GROWTH AND DRESSING PERCENTAGE OF TURKEYS REARED ON DIFFERENT FEEDING REGIMEN

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DECLARATION

I hereby declare that this thesis, entitled "**GROWTH AND DRESSING PERCENTAGE OF TURKEYS REARED ON DIFFERENT FEEDING REGIMEN"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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12.08.2008

CERTIFICATE

Certified that this thesis, entitled "**GROWTH AND DRESSING PERCENTAGE OF TURKEYS REARED ON DIFFERENT FEEDING REGIMEN"** is a record of research work done independently by **CHANDINI HERMAN,** under my guidance and supervision and it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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EXTERNAL EXAMINER

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CHANDINI HERMAN

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Introduction

1. INTRODUCTION

Broiler meat production in India grew at 6 per cent annually during the 1980's, accelerating to 11 per cent in the 1990's and nearly 19 per cent during the 1997 to 2002 period. India was ranked as the sixth largest chicken producer in the world with a poultry meat production of 1.4 million tons (USDA, 2004). Owing to wider consumer acceptance and affordable prices, chicken is the major meat consumed in India, with per capita consumption estimated at 1.9 kg (USDA, 2006). Food and Agricultural Organization assessed chicken meat production in India during 2006 as two million tones. As per recommendations of National Committee on human nutrition, the egg and broiler meat requirement will be around 180 billions and 9.1 million tons, respectively by the end of 2010 AD, while the estimated production is around 46.2 billion eggs and 3.04 million tons poultry meat only. There is a wide gap to be filled which offers tremendous scope for growth in broiler production. Beef and pork are not consumed by a large section of population in India due to religious taboos and also due to high cholesterol content. The availability of mutton is limited due to non availability of grazing pastures. Therefore poultry meat is preferred by majority of the people in the country.

In order to minimize the risks and hazards to the environment and to maximize the return from a given level of inputs, scientists are giving importance to alternate poultry species. Rearing of different species proves beneficial in areas where chicken production is not viable.

Many farmers in South India are now looking into turkey farming as an alternative means of employment since they are efficient converters of feed into meat. Turkey meat, being the avian meat protein with the lowest fat percentage, is well accepted by people from all strata. It has nutritional and sensorial properties which make it almost ideal raw material for rational and curative nutrition. Turkey meat has 24 per cent protein and is low in fat with a balanced lipid content of 6.6 per cent. Turkey meat is easily digestible, low in

calorie and rich in vitamins, minerals, essential fatty acids and unsaturated fatty acids.

When feed conversion ratio of chicken, turkey and duck are compared at 7 weeks of age, turkey broiler is found to be the most efficient feed utiliser (Shalev and Pasternak, 1989). This is mainly due to the markedly low fat deposition in turkeys which is about six and ten times lower than in chickens and ducks, respectively, and also due to the concave growth curve with reduced feed for maintenance.

Though turkey farming has been undertaken recently by many farmers in Kerala, not much work has been done on its nutritional requirements and managemental aspects. National Research Council (NRC) recommends 28 per cent crude protein (CP) for starter period which gradually reduces to 14 per cent through six changes of four weeks duration. Commercial turkey feed is not available in the market. The compounded feed with the highest protein content available in the market is broiler starter feed with 23 per cent CP. Hence farmers are compelled to use this feed to rear poults during the early stages of life. No work seems to be undertaken to compare the efficiency of using broiler starter feed for turkey rearing with feed as per NRC standards. Hence a study was planned to compare broiler feed having BIS specifications with feed compounded based on NRC standards on the growth and related traits of Beltsville Small White turkey.

Review of literature

2. REVIEW OF LITERATURE

Most of the works related to turkey nutrition have been conducted under temperate climate and very few reports are available in the literature regarding the protein and energy requirements of turkeys under tropical climate. Therefore, relevant literatures on other species of poultry were also reviewed for meaningful comparison.

EFFECT OF PROTEIN AND ENERGY ON BODY WEIGHT

Potter *et al.* (1981) reported that when male and female turkeys were fed separately with male diet and diet change occurring at 4 weeks interval from 8 to 20 weeks, body weight gain increased with higher dietary protein. Diets for 8 to 12 weeks contained 18, 21 and 24 per cent and decreased 3 per cent each during 12 to 16 and 16 to 20 weeks of age. Body weight gain was highest (2.99 kg in males and 2.12 kg in females) with 24 per cent protein diet from 8 to 12 weeks of age. During 12 to 16 weeks of age weight gain was highest with 21 per cent protein diet (2.94 kg in male and 1.82 kg in female). On the other hand, body weight gain was more with 18 per cent protein diet during 16 to 20 weeks of age (2.94 kg in male and 1.36 kg in females).

In a study by Potter and McCarthy (1985), Large White turkeys were sex separated and fed diet with increasing protein viz., 18, 20, 22 and 24 per cent for four weeks from 8 to 12 weeks of age after which protein was reduced by 2 per cent and change made every 4 weeks. The results showed that the protein levels required for maximum body weight gain in male turkeys were 22, 20 and 20 per cent during 8 to 12, 12 to 16 and 16 to 20 weeks of age, respectively. The corresponding values for female turkeys were 22, 22 and 18 per cent, respectively for the above periods.

Salmon (1986) showed that increasing nutrient density by adding fat in the diet of Small White turkeys caused an increase in body weight, while

increasing energy to protein ratios by decreasing protein and keeping energy constant in diet reduced body weight.

In a study to determine the protein requirements of growing hen turkeys under various environmental temperatures, Oju *et al.* (1987) found that from 8 to 11 weeks of age protein levels below 22.5 per cent produced lower body weight gain. From 11 to 14 weeks of age as temperature increased from 14^{o}C to 21^{o}C and further to 28^{o}C, crude protein level needed to produce maximum body weight was 17.6 per cent, 19.2 per cent and 20.9 per cent respectively. The crude protein levels required for producing maximum body weight gain, from 14 to 17 weeks of age at 21 and 28^{o}C, were 13.4 and 14.9 per cent, respectively.

Rose and Michie (1987) kept grower British United Turkeys (BUT) of 10 weeks of age at temperatures of 14, 17, 20 and 23^{o}C for 5 weeks and fed with diets containing 201, 229, 294 g/kg protein. Birds fed with 201 g/kg protein diet produced body weights of 7.196, 7.066, 7.084 and 6.968 kg at 14, 17, 20 and 23^{o}C, respectively. When turkeys were fed with protein diets of 294 g/kg, maximum body weight of 7.238 and 7.159 kg was attained at 17 and 20^{o}C, respectively.

Oju *et al.* (1988) studied the effect of early protein undernutrition and subsequent realimentation in turkeys. Two groups of male and female Large White Nicholas turkeys were fed a control diet with 28 per cent crude protein and low protein diet with 21 per cent protein for 6 weeks and thereafter control diet to both groups with crude protein reducing from 23 to 14 per cent through 8 to 24 weeks in male and 8 to 20 weeks in females. They found that body weights of both male and female undernourished birds were 30 per cent lower than control group at 6 weeks of age and were lower up to 14 weeks in males and up to 16 weeks in females. Irrespective of treatment, rate of body weight gain reduced sharply after 20 weeks in males and 14 weeks in females.

Effect of early protein restriction on compensatory growth of Large White Nicholas poults were studied by Ferket and Sell (1989). Four levels of protein, viz; 100, 80, 70 and 60 per cent of NRC recommendations were fed from 1 to 6 weeks of age. Subsequently the four treatment groups were fed a common diet according to NRC recommendations of crude protein for different periods up to 20 weeks of age. Body weights of toms fed 100, 80, 70 and 60 per cent of NRC protein recommendations at 6 weeks of age were 2.23, 1.94, 1.63 and 1.39 kg, respectively. At 20 weeks of age, 100 per cent NRC protein fed toms were significantly heavier than birds fed low protein levels. Weight gains from 6 to 20 weeks of age were statistically similar for all treatment groups.

Rivas and Firman (1994) fed turkeys with diets having 100 and 115 per cent of NRC protein levels and energy at 100 and 112 per cent of NRC recommendations from 0 to 15 weeks in hens and 0 to 18 weeks in tom turkeys. At the end of 18th week, body weight recorded a maximum of 30.94 kg in males fed with high energy/high protein diet and 18.58 kg in females fed with NRC protein/ high energy diet.

Two experiments were conducted with growing turkeys to compare the effectiveness of feeds having metabolizable energy (ME), crude protein (CP), and essential amino acids (EAA) at 110 per cent of levels advocated by the NRC with those at levels of 115 per cent (Moran *et al.,* 1995). The body weights were more for 110 per cent NRC recommended diets than 115 per cent regimen. The body weights at 3, 6, 9, 12, 15 and 18 weeks of age were 639, 2270, 4656, 6938, 8962 and 11293 g, respectively for the 110 per cent regimen. The corresponding values for 115 per cent regimen were 610, 2190, 4494, 6667, 8791 and 11037 g, respectively.

In a trial conducted by Noble *et al.* (1996), two strains of male turkeys (strain A & strain B) were fed diets calculated to contain 80, 100 and 120 per cent of NRC recommended levels of protein from 1 to 8 weeks of age and then recommended levels of protein at other ages. Body weight of both strains at 8

weeks of age fed 80 per cent NRC recommended protein were 3.61kg (A) and 3.75kg (B) relative to 3.86kg (A) and 4.13kg (B) in birds fed 100 per cent and 3.8 kg (A) and 4.23 kg (B) when fed 120 per cent NRC recommended protein. The body weight of strain A at 17 weeks of age was 13.99, 13.84 and 13.53 kg for the 80, 100 and 120 per cent of the NRC recommended protein fed birds, respectively. The corresponding body weights of strain B birds were 13.60, 13.63 and 13.95 kg, respectively.

Boiling and Firman (1997) evaluated the response of turkeys when fed three dietary treatments viz; control diet with 28 per cent CP, 18.4 per cent CP diet made to 28 per cent by addition of essential amino acids and glutamic acid and 18.4 per cent CP diet made to 22 per cent by adding essential amino acids and sucrose during four periods. Weight gains were highest for glutamic acid fed group compared to those fed standard diet.

Kidd *et al.* (1997) assessed the effect of reducing dietary crude protein by feeding Large White tom turkeys with four levels of dietary CP as 100, 92, 84 and 76 per cent of NRC (1994) recommendations. Additional treatments consisted of 0.1 and 0.2 per cent L- threonine added to 92 and 84 per cent CP treatments. Body weights were recorded at 3, 6, 12 and 18 weeks of age. The body weight at 3 weeks were highest for 92 per cent NRC protein recommendation fed group; while, at all other ages body weight was higher for birds fed 100 per cent NRC protein recommendations. The body weight at 18 weeks of age showed decreasing pattern with decreasing proteins in diet, though birds fed 84 per cent NRC protein recommended diet supplemented with 0.1 per cent L-threonine had body weight equal to 100 and 92 per cent protein diets.

The efficacy of fat and carbohydrate as energy sources was compared in 16 to 19 weeks old turkeys (Plavnik *et al.*, 1997). Within the tested energy range of 2650 to 3250 kcal/kg, response of body weight gain appeared linear. In the midregion of the tested energies, improvement of growth reached 7 to 8 per cent

per 100 kcal. No significant differences were observed between responses of carbohydrate or fat fed turkeys.

Waldroup *et al.* (1997) studied the response of Large White male turkeys by formulating six dietary treatments to meet minimum of 90, 95, 100, 105, 110 and 115 per cent of NRC (1994) suggested amino acid levels for turkeys when diets were changed at 3 weeks or 4 weeks interval. They found that 4 weeks interval feed change was efficient with 110 per cent of the recommended amino acid level producing more body weight at 6 and 18 weeks of age while 115 per cent produced more body weight at 12 and 24 weeks.

Waldroup *et al.* (1998) subjected two commercial Large White male turkeys, Nicholas 88 and BUT 6 to dietary treatments of three standard amino acids levels (100, 110, 120 per cent of NRC recommendations) and four restriction periods (no restriction, 0 to 3 weeks restriction, 0 to 6 weeks and 6 to 12 weeks restriction). During restriction time 75 per cent of NRC recommended amino acid for that age was fed *ad libitum*. Body weights taken at 3 weeks interval showed that from 6 to 18 weeks of age, birds fed 110 or 120 per cent of NRC recommended amino acid levels were heavier than those fed standard feed. Poults subjected to restriction from day old to 3 weeks were 22 per cent lighter, whereas 0 to 6 weeks and 6 to 12 weeks restriction produced 35 and 26 per cent lesser body weights respectively, at the end of their respective restriction period.

Crouch *et al.* (2002) studied the effect of physical feed restriction during rearing period on Large White turkey breeder hens. The four treatments were 1) *ad libitum* fed through out the study 2) feed restricted from 16 to 24 weeks 3) feed restricted from 3 to 16 weeks and 4) feed restricted from 3 to 24 weeks. The results showed that body weight at 16 weeks of age of *ad libitum* fed birds were 45 per cent more than feed restricted birds.

Majumdar *et al.* (2002) studied the requirements of protein and energy during starter (0 to 6 wk) and growing period (7 to 8 wk) of Small White turkey

poults by giving three protein levels (24, 26 and 28 per cent) and three energy levels (2600, 2800 and 3000 kcal/kg diet) in the starter diet. In grower diet, protein level was reduced by 2 per cent each while the energy level remained the same. They concluded that poults receiving higher protein and higher energy had significantly higher weight gain during 0 to 6 week while neither protein nor the energy content affected body weight gain during 6 to 8 week of age of the poults. Eighth week body weight was significantly higher in poults receiving high protein and medium energy.

Rajini and Prabhakaran (2003) conducted an experiment to study the protein requirement of native turkey poults in the tropics. In an 8 weeks trial, day old turkey poults were provided with 22, 25 and 28 per cent crude protein diet with a constant metabolizable energy level of 2750 kcal ME/kg. It was found that birds fed with 28 and 25 per cent crude protein were having higher body weight (132.8 g and 129.1 g respectively) at second week as compared to 22 per cent crude protein fed birds (109.8 g). At 4 weeks of age, birds fed 25 per cent crude protein diet had significantly better body weight (268.5 g) than 28 per cent (248.7 g) and 22 per cent (223.9 g) protein diet fed birds. This trend continued until 8 weeks of age. The body weight of 25 per cent crude protein fed birds at 8 weeks was 774.9 g which was significantly higher ($P < 0.05$) than 28 per cent CP diet fed group (706 g). Eighth week body weight of 22 per cent crude protein diet group (621.0 g) was significantly lower ($P < 0.05$) than 28 per cent crude protein group.

Waldroup *et al.* (2003) conducted a study to determine the minimum crude protein need of finisher diet of Large White male turkeys. Diets were formulated to contain a minimum of 105 per cent of NRC recommended levels of methionine, lysine, total sulphur amino acid, threonine and tryptophan for diets fed from16 to 20 weeks of age. The crude protein content of the diet ranged from 75 to 100 per cent of the recommended level of 16.5 per cent. The results indicated that reducing the crude protein content of the diet to less than 85 per

cent resulted in a significant reduction in weight at 20 weeks. The birds reared under 100 per cent NRC recommended protein diet attained body weight gain of 4.02 kg from 16 to 20 weeks compared to 3.37 kg gain by birds fed 75 per cent NRC recommended protein diet.

Wylie *et al.* (2003) concluded that while feeding traditional line and Large male line turkeys with dietary CP concentrations of 180, 220, 260 and 300 g/kg of ration for 6 weeks of age, body weight of birds fed 180g/kg CP was proportionately 0.19 lesser in traditional line and 0.44 lesser in male line than when fed 300 g/kg CP diet. Similarly breast muscle weight proportionately reduced in male line by 0.52 when feed was changed from 300 to 180 g/kg and in traditional line by 0.24.

Lemme *et al.* (2004) studied the effect of reduced dietary concentrations with amino acid supplementation on performance of turkey toms during 14 to 140 days of age. Results suggested that diets with a protein reduction up to 10 per cent can be fed without adverse effects on performance provided the whole range of essential amino acids is balanced. It was concluded that arginine, valine, isoluecine and leucine are important for optimum growth and should be considered in diets containing 10 per cent less crude protein.

Noy and Sklan (2004) studied the effect of energy and amino acid levels on the performance of turkeys by conducting 2 trials; one with five energy levels ranging from 200 kcal below to 200 kcal above the NRC recommendations, while keeping crude protein and limiting amino acid levels constant and other with 95, 100, 105 and 110 per cent of NRC recommended levels of amino acid while keeping the energy level constant and feed change made every 3 weeks interval. In the second trial, three additional diets containing either 95, 105 or 110 per cent of the recommended levels of both amino acid and ME were also fed. Body weight from 3 to 6 weeks and from 13 to 20 weeks showed higher values in birds fed 200 units below the NRC recommended energy level, while from 7 to 12 weeks, body weight was more when fed NRC recommended energy level. Using

95 per cent of NRC amino acid levels depressed performance, whereas birds receiving 105 and 110 per cent of the recommended amino acid levels had improved body weight until 6 weeks. Increasing both amino acid and metabolizable energy together did not, in all cases, produce the same effect as altering their levels independently.

Veldkamp *et al.* (2005) studied the growth response to dietary energy and lysine at 18ºC and 28ºC by providing male turkeys with 90, 100 and 110 per cent of NRC energy recommendations along with 105 and 120 per cent NRC lysine recommendations during various age intervals. Ninety per cent of NRC energy recommendation in diet produced higher body weight gain from 29 to 84 days of age; while, 105 per cent NRC lysine recommendation produced more body weight gain from 53 to 140 days. From 29 to 84 days of age, body weight gain reduced by 45 per cent as energy increased from 90 to 110 per cent of NRC recommendations. From 85 to 112 days, birds fed with 120 per cent lysine diets exhibited 3 per cent lower body weight gain than those fed 105 per cent.

Erener *et al.* (2006) investigated the effect of free choice feeding of starter feed and whole grains to Bronze turkey poults on their performance. Control group was fed only starter diet with 280 g CP and 11.7 MJ ME/kg. Treatments for choice fed turkey poults were offered a choice of starter feed and wheat (120 g CP and 12.3 MJ ME/kg) or maize (83 g CP and 13.9 MJ ME/kg) for 63 days. Final live body weight was heavier for wheat selecting group recording 2374.3 g compared to 2324.6 g in maize selecting and 2280.7 g in control group. Daily live weight gain also showed similar pattern.

Lemme *et al.* (2006) conducted experiment with male BUT Big 6 turkeys up to 154 days of age. Six dietary treatments were formed with variations in protein levels. Treatment 1 was taken as control, where protein was fed in balanced proportion as per NRC recommendations during 6 phases. In treatments 2 to 6, the dietary amino acid profiles were varied by 10 to 20 per cent in single phases. Six combinations of proteins were fed to treatment two through treatment

six and combinations were 120, 120, 120, 120, 90, 90 per cent for treatment two; 120, 120, 120, 100, 90, 90 per cent for treatment 3; 120, 120, 100, 100, 90, 90 per cent for treatment four; 120, 120, 120, 120, 100, 100 per cent for treatment five and 90, 90, 90, 100, 100, 100 per cent for treatment six. Final body weight was highest in treatment 4 (20.78 kg) and lowest ($P < 0.05$) in treatment 2 (20.07 kg), whereas final body weights were intermediate and statistically not different in treatments 1, 3, 5 and 6.

Min *et al.* (2007) assessed dietary CP and ME levels for optimum growth performance of goslings. Huoyan goslings were assigned to diets with 10.87, 11.37, 11.87, 12.37 and 12.87 MJ of ME/kg of diet each containing 15.0, 17.5 and 20.0 per cent CP, respectively from 0 to 4 weeks of age. The results showed that birds on diets with 11.87, 12.37 and 12.87 MJ of ME/kg from 0 to 4 weeks of age exhibited greater body weight gain than other energy levels. Similarly mean body weight gain of birds fed 17.5 and 20 per cent CP diets were higher ($P < 0.05$) than those fed 15.0 per cent dietary protein.

EFFECT OF PROTEIN AND ENERGERY ON FEED CONSUMPTION

Noll *et al.* (1991) assessed the performance of male Large White Nicholas turkeys from 0 to 20 weeks of age by feeding diets different in feed form and energy level under high and low stocking densities. Birds were fed a control diet in mash form; similar diet in pelleted form; diets same as control diet but with 1, 2, 4, 6 and 8 per cent fat added during 0 to 4, 4 to 8, 8 to 12, 12 to 16 and 16 to 20 weeks of age respectively; and a diet same as control diet but with barley included at 0, 20, 35, 50 and 65 per cent, respectively, during the respective 4 week age periods. It was noticed that birds fed with diet in pelleted form and those fed with diet having barley had significantly higher feed intake than other groups. They also found that birds reared under low stocking density showed higher feed intake compared to those under high stocking density.

Rivas and Firman (1994) fed turkeys with diets having 100 and 115 per cent of NRC protein levels and energy at 100 and 112 per cent of NRC recommendation from 0 to 15 weeks of age in turkey hens and 0 to 18 weeks in tom turkeys. High energy diet resulted in reduced feed intake.

In a trial conducted by Noble *et al.* (1996) two strains of male turkeys (strain A and strain B) were fed diets calculated to contain 80, 100 and 120 per cent of NRC recommended levels of protein from 1 to 8 weeks of age and then recommended levels of protein at other ages. Birds fed with 80 per cent crude protein diet consumed more feed than those fed 100 or 120 per cent NRC recommended levels of protein.

Waldroup *et al.* (1997) conducted trials to evaluate the NRC amino acids recommendations for growing turkeys from day old to 20 weeks of age by formulating diets for 4 weeks intervals to provide 85, 90, 95, 100, 105, 110, 115 and 120 per cent of suggested amino acid requirements. Highest feed consumption was noticed in group fed diet supplemented with 115 per cent of the NRC amino acid recommendation. Consumption of diets formulated to contain less than 100 per cent of the suggested minimum amino acid requirements did not increase compared to diets formulated to contain 100 per cent or more of the recommended amino acid requirements.

Turner *et al.* (1999) conducted studies in Nicholas male turkeys to assess the effect of feeding high carbohydrate or high fat diets from day old to 13 days of age. Two experimental diets were formulated to contain a high proportion of corn (CHO: 60.7 per cent) or 10 per cent supplemental animal-vegetable fat (FAT). All age comparisons were defined in terms of the initiation of *ad libitum* access to feed and water or days post feeding (DPF). Feed intake by poults fed the CHO rich diet was greater between 3 and 6 DPF ($P < 0.05$). After 7 DPF, however, poults fed the FAT diet consumed more feed ($P < 0.05$).

Veldkamp *et al.* (2000) assessed the interaction between ambient temperature and synthetic amino acid supplementation in commercial male turkeys during growing period. Male turkeys were fed a control diet as per breeder recommendation and a diet with 10 per cent higher methionine and threonine from 22 to 134 days of age and 10 per cent higher threonine from 22 to 68 days of age at two temperatures (15 or 25^{o} C). Results revealed that temperature had a major effect on feed intake. Feed intake was higher at low temperature and was not affected by diet.

Odetallah *et al.* (2002) fed Nicholas hen turkeys with two basal diets, one diet containing soyabean meal containing 44 per cent CP and other with soyabean meal having 48 per cent CP with or without the addition of mannan-endo-1,4-β-mannosidase from 1 to 98 days of age. The result showed that hens fed with soyabean meal having a CP of 48 per cent consumed more feed than did hens fed with the soyabean meal with lower CP ($P < 0.05$). Supplementing the diet with the enzyme had no effect on feed consumption.

Wylie *et al.* (2003) fed male line turkeys a basal ration (180 g CP/kg) to which amino acids arginine, valine, methionine and tyrosine were added separately to raise their concentration to that of a control ration (260 g CP/kg). Each ration was fed *ad libitum* from 2 to 6 weeks of age. It was concluded that feed intake from 3 to 6 weeks as not significantly affected by the composition of the feed. Mean cumulative feed intake for basal, tyrosine, arginine, methionine, valine and control rations were 3.76, 3.85, 3.75, 3.79, 3.77 and 3.92 kg respectively.

An experiment was conducted over five grow-out phases with BUT Big male turkeys from day old to 140 days of age to assess the effect of reduced dietary protein concentration on performance (Lemme *et al.*, 2004). Four dietary treatments differing in protein levels and amino acid supply were employed. It was observed that feed consumption decreased with decreasing dietary protein

resulting in 3.3 kg lower feed intake in turkey toms for the treatment in which dietary protein was reduced by 20 per cent with the least concentrations for the whole amino acid profile compared to the treatment in which the prevailing feeding practice with normal CP levels for different phases were practiced.

Noy and Sklan (2004) conducted two experiments with growing turkeys from hatch to market age, examining the performance at various dietary energy and amino acid levels as well as the relationship between energy and essential amino acids at these energy levels. They found that with increasing energy, feed consumption declined. They also observed that from 7 to 19 weeks of age, feed intake was reduced with increasing amino acid levels in the diet.

In an experiment to study the effects of dietary nutrient density on performance of male broilers, Saleh *et al.* (2004) found that feed intake tended to decrease with increasing nutrient density, but not at a rate commensurate with the change in energy levels.

MacIssac *et al.* (2005) conducted a study to examine the growth performance and carcass composition of broiler turkeys fed graded levels of roasted soybeans processed by flame roasting. Roasted soybeans were incorporated as a partial replacement of soybean meal in starter diets (0 or 15 per cent of the diet). At 21 days of age, the birds fed the starter diet with roasted soyabeans consumed more feed ($P < 0.05$).

Veldkamp *et al.* (2005), reported that when turkeys were fed diets with energy levels of 90, 100 and 110 per cent of NRC (1994) recommendations in combination with 105 and 120 per cent of NRC lysine recommendations at 18 and 28 ^{o}C, feed intake reduced with increasing temperature. When energy was increased from 90 to 110 per cent, feed intake reduced from 411.8 g/day to 361 g/day from 29 to 140 days.

In an experiment to assess free choice feeding system, day old poults were fed control diet containing 280g crude protein and 11.7 MJ ME/kg, control diet with wheat containing 120 g crude protein and 12.8 MJ ME/kg as free choice and control diet with free choice of maize containing 83 g CP and 13.9 MJ ME/kg (Erener *et al.* 2006). They found that daily feed intake and daily protein intake were higher for wheat selecting group (103.2 g/bird and 27g respectively) compared to control (95.2 g/bird and 26.7 g respectively) and maize selecting group (97.9 g/bird and 25.4 g respectively).

Min *et al.* (2007) found that when day old goslings were fed with diets having 10.87, 11.37, 11.87, 12.37 and 12.87 MJ ME/kg diet in combination with 15.0, 17.5 and 20.0 per cent crude protein from 0 to 4 weeks of age, feed intake was uninfluenced by energy intake levels but increased as crude protein percentage of diets increased.

EFFECT OF PROTEIN AND ENERGY ON FEED CONVERSION RATIO

Leeson and Caston (1981) while studying the carcass and cut up yield in growing poults as influenced by dietary levels of protein and energy observed no difference in feed conversion ratio of turkeys fed high and low protein diet at eighth week of age.

Rivas and Firman (1994) while studying diets with a constant amino acid level but with two energy levels and two crude protein levels in turkeys during the finisher period found that the higher energy and protein diets greatly improved feed conversion in both male and female birds.

Moran *et al.* (1995) examined the outcome of changing amino acid, protein and energy levels from hatch to marketing age using 110 and 115 per cent of NRC recommendations with two strains of turkeys. They found a slight improvement in feed conversion when 115 per cent of NRC recommendations were being used.

Kidd *et al.* (1997) demonstrated in Large White tom turkeys that decreasing the crude protein in diets of male turkeys from 0 to 18 weeks of age to 84 per cent of NRC (1994) recommendation had no adverse effect on feed conversion. Toms fed diet containing 76 per cent of NRC CP had depressed feed to gain in comparison to all other treatments. No adverse effect in cumulative feed to gain ratio (0 to 18 weeks) was noted by decreasing CP from 100 to 84 per cent of the NRC recommendations.

After keeping BUT and Nicholas turkeys under 75 per cent restriction of NRC recommended amino acid levels at various age groups and when not on restriction they were fed with 100,110 and 120 per cent NRC amino acid recommendations, Waldroup *et al.* (1998) concluded that feed conversion ratio improved with increasing amino acids in diet. Though strain differences were absent for feed conversion ratio at early ages, BUT turkeys had better feed conversion ratio than Nicholas turkeys at 15 and 18 weeks of age.

Veldkamp *et al.* (2000) studied the effect of supplementing 10 per cent higher lysine, methionine and threonine to basal diet at low (LT) and high (HT) temperatures (15 or 25 ^{o}C). FCR of turkeys on the HT were significantly lower, up to 42 days of age, than those of turkeys on the LT. Significant treatment interactions were observed from 22 to 41 days of age. Turkeys in the amino acid supplemented diets on the LT had significantly lower FCR, where as those on the HT did not respond. From 69 to 105 days of age, turkeys on the HT that were fed the supplemented diets had significantly increased FCR, but there were no dietary effects among turkeys on the LT.

Rajini and Prabhakaran (2003) conducted a trial in which turkey poults were fed with diets containing 22, 25 and 28 per cent crude protein at a constant energy level for 8 weeks and found that up to 4 weeks of age, no change in feed conversion ratio was shown by different treatments. However at 8 weeks of age 25 per cent crude protein diet fed poults had better feed conversion ratio of 2.19

compared to 2.31 and 2.30 in case of 22 and 28 per cent protein diet fed poults, respectively.

Waldroup *et al.* (2003) opined that when turkeys were fed with diets varying in crude protein levels having lysine, methionine, threonine and tryptophan values at least 105 per cent of NRC (1994) recommendations for test period of 16 to 20 weeks, feed conversion was more variable and was not significantly influenced by dietary crude protein.

Noy and Sklan (2004) conducted two feeding experiments, one with varying energy levels and other with varying energy and amino acids for 19 weeks and found that with increasing energy, feed efficiency and caloric efficiency improved. At reduced amino acid levels, feed efficiency was reduced during first six weeks and during seven to nineteen weeks, feed efficiency remained unchanged.

While studying the relationship of nutrient density on the performance of male broiler chickens, Saleh *et al.* (2004) concluded that feed conversion significantly improved as nutrient density increased but this trend decreased with age.

Sikur *et al.* (2004) reported that when fast feathering and slow feathering turkeys were fed with a control diet and a high nutrient density diet having 10 per cent more protein and energy than control diet, feed efficiency was less in groups fed control diet at 70 and 84 days of age. However, this trend was reversed from 140 to 198 days of age, during which period turkeys fed with control diet had better feed conversion.

Min *et al.* (2007) found that when day old goslings were fed with diets having 10.87, 11.37, 11.87, 12.37 and 12.87 MJ ME/kg diet in combination with 15.0, 17.5 and 20.0 per cent crude protein from 0 to 4 weeks of age, feed conversion ratio was low in birds fed low energy and low protein diets.

EFFECT OF DIETARY PROTEIN AND ENERGY ON LIVABILITY

Kidd *et al.* (1997) demonstrated that turkeys receiving diets low in protein with or without addition of L-threonine showed no mortality pattern with change in treatments.

Waibel *et al.* (2000) concluded that when growing turkeys were fed diets low in crude protein supplemented with or without threonine, mortality was not influenced by variation in treatment groups.

The effect of supplementing 10 per cent extra amino acids lysine, methionine and threonine to basal diet at two different temperatures was studied by Veldkamp *et al.* (2000) and reported that mortality was not affected by dietary treatments, where average mortality rate through out 134 day experimental period was 9.5 per cent.

Ozek *et al.* (2003) conducted an experiment in which CP and ME in diet were changed from 160 to 280 g/kg and from 10.9 to 13.8 MJ/kg respectively, during starter and grower phase of chukar partridge up to 16 weeks. It was found that CP and ME concentration of diet has no influence on mortality. Mortality was generally lower for groups fed low CP diets.

Saleh *et al.* (2004) conducted studies in broiler chickens to assess the effect of increasing nutrient density on growth and carcass quality and concluded that high dietary energy did not have adverse effect on mortality but is inversely related to it.

Lemme *et al.* (2006) conducted a feeding trial with male turkeys to examine the effect of different amino acid levels on their performance. In order to assess different protein level combinations of balanced protein (based on lysine) that ranged from 90 to 120 per cent of normal recommendations were used. The results indicated that those groups fed only 100 and 90 per cent of protein in diet during all six phases exhibited overall lower mortality compared to other groups.

EFFECT OF PROTEIN AND ENERGY ON CARCASS CHARACTERISTICS

Sell *et al.* (1985) conducted an experiment with Nicholas male turkeys to determine the independent and interactive effects of dietary metabolizable energy (95, 100 or 105 per cent of those used most frequently in commercial feeding programmes) and protein concentration levels (88, 97 or 107 per cent of those recommended by NRC) on performance of Large White toms from 9 to 20 weeks of age. Carcass composition and parts yield of the carcass were affected only slightly by dietary ME and protein concentration. No significant interaction effects of dietary ME and protein were detected except in case of absolute quantity of carcass protein.

Rose and Michie (1987) studied the relationship of four constant temperatures (14, 17, 20 and 23 ^{o}C) and three dietary protein concentrations (201, 229 and 294 g/kg diet) on meat yields of turkeys from 10 to 15 weeks of age. The result indicated that at higher temperatures breast meat yield was decreased, while dark meat yield was increased. At each temperature, the turkeys given higher dietary protein concentrations had increased body weight gains but their breast meat yields were similar. Thus the poor breast meat yields which resulted from rearing at high temperature could not be counteracted by high dietary protein concentration.

Salmon (1986) fed Small White turkeys with diets of increasing nutrient densities from 6 weeks of age to slaughter age and found that with each increment in nutrient density, carcass quality improved. At 13 weeks of age, carcass finish was greatly improved by higher nutrient density and at 14 weeks, the medium nutrient density diet also improved carcass finish with higher nutrient density producing further improvement.

Yield and composition of raw and cooked meat of Small White turkeys as influenced by dietary nutrient density and energy to protein ratio was determined (Salmon and Stevens, 1989). Three nutrient densities were formulated by adding

0, 30 and 90 g added fat/kg diet. Within each nutrient density, four energy to protein ratios were formed by keeping energy constant. Carcass studies showed that high nutrient density diet increased body weights, eviscerated carcass, relative carcass yields and carcass skin yield but not breast or total meat yields. Feeding a low nutrient density diet for 6 weeks followed by diets with progressively increasing nutrient density resulted in carcasses with qualities comparable to feeding diets of constant medium or high nutrient densities. Increasing calorie-protein ratios reduced body weights, eviscerated carcass weights and carcass yields.

Ferket and Sell (1989) fed Large White toms with diets containing 100, 80, 70 or 60 per cent of NRC (1984) recommendation for protein from 1 to 6 weeks of age and subsequently fed NRC (1984) dietary recommendations. At 6, 12 and 20 weeks of age two toms were sampled from each pen for carcass evaluation. Fat and dry matter concentration in the body increased by 0.5 and 0.27 per cent, respectively per 10 per cent decrement in protein content of diet. At 20 weeks of age total body protein of protein restricted toms was equal to that of unrestricted toms. At 6 weeks of age proportion of breast and thighs decreased as protein level decreased, which returned to normal proportion by 12 weeks of age, but absolute weights of their parts were still lesser than those from unrestricted toms.

Ferket and Sell (1990) subjected male poults from 10 days to 6 weeks of age to four dietary treatments; 100 per cent and 70 per cent of NRC (1984) protein recommendations and 100 per cent and 90 per cent of NRC (1984) energy recommendations. Subsequently they were fed with 4 or 8 per cent fat up to 20 weeks of age and sacrificed at 6,12 and 24 weeks of age. The protein restricted toms had higher carcass protein when fed low energy diets than when fed high energy diets. Carcass fat content at 12 and 20 weeks of age increased from 5.0 to 6.8 per cent and from 12.2 to 13.3 per cent, respectively as dietary fat increased from 4 to 8 per cent. Early protein restriction reduced breast muscle yield at 6

weeks of age but not during 12 and 20 weeks. Low protein fed toms exhibited reduction in breast skin percentage, which was increased by fat supplementation. Though protein supplementation reduced muscle tissue weight, it increased organ weights, while energy restriction reduced liver weight at 6 weeks of age.

Halvorson *et al.* (1991) reared Large White male turkeys at two different stocking densities and fed four types of diets; control diet with 1 per cent fat in mash form, same diet in pellet form, same diet with fat increasing from 1 to 8 per cent with age and diet with 0, 20, 35, 50 and 65 per cent barley added to control diet. Birds were reared under different lighting regimen at environmental temperatures of 7 and 21^{o}C. Higher amount of breast and leg meat were produced by birds fed pelleted feed and those received fat supplemented pellet feed. Percentage abdominal fat was more in toms received diets with supplemental fat while percentage fat content of carcass was less in control diet in mash form.

Clarke *et al.* (1993) conducted experiment to find out the effect of dietary protein restriction at an early age on the carcass characters of Nicholas male turkeys which were kept on 100, 90, 80 and 70 per cent of NRC protein recommended diets from 8 to 56 days of age and then fed control diet *ad libitum*. Unchilled and chilled carcass weights, whole breast, breast muscle weight, percentage yield of breast, total drum weight and total wing weight decreased in toms fed 70 and 80 per cent level of dietary protein, while toms fed 90 per cent crude protein had carcass part weights and yields similar to control.

Rivas and Firman (1994) fed turkeys with high energy high protein diet by making combinations of 100 per cent and 115 per cent NRC protein recommendation and 100 per cent and 112 per cent of NRC energy recommendation from 0 to 18 weeks of age in males and 0 to 15 weeks of age in females. Carcass studies showed that increasing dietary ME increased body fat deposition of male and female turkeys. They suggested that fat deposition can be reduced in the finisher period by increasing the protein level of the diets.

Barbour and Lilburn (1996) studied carcass development of male poults by rearing them under two different diets; one group with control diet as per NRC (1984) nutrient specifications and other group with isocaloric diet deficient in protein and lysine from 0 to 4 and 4 to 8 weeks, respectively, followed by control diet from 8 to 18 weeks of age. They concluded that protein or lysine restriction reduced breast muscle weights and yields at 18 weeks of age.

Kidd *et al.* (1997) studied dietary protein effect in conjunction with threonine supplementation on performance and carcass composition of Large White toms. They found that breast meat yield was significantly higher in toms fed 100 and 92 per cent NRC crude protein levels. The 84 and 76 per cent crude protein treatments resulted in decreased breast meat yields regardless of L-threonine supplements. Reducing diet protein to 84 per cent could decrease the carcass weight. Thigh weight was significantly decreased when crude protein was reduced to 84 and 76 per cent of NRC. However supplements of L-threonine to the diets containing 84 per cent NRC crude protein restored thigh weights equal to 100 per cent protein diet ($P<0.05$).

Waldroup *et al.* (1997) conducted experiment in BUT and Nicholas turkeys from day old to 24 weeks of age by providing diets with 90, 95,100,105,110 and 115 per cent NRC recommendation of amino acid and diets were changed at 3 or 4 weeks intervals. Carcass studies were conducted at 18 and 24 weeks of age. Results indicated that the amino acid levels suggested by NRC are adequate to support maximum dressing percentage in Large White males grown to 18 or 24 weeks of age, when fed on four weeks intervals. A 5 per cent higher level of amino acids was required to maximize breast meat yield.

Waldroup *et al.* (1998) conducted a 3x4 factorial experiment in two strains of Large White male turkeys by providing three standard amino acid levels (100, 110 and 120 per cent of NRC recommendation) and four amino acid restriction periods(no restriction, 0 to 3, 0 to 6 and 6 to 12 weeks). During the respective restriction periods, a diet was formulated to contain 75 per cent of the

amino acid levels recommended by the NRC was provided *ad libitum*. Increasing the dietary amino acid level resulted in a significant improvement in dressing percentage with significantly greater breast meat yield and lower percentages of drumstick and wing. Restricting the amino acid content during the early growth period had adverse effects on many processing parameters with the degree of response closely related to the severity of growth depression. Birds fed the amino acid restricted diets from 0 to 3 weeks of age did not differ significantly from those fed the unrestricted diet, whereas birds fed the amino acid restricted diets from 0 to 6 weeks had significantly lower breast yield, while birds fed the amino acid restricted diets from 6 to 12 weeks of age had significantly lower dressing percentage and breast yield than the unrestricted birds.

Waibel *et al.* (2000) studied the effectiveness of threonine and other amino acids replacing crude protein in methionine and lysine adequate diets in Large White male turkeys from 6 weeks to market age. The results showed that 82.8 to 85.2 per cent of NRC CP resulted in reduced breast meat yield and supplemental threonine or tryptophan was ineffective in reversing this reduction. Similarly 77 to 79 per cent NRC crude protein resulted in depressed breast meat yield. When threonine was supplemented to the above diets, there was no response in breast meat yield, whereas, a combination of threonine, isoleucine, valine, arginine and tryptophan partially returned breast meat yield to that of the normal CP control.

Mountney and Parkhurst (2001) reported the normal dressing percentage of Small White turkeys to be in the range of 80%.

Crouch *et al.* (2002) evaluated the effect of different levels of physical feed restriction on subsequent carcass composition by feeding turkeys *ad libitum*, feed restricted from 16 to 24 weeks, feed restricted from 3 to 16 weeks and feed restricted from 3 to 24 weeks of age, after which birds were fed *ad libitum*. They found that as restriction period increased the body fat percentage reduced.

Restricted fed turkeys had lighter breast muscle at early age but not at 54 weeks of age.

Decreasing dietary crude protein from 300 to 180 g/kg proportionately reduced the breast muscle weights by 0.52 in large male line and 0.24 in small traditional line (Wylie *et al.*, 2003). Decreasing dietary crude protein was associated with an increase in the fat content of feather free carcass. Large male line turkeys had a higher carcass fat than the traditional turkeys. In another trial, supplementation of amino acids to low protein diets increased breast muscle weights.

Lemme *et al.* (2004) conducted trials in turkeys from 14 to 140 days of age by feeding reduced protein diets with and without amino acid supplementation. They observed that protein in diet can be reduced up to 10 per cent , provided all amino acids are available in balanced proportion, without reduction in carcass weight, carcass yield, breast percentage and drumstick percentage. Breast meat yield was 6 per cent lower in turkeys fed 10 per cent less protein diet with only lysine, methionine+cystein,threonine and tryptophan were considered in feed formulation than in turkeys fed 10 per cent less protein with all amino acids in balanced proportion.

Saleh *et al.* (2004) conducted trial in broilers in which dietary energy levels were increased by adding poultry oil each from 0 to 9 per cent in increments of 1 per cent, keeping crude protein, amino acid and other nutrients in proportion with energy levels. They reported that dressing percentage tended to decrease as dietary nutrient density level increased. Breast meat yield and abdominal fat remained unchanged with increase in metabolisable energy when protein in the feed was maintained in proportion to energy.

Sikur *et al.* (2004) reported that high nutrient density diet with 10 per cent more protein and energy in turkeys significantly improved body weight, keel length, increased thoracic circumference, weight of pectoralis major and p.minor

by 9.8, 4.1, 5.1, 19.1 and 17.8 per cent respectively at 84 days of age. There was an increase in absolute and percentage weight of abdominal fat pad relative to body weight in poults fed high nutrient diet at 42 days of age but not at 84 days.

Veldkamp *et al.* (2005) studied the effects of ambient temperature (18 and 28^{o}C), dietary energy level (90, 100 and 110 per cent of NRC recommendations) and dietary lysine level (105 and 120 per cent of NRC recommendations) in male turkeys from 29 to 140 days of age. They found that breast meat yields were lower while thigh, drum and wing yields were higher at high temperature than at lower temperature. The highest energy resulted in lower carcass yields and breast meat yields and higher thigh and drum yields than the lowest energy. Dietary lysine level did not affect carcass yield.

Min *et al.* (2007) assessed dietary crude protein (15.0, 17.5 and 20.0 per cent) and metabolizable energy (10.87, 11.37, 11.87, 12.37 and 12.87 MJ/kg) concentration on the carcass characteristics of goslings. Slaughter studies at 28 days of age showed that eviscerated carcass percentage was significantly higher when ME was 11.87 MJ/kg. Breast meat and leg meat percentages were significantly increased when dietary crude protein was increased from 15.0 to 20.0 per cent. Abdominal fat showed upward tendency with increased dietary ME, while liver relative weight exhibited downward tendency with increased energy and crude protein.

EFFECT OF DIFFERENT FEEDING REGIMEN ON SERUM PROTEIN

Sturkey (1976) reported the total serum protein value for male chicken as 4 g/dl and for female chicken as 5.2 g/dl, on an average. Further, he opined that it was not constant and varies with many factors, of which, the major factor was protein content in the diet fed.

Augustine (1982) studied the effect of feed and water deprivation on blood characteristics of young turkeys and reported that as hours of feed

deprivation increased, plasma protein concentration reduced from 4 g per cent in control group to 3.8g per cent in 24 hr feed deprived group and to 3.1 g per cent in 72 hr feed deprived group. In water deprived group plasma protein increased from 4.6g per cent in control group to 5.1 g per cent in 24 hour water deprived group and to 5.2 g per cent in 48 hour water deprived group.

Morris *et al.* (1999) fed turkey poults with diets containing either 20 mg deoxynivalenol/kg or 100 mg moniliform/kg or combination of both from day old to 21 days and found that neither serum total protein nor serum cholesterol level were affected by dietary treatments.

In a study by Bounous *et al.* (2000) to establish reference values for hematology and serum chemistry parameters in forty eight clinically normal juvenile wild turkeys, the range for total serum protein in four month old turkey bird was set at 3.6 to 5.5 g/dl.

When turkey were poults fed 0, 100, 200 and 400 µg of aflatoxin/kg feed to 14 days of age, total plasma protein concentrations of poults in the 200 and 400 µg aflatoxin/kg feed groups were significantly lower ($P < 0.05$) than those of poults in the 0 or 100 µg aflatoxin/kg feed groups (Quist *et al.*, 2000).

Hassan *et al.* (2005) conducted trials on broiler chicks with diets containing increasing levels of choline to which betaine was added at 0 per cent, 0.072 per cent or 0.144 per cent. Irrespective of choline in the diet, betaine addition increased serum total protein. When choline was increased from 0 to 600 mg/kg feed independently without betaine in the diet, total serum protein elevated from 4.34 to 4.53 g/dl.

Calislar and Aydin (2006) studied the effect of feeding eight day old broiler chicks with basal diet and four other diets, each having 2, 4, 6 or 8 per cent animal bone fat to the basal diet for forty two days and found that as the

level of fat in the diet increased the blood protein level increased (from 4.86 in basal diet to 5.97 g/dl in 8 per cent fat included diet).

EFFECT OF DIFFERENT FEEDING REGIMEN ON SERUM CHOLESTEROL

In a study, Konjufca *et al.* (1997) supplemented garlic in the diet of broiler chicken and reported that garlic supplementation at 1.5 per cent level from day old to 21 days of age resulted in reduction in plasma total cholesterol. Further increase in garlic supplementation did not affect plasma cholesterol level.

Jin *et al.* (1998) determined the effect of lactobacillus culture on serum cholesterol level in broilers by feeding them with 0, 0.05, 0.10 and 0.15 per cent of lactobacillus culture. The serum cholesterol at 10, 20, 30 and 40 days of age were estimated. At 20 days of age birds fed 0.05 or 0.10 per cent lactobacillus culture had serum cholesterol lesser (89 and 82 mg/dl respectively) than the control groups (111 mg/dl). They found that serum cholesterol were significantly lower ($P < 0.05$) in groups fed with diets containing lactobacillus culture when compared to the control group at 30 days of age.

Pesti and Bakalli (1998) fed White Leghorn hens of 30 weeks of age with diets having 0,125 or 250 mg supplemental copper/kg basal diet for 8 weeks and found that plasma cholesterol level reduced in hens fed diets supplemented with copper at 4^{th} and 8^{th} weeks after diet was changed. Increasing the level of copper from 125 mg/kg feed did not reduce plasma cholesterol levels any further.

The potential of garlic in the feed to reduce serum cholesterol was investigated by Chowdhury *et al.* (2002). Twenty eight week old hens of different strains were fed with 0, 2, 4, 6, 8, or10 per cent sun dried garlic paste for 6 weeks. They found that garlic incorporation in the feed reduced serum cholesterol levels on an average by 15, 28, 33 and 43 per cent, when 2, 4, 6 or 8 per cent garlic paste, respectively was included in the diet. Significant difference was

noticed in serum cholesterol concentration among strains, which might be due to inherent genetic differences.

Yusrizal and Chen (2003) observed that when broilers were fed basal diet and diet with 1 per cent inulin and 1 per cent fructan for 6 weeks, the serum cholesterol in male broilers reduced from 140 g/dl in basal diet to 96 g/dl in both inulin and fructan supplemented diet. In female broilers basal diet fed group had total serum cholesterol of 128 g/dl, while inulin fed group had 107 g/dl and fructan fed group had 103 g/dl serum cholesterol levels.

Chowdhury *et al.* (2005) conducted trials to assess the role of tamarind incorporation in the diet in reducing serum cholesterol in different strains of laying hens. Forty three hens were fed with diets containing 0, 2, 4, 6 or 8 per cent dried tamarind for 6 weeks and reported that serum cholesterol concentrations reduced with increasing levels of tamarind in the diet.

Sahin *et al.* (2005) evaluated the effect of magnesium oxide and magnesium proteinate along with a basal diet at high and low temperature in quails on serum cholesterol level. They found that induced elevation in serum cholesterol by heat stressed can be reduced by dietary magnesium supplementation.

EFFECT OF DIFFERENT FEEDING REGIMEN ON MEAT CHOLESTEROL

Marion (1965) studied the effect of adding corn oil or beef tallow, at 6 or 12 per cent to a basal diet fed to cockerels. Breast meat sample analysis was done at 21, 42 and 63 days of age and thigh meat sample was analyzed at 63 days of age. The result showed that lipid content of neither breast nor thigh meat was influenced by diet but by age. As age increased the total lipid content of breast meat decreased.

When broiler chicks were fed either control diet or diet with 0, 1.5, 3 or 4.5 per cent garlic powder up to 21 days of age, Konjufca *et al.* (1997) observed a

reduction in breast meat cholesterol levels by 15 per cent. When 3 per cent garlic powder diet was supplemented with 180 ppm copper, both thigh and breast meat cholesterol were reduced from 137 to 98 mg/100g and from 56 to 34 mg/100g respectively.

Crespo and Esteve-Garcia (2001) conducted an experiment to determine the effect of inclusion of four different types of fat viz; tallow, olive oil, sunflower oil and linseed oil at 6 or 10 per cent level in female broiler chicken from day 21 to 49 days of age. Breast muscle showed lower values for cholesterol than thigh muscle. Tallow fed groups showed higher breast cholesterol level (64.7 mg/100 g) compared to other fat fed groups.

Aletor *et al.* (2003) assessed the tissue lipid concentration of broiler chicks fed with a high and low protein feed. Low protein feed was supplemented with either 20 or 40 g/kg conjugated linoleic acid or with either 50 or 100 mg of α glucosidase inhibitor, Bay g 5421 for 6 weeks. The results showed that Bay g 5421 fed groups of birds had lower thigh meat cholesterol of 2.7 µ mol/g than low protein fed birds (3.5 µ mol/g). Thigh meat cholesterol of high protein fed birds was 4.2 µ mol/g.

In order to assess the possible influence of alfalfa meal in altering the broiler meat cholesterol, Ponte *et al.* (2004) carried out an experiment in male broiler chicken, in which, birds were maintained on three dietary regimen viz; high energy diet on *ad libitum* intake, restriction of high energy diet on 75 per cent and 50 per cent of *ad libitum* intake. Restricted birds were fed dehydrated alfalfa meal *ad libitum*. Birds that consumed alfalfa showed lower breast meat cholesterol levels of 43.18 mg/100g (75 per cent restriction) and 43.74 mg/100g (50 per cent restriction) than 47.11 mg/100g in *ad libitum* fed birds.

Materials and Methods

3. MATERIALS AND METHODS

An experiment was conducted at the Department of Poultry Science, College of Veterinary and Animal Sciences, Kerala Agricultural University, Mannuthy to evaluate the comparative growth performance and dressing percentage in turkeys fed with different levels of protein and energy. The study was conducted for a period of 20 weeks from December 2007 to April 2008.

3.1 EXPERIMENTAL MATERIALS

3.1.1 Birds

Beltsville Small White (BSW) variety of turkey was utilized for the experiment. Fertile turkey eggs were obtained from Poultry Research Station, Tamilnadu Veterinary and Animal Sciences University, Chennai. The eggs were hatched at the Revolving Fund Hatchery of the Centre for Advanced Studies in Poultry Science, Mannuthy. Of the turkey poults hatched, 96 poults with an average body weight of 48 g were selected for the study. They were brooded for the first 4 weeks in battery brooders. At fifth week of age the poults were transferred to deep litter pens.

3.1.2 Rations

The poults were wing banded and weighed individually. They were allotted randomly to two treatment groups each having six replicates of 8 birds each.

Birds grouped under treatment 1 (T1) were fed with ration compounded based on National Research Council recommendations for turkey (1994), in which crude protein and metabolisable energy levels changed in every 4 weeks as follows:

Age of birds (in weeks)	Crude Protein (%)	Metabolisable Energy (kcal/kg)
0-4	28	2800
5-8	26	2900
9-12	22	3000
13-16	19	3100
17-20	16.5	3200

Birds in the treatment 2 (T2) were fed with ration which was formulated according to BIS recommendation (1992) for broiler starter and finisher rations as given below.

Age in weeks	Crude Protein (%)	Metabolisable Energy (kcal/kg)
0-16	23	2800
17-20	20	2900

The ingredient composition of experimental rations of T1 and T2 are presented in Tables 1 and 2.

Proximate analysis of the feed ingredients and rations were done as per procedure described by AOAC (1990).The per cent chemical composition of experimental diets on dry matter basis is given in Tables 3 and 4.

3.2 EXPERIMENTAL METHODS

3.2.1 Housing of Poults

Poults were brooded in battery brooder for 4 weeks. Each replicate was brooded in separate compartment with dimensions of 2 ft length, 1.5 ft breadth

and 1 ft height. Cages, feeders and waterers were thoroughly washed, disinfected and sun dried before introducing the birds. The poults were given supplementary heat for 2 weeks and thereafter light was provided only in the night time. At fifth week of age, poults in each replicate were transferred to floor pens having an area of 30 sq.ft. The pens were cleaned, disinfected and whitewashed one week prior to transfer.

3.2.2 Management

The birds were given *ad libitum* feed and water during the course of the experiment. Poults were vaccinated against Ranikhet Disease at one week of age via ocular route. At eighth week of age, they were given booster dose for Ranikhet Disease by subcutaneous route. Standard management practices were given identically to all birds.

3.3 OBSERVATIONS MADE

3.3.1 Body Weight

Birds were weighed individually at day old and at fortnightly interval until they attained 20 weeks of age. From this data the average fortnightly body weight and weight gain for each treatment were calculated.

3.3.2 Feed Consumption

Feed consumed by each replicate was recorded at weekly interval and from this data average feed consumed by each bird per day was calculated.

3.3.3 Feed Conversion Ratio

Feed consumed per kg gain in body weight was calculated in each replicate based on the data on body weight gain and feed intake.

3.3.4 Livability

The mortality of birds for each treatment was recorded during the experimental period and from this data livability per cent was calculated. Postmortem examination was conducted in each case to find out the cause of death.

3.3.5 Dressing percentage

At the end of 20 weeks of age, two turkeys from each replicate, one male and one female, totaling 24 birds were selected for slaughter studies to assess the processing yield and losses (BIS, 1973). The birds were hard scalded after bleeding and the weights of eviscerated carcass and giblets were recorded from each turkey to calculate processing yield and losses.

3.3.6 Serum Total Protein and Total Cholesterol

Two samples of fresh blood from each bird were collected in clean and dry test tubes during the time of slaughter to study the serum total protein and total cholesterol. The blood samples were centrifuged to separate serum. Serum total protein was estimated colorimetrically by the Biuret method utilizing the kit supplied by M/s. Agappe Diagnostics Pvt. Ltd., Agappe Hills, Ernakulam, Kerala and serum total cholesterol was estimated colorimetrically by CHOD-PAP method utilizing the kit supplied by M/s. Agappe Diagnostics Pvt. Ltd., Agappe Hills, Ernakulam, Kerala.

3.3.7 Total Meat Cholesterol

At the time of slaughter at 20^{th} week of age, samples from breast and thigh muscles were collected. The breast and thigh muscle samples were preserved at -18^{0} C under deep freezer. The meat samples were chopped and minced with mortar and pestle. The total lipid was extracted from the muscle

sample as per the method suggested by Folch *et al.* (1957). The muscle total cholesterol was estimated from extracted lipid by one step method of Wybenga *et al.* (1970). The mean value was found out for each treatment.

3.4 STATISTICAL ANALYSIS

The data obtained from the experiment were analyzed statistically as per Snedecor and Cochran (1994).

Table 1. Ingredient composition of T1 experimental rations in per cent.

Ingredients	Periods				
	(0-4wks)	(5-8wks)	(9-12wks)	(13-16wks)	(17-20wks)
Yellow maize	49.50	54.90	66.50	68.00	69.00
Soya bean meal	34.50	32.00	17.50	17.00	15.00
Unsalted dried fish	15.00	12.00	15.00	10.00	5.50
Deoiled rice bran	-	-	-	-	5.00
Rice bran oil	-	-		2.00	3.50
Dicalcium phosphate	-	0.25	0.50	1.75	1.75
Calcite	0.80	0.60	0.30	1.00	0.00
Salt	0.20	0.25	0.20	0.25	0.25
TOTAL	100	100	100	100	100
Added to 100 kg feed the following supplements:					
Tefroli (g)	25	25	25	25	25
UTPP(g) [1]	100	100	100	100	100
Tm-6(g) [2]	130	130	130	130	130
Merivite (g)[3]	10	10	10	10	10
E care Se(g) [4]	10	10	10	10	10

UTPP[1] Powder: (Tetragon Chemic Pvt. Ltd., Bangalore) containing treated Aluminosilicates, Propionates, Formates and Acetates.

Tm-6 [2] : Trace mineral mixture

Composition per kg: Cobalt:1 g, Iodine:2 g, Copper:2 g, Iron:20 g, Zinc:52 mg, Manganese:55 g.

Merivite [3] : A+B_2+D_3+K (Wockhardt Ltd., Mumbai)

Composition per kilogram: Vitamin A: 82,000 IU, Vitamin B_2: 52 mg

Vitamin D_3: 12,000 IU, Vitamin K: 10 mg, Calcium: 166 mg, Phosphate: 395 mg.

E care Se [4] : Composition per kilogram: Vit. E: 500g, Selenium: 1000 mg .

Table 2. Ingredient composition of T2 experimental rations in per cent.

Ingredients	Periods	
	(0-16wks)	(17-20wks)
Yellow maize	56.00	65.00
Soya bean meal	28.00	21.25
Unsalted dried fish	9.00	10.00
Deoiled rice bran	3.00	-
Dicalcium phosphate	2.00	2.00
Calcite	1.75	1.50
Salt	0.25	0.25
TOTAL	100	100
Added to 100 kg feed the following supplements:		
Tefroli (g)	25	25
UTPP(g) [1]	100	100
Tm-6(g) [2]	130	130
Merivite (g) [3]	10	10
E care Se(g) [4]	10	10

UTPP[1] Powder: (Tetragon Chemic Pvt. Ltd., Bangalore) containing treated Aluminosilicates, Propionates, Formates and Acetates.

Tm-6 [2] : Trace mineral mixture

Composition per kg: Cobalt:1 g, Iodine:2 g, Copper:2 g, Iron:20 g, Zinc:52 mg, Manganese:55 g.

Merivite [3] : A+B_2+D_3+K (Wockhardt Ltd., Mumbai)

Composition per kilogram: Vitamin A: 82,000 IU, Vitamin B_2: 52 mg, Vitamin D_3: 12,000 IU, Vitamin K: 10 mg, Calcium: 166 mg, Phosphate: 395 mg.

E care Se [4]: Composition per kilogram: Vit. E: 500g, Selenium: 1000 mg.

Table 3. Per cent chemical composition of experimental NRC diet (on dry matter basis).

Sl. No.	Nutrients	T1				
		(0-4wks)	(5-8wks)	(9-12wks)	(13-16wks)	(17-20wks)
1	Dry matter	89.83	89.10	88.35	90.60	89.25
2	Crude protein	28.20	25.80	21.98	18.89	15.97
3	Ether extract	3.00	3.00	3.40	4.60	5.68
4	Crude fibre	3.00	3.00	2.61	2.80	3.70
5	NFE	47.03	46.60	51.06	54.30	54.88
6	Total ash	8.60	10.70	9.30	10.10	8.80
7	Acid insoluble ash	0.98	1.64	1.76	1.02	1.56
Calculated values						
1.	ME(Kcal/kg)	2867	2900	3025	3114	3211
2.	Lysine	2.02	1.61	1.53	1.08	0.86
3.	Methionine	0.61	0.49	0.45	0.38	0.31
4.	Calcium	1.2	1.01	1.02	1.29	0.72
5.	Total Phosphorus	0.50	0.51	0.57	0.65	0.55

Table 4. Per cent chemical composition of experimental BIS diet (on dry matter basis).

Sl. No.	Nutrients	T2	
		(0-16wks)	(17-20wks)
1.	Dry matter	90.27	89.55
2.	Crude protein	22.58	20.40
3.	Ether extract	2.80	3.19
4.	Crude fibre	3.00	2.80
5.	NFE	53.59	52.76
6.	Total ash	8.30	10.40
7.	Acid insoluble ash	1.11	1.27
Calculated values			
1.	ME(Kcal/kg)	2844	2937
2.	Lysine	1.60	1.23
3.	Methionine	0.50	0.43
4.	Calcium	1.68	1.53
5.	Total Phosphorus	0.69	0.70

Results

4. RESULTS

The results of an experiment carried out to study the growth and processing yields of turkeys reared on different feeding regimen are presented in this chapter.

4.1. BODY WEIGHT

The data on mean body weight of Beltsville Small White turkey at fortnightly interval as influenced by feeding them with broiler chicken feed having BIS specifications and feed compounded based on NRC standards for turkey is given in Table 5 and graphically represented in Fig.1.

Day old mean body weight of treatment 1 (NRC recommended diet for turkey) and treatment 2 (BIS specified diet for broiler chicken) was 48.15 and 47.34 g respectively, which on statistical analysis showed no significant difference. At two weeks of age, birds in T1, which were fed with NRC diet had mean body weight of 163.71 g, while T2 poults which were fed with BIS broiler diet had a body weight of 153.9 g. At fourth, sixth and eighth weeks of age mean body weights were 395.18, 762.97 and 1274.55 g respectively in T1. The corresponding body weights in T2 in the above age groups were 359.04, 690.51 and 1178.58 g, respectively. Poults fed with NRC turkey diet had significantly ($P \leq 0.05$) higher body weights than those fed with BIS broiler diet at 4^{th}, 6^{th} and 8^{th} weeks of age.

When the birds attained 10 weeks of age, mean body weight was 1816.35 g for the group T1 and 1736.78 g for T2. Twelfth week mean body weights were 2317.35 g for NRC recommended diet fed turkeys (T1) and 2348.89 g for BIS broiler diet fed turkeys. The mean body weights recorded during the fourteenth week of age for NRC and BIS diet fed groups was 2932.89 g and 3012.35 g, respectively. At 16^{th} and 18^{th} week of age mean body weights recorded were

Table 5. Mean (± SE) fortnightly body weight (g) of Beltsville Small White turkeys in the experimental groups

Age in weeks	NRC Turkey feed (T1)	BIS Broiler chicken feed (T2)
0	48.15 ± 0.55	47.34 ±1.15
2	163.71 ±3.97	153.9 ±3.69
4	395.18 [a] ±11.24	359.04[b] ± 9.97
6	762.97 [a] ±21.01	690.51 [b] ±20.37
8	1274.55 [a] ±32.59	1178.58 [b] ±36.55
10	1816.35 ±41.65	1736.78 ±53.92
12	2317.35 ±56.63	2348.89 ±74.13
14	2932.89 ±73.64	3012.35 ±91.96
16	3542.34 ±91.79	3645.48 ±115.67
18	3831.47 ±105.34	4003.70 ±126.31
20	4338.09 ±126.48	4456.92 ±149.67

(n = 48)

The mean values bearing different superscripts within a row differ significantly. ($P<0.05$)

3542.34 and 3645.48 g and 3831.47 g and 4003.7 g, respectively for NRC and BIS diet fed groups of turkeys. The mean body weights at the end of twenty weeks experimental period were 4338.09 g in case of NRC diet fed group and 4456.92 g in BIS diet fed group.

Statistical analysis of the data on the mean fortnightly body weight revealed that except at the end of fourth, sixth and eighth week of age this trait was not significantly influenced by the different dietary regimen employed in this study.

4.2. BODY WEIGHT GAIN

The data on mean body weight gain of Beltsville Small White turkey at fortnightly interval as influenced by feeding them with turkey diet having NRC standards and broiler chicken feed of BIS standard is given in Table 6 and graphically depicted in Fig. 2.

The mean gain in body weight at the end of two weeks of age was 115.36 g in NRC turkey diet fed group, while it was only 105.82 g in BIS broiler diet fed group. Statistical analysis of the data on body weight gain at the end of two weeks of age revealed no significant ($P \leq 0.05$) difference between the treatments. In the second fortnight covering third and fourth weeks of age the poults fed NRC turkey diet gained a body weight of 231.27 g, whereas their counter parts in the broiler diet fed group showed a body weight gain of 209.47 g. Similar to the first fortnightly weight gain, the gain in the second fortnight was not different statistically.

Body weight gain at the end of sixth week of age was 367.94g in NRC diet fed group and 327.23g in BIS diet fed group of turkeys. Unlike in the first two fortnights, weight gain during this period showed a difference upon statistical analysis. Gain in weight was significantly more ($P \leq 0.05$) in the NRC turkey diet

Table 6. Mean (± SE) fortnightly body weight gain (g) of Beltsville Small White turkeys in the experimental groups

Age in weeks	NRC Turkey feed (T1)	BIS Broiler chicken feed (T2)
2	115.36 ±3.60	105.82 ± 3.33
4	231.27 ±8.39	209.47 ±8.24
6	367.94 [a] ±11.95	327.23 [b] ±12.11
8	511.58 ±16.62	500.97 ±17.30
10	541.86 ±19.71	558.26 ±23.75
12	502.05 [b] ±21.37	626.79 [a] ±24.90
14	618.36 ±20.62	664.35 ±30.53
16	591.33 ±26.57	650.90 ±27.40
18	291.29 [b] ±22.32	363.96 [a] ±26.70
20	506.62 ±29.67	453.21 ±45.22
0-12 weeks	2269.00 ± 56.43	2298.37 ± 74.22
0-16 weeks	3491.83 ± 91.27	3597.07 ± 115.67
0-20 weeks	4289.73 ± 126.31	4408.51 ± 149.64

(n = 48)

The mean values bearing different superscripts within a row differ significantly. ($P<0.05$)

fed group than that of broiler feed offered group. Comparison of mean body weight gain in the fourth fortnight consisting of seventh and eighth weeks of age revealed higher body weight gain for NRC group than BIS group of turkeys, recording 511.58 g for NRC group and 500.97 g for BIS group. However when the magnitude of difference between the mean values of two groups was tested statistically, it failed to give any difference.

In the fifth fortnight encompassing ninth and tenth week, body weight gain was higher for BIS diet fed group with a gain of 558.26 g when compared to 541.86 g in case of NRC diet fed group. The statistical analysis of the data on mean body weight gain recorded at the end of twelfth week of age revealed significant ($P \leq 0.05$) difference between the treatments. NRC standard turkey diet fed group showed a body weight gain of 502.05 g, while turkeys fed with broiler diet as per BIS standard showed a weight gain of 626.79 g. Seventh and eighth fortnightly weight gain covering thirteenth and fourteenth week of age and fifteenth and sixteenth week of age, showed no significant difference between the treatments though higher body weight gain was recorded for BIS diet fed turkeys than the turkey diet fed group. The mean body weight gains in the seventh fortnight for the group T1 and T2 were 618.36 and 664.35 g respectively. The corresponding values in the eighth fortnight were 591.33 and 650.90g, respectively.

Statistical analysis of the data on mean body weight gain at the end of eighteenth week of age revealed significant difference between NRC and BIS diet fed turkeys at 5 % level. Eighteenth week mean body weight gain was 363.96 g for BIS diet fed turkeys and the value for NRC diet fed turkeys was 291.29 g. In the last fortnight of the study covering nineteen and twenty weeks of age, mean body weight gains for NRC and BIS diet fed turkeys were 506.62 g and 453.21 g respectively, which showed no significant difference on statistical analysis.

Cumulative body weight gain for both the treatments was calculated for 3 periods, that is, from day old to twelve weeks, day old to sixteen weeks and day old to twenty weeks of age. Cumulative body weight gains for twelve, sixteen and twenty weeks of age in NRC turkey diet fed group were 2269.00, 3491.83 and 4289.73g, respectively. The corresponding body weight gain for the above periods in the BIS broiler diet fed groups were 2298.37, 3597.07 and 4408.51 g, respectively. Statistical analysis of the mean cumulative body weight gain calculated for the above periods showed that the different feeding regimen employed in the study did not have any significant influence on this trait.

4. 3. FEED CONSUMPTION

The mean daily feed intake per bird calculated week wise from zero to twenty weeks of age and the mean cumulative feed intake per bird from zero to twelve weeks, sixteen weeks and twenty weeks of age as influenced by feeding them with NRC recommended turkey diet and BIS recommended broiler ration are presented in table 7. The graphical representations for the same are depicted in Figures 3 and 4, respectively.

Mean daily feed consumption per poult during the first week was 9.20 and 9.26 g in NRC turkey diet and BIS broiler diet fed turkeys, respectively. Feed intake gradually increased in each week and during the fourth week the mean daily feed consumption for the groups T1 and T2 was 36.03 and 33.88 g, respectively. Till fifth week of age the mean daily feed intake was more with NRC turkey diet fed group. Subsequently the trend was reversed so that during eighth week mean daily feed intake per bird was more with broiler diet fed turkeys. The mean daily feed intake during eighth week was 98.00 and 104.74 g per bird for the groups T1 and T2 respectively. This trend was continued till the end of the experiment at 20^{th} week of age with the exception at 9^{th} week of age. The mean daily feed consumption values for the NRC recommended turkey feed offered group during 12^{th}, 16^{th} and 20^{th} week of age were 126.10, 176.41 and

156.63 g, per bird respectively. The corresponding mean daily intake values in the above weeks for the broiler diet fed turkeys were 143.51, 204.67 and 169.86 g, per bird respectively.

Statistical analysis of the week-wise mean daily feed consumption showed that during 10^{th}, 12^{th}, 13^{th}, 16^{th}, 18^{th} and 19^{th} week of age this trait differed significantly between treatments. In all these weeks, birds offered broiler diet consumed significantly ($P \leq 0.05$) more feed. The mean daily feed intake in NRC turkey diet fed turkeys (T1) during 10^{th}, 12^{th}, 13^{th}, 16th, 18^{th} and 19^{th} week of age was 113.93, 126.10, 133.13, 176.41, 150.76 and 133.46 g respectively. In broiler diet fed turkeys the mean daily feed consumption for the above weeks was 129.49, 143.51, 158.69, 204.67, 173.18 and 161.69 g, per bird respectively.

Cumulative feed intake per bird was calculated for zero to twelve weeks, zero to sixteen weeks and zero to twenty weeks of age. Mean cumulative feed intake per bird was 6122.87 g and 6414.77 g for zero to twelve weeks, 10542.08 g and 11455 g for zero to sixteen weeks and 14310.69 g and 15735.89 g for zero to twenty weeks of age for NRC and BIS diet fed turkey groups, respectively. Cumulative mean feed intake per bird showed significant difference at 5% level during zero to sixteen weeks and zero to twenty weeks of age. In both these periods, turkeys offered broiler chicken feed consumed significantly more feed than NRC recommended turkey feed offered group.

4. 4. FEED CONVERSION RATIO

The data on fortnightly mean feed conversion ratio of turkey poults maintained on different dietary treatments is presented in Table 8.

In the first fortnight, NRC recommended turkey diet fed group had a feed conversion ratio of 1.64, while BIS broiler diet fed group had FCR of 1.79. In the second fortnight consisting of 3^{rd} and 4^{th} weeks of age, the ratios for groups 1 and

Table 7. Mean (± S.E.) feed intake per bird per day (g) of Beltsville Small White turkeys in the experimental groups

Age in weeks	NRC Turkey feed (T1)	BIS Broiler chicken feed (T2)
1	9.20 ± 0.53	9.26 ± 0.92
2	17.84 ± 1.05	17.56 ± 0.47
3	31.29 ± 1.11	29.50 ± 0.97
4	36.03 ± 1.52	33.88 ± 1.65
5	50.35 ± 1.89	48.52 ± 2.26
6	58.31 ± 1.73	59.73 ± 4.38
7	75.43 ± 2.71	79.93 ± 2.47
8	98.00 ± 4.43	104.74 ± 5.75
9	130.65 ± 5.16	127.42 ± 3.42
10	113.93^{b} ± 2.97	129.49^{a} ± 4.24
11	127.57 ± 6.30	132.85 ± 6.48
12	126.10^{b}± 5.36	143.51^{a} ± 5.21
13	133.13^{b} ± 3.71	158.69^{a} ± 2.56
14	151.44 ± 5.35	173.10 ± 10.43
15	170.34 ± 5.37	183.60 ± 8.51
16	176.41^{b} ± 6.21	204.67^{a} ± 9.23
17	97.53 ± 6.06	106.80 ± 2.47
18	150.76^{b} ± 4.73	173.18^{a} ± 6.85
19	133.46^{b} ± 10.34	161.69^{a} ± 6.23
20	156.63 ± 6.93	169.86 ± 4.65
MEAN CUMULATIVE FEED INTAKE PER BIRD (g)		
0-12 wks	6122.87 ± 145.81	6414.77 ± 191.44
0-16 wks	10542.08^{b}± 229.70	11455.00^{a} ± 360.65
0-20 wks	14310.69^{b} ±319.80	15735.89^{a} ± 466.05

The mean values bearing different superscripts within a row differ significantly. ($P<0.05$)

2 were 2.04 and 2.15, respectively. The FCR calculated for the third fortnight covering five and six weeks of age was 2.07 and 2.29 for the groups T1 and T2, respectively. In the forth fortnight, NRC fed group of turkeys had FCR of 2.37 and BIS diet fed turkeys had FCR of 2.65. Statistical analysis of eighth week feed efficiency revealed significant difference at 5% level showing superior feed efficiency for NRC diet fed group.

At tenth week (fifth fortnight) both NRC and BIS dietary groups had almost similar feed conversion ratio of 3.20 and 3.23 respectively. At twelfth week feed conversion ratio for NRC and BIS groups was 3.54 and 3.17 respectively which showed significant difference at 5% level. At this stage significantly better FCR was noted with BIS chicken feed fed group. Significant difference was also observed in feed conversion ratio of seventh fortnight, which was 3.22 for NRC treatment and 3.49 for BIS treatment. During this period BIS diet fed group had inferior FCR.

The FCR calculated for the eighth fortnight consisting of 15^{th} and 16^{th} weeks of age was 4.06 and 4.36 for the dietary groups 1 and 2, respectively. In the last two fortnights consisting of 17^{th} and 18^{th} weeks of age and 19^{th} and 20^{th} weeks of age, the FCR recorded for the Treatment 1 (NRC turkey feed offered group) was 6.07 and 4.07, respectively. In Treatment 2 (BIS broiler diet group), the FCR for the above periods was 5.72 and 5.36, respectively. Even though the FCR for the ninth fortnight was statistically similar for the dietary groups T1 and T2, the tenth fortnight FCR was statistically different for the dietary treatments. It was significantly superior in NRC diet fed group.

The mean cumulative feed efficiency for the periods from day old to twelve weeks, day old to sixteen weeks and day old to twenty weeks of age as influenced by the dietary treatments is set out in Table 9 and graphically depicted in Fig.5. The FCR from zero to twelve weeks of age was 2.69 for NRC diet fed turkeys and 2.75 for BIS diet fed turkeys. Zero to sixteen weeks and zero to

Table 8. Mean (± S.E.) fortnightly feed conversion ratio of Beltsville Small White turkeys in the experimental groups

Age in weeks	NRC Turkey feed (T1)	BIS Broiler chicken feed (T2)
2	1.64 ±4.86	1.79 ±5.54
4	2.04 ±3.04	2.15 ±4.99
6	2.07 ±1.35	2.29 ±9.30
8	2.37[b] ±7.96	2.65 [a] ±6.97
10	3.20 ±0.19	3.23 ±9.70
12	3.54[b] ±6.12	3.17 [a] ±5.00
14	3.22[b] ±5.59	3.49 [a] ±8.80
16	4.06 ±0.24	4.36 ±0.25
18	6.07 ±0.30	5.72 ±0.57
20	4.07[b] ±0.21	5.36 [a] ±0.46

The mean values bearing different superscripts within a row differ significantly. ($P<0.05$)

Table 9. Cumulative mean (± S.E.) feed conversion ratio of Beltsville Small White turkeys

Cumulative FCR	NRC Turkey feed (T1)	BIS Broiler chicken feed (T2)
0-12 wks	2.69 ± 0.02	2.75 ± 0.04
0-16 wks	3.02[b] ± 0.03	3.14 [a] ± 0.03
0-20 wks	3.34[b] ± 0.04	3.53 [a] ± 0.05

The mean values bearing different superscripts within a row differ significantly. ($P<0.05$)

twenty weeks feed conversion ratios for NRC diet fed group were 3.02 and 3.34, while the same for BIS treatment were 3.14 and 3.53 respectively, which showed significant difference at 5% level on statistical analysis. The mean cumulative feed conversion ratio was found to be significantly better in NRC diet fed turkeys in sixteen weeks and twenty weeks period.

4. 5. LIVABILITY

The mean livability percentage from first week to twenty weeks of age as influenced by dietary feeding regimen was worked out.

Only one bird each from both the treatments died during the 20 weeks experimental period. In the BIS broiler diet fed group, one poult died during the fifth week of age, whereas in the NRC turkey diet offered group the death occurred during the ninth week of age. Altogether the livability was excellent.

4. 6. PROCESSING YIELDS AND LOSSES

At the end of twenty weeks experimental period one each of tom turkey and hen turkey from each replicate from both dietary treatments (a total of 12 birds from each treatment) were sacrificed and the mean dressing per cent, eviscerated yield, ready to cook yield, giblet yield, blood loss and feather loss were found out and are given in Table 10 and Table 11, respectively.

In both tom and hen turkeys mean per cent feather loss and blood loss were numerically higher in broiler diet fed turkeys, whereas mean dressing per cent eviscerated yield, ready to cook yield, giblet yield and dressing percentage were numerically higher in NRC turkey diet fed group than broiler diet fed group. In tom turkeys, BIS diet fed groups recorded more percent weight for heart. In tom turkeys mean ready to cook yield was 80.10 % and 79.20 % for NRC and BIS diet fed turkeys while in hen turkeys mean value for ready to cook yield was 80.95 % and 79.77 % for NRC and BIS diet fed groups of turkeys.

Table 10. Processing yields and losses in Tom Turkeys in the experimental groups at twenty weeks of age

Variable	NRC Turkey feed (T1)	BIS Broiler chicken feed (T2)
Live weight(g) (n=6)	5156.00 ±118.37	4985.83 ± 75.04
Dressing percentage (%)	93.19 ± 0.92	90.98 ± 0.44
Eviscerated yield (%)	75.45 ± 1.29	74.75 ± 1.49
Ready to cook yield (%)	80.10 ± 1.29	79.20 ± 1.49
Giblet wt.(%)	4.65 ± 0.19	4.46 ± 0.15
Liver wt.(%)	1.62 ± 0.06	1.39 ± 0.09
Heart wt. (%)	0.44 ± 0.01	0.47 ± 0.01
Gizzard wt. (%)	2.59 ± 0.15	2.59 ± 0.15
Blood loss (%)	1.91 ± 0.64	2.90 ± 0.09
Feather loss (%)	6.81 ± 0.92	9.02 ± 0.44

Table 11. Processing yields and losses in Hen Turkeys in the experimental groups at twenty weeks of age

VARIABLE	NRC Turkey feed (T1)	BIS Broiler chicken feed (T2)
Live weight(g) (n=6)	3842.50 ± 93.05	3590.00 ± 188.14
Dressing percentage (%)	91.96 ± 0.68	90.92 ± 0.71
Eviscerated wt.(%)	76.50 ± 1.26	75.16 ±0.91
Ready to cook yield (%)	80.95 ± 1.30	79.77 ±0.96
Giblet wt.(%)	4.87 ± 0.17	4.62 ± 0.24
Liver wt.(%)	1.50 ± 0.05	1.50 ± 0.04
Heart wt. (%)	0.45 ± 0.01	0.38 ± 0.03
Gizzard wt.(%	2.92 ± 0.16	2.75 ± 0.19
Blood loss(%)	2.78 ± 0.32	2.99 ± 0.19
Feather loss (%)	8.04 ±0.68	9.08 ±0.71

Dressing percentage of tom turkeys were 93.19 % and 90.98 % for NRC and BIS groups respectively, while the same for hen turkeys were 91.96% and 90.92 %, respectively. The statistical analysis of the data on processing yields and losses revealed that eviscerated yield, ready to cook yield, giblet yield, weight after bleeding and defeathered weight did not differ significantly between both the treatments.

4. 7. SERUM BIOCHEMICAL PROFILE

The mean serum total protein (gm per dl) and serum total cholesterol (mg per dl) of tom turkeys and hen turkeys of both the dietary treatments determined at the end of twenty weeks of age are set out in table 12 and in Fig.6 and 7. The mean serum total protein at the end of twenty weeks of age in tom turkeys was 3.65 g per dl in NRC treatment and 4.67 g per dl in BIS treatment, which were found to be homogenous on statistical analysis. In hen turkeys the mean serum total protein determined at the end of twenty weeks of age was 3.95 and 3.43 g per dl in NRC and BIS treatments, respectively which was also statistically comparable.

The mean serum total cholesterol recorded was 149.83 and 131.17 mg per dl for NRC and BIS diet fed tom turkeys respectively. In case of hen turkeys the mean serum total cholesterol level was 152.0 and 132.0 mg per dl. Statistical analysis of the data on serum total cholesterol for both tom and hen turkeys at twentieth week of age did not reveal any significant difference between the treatments.

4.8. MEAT CHOLESTEROL

The mean breast meat and thigh meat total cholesterol estimated at twenty weeks of age in tom turkeys and hen turkeys are given in table 13 and Fig.8 and 9. The mean values for breast meat cholesterol were 50.33 and 39.17 mg per dl in tom turkeys for NRC and BIS treatments, respectively. In hen turkeys the corresponding

Table 12. Mean (± S.E.) serum total protein (g/dl) and serum total cholesterol (mg /dl) of Beltsville Small White turkeys at twenty weeks of age

Treatments	Total protein(g/dl)		Total cholesterol(mg/dl)	
	Tom turkeys	Hen turkeys	Tom turkeys	Hen turkeys
NRC Turkey feed (T1)	3.65 ± 0.08	3.95 ± 0.27	149.83 ± 9.17	152.00 ±10.38
BIS Broiler chicken feed (T2)	4.67 ± 0.59	3.43 ± 0.11	131.17 ± 1.47	132.00 ± 6.74

Table 13. Mean (± S.E.) meat cholesterol (mg /dl) of Beltsville Small White turkeys in the experimental groups at twenty weeks of age

Treatments	Breast meat cholesterol(mg/dl)		Thigh meat cholesterol(mg/dl)	
	Tom turkeys	Hen turkeys	Tom turkeys	Hen turkeys
NRC Turkey feed (T1)	50.33 ± 5.26	59.33 ± 6.93	144.50 [a] ± 7.78	152.67 ± 6.76
BIS Broiler chicken feed (T2)	39.17 ± 3.63	69.83 ± 6.58	120.67[b] ± 4.27	164.33 ± 13.19

The mean values bearing different superscripts within each column differ significantly. ($P<0.05$)

values were 59.33 and 69.83 mg per dl, respectively. Statistical analysis revealed no significant difference between the treatments.

Statistical analysis of thigh meat cholesterol of tom turkeys estimated at twenty weeks of age revealed significant difference at 5% level. Thigh meat cholesterol mean value for NRC treatment was significantly higher (144.5mg per dl) than BIS treatment (120.67 mg per dl). On the other hand, thigh meat cholesterol values for hen turkeys were statistically similar in NRC and BIS treatment groups of turkeys (152.67 and 164.33 mg/dl, respectively).

4.9 ECONOMICS

The economics of rearing turkeys by feeding them with broiler chicken feed having BIS specifications and feed compounded based on NRC standards for turkey was worked out and are given in Table 14. In order to assess the economics of feeding different dietary regimen, return over feed cost alone was considered. The mean body weight of turkey poults at twelve, sixteen and twenty weeks of age for dietary group T1 (NRC turkey diet fed group) was 2317.35, 3542.34 and 4338.09 g, respectively. The corresponding body weights for treatment T2 were 2348.89, 3645.48 and 4456.92 g, respectively. The mean cumulative feed intake recorded for the dietary groups T1 and T2 for 0 to 12 weeks of age was 6122.87 and 6414.77 g, respectively. The mean cumulative feed intake recorded for the dietary groups T1 and T2 for 0 to 16 weeks of age were 10542.08 and 11455.00 g respectively. The mean cumulative feed intake measured for the dietary groups T1 and T2 for 0 to 20 weeks of age was 14310.69 and 15735.89 g, respectively.

The costs of NRC turkey ration used in this study were 11.6, 11.4, 10.8, 11.8 and 12.3 rupees per kg feed during 0 to4, 5 to 8, 9 to 12, 13 to 16 and 17 to 20 weeks period, respectively. The cost of BIS broiler starter and finisher rations were 11.0 rupees per kg feed. In order to calculate the cost of different rations

Table 14. Economics of rearing turkeys with NRC specified turkey diet and feed as per BIS broiler chicken specifications for 12 weeks, 16 weeks and 20 weeks of age

Parameters	0-12 weeks		0-16 weeks		0-20 weeks	
	NRC turkey feed	BIS broiler feed	NRC turkey feed	BIS broiler feed	NRC turkey feed	BIS broiler feed
Mean BW (g)	2317.35	2348.89	3542.34	3645.48	4338.09	4456.92
Cumulative feed intake per turkey (g)	6122.87	6414.77	10542.08	11455.00	14310.69	15735.89
Feed cost per kg. (Rs.)	NRC turkey feed		BIS broiler feed			
0-4 wks	Rs. 11.6		Rs. 11			
5-8 wks	Rs. 11.4		Rs. 11			
9-12 wks	Rs.10.8		Rs. 11			
13-16 wks	Rs .11.8		Rs. 11			
17-20 wks	Rs .12.3		Rs .11			
Feeding cost per turkey (Rs.)	67.84	70.56	119.98	126.01	166.33	173.09
Return by sale of turkeys @ Rs.80 per kg live BW(Rs.)	185.36	187.92	283.39	291.64	347.05	356.55
Margin of return over feed cost (Rs.)	117.52	117.36	163.41	165.63	180.72	183.46

used in this experiment, the prevailing rate of feed ingredients in the Revolving Fund Project, Centre for Advanced Studies in Poultry Science at the time of the experiment was taken.

The total feeding cost per turkey for the period from 0 to 12 weeks of age, for dietary groups T1 and T2 were Rs. 67.84 and 70.56 respectively. The total feeding cost per turkey for the period from 0 to 16 weeks and 0 to 20 weeks of age in T1 was Rs.119.98 and Rs.166.33 in NRC diet fed group, while the corresponding feed cost for the broiler diet fed group of turkeys was Rs.126.01 and Rs. 173.09 respectively. The turkeys were sold at the rate of Rs. 80 per kg live weight and the return from the sale of NRC turkey diet fed birds at the end of 12, 16 and 20 weeks of age were Rs.185.36, 283.39 and 347.05 and the corresponding return from BIS broiler chicken diet fed turkeys for the above periods were Rs. 187.92, 291.64 and 356.55, respectively

The margin of return over feed cost was calculated and was found to be increasing with age. The highest margin of return over feed cost was obtained for broiler diet fed turkey at 20 weeks of age which was Rs. 183.46 while that of NRC diet fed turkey was Rs.180.72. At 12 weeks and 16 weeks of age NRC diet fed turkeys had a margin of return over feed cost of Rs.117.52 and Rs.163.41 respectively, while that of broiler diet fed turkey was Rs.117.36 and Rs.165.63 during the respective periods.

Discussion

5. DISCUSSION

The results obtained in the study to evaluate the effect of different diets on growth and dressing percentage of turkeys are discussed in this chapter.

5. 1 BODY WEIGHT

The mean fortnightly bodyweight of Beltsville Small White turkey poults from zero to 20 weeks of age as influenced by the dietary treatments is given in Table 5. The day old mean body weight of poults in both the treatments was comparable (48.15 and 47.34 g respectively for T1 and T2 groups). Perusal of the mean fortnightly body weight revealed that feeding turkey poults with NRC recommended CP and ME resulted in higher body weight till 10 weeks of age. However, from 12 weeks onwards the trend was reversed so that broiler diet group attained more body weight than NRC turkey feed group till the end of the trial.

Statistical analysis of the mean fortnightly body weight data showed that except in the fourth, sixth and eighth week fortnightly periods, weights in all other periods were statistically similar. In the fourth, sixth and eighth week, body weights were significantly higher ($P \leq 0.05$) in the turkey feed group than chicken feed group. The results indicated that during the initial period higher dietary CP is required for obtaining higher body weight. NRC diet had CP content of 28% from zero to four weeks, 26% from five to eight weeks and 22% CP from nine to 12 weeks of age. The CP level was reduced to 19% during the period from 13 to 16 weeks of age. On the other hand, the poults offered broiler diet had a CP content of 23% right from day old to 16 weeks of age. Mean fortnightly body weight at 12^{th} week of age was 2317.35 and 2348.89 g for T1 and T2 groups respectively. It showed that the difference in body weight between turkey feed given group and chicken feed fed group is narrow at this age (31.54 g). This indicated that CP requirement of turkey poults is comparatively less after 10

weeks of age. The results also showed that body weight of turkeys offered broiler diets was numerically more than NRC group after 12 weeks.

The results of the present study is in agreement with that of Noble *et al*. (1996), who conducted a trial, in which two strains of turkey poults were fed with 80, 100 and 120% of NRC recommended protein from 1 to 8 weeks of age and then recommended levels of protein at other ages and reported that even though 8^{th} week body weight of turkeys were slightly lower on 80% NRC recommended protein diet, it was fully compensated when the birds reached 17 weeks of age. Higher CP level for turkey poults in the initial period was also recommended by Rajini and Prabhakaran (2003). An 8 week trial was conducted in which day old poults were provided with 22, 25 and 28% CP diet with a constant metabolizable energy of 2750 kcal ME/kg and they reported that 28% CP diet resulted in higher body weight at second week, whereas at 4 weeks of age the feed with 25% protein had significantly better body weight. They also reported that 25% CP diet caused significantly higher body weight at 8 weeks of age. The results of this study also agrees with the findings of Leeson and Caston (1981) who reported significantly ($P \leq 0.05$) higher 8^{th} week body weight in turkeys fed higher protein diet.

On the other hand, Ferket and Sell (1989) studied early protein restriction (100, 80, 70 and 60% of NRC recommendations) on compensatory growth of Large White Nicholas poults from 1 to 6 weeks of age and subsequently all the four treatments were fed with a common diet as per NRC recommendations of CP, and reported that body weights were less in the birds under restriction at 6 weeks of age. Even at 20 weeks of age, 100% NRC recommended protein fed toms were significantly heavier than birds fed with low protein diet. The severe restriction adopted in the experiment could be the reason for the lower body weight of turkeys. Whereas in the present experiment, the lower body weight observed in the early periods was due to lower protein feed (BIS broiler diet) and

the reduction in weight was fully compensated when the birds reached 20 weeks of age.

The results of the present study clearly indicated that BIS broiler diet can be advocated for turkey poults from 0 to 20 weeks of age. At 20 weeks of age, birds maintained on BIS broiler diet was 118.83 g heavier than turkey feed given group. Even though, unsexed experimental poults were allotted to the treatments and replicates randomly, it was found that four males were more in the BIS group than in the NRC group. This could also be one of the reasons for slightly higher body weight for this group.

5. 2 BODY WEIGHT GAIN

The data on mean body weight gain of turkeys for the treatments recorded at fortnightly interval are presented in Table 6. Statistical analysis of the data revealed significant difference ($P \leq 0.05$) between treatments during sixth, twelfth and eighteenth weeks of age.

In both the groups weight gain was lowest in the first fortnight (115.36 and 105.82 g for T1 and T2 respectively). The gain in weight gradually increased from first fortnight and recorded a maximum gain of 618.36 g in T1 and 664.35 g in T2 in the seventh fortnight covering 13 and 14 weeks of age. Thereafter weight gain gradually reduced in the subsequent fortnights and in the last fortnight the gain was 506.62 and 453.21 g, for T1 and T2, respectively.

Weight gain was numerically higher up to 8^{th} week of age for the NRC diet fed turkeys with 6^{th} week gain showing significantly higher value than BIS diet fed group of turkeys. During this period NRC group was fed with diets high in protein, with CP levels of 28 and 26% from 0 to 4 and 5 to 8 weeks, respectively. Protein, the vital nutrient for the tissue synthesis in actively growing young ones, is in high level in the diet of treatment 1, which might be the reason

for higher weight gain in this treatment during initial period of the growth. This is in close agreement with the findings of Waldroup *et al.* (2003) who reported that weight gain in turkeys were more when fed with high protein diets than when fed with low protein diets. Min et al. (2007) also observed higher weight gain in goslings fed with higher levels of CP. At tenth week, there was a reversal of trend and BIS diet fed group began making up the loss by registering higher body weight gain (558.26 g) than NRC diet fed group of turkeys (541.86 g). This trend continued during remaining periods of the study except last fortnight. Twelfth week body weight gain was significantly higher for BIS group of turkeys than NRC group.

At 18^{th} week NRC diet fed group showed significantly lower weight gain of 291.29 g than the BIS diet fed turkeys (363.96 g). This might be due to the lower feed intake recorded in the NRC diet fed group during that period. The energy content of NRC feed was increased to 3200 kcal ME/kg and CP level reduced to 16.5% during 17^{th} to 20^{th} week, while BIS diet was computed with 2900 kcal ME/kg and 20% CP. This high energy might have caused lower feed intake and subsequent reduction in body weight gain in NRC group. It can be concluded that in tropical countries like India, energy-protein ratio similar to BIS recommendation food broilers is best suited for turkeys to sustain their weight gain during later part of growth also when compared to NRC recommendations, which is mainly meant for temperate climatic condition. Veldkamp *et al.* (2005) reported that body weight gain reduced by 45% as energy was increased from 90 to 110% of NRC recommendations during 29 to 84 days of age in turkeys. However, in the present study only NRC recommended energy level was provided. The increase in weight gain for BIS diet group than that of NRC group during later period might also be due to higher protein intake in the BIS group. Majumdar *et al.* (2002) also reported that turkeys fed with higher protein diet recorded higher body weight gain.

Perusal of the cumulative body weight gain data calculated for zero to 12, 0 to 16 and zero to 20 weeks of age (Table 6) indicated that the gain was numerically more to the tune of 29.37, 105.24 and 118.78 g respectively in the broiler feed given group (T2) than the turkey feed given group (T1). However, statistical analysis showed that cumulative weight gain was comparable between treatments. The results of this study showed that though turkey poults fed with diets as per NRC recommendations attained better body weight during initial period, higher cumulative weight gain could be achieved in turkeys with BIS broiler diet from day old to 20 weeks of age. The body weight gain data also showed that slaughtering the birds at 16 weeks of age would be more economical since gain in weight of turkeys were less thereafter. However, before making a final conclusion the cost benefit data has to be evaluated critically.

FEED INTAKE

Data on mean weekly feed intake from zero to 20 weeks of age and cumulative feed intake upto 12, 16 and 20 weeks of age for the NRC and BIS dietary treatments are given in Table 7. Statistical analysis revealed that up to 9 weeks of age the daily feed intake per bird in both the treatments were comparable. In as much as birds consume feed to satisfy their energy requirement, comparable feed intake noticed in both the treatments is normal. The ME content of the feed given to T1 group was 2800 and 2900 kcal /kg during 0 to 4 and 5 to 8 weeks of age, respectively. The feed for T2 contained 2800 kcal ME/kg up to 16 weeks of age. Contrary to the present findings, Majumdar *et al.* (2002) reported that feed intake was higher for turkeys when fed with high protein diet than with low protein diet during 0 to 6 weeks of age.

At 10^{th} and 12^{th} week of age significant difference ($P<0.05$) was found between the two treatments, with the group fed NRC diet with 3000 kcal ME/kg and 22% CP consumed lesser feed (113.93 and 126.10 g respectively) than BIS

diet group (129.49 and 143.51 g, respectively), the diet for which contained only 2800 kcal ME/kg.

Turkey poults in T1 group were fed a diet containing 19% CP from 13 to 16 weeks of age, whereas in T2 group the CP level in the diet was 23% in the above period. At 13th and 14th week of age, energy content of the NRC feed was further increased to 3100 kcal ME/kg, while keeping ME content of BIS feed at 2800 kcal ME/kg. Significant difference ($P<0.05$) was noticed in daily feed intake at 13th and 16th weeks of age, with NRC group consuming lesser feed than BIS group of turkeys. This can be attributed to the fact that higher energy content in the feed decreases feed intake. Leeson and Caston (1981) reported that birds fed higher protein diet had significantly higher feed intake. Similarly, Odetallah *et al*. (2002) observed that hen turkeys fed with soyabean meal having a CP content of 48% consumed significantly more feed than with hen turkeys fed with soyabean meal of lower CP.

Significant difference in daily feed intake was found at 18th and 19th weeks of age (Table 7) with BIS group consuming more feed (173.18 and 161.69 g, respectively) than NRC diet fed group (150.76 and 133.46 g, respectively). It was also observed that feed intake of both groups showed a gradual increasing pattern up to 16 weeks of age followed by a sudden drop from 204.67 g at 16 weeks to 106.80 g at 17th week in BIS diet fed group. The drop in feed intake of NRC group in the above period was 97.53 g from 176.41 g. The sudden drop in feed intake could be attributed to the effect of change of diet in both the groups with energy being increased to 3200 kcal ME/kg and CP being decreased to 16.5% in NRC feed, while in BIS the corresponding change was an increase in energy to 2900 kcal ME/kg and CP being reduced to 20%. Sudden increase in the ambient temperature during the above period also contributed for the reduced feed intake. Frequent change in diet and as a result time needed for birds to adapt to that change might be one of the reasons for the variation in feed intake in both the groups. In general, the results suggested that feed intake of turkeys reduced

with high energy content of the feed. Rivas and Firman (1994) and Noy and Sklan (2004) also found that with increasing energy in the diet of turkeys, feed consumption decreased.

Statistical analysis of cumulative feed intake per bird upto 16 and 20 weeks of age revealed that zero to 16 and zero to 20 weeks feed consumption showed significant ($P<0.05$) difference with BIS diet birds having higher feed intake than NRC group (11455.00 vs. 10542.08 g, respectively) and (15735.89 vs. 14310.69 g respectively) upto twenty weeks. In other periods, that is, from zero to16 and zero to 20 weeks, birds in BIS group consumed 912.92 and 1425.20 g more feed per bird, respectively, than the NRC feed given group. Data on zero to 12 weeks cumulative feed intake per bird did not reveal significant difference between the two treatment groups, although numerically higher feed intake was recorded for BIS diet fed group. Mean cumulative feed intake per bird was more to the tune of 291.90 g in BIS broiler diet given group during zero to 12 weeks period. Comparatively higher body weight gain for the BIS group turkeys could be one of the reasons for higher feed intake in this group. Birds with higher body weight require more feed for maintenance allowance.

The result of this study reveals that feed consumption is lower in turkeys fed with NRC diet than with BIS broiler diet when reared up to 20 weeks of age.

FEED CONVERSION RATIO (FCR)

Mean fortnightly feed conversion ratio of turkeys as influenced by feeding them with NRC turkey diet and BIS broiler diet presented in table 8 revealed that numerical differences existed between the treatments except at 10^{th} week of age. However statistical analysis of the data showed significant difference between treatments for the fortnights ended at 8^{th}, 12^{th}, 14^{th} and 20^{th} weeks of age. Only in fortnights ended at eighth, fourteenth and twentieth weeks, FCR of NRC group was significantly superior ($P < 0.05$) than that of BIS group,

whereas in twelfth week broiler diet fed group exhibited superior ($P < 0.05$) FCR. The difference in feed efficiency noted among the treatments might be due to variation in the nutrient content of diets offered at different ages.

Poults in the NRC turkey diet group (T1) were fed with a ration containing 26% CP and 2900 kcal ME/kg during 5 to 8 weeks of age, whereas poults in the broiler diet group during this period received only a diet having 23 % CP and 2800 kcal ME/kg. This high protein and energy might have contributed for the better FCR in turkey feed given group during the fourth fortnight. As indicated earlier, 12th week FCR was superior with broiler diet fed group, in which period NRC group poults were fed with a diet containing 22% CP and 3000 kcal ME/kg, while in the BIS diet group, the earlier diet was continued. Significantly higher weight gain attained in the broiler diet fed group at 12th week of age might have contributed for the better FCR in this group.

The ME content of diet given to the poults in the NRC group was enhanced to 3100 kcal/kg at 13th week and it further increased to 3200 kcal/kg at 17th week of age. In the broiler diet fed group the corresponding ME levels in the diets were 2800 and 2900 kcal/kg, respectively. Therefore, it is safe to conclude that high energy content of turkey feed might have contributed for the superior feed efficiency in NRC turkey diet fed poults during 7th and 10th fortnightly periods.

Better FCR observed in the initial period in the turkey feed given group is in conformity with the findings of Ferket and Sell (1989), who reported better FCR with high protein diet at 6 weeks of age. However, the cumulative FCR for the period from 0 to 12 weeks failed to show any difference between the treatments. On the other hand, Leeson and Caston (1981) observed no difference in FCR of turkeys fed high and low protein diet at 8th week of age. Therefore it is imperative to state that high energy content of the feed could have contributed for superior FCR in NRC diet given group.

The mean cumulative feed efficiency for 12, 16 and 20 weeks period presented in Table 9 indicated that nonsignificant difference existed between NRC and BIS groups during 0 to 12 weeks with NRC turkey feed group (T1) showing numerically better FCR (2.69) than BIS group (2.75). However, the difference between the treatments is only narrow (0.06). The mean cumulative FCR for 0 to 16 and 0 to 20 weeks periods showed significantly superior ($P<0.05$) values with NRC group (T1) recording 3.02 and 3.34, respectively. The corresponding cumulative FCR values for broiler diet group were 3.14 and 3.53, respectively. The FCR of broiler diet fed group was inferior to the tune of 0.12 and 0.19 than NRC diet fed group during 0 to 16 and 0 to 20 weeks period, respectively. In NRC group of turkeys, the ME content of the feed was enhanced in each 4 weeks period at the rate of 100 kcal ME from the beginning of the experiment. The ME content of the feed at the start of the experiment was 2800 kcal ME/kg and it was raised to 3200 kcal ME/kg at 16 weeks of age. In general, the nutrient concentration in terms of energy and CP was higher in NRC diets compared to BIS ration. This could be the reason for better cumulative FCR in NRC diet fed turkeys than their counterparts in BIS groups. Rivas and Firman (1994) and Noy and Sklan (2004) reported that increasing the energy content of the diet of turkey significantly improved feed efficiency and caloric efficiency. Sikur *et al*. (2004) also opined that 10% more of CP and ME levels in the diet improved feed efficiency in turkeys in early growth period.

The results of the present study clearly indicated that turkey diet with NRC specifications has an edge over broiler diet as far as FCR is concerned. However, it has to be adjudged in conjunction with other parameters, especially cost benefit ratio.

LIVABILITY

There was one mortality each in both the treatments during the entire experimental period of 20 weeks. Changes made in the energy and protein

combinations in the diet were well tolerated by the turkeys. In as much as recommended levels of protein and energy were available in the experimental diets, there was no deleterious effect on livability. This goes true with the findings of Kidd *et al.* (1997); Waibel *et al.* (2000); Saleh *et al.* (2004) and Veldkamp *et al.* (2005), who reported that presence of recommended nutrient levels in the diet and narrow deviations from this have not affected mortality in dietary treatments. On the contrary Ozek *et al.* (2003) and Lemme *et al.* (2006) reported that mortality rate was comparatively lower for birds fed diet containing low crude protein. Low levels of CP in the experimental diets could be the reason for low mortality in these studies.

PROCESSING YIELDS AND LOSSES

Data on mean per cent processing yields and losses for tom turkeys and hen turkeys as influenced by different diets are presented in Tables 10 and 11, respectively. Statistical analysis of the data on processing yields and losses of both tom turkeys and hen turkeys failed to give any difference between the treatments. The numerical differences observed in various traits on processing yields and losses between the treatments were also minimal. The per cent eviscerated yield, ready to cook yield and giblet yield in groups T1 (NRC turkey feed group) and T2 (BIS broiler diet group) were 75.45 and 74.75, 80.10 and 79.20 and 4.65 and 4.46, respectively in tom turkeys. The differences between T1 and T2 with respect to the above traits were 0.70, 0.90 and 0.19% respectively. Similarly the per cent losses occurred during slaughter viz, blood loss and feather loss between the treatments were also comparable.

In the case of hen turkeys also the difference in mean per cent yields and losses between the treatments were minimal (Table 11). Perusal of mean per cent processing yields and losses of tom and hen turkeys also revealed that, irrespective of sex, all traits were comparable. The comparatively higher values noted in all carcass traits by NRC diet fed turkeys than BIS group might be due to

the high mean live body weight of birds selected for slaughter. The results showed that varying protein and energy content of the diet employed in this study had no influence on the carcass parameters of 20 week old turkeys. This observation is in conformity with the finding of Majumdar *et al.* (2002), who reported that protein and energy content of the diet had no significant effect on the carcass parameters of 8 week old poults.

The results of the present study is also in agreement with Sell *et al.* (1985), who determined the independent and interactive effects of dietary ME and protein concentration on performance of Large White toms from 9 to 20 weeks of age and opined that carcass composition and parts yield of the carcass were affected only slightly by dietary ME and CP concentrations. Clarke (1993) and Lemme *et al.* (2004) also reported that up to 10% reduction in CP level in the diet had not affected carcass yield in turkeys. Clarke(1993) further observed that higher CP restriction in the diets of turkeys resulted in significantly lower yield.

The results of the study confirmed that different CP and ME levels employed in both the treatments in this study supported maximum dressing percentage in Beltsville Small White turkeys. The study also showed that the per cent yield and loss values reported in the present trial falls under the normal range of values for BSW turkeys (Mountney and Parkhurst, 2001).

SERUM TOTAL PROTEIN

The mean serum total protein of tom and hen turkeys as influenced by feeding them with NRC turkey diet and broiler diet estimated at 20 weeks of age is presented in Table 12. Statistical analysis of the data on serum total protein revealed that both the diets employed in the trial did not have any significant effect on serum total protein. The mean serum protein value of tom turkeys fed NRC and BIS diets was 3.65 and 4.67 g/dl, respectively and the corresponding values for the hen turkeys were 3.95 and 3.43 g/dl, respectively.

These values fell well within the normal range of 3.6 to 5.5 g/dl in 4 month old turkeys as reported by Bounous *et al.* (2000). Sturkey (1976) reported that the total serum protein values for male and female turkeys were not constant and it varies with many factors of which the major factor was protein content of the diet fed. Considering this yardstick it can be conclusively stated that the different protein levels advocated in this experiment are sufficient for the satisfactory physiological requirement and well being of turkeys till 20 weeks of age.

SERUM TOTAL CHOLESTEROL

The mean serum total cholesterol of tom and hen turkeys estimated at 20 weeks of age as influenced by different diets is presented in Table 12. Statistical analysis of the data on serum total cholesterol revealed that change in feeding regimen did not affect this trait significantly and therefore dietary changes of this experiment had no effect on serum total cholesterol. Mean serum total cholesterol of tom turkeys were 149.83 and 131.17 mg/dl in NRC and BIS diet fed turkeys, while the values for hen turkeys were 152.0 and 132.0 mg/dl, respectively.

Though mean serum cholesterol values were not different statistically between the treatments, the values were more in the NRC turkey diet fed group to the tune of 18.66 and 20.00 mg/dl in tom and hen turkeys, respectively than broiler diet fed group. It might be due to the incorporation of rice bran oil up to 3.5% in the NRC turkey diet to increase the energy content of the feed to 3200 kcal ME/kg during the finisher period. On scanning the literature studies to correlate dietary protein and energy levels with serum cholesterol could not be noticed to make any efficient corroboration of the findings of the study.

MEAT CHOLESTEROL

The mean breast meat and thigh meat cholesterol in tom turkeys and hen turkeys maintained on different diets is presented in Table 13. The mean breast meat cholesterol in NRC and BIS diets fed turkeys were statistically comparable. In tom turkeys breast meat cholesterol was numerically higher for NRC fed group (50.33 mg/dl), while in hen turkeys BIS diet fed group had higher value for the same (69.83 mg/dl). In general, breast meat cholesterol was more in hen turkeys than tom turkeys in both turkey and broiler feed given groups. In turkey feed given group, the hen turkeys had 9.0 mg/dl more of breast meat cholesterol than tom turkeys, while in broiler feed given group hen turkeys had 30.66 mg/dl more meat cholesterol value than tom turkeys.

The mean thigh meat cholesterol of tom turkeys fed NRC turkey diet (144.5 mg/dl) was significantly higher ($P<0.05$) than that of broiler diet fed tom turkeys (120.67 mg/dl). But in hen turkeys thigh meat cholesterol values were statistically comparable between treatments. Thigh meat cholesterol value was numerically higher for BIS diet fed hen turkeys (164.33 mg/dl) than NRC diet fed hen turkeys (152.67 mg/dl).

Similar to breast meat cholesterol values, thigh meat cholesterol was numerically more in hen turkeys than tom turkeys, irrespective of the dietary treatments. In turkey feed given group, hen turkeys had 8.17 mg/dl more of thigh meat cholesterol than tom turkeys, while in broiler feed given treatment the excess was 43.66 mg/dl. Overall meat cholesterol results suggest that dietary CP and energy levels had no consistent effect on meat cholesterol in turkeys.

ECONOMICS

The economics of rearing Beltsville Small White turkeys by feeding them with two types of diets, NRC turkey feed and BIS broiler diet for periods of 12,

16 and 20 weeks of age, were worked out and are presented in Table 15. Return over feed cost alone was considered for calculating the economics since other costs are variable. As feed cost alone accounts to approximately 70% of the total cost of production in poultry enterprise, this calculation will definitely give an indication as to which treatment will be economically viable.

The mean cumulative feed intake of NRC diet fed turkeys during 0 to 12, 0 to 16 and 0 to 20 weeks of age were 6122.87, 10542.08 and 14310.69 g respectively, while the same for broiler diet fed group for the corresponding periods were 6414.77, 11455.00 and 15735.89 g, respectively. The cost of NRC turkey diet was comparatively higher than that of BIS broiler diet. The initial cost of turkey feed was higher due to higher CP content of the diet. Again from 13 weeks onwards due to the addition of rice bran oil to meet the high energy requirement in the ration, the cost of feed went up. On the other hand, the cost of broiler starter as well as finisher was maintained uniformly at Rs.11.

The cumulative feeding cost per turkey upto 12, 16 and 20 weeks of age for NRC turkey diet fed group worked out to Rs. 67.84, 119.98 and 166.33, respectively, while that of broiler diet fed turkeys for the corresponding periods were Rs. 70.56, 126.01 and 173.09, respectively. The cumulative feeding cost was more in broiler diet fed group (T2) than the turkey group (T1) due to higher cumulative feed intake in group T2 in spite of the lower feed cost per kg diet.

The mean body weight of turkeys at 12, 16 and 20 weeks of age indicated that it was numerically more in the broiler diet fed group. The return from sale of each turkey at the rate of Rs.80 per kg live body weight was Rs. 185.36, 283.39 and 347.05 in NRC turkey feed group at 12, 16 and 20 weeks of age and that of broiler diet fed group were Rs.187.92, 291.64 and 356.55, respectively.

The margin of return over feed cost given in Table 14 indicated that it was comparable between treatments in all the three cumulative periods. In 0 to 12

weeks period the BIS diet fed group had an advantage of Rs. 0.16, where as in 0 to 16 weeks and 0 to 20 weeks period, the advantage is with NRC turkey diet fed group to the tune of Rs.2.22 and 2.74 per turkey, respectively. In as much as the margin of return over feed cost between the treatments was narrow, it is advisable to advocate BIS broiler diet for turkey poults meant for meat production.

More over, BIS broiler diets are more feasible compared to turkey feed because ready made feeds are available as such in the market and farmers need not undergo the difficulty of changing feed formulation in every 4 weeks while advocating broiler rations. Besides, commercial turkey feed is not available in the market anywhere in the country. When adopting turkey feed, birds are also subjected to stress due to frequent feed change, especially in tropical climate. Therefore, farmers can very well rear turkeys successfully using broiler starter and finisher rations. Majumdar *et al.* (2002) also reported that turkeys in our climate need not be fed as per NRC standards and that they will perform well with lower protein and energy in the diet. Considering the body weight of turkeys at 16 weeks of age and the margin of return over feed cost, marketing of turkey poults at 16 weeks of age was found to be economical.

Summary

6. SUMMARY

An experiment was conducted at the Department of Poultry Science, College of Veterinary and Animal Sciences, Mannuthy to study the growth and dressing percentage of turkeys reared on different feeding regimen from zero to 20 weeks of age. Beltsville Small White (BSW) variety of turkey was utilized for the experiment. Fertile turkey eggs were obtained from Poultry Research Station, Nandanam, TANUVAS, Chennai. The eggs were hatched at the Revolving Fund Hatchery of the Centre for Advanced Studies in Poultry Science, Mannuthy.

Ninety six turkey poults were randomly selected, wing banded, weighed individually and distributed randomly to two dietary treatment groups, T1 and T2. Each group comprised of six replicates of eight poults each. The group T1 was fed a ration formulated as per the NRC standards (1994) for turkey feed. The group T2 was fed a ration formulated as per the BIS (1992) specifications for broiler feed.

Standard managemental practices were followed throughout the experimental period. Feed and water were provided *ad libitum*. The T1 group was fed with NRC turkey specified diet with feed change occurring at 4 weeks interval. The T2 group of birds were provided with ration having 23% CP and 2800 kcal ME/kg from 0 to 16 weeks of age and finisher ration with 20% CP and 2900 kcal ME/kg from 17 to 20 weeks of age.

Each replicate was reared in battery brooder from zero to four weeks of age and then transferred to deep litter pens at 5^{th} week. The growth performance of turkeys was evaluated for a period of twenty weeks. Individual body weight was recorded at fortnightly interval. Weekly feed consumption was recorded replicate wise. From these data, fortnightly weight gain and feed conversion ratios were calculated.

The cumulative weight gain, feed consumption and feed efficiency were calculated for periods of zero to 12, zero to 16 and zero to 20 weeks of age. At the end of twenty weeks of age two turkeys from each replicate, one each of male and female turkey were sacrificed from both the treatments. At the time of slaughter, blood samples were collected for the determination of serum total protein and serum total cholesterol. The mean eviscerated yield, ready to cook yield, giblet yield, blood loss and feather loss were determined. By utilising meat samples from breast and thigh region, meat cholesterol was also determined. The cost-benefit analysis of rearing turkeys with two types of feed was also worked out.

The summary of the results are presented in Table 15.

Based on the results obtained in the present study, the following conclusions were made.

1. The mean body weights of birds in the treatments T1 (NRC turkey feed given group) and T2(BIS broiler diet fed group) at twenty weeks of age were 4338.09 and 4456.92 g, respectively. Body weight in all fortnightly periods except at fourth, sixth and eighth week of age was statistically similar. In general, feeding poults with NRC recommended CP and ME resulted in higher body weight till 10 weeks of age and thereafter the trend was reversed till the end of the trial.
2. Mean cumulative body weight gain from 0 to 12 , 0 to 16 and 0 to 20 weeks of age for the groups T1 and T2 were 2269.00 and 2298.37, 3491.83 and 3597.07 and 4289.73 and 4408.51 g respectively, and was statistically comparable between treatments.
3. Mean cumulative feed intake was significantly ($P<0.05$) more with broiler diet fed group (T2) during 0 to 16 and 0 to 20 weeks periods. However,

12 weeks cumulative feed intake did not reveal significant difference between treatments.

4. The mean cumulative feed conversion ratio up to twelve weeks of age was 2.69 and 2.75 for T1 and T2 respectively which was statistically similar. The mean cumulative FCR for zero to sixteen and 0 to 20 weeks periods showed significantly ($P<0.05$) superior values with NRC group (T1) recording 3.02 and 3.34, respectively. The corresponding values for broiler diet fed group (T2) were 3.14 and 3.53 respectively. The cumulative FCR up to twelve weeks of age was statistically comparable between treatments(2.69 and 2.75 for T1 and T2, respectively).

5. In general, livability of poults was excellent in both the treatments and was not influenced by dietary variations in protein and energy.

6. Mean dressing percentage, per cent eviscerated yield and ready to cook yield in tom turkeys were 93.19, 75.45 and 80.10 respectively for T1 and 90.98, 74.75 and 79.20 respectively for T2, which on statistical analysis revealed no significant difference between the dietary treatment groups.

7. Mean dressing percentage, per cent eviscerated yield and ready to cook yield in hen turkeys were 91.96, 76.50 and 80.95 respectively for T1.The corresponding values for T2 were 90.92, 75.16 and 79.77 respectively. All the values were statistically comparable between treatments.

8. The mean per cent giblet yield was 4.65 and 4.46 tom turkeys and 4.87 and 4.62 in hen turkeys for the treatments in T1 and T2 respectively.

9. Diets studied in this trial did not influence the serum total protein in tom turkeys and hen turkeys. The serum total protein values in the dietary groups T1 and T2 for tom turkeys were 3.65 and 4.67 g/dl respectively and were statistically comparable between treatments. The corresponding values for hen turkeys were 3.95 and 3.43 g/dl respectively, which showed no significant difference on statistical analysis.

10. Mean serum total cholesterol in tom turkeys and hen turkeys were 149.83 and 152 mg/dl respectively in NRC turkey diet fed group. The corresponding values in BIS diet fed group were 131.17 and 132.00 mg/dl respectively. Mean serum total cholesterol values in both tom and hen turkeys were statistically comparable between T1 and T2.

11. The breast meat cholesterol in male and female turkeys at 20 weeks of age was not significantly affected by change in dietary regimen. The thigh meat cholesterol level of hen turkeys at 20 weeks of age was statistically comparable between the turkey feed given group and broiler feed fed group. Whereas, significant difference was observed in thigh meat cholesterol of tom turkeys at 20 weeks of age with NRC diet offered group showing significantly ($P \leq 0.05$) higher mean value (144.50 mg/dl) than BIS diet fed group (120.67 mg/dl).

12. Breast meat cholesterol and thigh meat cholesterol values were numerically more in hen turkeys than tom turkeys irrespective of the dietary treatments.

13. The cumulative feeding cost per turkey in NRC turkey diet fed group (T1) for periods of 12, 16 and 20 weeks of age were Rs. 67.84, 119.98 and 166.33, while that of broiler diet fed turkeys (T2) for the above periods were Rs.70.56, 126.01 and 173.09 respectively. The return per turkey in T1 at 12, 16 and 20 weeks of age was Rs.185.36, 283.39 and 347.05 whereas the same for T2 turkeys in the corresponding periods were Rs.187.92, 291.64 and 356.55 respectively. The margin of return over feed cost per turkey for T1 and T2 were Rs.117.52 and 117.36, Rs.163.41 and 165.63 and Rs.180.72 and 183.46 respectively at 12, 16 and 20 weeks of age.

The result of this study proved that turkeys meant for meat purpose can be reared economically by feeding them with commercial broiler feed.

Table 15. Summary of performance of Beltsville Small White variety of turkeys in the experimental groups

Sl. No.	Parameter	NRC turkey feed(T1)		BIS broiler feed (T2)	
1.	20^{th} week body weight (g)	4338.09		4456.92	
2.	Weight gain (g)				
	0 to 12	2269.00		2298.37	
	0 to 16	3491.83		3597.07	
	0 to 20	4289.73		4408.51	
3.	Cumulative feed intake (g)				
	0 to 12	6122.87		6414.77	
	0 to 16	10542.08		11455.00	
	0 to 20	14310.69		15735.89	
4.	Cumulative feed conversion ratio				
	0 to 12	2.69		2.75	
	0 to 16	3.02		3.14	
	0 to 20	3.34		3.53	
5.	Yields (%)	Tom turkeys	Hen turkeys	Tom turkeys	Hen turkeys
	Eviserated	75.45	76.50	74.75	75.16
	Ready to cook	80.10	80.95	79.20	79.77
	Giblet	4.65	4.87	4.46	4.62
6.	Serum total protein (g/dl)	3.65	3.95	4.67	3.43
7.	Serum total cholesterol (mg/dl)	149.83	152.00	131.17	132.00
8.	Breast meat cholesterol (mg/dl)	50.33	59.33	39.17	69.83
9.	Thigh meat cholesterol (mg/dl)	144.50	152.67	120.67	164.33

References

REFERENCES

Aletor, V.A., Eder, K., Becker, K., Paulicks, B.R., Roth, F.X., and Roth-Maier, D.A. 2003. The effects of conjugated linoleic acids or an α glucosidase inhibitor on tissue lipid concentrations and fatty acid composition of broiler chicks fed a low protein diet. *Poult. Sci*. 82: 796-804.

Association of Official Analytical Chemists, 1990. Official methods of analysis. AOAC. , 15th ed., Washington, DC., USA.

Augustine, P.C. 1982. Effect of feed and water deprivation on organ and blood characteristics of young turkeys. *Poult. Sci*. 61: 796-799.

Barbour, G.W., and Lilburn, M.S. 1996. Comparative growth and development of Nicholas and hybrid toms from 16 to 82 days and effects of protein restriction from 0 to 59 days on growth of hybrid toms through 125 days of age. *Poult. Sci.* 75: 790-796.

Boiling, S.D. and Firman, J.D. 1997. A low protein diet for turkey poults. *Poult. Sci*. 76: 1298-1301.

Bounous, D.I., Wyatt, R.D., Gibbs, P.S., Kilburn, J.B., and Quist, C.F. 2000. Normal hematologic and serum biochemical reference intervals for juvenile wild turkeys. *J. Wildlife Dis.* 36(2): 393-396.

Bureau of Indian Standards (BIS). 1973. Code for handling, processing, quality evaluation and storage. IS: 7049 – 1973. Manak Bhavan, 9, Bahadur Shah Zafar Marg, New Delhi, 39 P.

Bureau of Indian Standards (BIS). 1992. *Poultry Feeds – specification*. Fourth revision. Bureau of Indian Standards, New Delhi. PP. 4

Calislar, S., and Aydin, R. 2006. The effect of animal bone fat on body performance and carcass characteristics in broilers. *Int. J. Poult. Sci.* 5(11): 1057-1060.

Chowdhury, S.R., Chowdhury, S.D., Smith, T.K. 2002. Effects of dietary garlic on cholesterol metabolism in laying hens. *Poult. Sci.* 81: 1856-1862.

Chowdhury, S.R., Sarkar, D.K., Chowdhury, S.D., Smith, T.K., Roy, P.K., and Wahid, M.A. 2005. Effects of dietary tamarind on cholesterol metabolism in laying hens. *Poult. Sci*. 84: 56-60.

Clarke, J.P., Ferket, P.R., Elkin, R.G., McDaniel, C.D., Freed, M., MacMurtry, J.P., Krueger, K.K., and Hester, P.Y. 1993. Early dietary protein restriction and intermittent lighting 2. Effects on carcass characteristics of male turkeys. *Poult. Sci.* 72: 2144-2151.

Crespo, N., and Esteve-Garcia, E. 2001. Dietary fatty acid profile modifies abdominal fat deposition in broiler chickens. *Poult. Sci.* 80: 71-78.

Crouch, A.N., Grimes, J.L., Christensen, V.L., and Krueger, K.K. 2002. Effect of physical feed restriction during rearing on large white turkey breeder hens: 1. Growth performance. *Poult. Sci.* 81: 9–15.

Erener, G., Ocak, N., Garipoglu, A.V., Sahin, A., and Ozturk, E. 2006. Feeding turkey poults with starter feed and whole wheat or maize in free choice feeding system: Its effect on their performances. *Asian-Aust. J.Anim. Sci.* 19(1): 86-90.

Ferket, P.R. and Sell, J.L. 1989. Effect of severity of early protein restriction on large white turkey toms. 1. Performance characteristics and leg weakness. *Poult. Sci*. 68: 676-686.

Ferket, P.R. and Sell, J.L. 1990. Effect of early protein and energy restriction of large turkey toms fed high fat or low fat realimentation diets. 2. Carcass characteristics. *Poult. Sci.* 69: 1982-1990.

Folch, B.J., Less, M. and Stanley, H.S. 1957. A simple method for the isolation and purification of total lipids from animal tissues. *J. Biol. Chem*. 26: 497 – 509.

Halvorson, J.C., Waibel, P.E., Oju, E.M., Noll, S.L., and El Halawani, M.E. 1991. Effect of diet and population density on male turkeys under various environmental conditions. 2. Body composition and meat yield. *Poult. Sci.* 70: 935-940.

Hassan, R.A., Attia, Y.A., and El-Ganzori, E.H. 2005. Growth, carcass quality and serum constituents of slow growing chicks as affected by betaine addition to diets containing 1. Different levels of choline. *Int. J. Poult. Sci.* 4(11): 840-850.

Jin, L.Z., Ho, W.Y., Abdullah, N., and Jalaludin, S. 1998. Growth performance, intestinal microbial populations and serum cholesterol of broilers fed diets containing *Lactobacillus* culture. *Poult. Sci*. 77: 1259-1265.

Kidd, M.T., Kerr, B.J., England, B.J. and Waldroup, P.W. 1997. Performance and carcass composition of Large White toms as affected by dietary crude protein and threonine supplements. *Poult. Sci.* 76: 1392-1397.

Konjufca, V.H., Pesti, G.M. and Bakalli, R.I. 1997. Modulation of cholesterol level in broiler meat by dietary garlic and copper. *Poult. Sci*. 76: 1264 – 1271.

Leeson, S. and Caston, L.J. 1981. Carcass and cut up yield in growing poults as influenced by dietary levels of protein and energy. *Poult. Sci*. 70: 1739-1747.

Lemme, A., Frackenpohl, U., Petri, A. and Meyer, H. 2004. Effects of reduced dietary protein concentrations with amino acid supplementation on performance and carcass quality in turkey toms 14 to 140 days of age. *Poult. Sci.* 3(6): 391-399.

Lemme, A., Frackenpohl, U., Petri, A. and Meyer, H. 2006. Response of male BUT big 6 turkeys to varying amino acid feeding programs. *Poult. Sci.* 85: 652-660.

MacIssac, J.L., Burgoyne, K.L., Anderson, D.M. and Rathgeber, B.R. 2005. Roasted full-fat soybeans in starter, grower, and finisher diets for female broiler turkeys. *J. Appl. Poult. Res.* 14: 116-121.

Majumdar, S., Tyagi, P.K., Bhanja, S.K., Agarwal, S.K. and Singh, R.P. 2002. Growth performance and carcass characteristics of turkey poults maintained at different protein and energy levels during winter. *Poult Sci.* 37(3): 236-240.

Marion, J.E. 1965. Effect of age and dietary fat on the lipids of chicken muscle. *J. Nutr.* 85: 38-44.

Min, Y.N., Hou, S.S., Gao, Y.P., Huang, W. and Liu, F.Z. 2007. Effect of dietary crude protein and energy on gosling growth performance and carcass trait. *Poult Sci.* 86(4): 661-664.

Moran, E.T.Jr., Krueger, K.K. and Stilborn, H.L. 1995. Performance of turkeys at 110 vs. 115% of NRC (1994) protein recommendation. *J. Appl. Poult. Res.* 4: 138-147.

Morris, C.M., Li, Y.C., Ledoux, D.R., Bermudez, A.J. and Rottinghous, G.E. 1999. The individual and combined effects of feeding moniliformin supplied by *Fusarium fujikuroi* culture material, and deoxynivalenol in young turkey poults. *Poult. Sci*. 78: 1110-1115.

Mountney, G.J. and Parkhurst, C.R. 2001. Poultry Products Technology. 1st Indian ed. Viva Books Private Ltd, New Delhi. 83 p.

National Research Council, 1994. Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press, Washington, DC.

Noble, D.O., Muir, F.V., Krueger, K.K. and Nestor, K.E. 1996. Effects of altering the early dietary protein level on males from two strains of commercial turkeys. *Poult. Sci*. 75: 1334-1344.

Noll, S.L., El Halavani, M.E., Waibel, P.E., Redig, P. and Janni, K. 1991. Effect of diet and population density on male turkeys under various environmental conditions. 1. Turkey growth and health performance. *Poult. Sci*. 70: 923-934.

Noy, Y. and Sklan, D. 2004. Effects of metabolizable energy and amino acid levels on turkey performance from hatch to marketing. *J. Appl. Poult. Res.* 13: 241–252.

Odetallah, N.H., Ferket, P.R., Grimes, J.L. and McNaughton, J.L. 2002. Effect of mannan-endo-1, 4-β-mannosidaase on the growth performance of turkeys fed diets containing 44 and 48% crude protein soyabean meal. *Poult. Sci*. 81: 1322-1331.

Oju, E.M., Waibel, P.E. and Noll, S.L. 1987. Protein, methionine and lysine requirements of growing hen turkeys under various environmental temperatures. *Poult. Sci*. 66: 1675-1683.

Oju, E.M., Waibel, P.E. and Noll, S.L. 1988. Early protein undernutrition and subsequent realimentation in turkeys. 1. Effect of performance and body composition. *Poult. Sci*. 67: 1750-1759.

Ozek, K., Yazgan, O. and Bahtiyarca, Y. 2003. Effects of dietary protein and energy concentrations on performance and carcass characteristics of

chukar partridge (*Alectoris chukar*) raised in captivity. B*r. Poult. Sci*. 44(3): 419-426.

Pesti, G.M. and Bakalli, R.I. 1998. Studies on the effect of feeding cupric sulphate pentahydrate to laying hens on egg cholesterol content.

Plavnik, I., Wax, E., Skalan, D., Bartov, I. and Hurwitz, S. 1997. The response of broiler chickens and turkey poults to dietary energy supplied either by fat or carbohydrates. *Poult. Sci.* 76: 1000-1005.

Ponte, P.I.P., Mendes, I., Quaresma, M., Aguiar, M.N.M., Lemos, J.P.C., Ferreira, L.M.A., Soares, M.A.C., Alfaia, C.M., Prates, J.A.M. and Fontes, C.M.J.A. 2004. Cholesterol levels and sensory characteristics of meat from broilers consuming moderate to high levels of alfalfa. *Poult. Sci*. 83: 810-814.

Potter, L.M. and McCarthy, J.P. 1985. Varying fat and protein in diets of growing large white turkeys. *Poult. Sci*. 64: 1941-1949.

Potter, L.M., Shelton, J.R. and McCarthy, J.P. 1981. Lysine and protein requirements of growing turkeys. *Poult. Sci*. 60: 2678-2686.

Quist, C.F., Bounous, D.I., Kilburn, J.V., Nettles, V.F. and Wyatt, R.D. 2000. The effect of dietary aflatoxin on wild turkey poults. *J. Wildlife Dis.*36 (3): 436-444.

Rajini, R.A. and Prabhakaran, R. 2003. Protein requirement of native turkey poults in the tropics. *Indian J. Poult. Sci*. 38(2): 163-165.

Rivas, F.M. and Firman, J.D., 1994. Influence of energy and protein in turkeys during the finisher period. *J. Appl. Poult. Res.* 3: 327-335.

Rose, S.P. and Michie, W. 1987. Environmental temperature and dietary protein concentrations for growing turkeys. *Br. Poult. Sci*. 28: 213-218.

Sahin, N., Onderci, M., Sahin, K., Cikim, G. and Kucuk, O. 2005. Magnesium proteinate is more protective than magnesium oxide in heat stressed quail. *J. Nutri.* 1732-1737.

Saleh, E.A., Watkins, S.E., Waldroup, A.L. and Waldroup, P.W. 2004. Effects of nutrient density on performance and carcass quality of male broilers grown for further processing. *Int. J. Poult. Sci.* 3(1): 1-10.

Salmon, R.E. 1986. Effect of nutrient density and energy to protein ratio on performance and carcass quality of small white turkeys. *Br. Poult. Sci*. 27: 629-638.

Salmon, R.E. and Stevens, V.I. 1989. Yield and composition of raw and cooked meat of small white turkey as influenced by dietary nutrient density and energy to protein ratio. *Br. Poult. Sci*. 30: 283-288.

Sell, J.L., Hasiak, R.J. and Owings, W.J. 1985. Independent effects of dietary metabolizable energy and protein concentrations on performance and carcass characteristics of tom turkeys. *Poult. Sci.* 64: 1527-1535.

Shalev, B.A. and Pasternak, H. 1989. Meat production efficiencies of turkey, chicken and duck broilers. *Worlds Poult. Sci. J.* 45: 109-114.

Sikur, V.R., Robinson, F.E., Korver, D.R., Renema, R.A. and Zuidhof, M.J. 2004. Effects of nutrient density on growth and carcass traits in fast- and slow-feathering female turkeys. *Poult. Sci.* 83 : 1507-1517.

Snedecor, G. W. and Cochran, W. G. 1994. *Statistical Methods.* Eighth edition. Affiliated East-West Press,

Sturkey, P.D. 1976. Avian Physiology. Third edition. Springer-Verlag, New York, Heidelberg, Berlin.

Turner, K.A., Applegate, T.J. and Lilburn, M.S. 1999. Effects of feeding high carbohydrate or high fat diets. 1. Growth and metabolic status of the post

hatch poult following immediate or delayed access to feed. *Poult. Sci*. 78: 1573-1580.

USDA, 2004. www.ers.usda.gov

USDA, 2006. www.fas.usda.gov

Veldkamp, T., Ferket, P.R., Kwakkel, R.P., Nixey, C. and Noordhuizen, J.P.Z.N. 2000. Interaction between ambient temperature and supplementation of synthetic amino acids on performance and carcass parameters in commercial male turkeys. *Poult Sci.* 79: 1472-1477.

Veldkamp, T., Kwakkel, R.P., Ferket, P.R. and Verstegen, M.W.A. 2005. Growth responses to dietary energy and lysine at high and low ambient temperature in male turkeys. *Poult. Sci.* 84: 273-282.

Waibel, P.E., Carlson, C.W., Brannon, J.A. and Noll, S.L. 2000. Limiting amino acids after methionine and lysine with growing turkeys fed low-protein diets. *Poult. Sci.* 79: 1290-1298.

Waldroup, P.W., Anthony, N.B. and Waldroup, A.L. 1998. Effects of amino acid restriction during starter and grower periods on subsequent performance and incidence of leg disorders in two strains of male Large White turkeys. *Poult. Sci*. 77:702–713.

Waldroup, P.W., England, J.A., Waldroup, A.L. and Anthony, N.B. 1997. Response of two strains of large white male turkeys to amino acid levels when diets are changed at three- or four-week intervals. *Poult. Sci.* 76:1543–1555.

Waldroup, P.W., Fritts, C.W., Kersey, J.H., Saleh, E.B., Kerr, J. and Kidd, M.T. 2003. Evaluation of crude protein needs for large white male turkeys from 16 to 20 weeks of age. *Int. J. Poult. Sci.* 2(1): 15-18.

Wybenga, D.R., Pileggi, P.H., Dirstine, and Giorgio, J.D. 1970. Direct manual determination of serum total cholesterol with a single stable reagent. *Clin. Chem.*16 (12): 980 – 984.

Wylie, L. M., Robertson, G.W. and Hocking, P.M. 2003. Effect of dietary protein concentration and specific amino acids on body weight, body composition and feather growth in young turkeys. *Br. Poult. Sci*. 44: 75-87.

Yusrizal, and Chen, T.C. 2003. Effect of adding chicory fructans in feed on broiler growth performance, serum cholesterol and intestinal length. *Int. J. Poult. Sci.* 2(3): 214-219.

Abstract

ABSTRACT

An experiment was conducted at the Department of Poultry Science, College of Veterinary and Animal Sciences, Mannuthy to study the growth and dressing percentage of turkeys reared on different feeding regimen. Ninety six, day-old Beltsville Small White turkey poults were reared under two dietary groups with six replicates of eight birds each. The group T1 was fed with feed compounded as per NRC (1994) turkey feed specifications and T2 group was fed with BIS (1992) broiler feed.

NRC diet fed group (T1) had feed change in every four week interval with CP level starting from 28% during the first four week period, gradually reduced in the subsequent 4 week periods and in the last phase of 17 to 20 weeks it was 16.5%. T2 group was fed with broiler starter diet with 23% CP and 2800 kcal ME/kg from 0 to 16 weeks and finisher diet having 20% CP and 2900 kcal ME/kg from 17 to 20 weeks of age.

The turkeys were reared under standard managemental conditions up to twenty weeks of age. Body weight was recorded for individual birds at fortnightly intervals and feed balance per replicate was recorded at weekly interval. At the end of the trial, slaughter studies were conducted from two birds per replicate and blood samples were collected for serum profile studies.

The mean body weight at the end of twenty weeks of age was 4338.09 and 4456.92 g respectively in T1 and T2, which was statistically comparable. Cumulative body weight gain for zero to 20 weeks was 4289.73 and 4408.51 g respectively for T1 and T2 and was statistically comparable. Cumulative feed intake for zero to 16 weeks of age was 10542.08 and 11455.00 g respectively for T1 and T2 which showed statistical difference at 5% level. The cumulative feed intake from zero to 20 weeks of age was significantly higher ($P \leq 0.05$) in T2 (15735.89 g) than T1(14310.69 g). The cumulative feed conversion ratio for zero

to 16 and zero to 20 weeks showed significantly ($P \leq 0.050$) superior values for T1(3.02 and 3.34 respectively) than T2 (3.14 and 3.53 respectively). Cumulative feed intake and cumulative FCR for zero to twelve weeks were nonsignificant. The dressing percentage, eviscerated yield, ready to cook yield, and giblet yield were not influenced by the dietary regimen.

The diets studied did not have any influence on the serum total protein and serum total cholesterol values in turkeys. But thigh meat cholesterol in male turkeys was significantly ($P \leq 0.05$) higher in T1 than in T2. Dietary regimen had no effect in altering the breast meat cholesterol in turkeys. Livability in both the groups was unaffected by change in diet.

The results obtained from this study showed that turkeys reared for meat purpose can be economically raised by feeding them with BIS broiler feed.