cd} \pm 0.21$ |
| | $3.33^{a} \pm 0.33$ | $2.83^{a} \pm 0.17$ | $4.33^{b} \pm 0.21$ | $4.33^{b} \pm 0.21$ | $4.50^{b} \pm 0.22$ | $5.00^{b} \pm 0.26$ | $4.67^{b} \pm 0.21$ | $4.83^{b} \pm 0.17$ | $4.67^{b} \pm 0.21$ |

[abcd] Values with different superscripts in a row differ significantly (P<0.05)

**Fig- 4. Immune response relation with PI on dietary protein-energy variation**



## Table 13. Economics as influenced by different dietary treatments

| Attributes | $T_1$ | $T_2$ | $T_3$ | $T_4$ | $T_5$ | $T_6$ | $T_7$ | $T_8$ | $T_9$ |
|---|---|---|---|---|---|---|---|---|---|
| Feed cost/kg ration (Rs.) | 18 | 18.50 | 19.0 | 20.0 | 21.0 | 22.20 | 23.40 | 23.5 | 25.00 |
| Cost of ration consumed (Rs.) | 30.80 | 32.10 | 34.15 | 36.50 | 37.0 | 38.50 | 39.60 | 41.10 | 44.10 |
| Total feed cost (Rs.) | 30.80 | 32.10 | 34.15 | 36.50 | 37.0 | 38.50 | 39.60 | 41.10 | 44.10 |
| Cost of Chicks + Medicines+ Misc. cc(Rs.) | 43.50 | 43.50 | 43.50 | 43.5 | 43.5 | 43.5 | 43.5 | 43.5 | 43.5 |
| Total cost (Rs.) | 74.30 | 75.60 | 77.65 | 80.0 | 80.5 | 82.0 | 83.1 | 84.60 | 87.60 |
| Average live weight of broiler bird (kg.) | 0.999 | 1.028 | 1.071 | 1.112 | 1.028 | 1.356 | 1.109 | 1.265 | 1.364 |
| Market price of bird (Rs.) at the rate of Rs. 100/- | 99.9 | 102.8 | 107.1 | 111.2 | 120.8 | 135.6 | 110.9 | 126.5 | 136.4 |
| Net profit/bird (Rs.) | 25.6 | 27.2 | 29.45 | 31.2 | 40.30 | 53.6 | 27.8 | 41.9 | 48.8 |
| Profit/kg live weight (Rs.) | 25.85 | 26.45 | 27.49 | 28.05 | 33.36 | 39.52 | 25.06 | 33.12 | 35.7 |

# CHAPTER -5

# SUMMARY AND CONCLUSION

# SUMMARY AND CONCLUSION

In present scenario farming is gaining strength with fast pace of development in our countries and about 67 % of population are dependent upon agriculture and allied for their livelihood security, poultry farming promise a great scope to mitigate the challenge of poverty. Alleviation, women empowerment, income generation, employment generation, improvement in standard of living, employment to unskilled, illiterate women, landless farmer, small land holding farmers, laboures and in all these *Vanaraja* strain of broiler is very helpful. *Vanaraja* is a dual purpose chicken developed at Project Directorate on Poultry, Hyderabad and it can grow well under backyard/ free range condition with low input. Net profit to the farmer is also higher because the main thing about the bird reared is its ration. About 2/3 part of expenditure on poultry feed and as we know that the two essential component of poultry ration is compresses protein and energy, about 90% of total cost of ration is depend upon level of energy and protein in feed.

So, the present study was planned to investigate the effect of feeding different dietary level of energy and protein on the performance of *Vanaraja* broiler. The entire research study consisted of 9 treatment groups. The experimental diet were formulated with three level of protein i.e. 17 %, 19 %, 21 % each with three level of energy 2600, 2800, 3000 kcal ME/kg in 3x3 factorial arrangement. All the managemental procedure were rendered uniform for all the birds. In this study different parameter like feed intake, body weight gain, feed conversion ratio, performance index, blood serum profiles, immune response of broiler and carcass quality were observed, respectively. This experiment was conducted for 56 days on 540 birds.

## GROWTH PARAMETER

**Feed intake:** A good fluctuation was observed in feed intake in every week among different treatment groups. On the whole after 8th week average feed intake in $T_5$ (2872.04 g) was found to be significantly ($P<0.05$) lower than $T_1$, $T_2$, $T_3$, $T_4$, $T_6$, $T_7$, $T_8$, $T_9$ group, whereas value of $T_8$ (3129.66 g) group was found to be highest ($P<0.05$) among the different groups.

**Body weight:** Average body weight in broiler was found to be highly significant ($P<0.05$). During the experiment definite trend was observed in body weight of different treatment group. As whole the level of protein and energy increases body weight increased. At 8th week of age $T_8$ group had higher body weight but significantly there was no difference between $T_6$ and $T_8$ groups.

**Body weight gain**: Average body weight gain at the end of 1st week of age was highest in $T_8$ group, fed diet containing 21 % CP and 3000 kcal ME/kg but significantly there was no difference in body weight gain of $T_6$ group fed 19% CP and 3000 kcal ME/kg and control. The body weight gain in $T_9$ group was highest but significantly there was no difference with $T_8$ group. Numerically and significantly $T_1$ group showed lower body weight gain in 2nd week. Average body weight gain at the end of 3rd week of age was highest in $T_6$ group that fed diet containing 19 % CP 3000 kcal ME/kg energy. In 4th week body weight gain was significant ($P<0.05$) among different treatment groups. Significantly there was no difference in body weight gain of $T_6$, $T_8$ and control group in 5th week of age. In 6th week $T_6$ group body weight gain was significantly comparable to control, whereas no significant difference were observed between $T_6$ and $T_8$ group during 7th and 8th week of age. During 1- 8 week body weight gain was highest for $T_8$ group that fed 21 % CP and 3000 kcal ME/kg but significantly there were no difference with $T_6$ group that fed 19 % CP and 3000 kcal ME/kg. Level of protein and energy exerted significant ($P<0.05$) effect on body weight gain but 19 % and 21 % protein as well as 3000 kcal ME/kg had similar effect and significantly higher than 17 % and 2600 kcal ME/kg diet.

**Feed conversion ratio (FCR):** Feed conversion ratio in broiler was found to be highly significant ($P<0.05$) at every week of experiment. During the entire experimental period of 1 to 8th week of age FCR value ranging from 2.22 to 2.96 was significantly affected dietary treatment and level of protein and energy. Chicks fed diet with 19% CP and 3000 kcal ME/kg of energy utilized feed more efficiently and had comparable FCR value with the chicks fed diet containing 21 % CP and 3000 kcal ME/kg energy. High protein and energy level reflected lower FCR value.

**Performance index (PI):** The performance index of chicks was significantly ($P<0.05$) influenced by dietary treatments and level of protein and energy in a every week of experiment. The PI during entire experimental period of 1- 8 week was significantly influenced dietary treatment level of protein and energy. A significantly ($P<0.05$) higher index value (44.98) was obtained in *Vanaraja* broiler fed diet containing 19% CP and 3000 kcal ME/kg and significantly not differ from $T_8$ group, but lower than the control. The index value increased as the level of protein and energy concentration in the diet was increased. A high energy and a high level of protein in the diet showed better utilization of feed commensurate with weight of growth.

## BALANCE STUDY

**Nitrogen retention percentage:** Average nitrogen retention percentage was highest in $T_9$ group fed diet containing 21 % CP and 2800 kcal ME/kg, and was found that there were no significant difference among treatment groups $T_6$, $T_7$, and $T_8$.

**Energy metabolizability percentage:** Energy metabolizabitily percentage was found to be highest in $T_8$ group but significantly there was no difference among treatment groups $T_5$, $T_6$, $T_8$ and control.

**Calcium and Phosphorus retention percentage:** During entire experimental period (1 - 8$^{th}$) week it was observed that calcium and phosphorus was not significantly different from control and other treatment groups.

The balance study showed that all there significantly difference except calcium and phosphorus retention percentage, indicating the effect of feeding different level of energy and protein in *Vanaraja* strain of broilers.

## CARCASS CHARACTERISTIC

**Dressing percentage:** Dressing percentage was numerically highest in $T_8$ group fed diet with 21 % CP 3000 kcal ME/kg but significantly it was comparable to $T_6$ group fed 19% CP 3000 kcal ME/kg and control. As the level of protein and energy in the diet was increased the dressing percentage was also increased.

**Eviscerated percentage:** The mean of eviscerated percentage varying from 60.90 to 68.70 was significantly influenced by concatenate of energy in the diet at each level of protein reflected higher eviscerated percentage.

**Giblet percentage:** On statistical analysis it was found that the giblet percentage was significantly influenced by the different level of energy and protein in the diet. Giblet percentage was lowest in $T_4$ group and it is significantly comparable to $T_5$ group. The giblet percentage of $T_6$ group that fed 19 % protein and 3000 kcal ME/kg was significantly comparable to control.

**Spleen and Bursa:** Lymphoid organ i.e. spleen and bursa weight were not influenced by dietary protein and energy concentration. Bursa and spleen weight of $T_6$ group are significantly comparable to control.

**Abdominal fat:** Average abdominal fat ranging from 3.97 to 1.28 and significantly there was no difference among $T_7$, $T_8$ and control but $T_6$ group showed significantly higher abdominal fat than other treatment groups.

**Intestine:** The relative weight of intestine were significantly higher ($P<0.05$) in birds fed 21% CP and it was comparable to $T_7$ and $T_3$ group.

**Liver:** The relative weight of liver was significantly affected with different level of protein and energy in the diet. The value of $T_6$ group was significantly comparable to $T_7$, $T_8$ and control group.

## BLOOD BIOCHEMICAL PARAMETER

**Haemoglobin:** The diet containing higher protein and energy showed highest numerical value of hemoglobin. There was no significant difference among different treatment groups. It has been seen that the level of hemoglobin increased as the level of energy and protein in diet increased.

**Packed Cell Volume:** Control group had numerically higher PCV value. There is no significantly difference between control and $T_6$, $T_7$ and $T_8$ group. $T_1$ group had numerically lower value and there was no significant difference between $T_2$ and $T_3$ treatment groups.

**Serum Glucose**: There was no significantly difference between control and $T_8$ group, while $T_6$ had lower glucose level than control.

**Total protein:** Numerically highest protein energy contain diet had higher total protein value but significantly there was no difference in 19% protein containing diet.

**Blood urea nitrogen (BUN):** The data showed that BUN was not much influenced by dietary treatment. As level of protein increased in diet, the BUN level in serum also increased. 21% CP containing diet showed higher level of BUN in serum but significantly not different from 19% CP but higher than 17% fed diet.

**SGOT:** SGOT level was found to be highest in $T_8$ group and lowest in $T_3$ group. The statistical analysis for the effect of different level of protein and energy on SGOT was found to be highly significant ($P<0.05$).

**SGPT:** SGPT level was found to be highest in $T_8$ group and lowest in $T_2$ group. On statistical analysis for dietary treatment was found to be significant ($P<0.05$).

**Total cholesterol:** Statistical analysis for the effect of feeding different level of protein and energy on total cholesterol level was found to be significant ($P<0.05$). The average total cholesterol in serum was highest in group fed higher level of protein & energy and lowest in group fed lower protein and energy containing ration. It was seen that feeding of different level of energy and protein affected the level of cholesterol in *Vanaraja* of broiler.

**Triglyceride:** Statistical analysis for the effect of feeding different level of protein & energy was found to be significant. The group which fed highest level of energy and protein shows higher level of triglyceride while the other groups were not significantly different.

**High density lipoprotein (HDL):** The effect of treatment on HDL level was found to be highly significant ($P<0.05$). Average HDL was found highest in group which fed highest protein & energy containing diet but significantly comparable to group fed lower protein i.e. 19% crude protein with similar energy contain diet.

**Low density lipoprotein (LDL):** There was no significant difference between control and other treatment groups. But numerically 19% CP and 3000 kcal energy fed group had higher LDL value than control.

**Very low density lipoprotein (VLDL):** There was no significant difference between control and other treatment groups but numerically highest protein energy fed group had higher VLDL value than control.

## IMMUNE RESPONSE

Immune response to Ranikhet disease vaccine (F-strain) due to dietary protein energy variation was examined. During the entire experimental period it was observed that the immune status of $T_6$ group fed 19% CP, 3000 kcal ME/kg containing diet was higher but significantly there was no any differences found between $T_8$ and control group. The serum samples were also subjected to agar gel precipitation test (AGPT), a precipitin band on the gel inferred about the antibody conversion to IBDV vaccine.

## ECONOMICS OF PRODUCTION

As the level of protein and energy in diet increased the cost of experiment ratio also increased. Cost of feed per kg live weight was found maximum in $T_6$ group which fed 19% crude protein and 3000 kcal ME/kg energy and minimum in $T_1$ group which fed minimum level i.e. 17% crude protein, 2600 kcal ME/kg.

## CONCLUSIONS:

(i) Ration containing 19% and 21% crude protein with 3000 kcal ME/kg showed highest weight gain in *Vanaraja* broiler.

(ii) The efficiency of feed utilization was found to be more in chicks fed diets either with 19% and 21% crude protein having 3000 kcal ME/kg of energy.

(iii) The performance index value increased as level of protein and energy concentration of diet was increased. A high energy and protein in diet showed better utilization of feed commensurate with weight gain of chicks.

(iv) Study of balance of nutrient, nitrogen retention percentage and energy metabolizability percentage was seen highest among 21% crude protein fed group while no significant changes in calcium and phosphorus retention percentage among the different treatment groups and control.

(v) High level of protein and energy concentration in diet influenced carcass trait in term of dressing percentage, eviscerated percentage, giblet percentage and lymphoid organ weight.

(vi) In case of hemoglobin and packed cell volume in blood there was no significantly difference between control and treatment groups.

(vii) Lipid profile of blood serum like total cholesterol, triglyceride HDL, LDL, VLDL, were significantly comparable to control and high energy diet containing treatment groups.

(viii) Immune response of *Vanaraja* strain of broiler during the period of 28 days shown highest in group fed with 19% crude protein and 3000 kcal ME/kg energy and it was comparable to 21% crude protein fed group.

(ix) So, to obtained desirable performance economically, ration containing 19% crude protein with 3000 kcal ME/kg diet should be adopted for *Vanaraja* broiler.

**RECOMMENDATIONS**

1. Considering the overall performance of *Vanaraja* chicks to achieve the desirable market weight economically, a ration containing 19% crude protein with 3000 kcal ME/kg is suggested to the poultry producer.

2. Present investigation will also help to reduce environmental pollution by decreasing the level of nitrogen as waste materials in environment though low level protein supplements.

# CHAPTER -6

# BIBLIOGRAPHY

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# ANNEXURE

l. **Analysis of variance for the effect of treatment on Feed intake in broilers during different experimental period :**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatments | 8 | 13669.353 | 14208.669 | 157.828** |
| Within treatments | 9 | 810.238 | 90.026 | 157.828** |

*Significant at 5 % level (P<0.05)

**= significant at 1 % level (P<0.05)

. **Analysis of variance for the effect of treatment on body weight in broilers during experimental period :**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatments | 8 | 3748324.22 | 468540.528 | 424.648** |
| Within treatments | 216 | 238326.00 | 1103.361 | 424.648** |

**= significant at 1 % level (P<0.05)

**Analysis of variance for the effect of treatment on body weight gain in broilers experimental periods :**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatments | 8 | 3717598.51 | 464699.814 | 423.315** |
| Within treatments | 216 | 237117.040 | 1097.764 | 423.315** |

**= significant at 1 % level (P<0.05)

V. **Analysis of variance for the effect of treatment on Feed conversion ratio in broilers during different experimental periods :**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatments | 8 | 1.059 | 0.132 | 1588.517** |
| Within treatments | 9 | 0.001 | 0.00 | 1588.517** |

*Significant at 5 % level (P<0.05)

**= significant at 1 % level (P<0.05)

/. **Analysis of variance for the effect of treatment on performance (PI) in broilers during different experimental periods :**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatments | 8 | 269.360 | 33.670 | 769.992** |
| Within treatments | 9 | 0.394 | 0.044 | 769.992** |

*Significant at 5 % level (P<0.05)

**= significant at 1 % level (P<0.05)

[. **Analysis of variance for the effect of treatment on Nitrogen retention in broilers during different experimental periods :**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatments | 8 | 52.544 | 6.568 | 4.346* |
| Within treatments | 9 | 13.603 | 1.511 | 4.346* |

*Significant at 5 % level (P<0.05)

**= significant at 1 % level (P<0.05)

**X. Analysis of variance for the effect of treatment on intestine percentage in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between Treatment | 8 | 32.772 | 4.097 | 83.194** |
| Within treatments | 9 | 0.886 | 0.49 | 83.194** |

**= significant at 1 % level (P<0.05)

**XI. Analysis of variance for the effect of treatment on abdominal fat percentage in broilers during experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 23.931 | 2.991 | 76.001* |
| Within treatments | 9 | 0.708 | 0.039 | 76.001* |

*Significant at 5 % level (P<0.05)

**XII. Analysis of variance for the effect of treatment on spleen percentage in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 0.071 | 0.009 | 6.193* |
| Within treatments | 9 | 0.026 | 0.001 | 6.193* |

*Significant at 5 % level (P<0.05)

XIII. **Analysis of variance for the effect of treatment on bursa percentage in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 0.065 | 0.1008 | 17.256** |
| Within treatments | 9 | 0.08 | 0.00 | 17.256** |

**= significant at 1 % level (P<0.05)

XIV. **Analysis of variance for the effect of treatment on giblet percentage in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 11.110 | 1.389 | 4.430** |
| Within treatments | 9 | 5.643 | 0.314 | 4.430** |

**= significant at 1 % level (P<0.05)

XV. **Analysis of variance for the effect of treatment on dressing percentage in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 39.432 | 1.942 | 4.613** |
| Within treatments | 9 | 19.234 | 1.069 | 4.613** |

**= significant at 1 % level (P<0.05)

XVI. **Analysis of variance for the effect of treatment on eviscerated percentage in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 105.076 | 13.134 | 22.115** |
| Within treatments | 9 | 10.690 | 0.594 | 22.115** |

**= significant at 1 % level (P<0.05)

XVII. **ANOVA showing the analysis of variance for effect of treatment on Haemoglobin level of blood in broilers during experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 3.866 | 0.483 | 0.402* |
| Within treatments | 45 | 54.107 | 1.202 | 0.402* |

*Significant at 5 % level (P<0.05)

XVIII. **Analysis of variance for the effect of treatment on Glucose level of serum in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 3424.245 | 428.031 | 10.579** |
| Within treatments | 45 | 1820.731 | 40.461 | 10.579** |

**= significant at 1 % level (P<0.05

**XIX. Analysis of variance for the effect of treatment on PCV level of blood in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 38.25 | 4.781 | 3.412** |
| Within treatments | 45 | 63.055 | 1.401 | |

**= significant at 1 % level (P<0.05)

**XX. Analysis of variance for the effect of treatment on Protein level of serum in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 11.299 | 1.412 | 3.136* |
| Within treatments | 45 | 20.264 | 0.450 | |

*Significant at 5 % level (P<0.05)

**XXI. Analysis of variance for the effect of treatment on BUN- level of serum in broilers during different experimental periods**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 9.019 | 1.127 | 5.805** |
| Within treatments | 45 | 8.743 | 0.194 | |

**= significant at 1 % level (P<0.05)

**XXII. Analysis of variance for the effect of treatment on SGOT level of serum in broilers during different experimental periods**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 6415.371 | 801.921 | 33.461** |
| Within treatments | 45 | 1078.461 | 23.966 | |

**= significant at 1 % level (P<0.05)

**XXIII. Analysis of variance for the effect of treatment on SGPT level of serum in broilers during different experimental periods**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 297.163 | 37.145 | 19.504** |
| Within treatments | 45 | 85.680 | 1.904 | |

**= significant at 1 % level (P<0.05)

**XXIV. Analysis of variance for the effect of treatment on Cholesterol level of serum in broilers during experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 5230.074 | 653.759 | 3.664* |
| Within treatments | 45 | 8029.925 | 178.443 | |

*Significant at 5 % level (P<0.05)

**XXV. Analysis of variance for the effect of treatment on Triglyceride level of serum in broilers during experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 4114. 716 | 514.340 | 5.685** |
| Within treatments | 45 | 4072.760 | 90.506 | |

**= significant at 1 % level (P<0.05)

**XXVI. Analysis of variance for the effect of treatment on HDL level of serum in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 978.235 | 122.279 | 9.8** |
| Within treatments | 45 | 561.515 | 12.478 | |

**= significant at 1 % level (P<0.05)

**XXVII. Analysis of variance for the effect of treatment on LDL level of serum in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 1500.205 | 187.526 | 1.097 |
| Within treatments | 45 | 7691.969 | 170.933 | |

**= significant at 1 % level (P<0.05)

**XXVIII. Analysis of variance for the effect of treatment on VLDL level of serum in broilers during different experimental periods:**

| Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|
| Between treatment | 8 | 164.432 | 20.554 | 5.676** |
| Within treatments | 45 | 162.967 | 3.621 | |

**= significant at 1 % level (P<0.05)

**XXIX. Analysis of variance for the effect of treatment on Immune response to Ranikhet disease vaccine in broilers:**

| Days | Source of Variance | Degree of freedom | Sum of square | Mean square | F |
|---|---|---|---|---|---|
| 7 | Between treatment | 8 | 00.00 | 00.00 | |
| | Within treatments | 45 | 00.00 | 00.00 | |
| 14 | Between treatment | 8 | 1.370 | 0.171 | $0.593^{NS}$ |
| | Within treatments | 45 | 13.00 | 0.289 | |
| 21 | Between treatment | 8 | 22.704 | 2.838 | 8.420** |
| | Within treatments | 45 | 15.167 | 0.337 | |
| 28 | Between treatment | 8 | 41.667 | 5.208 | 19.806** |
| | Within treatments | 45 | 11.883 | 0.263 | |

**= significant at 1 % level (P<0.05)

NS=Non significant

# "TO STUDY THE EFFECT OF FEEDING DIFFERENT LEVEL OF ENERGY AND PROTEIN IN VANARAJA STRAIN OF BROILER"

## ABSTRACT OF THESIS

SUBMITTED TO THE

**BIHAR AGRICULTURAL UNIVERSITY**

(FACULTY OF POST-GRADUATE STUDIES)

SABOUR (BHAGALPUR) BIHAR

IN PARTIAL FULFILLMENT OF THE REQUIREMENT

FOR THE DEGREE OF

**MASTER OF VETERINARY SCIENCE**

(Animal Nutrition)

*By*

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BIHAR VETERINARY COLLEGE

PATNA (BIHAR)

**2014**

# ABSTRACT

The traditional diet of the majority of rural people is moderate in energy and low in protein, because of more use of cereals and restricted use of costly food items like fish, meat and egg are restricted. The vegetable protein sources used by the village households are deficient in critical and, essential amino acids like lysine and methionine which in turn can cause protein malnutrition in them. Feeding of diets deficient in quality protein sources like chicken egg, meat and other products of chicken origin exposes them particularly pregnant women, feeding mother and growing children to many common diseases. Backyard poultry farming can perform well in village conditions to improve the nutritional status and economic condition of rural poor. Eggs and birds can be used at home level, as well as it can be sold in premium prices even in urban market where considerable demand for backyard produced egg and birds. The backyard breed namely *Vanaraja* developed by Project Directorate of Poultry (PDP), Hyderabad are very well acclimatized to village climate with good growth and moderate egg production as per the performance study conducted in our research unit as well as in farmer's field.

*Vanaraja* strain of broiler gaining popularity among farmers in Bihar because of low requirement, however, there is no systemic study in Bihar on this strain for different level of energy and protein. *Vanaraja* strain of broiler is introducing in Bihar to promote backyard poultry farming among the landless and marginal farmers.

So, the present study planned to investigate the effect of feeding different level of energy and protein on the performance of *Vanaraja* broiler. The entire research study consisted of 9 treatment groups. The experimental diet were formulated with 3 level of protein i,e 17 %, 19 %, 21 % each with three level of energy 2600,2800,3000 kcal ME/kg in 3x3 factorial arrangement . This experiment was conducted for 56 days on 540 birds.

**GROWTH PARAMETER**

**Feed intake :** A good fluctuation was observed in feed intake in every week among different treatment groups. On the whole after $8^{th}$ week average feed intake in $T_5$ (2872.04g) was found to be significantly ($P<0.05$) lower than $T_1$, $T_2$, $T_3$, $T_4$, $T_6$, $T_7$, $T_8$, $T_9$, group where have value of T8(3129.66g) group was found to be highest ($P<0.05$) among group .

**Body weight :** Average body weight in broiler was found to be highly significant ($P<0.05$). During the experiment definite trend was observed in body weight of different treatment group. As whole the level of protein & energy increases body weight increased. At $8^{th}$ week of age T8 group had higher body weight but significantly there is no difference between $T_6$ & $T_8$ groups.

**Body weight gain** : Average body weight gain at the end of $1^{st}$ week of age was highest in T8 group, fed diet containing 21 % CP & 3000 kcal ME/kg but significantly there is no difference in body weight gain of $T_6$ group fed 19% CP &3000 kcal ME/kg and control. The body weight gain in $T_9$ group was highest and significantly there is no difference with $T_8$ group. Numerically and significantly $T_1$ group showed lower body weight gain in $2^{nd}$ week. Average body weight gain at the end of 3rd week of age was highest in $T_6$ group that fed diet containing 19 % CP 3000 kcal ME/kg energy. In 4th week body weight gain was significant ($P<0.05$) among different treatment groups. Significantly there is no difference in body weight gain of T6, $T_8$ and control group in 5th week of age. In 6th week $T_6$ group body weight gain was significantly comparable to control. There is no significant difference were observed between $T_6$ & $T_8$ group during 7th and 8th week of age. During 1-8 week body weight gain was highest for T8 group that fed 21 % CP & 3000 kcal ME/kg but significantly there is no difference with $T_6$ group that fed 19 % CP & 3000 kcal ME/kg . Level of protein and energy exerted significant ($P<0.05$) effect on body weight gain but 19 % and 21 % protein as well as 3000 kcal ME/kg had similar effect and significantly higher than 17 % and 2600 kcal ME/kg diet.

**Feed conversion ratio (FCR) :** Feed conversion ratio in broiler was found to be highly significant ($P<0.05$) at every week of experiment. During the entire experimental period of 1 to 8th week of age FCR value ranging from 2.22 to 2.96 was significantly affected dietary treatment and level of protein and energy. Chicks fed diet with 19% CP and 3000 kcal ME/kg of energy utilized feed more efficiently and had comparable FCR value with the chicks fed diet containing 21 % CP & 3000 kcal ME/kg energy. High protein & energy level reflected lower FCR value.

**Performance index (PI) :** The performance index of chicks was significantly ($P<0.05$) influenced by dietary treatments and level of protein , energy in a every week of experiment. The PI during entire experimental period of 1to 8 week was significantly influenced dietary treatment level of protein & energy. A significantly ($P<0.05$) higher index value (44.98) was obtained in *Vanaraja* broiler fed diet containing 19% CP and 3000 kcal ME/kg and it significantly not differ from T8 group, but lower than the control. The index value increased as the level of protein and energy concentration in the diet was increased. A high energy & a high level protein in the diet showed better utilization of feed commensurate with weight of growth.

**BALANCE STUDY**

**Nitrogen retention percentage:** Average nitrogen retention percentage was highest in $T_9$ group fed diet containing 21 % CP & 2800 kcal ME/kg , but is was found that significantly there is no difference among treatment groups $T_6$, $T_7$, & $T_8$ .

**Energy Metabolizability percentage :** Energy metabolizabitily percentage was found to be highest in T8 group but significantly there is no difference among treatment groups $T_5$, $T_6$, $T_8$ & control.

**Calcium and Phosphorus Retention Percentage :** During entire experimental period (1 to 8th) week it was observed that calcium and phosphorus was not significantly different from control & other treatment groups.

The balance study showed that all there significantly difference except calcium & phosphorus retention percentage, indicating effect of feeding different level of energy and protein in *vanaraja* strain of broilers.

**CARCASS CHARACTERISTIC**

**Dressing percentage :** Dressing percentage was numerically highest in $T_8$ group fed diet with 21 % CP 3000 kcal ME/kg but significantly it was comparable to $T_6$ group fed 19% CP 3000 kcal ME/kg and control. As the level of protein and energy in the diet was increased the dressing percentage was also increased.

**Eviscerated Percentage :** The mean of eviscerated percentage varying from 60.90 to 68.70 was significantly influenced by concatenate of energy in the diet at each level of protein reflected higher eviscerated percentage.

**Giblet Percentage :** On statistical analysis it was found that giblet percentage was significantly influenced by the different level of energy and protein in the diet. Giblet percentage was lowest in $T_4$ group and it is significantly comparable to $T_5$ group. The giblet percentage of $T_6$ group that fed 19 % protein and 3000 kcal ME/kg is significantly comparable to control.

**Spleen & Bursa :** Lymphoid organ i.e spleen & Bursa weight were not influenced by dietary protein & energy concentration . Bursa spleen weight of $T_6$ group are significantly comparable to control.

**Abdominal fat :** Average abdominal fat ranging from 3.97 to 1.28. significantly there is no difference among $T_7$, $T_8$ and control but $T_6$ group is significantly higher abdominal fat than other treatment groups.

**Intestine :** The relative weight of intestine were significantly higher ($P<0.05$) in birds fed 21% CP & it was comparable to $T_7$ & $T_3$ group

**Liver :** The relative weight of liver is significantly affected with different level of protein & energy in diet. The value of $T_6$ group was significantly comparable to $T_7$ $T_8$ & control.

## IMMUNE RESPONSE :

Immune response to Ranikhet disease vaccine (F-strain) due to dietary protein energy variation was give in table no. 12. For examine immune status of Vanaraja broiler blood was collected at 7, 14, 21 & 28 days of age. During the entire experimental period it was observed that the immune status of T6 group fed 19% CP, 3000 kcal ME/kg containing diet was higher but significantly there is no difference among T8 group and control.

**AGPT :**The serum samples were subjected to AGPT, a precipitin band on the gel inferred about the antibody conversion to IBDV vaccine .

### BLOOD PARAMETER

**Haemoglobin :** The diet containing higher protein & energy showed highest numerical value of hemoglobin. There was no significant difference among different treatment groups. It has been seen that the level of Hb increased as the level of energy & protein in diet increased .

**Packed Cell Volume :** Control group had numerically higher PCV value. There is no significantly difference between control & $T_6$, $T_7$ & $T_8$ group. $T_1$ group had numerically lower value & there is no significant difference with $T_2$ & $T_3$ treatment groups.

## SERUM BIOCHEMICAL PARAMETER

**Glucose in serum** : there is no significantly difference between control & $T_8$ group. While $T_6$ had lower glucose level than control.

**Total protein in serum :** Numerically highest protein energy contain diet had higher total protein value but significantly there is no difference 19% protein containing diet.

**Blood urea nitrogen (BUN) :** The data showed that BUN was not much influenced by dietary treatment. As level of protein increased in diet, the BUN level in serum also increased. 21% CP containing diet showed higher level of BUN in serum but significantly not different from 19% CP but higher than 17% fed diet.

**SGOT :** SGOT level was found to be highest in $T_8$ group & lowest in $T_3$ group . The statistical analysis for the effect of different level of protein & energy on SGOT was found to be highly significant ($P<0.05$).

**SGPT :** SGPT level was found to be highest in T8 group & lowest in T2group. On statistical analysis for dietary treatment was found to be significant ($P<0.05$).

**Total cholesterol in serum :** Statistical analysis for the effect of feeding different level of protein & energy on total cholesterol level was found to be significant ($P<0.05$) . The average total cholesterol in serum was highest in group fed higher level of protein & energy and lowest in group fed lower protein & energy containing ration. It was seen that feeding of different level of energy & protein effected the level of cholesterol in *Vanaraja* of broiler.

**Triglyceride in serum :** Statistical analysis for the effect of feeding different level of protein & energy was found to be significant. The group which fed highest level of energy & protein shows higher level of triglyceride while the other groups was not significantly differ.

**High density lipoprotein (HDL)in serum :** the effect of treatment on HDL level was found to be highly significant (P<0.05). Average HDL was found highest in group which fed highest protein & energy containing diet but significantly comparable to group fed lower protein i.e 19% crude protein with similar energy contain diet.

**Low density lipoprotein (LDL) in serum :** There is no significant difference between control & other treatment groups. But numerically 19% CP & 3000 kcal energy fed group had higher LDL value than control.

**Very low density lipoprotein (VLDL) in serum :** There is no significant difference between control & other treatment groups but numerically highest protein energy fed group had higher VLDL value than control.

**Economics of production :** As level of protein & energy in diet increased the cost of experiment ratio also increased. cost of feed per kg live weight was found maximum in $T_6$ group which fed 19 crude protein & 3000 kcal ME/kg energy and minimum in $T_1$ group which fed minimum level i.e 17% crude protein, 2600 kcal ME/kg.

**CONCLUSION :**

**(i)** Experimental diets for *Vanaraja* broiler were formulated to contain three level of protein (17,19,21 %) each with three level of energy (2600, 2800, 3000) in 3x3 factorial arrangement to study the performance of *Vanaraja* broiler.

**(ii)** Ration containing 19% & 21% crude protein with 3000 kcal ME/kg supported highest weight gain in *Vanaraja* broiler.

**(iii)** The efficiency of feed utilization was found to be more in chicks fed diets either with 19% & 21% crude protein and 3000 kcal ME/kg of energy.

**(iv)** The performance index value increased as level of protein and energy concentration of diet was increased. A high energy and protein in diet showed better utilization of feed commensurate with weight gain of chicks.

(v) Study of balance of Nutrient, nitrogen retention percentage and energy metabolizability percentage was seen highest among 21% crude protein fed group while no significant changes in calcium & phosphorus retention percentage in treatment groups and control.

(vi) High level of protein & energy concentration in diet influenced carcass treat in term of dressing percentage, eviscerated percentage, giblet percentage and lymphoid organ weight.

(vii) In case of hemoglobin and packed cell volume in blood there is no significantly difference between control and treatment groups.

(viii) Lipid profile of blood serum like total cholesterol, triglyceride HDL, LDL, VLDL, was significantly comparable to control and high energy diet containing treatment groups.

(ix) Immune response of *Vanaraja* strain of broiler during the period of 28 days was seen highest in group fed 19% crude protein and 3000 kcal ME/kg energy and it was comparable to 21% crude protein fed group.

(x) To obtained desirable performance economically, ration containing 19% crude protein with 3000 kcal ME/kg diet should be adopted for *Vanaraja* broiler.