ANIMAL PRODUCTION & TECHNOLOGY
EFFECTS OF FLOOR AND NEST EGGS ON INCUBATION AND CHICK QUALITY PARAMETERS

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Broiler breeders influence the quantitative and qualitative parameters of eggs and day old chicks. Floor and nest eggs are used by commercial layer farms to perform incubation. This study was carried out to evaluate the eggs and chick quality parameters between floor and nest eggs of broiler breeders. The experiment was conducted at the hatchery, Bairaha Farms PLC in a Complete Randomized Design (CRD) with two treatments. Five replicates were maintained for each treatment and each replicate consisted of 90 eggs. Nine hundred eggs from MX male x Cobb 500 female (35 - 40 weeks of age) were collected from the breeder farm. Eggs were incubated at Petersime commercial multi-stage (MS) incubator. Egg quality parameters; initial egg weight and shape index were measured just before the setter period. Egg weight reduction was calculated during incubation period. Live chicks and hatch residues were collected separately at the end of incubation period. Chick quality parameters such as chick weight, chick length and pasgar score were measured. Breakout test was conducted with hatch residues. Data was statistically analyzed using two sample t-test in SAS. Results revealed that there was a significant difference \( p < 0.05 \) on hatchability between two types of eggs. Nest eggs reported the highest hatchability (90.0%) compared to floor eggs. Initial egg weight, egg shape index, moisture loss, hatch of fertile, chick weight, chick length, chick yield and pasgar score did not show any significant difference \( p > 0.05 \) between two types of eggs. Break out analysis showed that higher embryo mortality and contamination occurred in floor eggs compared to nest eggs. Therefore, it can be concluded that hatchability of nest eggs is better than those of floor eggs. However, floor eggs should be kept separately in the commercial hatcheries to minimize the contamination.

Keywords: Chick yield, Fertility, Hatchability, Hatch of fertile
EVALUATION OF PERFORMANCES OF AQUAPONIC SYSTEM WITH ORNAMENTAL AND TABLE FISH

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Aquaponic system is an integration of fish and hydroponics in a closed recirculating system. The present study was aimed to investigate the suitable fish species and evaluate the performances of tomato plants in the aquaponic systems. The experiment was conducted as Complete Randomized Design with three treatments. Hydroponic system was setup as the control and two aquaponic systems with ornamental (Koi carp) and table fish (Tilapia) were used as treatments. A total of 100 fingerlings were stocked in each aquaponic system. Three replicates, each with six tomato plants were maintained for two systems. Three plants were randomly selected from each replicate for data collection. Body weight, standard length and girth of ornamental and table fish were measured. Data were analyzed using one way ANOVA in SAS. Results revealed that tomato yield showed a significant difference ($p<0.05$) among systems. Hydroponic system reported the highest tomato yield ($303 \pm 41$ g per plant). The tomato yields in the aquaponic systems with ornamental and table fish were $191 \pm 41$ g and $112 \pm 41$ g per plant, respectively. Leaf length, leaf width and number of leaves were significantly different ($p<0.05$) among systems. However, plant height did not differ significantly ($p>0.05$). Hydroponic system showed the higher leaf length ($26 \pm 1$ cm), leaf width ($17 \pm 0$ cm) and number of leaves ($16 \pm 0.6$). Table fish (Tilapia) reared in the aquaponic system performed better (final average body weight; $61.4$ g, length; $11.3$ cm and girth; $6.7$ cm) than ornamental fish (Koi carp)(final average body weight; $16$ g, length; $8.4$ cm, girth; $4$ cm). It is concluded that tomato plants in the hydroponic system perform better than aquaponic systems. In addition, table fish in the aquaponic system performs better in terms of growth parameters. Tomato plants perform better in terms of yield in the aquaponic system with ornamental fish.

**Keywords:** Aquaponic, Hydroponic, Ornamental fish, Table fish
DEVELOPMENT OF A SET YOGHURT USING LOCALLY AVAILABLE WATERMELON VARIETIES

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Health benefits and consumer preference of set yoghurt can be improved by incorporating different fruit pulp or juices. Juices of three watermelon varieties, Thilini, Kinaree C28 and Rocky 475 were used with 25% (v/v) concentration level to develop a set yoghurt and selected the best variety for yoghurt preparation. Four incorporation levels of juice as 15%, 20%, 25% and 30% (v/v), were used to develop the set yoghurt using the selected watermelon variety. Authenticated set yoghurt without adding watermelon was used as the control. Thirty (30) untrained panellists were used in the sensory evaluation to select the best watermelon variety and respective concentration level. Organoleptic, microbiological and physicochemical properties of all samples were analysed during the 21 days of storage period. Parametric and sensory data were analysed using Analysis of Variance procedure and Friedman test, respectively. Rocky 475 variety at 20% (v/v) concentration level resulted the best sensory properties for colour, taste, texture and aroma. Fat content in watermelon incorporated yogurts decreased gradually with the increasing levels of watermelon juice ($p<0.05$). The highest titratable acidity and the lowest pH were recorded in the control. The syneresis of yoghurt samples were increased and the Total Plate Count (TPC) was reduced ($p<0.05$) with the increasing levels of watermelon juice. The lowest TPC (log$_{10}$ 5.72 CFUg$^{-1}$) was observed in 30% (v/v) incorporation level. Yeast and mould counts of all yoghurt samples were lower than the acceptable range ($1\times10^2$ CFUg$^{-1}$) during the storage period. This study showed that set yoghurt could be enriched with desirable organoleptic properties, while ensuring microbiological safety by incorporating 20% (v/v) of Rocky 475 variety of watermelon juice.

Keywords: Organoleptic properties, Set yoghurt, Watermelon juice
EVALUATION OF VACUUM LEAKAGE CONDITION OF MEAT PRODUCTS PRODUCED AT KEELLS FOOD PLC - EKALA, JA-ELA

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Leaks in food packages may result in the ingress of gases, microorganisms or contaminants. Keells Food Products PLC is experiencing a large number of returns due to the vacuum leaks. Hence, this study was conducted to evaluate the present circumstances of the company regarding vacuum leakages in their meat products. It was found that packages of sausages and meatballs are mostly returned to the company. Further, these returns were from two distribution channels that are supplying the products to supermarkets and to retail shops through modern and general channels, respectively. Dispatched level data of mostly returned products (250 g, 450 g, 500 g of sausages and 200 g, 500 g of meatballs packages) were collected over a five day period. Bubble test was carried out for 900 returned samples of above products from both distribution channels. Thickness of the bottom and top reels of 250 returned samples were measured by using a gauge meter. The factory introduced a new packaging material and return data were collected. It was revealed that, at the dispatch level all products had similar number of leaks. Further, average number of micro holes (39.7 ± 7.1) and macro holes (38 ± 6.4) were significantly high ($p<0.05$) in the modern channel while significantly ($p<0.05$) higher number of micro holes (45 ± 4.4) were reported in the general channel. Significantly higher ($p<0.05$) number of leaks were observed at the bottom reel (89.8 ± 7.41%). There was a significant ($p<0.05$) negative correlation ($r = -0.702$) between the gauge of the packing material and the number of leaks. Further, number of returns were decreased ($p<0.05$) significantly by introducing a new packaging material with higher gauge (180 ± 10.8 µm). Hence, it is possible to lower the incidences of leakages at the factory by increasing the thickness of the packaging material.

Keywords: Thickness, Vacuum leaks, Vacuum packaging
Lacto vegetarians are reluctant to eat yoghurts due to gelatin as it is a non-vegan compound. Thus, this study was focused in developing a set yoghurt using Patha (*Cyclea peltata*) leaf gel as a gelatin substitute. The gelatin was extracted by grinding the leaves. There were four recipes of set yoghurts prepared incorporating different levels (0, 4, 6 and 8 g) of *Cyclea peltata* leaf gel per one liter of yoghurt mix. The other ingredients were used in similar proportions in all four recipes. The yoghurt prepared with zero level of *Cyclea peltata* leaf gel level was considered as the control and it contained 6 gL⁻¹ gelatin instead. The most effective recipe was selected by analyzing for proximate composition, pH, titratable acidity and shelf life and finally by undertaking a sensory evaluation. Leaf gel added set yoghurts possessed lower \( p<0.05 \) pH values compared to control. Titratable acidity was not different \( p>0.05 \) in all four recipes and it was within the acceptable range of 0.8 up to 4 days of storage. There were no Coliforms observed in all four recipes; neither the yeast nor mould was observed up to 12th day of storage. The color and appearance were not different \( p>0.05 \) among the four recipes. Yoghurt prepared with 6 gL⁻¹ of leaf gel had the highest \( p<0.05 \) sums of rank in the sensory evaluation followed by control. The proximate composition was similar \( p>0.05 \) in the yoghurts prepared with 6 gL⁻¹ of leaf gel and control except for crude fiber content which was higher \( p<0.05 \) in the yoghurts prepared with 6 gL⁻¹ of leaf gel. Thus, it can be concluded that *Cyclea peltata* leaf gel can be used as a total substitute for gelatin incorporating up to 6 gL⁻¹ in the preparation of set yoghurt and it can be stored up to 12 days without interfering with sensory attributes.

**Keywords:** Gelatine substitute, Leaf gel extract, Shelf life, Set yoghurt
EFFECT OF QUANTITATIVE EARLY FEED RESTRICTION ON GROWTH PERFORMANCE AND FAT DEPOSITION IN BROILERS

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The fast growth rate of broilers' is associated with high body fat deposition and nutritional studies have indicated that early feed restriction induces the metabolic programming. This experiment was conducted to study the effect of feed restriction at early age on growth performance and fat deposition in broilers. Two hundred, Cobb-500 day-old chicks were randomly assigned into five treatments with four replicates in a completely randomized design. Treatments were T1: ad-libitum feeding (control), T2 and T3: 75% and 50% of ad-libitum feeding from day 7 – 14, respectively, T4 and T5: 75% and 50% of ad-libitum feeding from day 14 - 21, respectively. All birds were fed with ad-libitum before and after the completion of the respective restriction periods, adapting two phase feeding program. Growth performances were recorded weekly and carcass quality parameters and serum lipid profile were measured at slaughtering on the 38th day. Feed intake was significantly lower ($p<0.05$) in T3 and T5 (2.9 ± 0.04 kg) compared to the birds in the control group (3.2 ± 0.04 kg). However, no differences ($p>0.05$) were observed in weight gain, feed conversion ratio, and dressing percentage among the treatments. Abdominal fat (13 - 17 g) and muscle crude fat (1.9 - 2.5%) contents in birds fed with restricted diets from day 7 - 14 were significantly lower ($p<0.05$) compared to the control (27 ± 2 g and 5.06 ± 0.6%, respectively). There was no influence ($p>0.05$) of treatments on carcass cuts or organ weights, muscle protein content, and serum lipid profile. According to the cost benefit analysis, profit earned per bird from T3 (LKR 187.00) was higher compared to the control (LKR 173.00). In conclusion, 50% feed restriction during day 7 - 14 is a better solution to reduce the fat deposition without interfering on growth performances of broilers with lower cost.

Keywords: Abdominal fat, Carcass quality, Lipid, Restricted feeding
EFFECT OF PHOTO PERIOD ON GROWTH PERFORMANCES OF GUPPY FISH

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Photoperiod has a positive effect on the growth performances of fish by inducing feed consumption, growth of muscles due to the high locomotor activity and efficient usage of nutrients. This experiment focused on determining the effect of photoperiod on the growth performances and survival of guppy (Poecilia reticulata) juveniles. There were five treatments with three replicates; A-12 h (hour) lightness and 12 h darkness as the control, B-24 h lightness; C-24 h darkness, D-8 h lightness and 16 h darkness, E-16 h lightness and 8 h darkness. Fish with an average initial weight (2.28 ± 0.10 g) and an average length (1.92 ± 0.24 cm) were randomly distributed at a stocking rate of 20 fish per tank. Total culture period was 10 weeks. Fishes were fed twice a day with a commercial feed (protein 48%). Temperature (28 - 30°C), dissolved Oxygen (7 - 8 mgL⁻¹), pH (6.5 - 8) and volume of water (48 liters) were maintained at constant levels throughout the experiment. The average body weight of the fish was measured at 7 days intervals and the standard body length was measured at the beginning and the end of the experiment. Specific growth rate (SGR), weight gain (WG), daily growth rates (DGR), length gain (LG) and condition factor (K) were calculated using the collected data. Significantly higher ($p<0.05$) average body weight and average body length of guppy were exhibited in treatment E and A. Further, treatment E had a higher ($p<0.05$) calculated SGR (2.43% d⁻¹), WG (363.39%), LG (89.55%), DGR (2.57) and the lowest ($p<0.05$) K (1.08) among the treatments. There was no mortality reported during the total culture period among the treatments. In conclusion, exposure to 12 and 16 h of lightness enhances the growth performances of guppy juveniles under controlled conditions and photoperiod had not affected on the survival of guppy fish.

Keywords: Growth performances, Guppy, Photoperiod
PROBIOTIC EFFECT OF INULIN INCORPORATED SET YOGHURT PREPARED USING CATTLE AND BUFFALO MILK

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Demand for probiotic food products has been increased remarkably over the last few decades. Yoghurt is one of the popular functional food enriched with probiotic activity. In this study microbiological and physicochemical properties of two set yoghurt types prepared using cow milk (CM) and buffalo milk (BM) were evaluated at 3 different levels of inulin additions (1%, 2% and 3% w/w) in refrigerated storage at 4°C for 21 days. Two types of starter cultures as BB12 (Bifidobacterium bifidum) and YC-X11 (Streptococcus thermophilus and Lactobacillus bulgaricus subspp. bulgaricus) were used to prepare the set type yoghurt. Probiotic viable cell counts for all three probiotic micro-organisms, whey separation (syneresis), total acidity and pH were evaluated weekly. Organoleptic properties and viscosity were also evaluated within the first week of preparation. Both inulin incorporated CM and BM showed the higher probiotic counts at the end of the enumeration period (~8.0 log CFU mL⁻¹) while control samples of each group showed significantly lower (~7.0 log CFU mL⁻¹) probiotic counts. The highest probiotic count was recorded in 3% inulin incorporated CM and BM yoghurts from each category. S. thermophilus, B. bifidum and L. bulgaricus counts in CM yoghurts were 9.11 log CFU mL⁻¹, 8.90 log CFU mL⁻¹ and 8.96 log CFU mL⁻¹ respectively and in BM yoghurts those were 8.72 log CFU mL⁻¹, 8.67 log CFU mL⁻¹ and 8.73 log CFU mL⁻¹ respectively. Viscosity of the yoghurt samples were significantly different (p<0.05) among the treatments while the highest viscosity was observed in 2% inulin incorporated yoghurt (CM: 55850 ± 70.71 mPa.s; BM: 86450 ± 70.73 mPa.s). The CM and BM yoghurt containing 2% inulin showed the higher consumer acceptability and probiotic stability during the storage. This study showed that the addition of inulin can improve microbiological, sensory and viscosity of yoghurt prepared from CM and BM.

Keywords: Buffalo milk, Cow milk, Inulin, Probiotic, Set yoghurt
INFLUENCE OF TOTAL MIXED RATION ON PRODUCTIVITY AND COMPOSITION OF MILK OF LACTATING BUFFALOES UNDER THE DRY ZONE FARM CONDITIONS

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A 22 day lactation trial was conducted to determine the effect of total mixed ration on productivity and composition of milk of lactating buffaloes under the dry zone farm condition. Six Murrah × Nili-Ravi cross bred, early lactating buffaloes were blocked according to their parity and randomly allocated into two treatment groups. They were either offered a total mixed ration (TMR) or fed by conventional feeding system with only chopped guinea grass (control group). Milk yield, composition, feed intake were measured daily and milk urea nitrogen (MUN) and body weight were determined weekly. Data were analyzed using Analysis of Variance in SAS. Economic efficiency was evaluated by cost benefit analysis. Milk yield and average body weight were significantly higher \( (p<0.05) \) in animals fed with TMR (4.90 ± 0.13 L and 616.54 ± 2.55 kg, respectively) than those fed by the conventional system (2.67 ± 0.13 L and 604.99 ± 2.55 kg, respectively). Milk fat content was significantly higher \( (p<0.05) \) in TMR fed group while milk protein, density, solids-non-fat and lactose contents were higher \( (p<0.05) \) in the control group. However, the MUN content was not significantly different \( (p>0.05) \) when fed with TMR or only with chopped guinea grass. Moreover, average feed intake was higher \( (p<0.05) \) in control group (37.98 ± 0.44 kg) than the TMR fed group (28.56 ± 0.44 kg). A higher profit was reported with the TMR feeding (LKR 29.42/animal/day) compared to the control group. The results reveal that, TMR feeding do have a significant impact on milk yield and milk fat content of lactating buffaloes which improves the profit margin.

**Keywords:** Lactating buffaloes, Milk composition, Milk yield, Productivity, Total mixed ration
DEVELOPMENT OF A STRATEGIC CLEANING PROCEDURE FOR EFFECTIVE WATER USAGE AT THE MEAT PROCESSING FACTORY, KEELLS FOOD PRODUCT PLC

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Wastewater generation at the Keells Food Product factory is above the capacity of the wastewater treatment plant. There are three main product processing lines; skin on sausage, skin less sausage and frozen meat product. All the production lines are mechanized and operated by fourteen different machineries. After any given production each and every machine is cleaned until no physical particles remaining in the machineries and flow area. After cleaning, microbial count should be below $10^2$ CFU. The cleaning process produced a massive volume of wastewater due to the absence of a proper cleaning procedure. Thus, a study was conducted at the above factory with the objective to propose a strategic cleaning procedure (SCP) to reduce the amount of wastewater generation. The amount of water used for cleaning these 14 machineries at different processing lines was estimated by two procedures employing a regular labourer; (1) using the current procedure and (2) using a proposed SCP. The data were collected for each machine for seven consecutive production days for the each procedure. The water usage for cleaning using both procedures was compared by a paired T test. According to the results the regular labourer has used 484.5 ± 3.37 of water for cleaning one machine compared to 326.29 ± 3.62 from the proposed SCP which was a significant reduction of 33\% due to the proposed SCP. Further, the water meters indicating the water input, water storage and water output were also tested for errors. It was observed that there were defects in water meters. Thus, the Keells Food Product PLC, Gonawila, Makandura has taken necessary steps to adapt the proposed SCP for cleaning the machineries at different processing lines and adjust the defects in water meters. Further, the findings were to be included in the water foot print plan expected to be developed for the factory.

\textit{Keywords:} Cleaning machinery, Processed meat products, Waste water, Water usage
EFFECT OF MILKING TIME AND STORAGE TEMPERATURE ON THE MICROBIOLOGICAL QUALITY OF RAW MILK

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Farmers tend to chill the evening milk using domestic refrigerators and mix with the morning fresh milk in the following day due to the inadequacy of evening milk collecting facilities. The objectives of the current study were (1) to evaluate whether the Total Plate Counts (TPC) differ in milk samples obtained from different milking times (2) whether the chilled evening milk at farmer refrigerators affect the TPC levels. The data were analyzed as randomized block design for objective one and complete randomized design for objective two. Milk samples (N=180) were collected from 15 dairy farmers in the Anuradhapura District, Sri Lanka. Milk samples were collected from each farmer for three (3) consecutive days. In the first study milk samples were collected as evening (a), morning (b), evening chilled (c) and the mixture of evening chilled with the following day morning fresh milk (d). In the second study, evening fresh milk samples were chilled under laboratory conditions at 4°C, 6°C and 8°C and also at the farmer's refrigerators. All these samples were cultured and evaluated for TPC. The average TPC values obtained for a, b, c and d samples in the first study varied between log₁₀ 8.13 CFU/mL and log₁₀ 8.18 CFU/mL respectively. These TPC values didn't show any significant difference but they were higher than standard TPC level (log₁₀ 5.0 CFU/mL) for raw milk. In the second study the lowest TPC values (log₁₀ 8.13) were resulted from samples stored at 4°C compared to 6°C, 8°C and farmer's refrigerator. This study concludes that milk stored at the domestic refrigerators fail to maintain the optimum chilling temperature (4°C) and milking time has no effect on the microbiological quality of raw milk.

Keywords: Microbiological quality, Raw milk, Storage temperature
Broiler industry is currently looking for alternatives to increase the efficiency of feed consumption while eliminating the use of antibiotic growth promoters (AGP). This study was conducted to investigate the effect of supplementing broiler chicken diets with secondary plant compounds (SPC) and zinc bacitracin on growth performance and serum lipid profile. Three hundred, eight day-old Cobb500 broiler chicks were randomly allocated to five experimental diets with six replicates each in a completely randomized design. The supplements were mixed in the commercial diet at two different levels (SPC; 10% and 20% Activo® and AGP; 20% and 40% Zinc bacitracin (ZB)). Broilers fed on the commercial broiler diets without supplements were considered as the control. Body weights and feed consumption were recorded at weekly intervals and body weight gain and feed conversion ratio (FCR) were calculated. On 42nd day, birds were slaughtered and dressed weight, internal organs weight, and serum lipid profile were measured. Data were analyzed using one way Analysis of Variance in SAS. Dietary intake of 20% Activo® resulted significant increase ($p<0.05$) in body weight gain (2296 ± 51 g) and decrease in FCR (1.55 ± 0.03) compared to the control group (2152 ± 51 g and 1.68 ± 0.03, respectively). However, weight gains and FCR were similar in ($p>0.05$) birds fed with different percentages of ZB and Activo®. Carcass and internal organ weights were not significantly different ($p>0.05$) among the treatments. Inclusion of supplements significantly reduced ($p<0.05$) the serum total cholesterol (160 ± 25 mgdL$^{-1}$) and low density lipoprotein (72 ± 26 mgdL$^{-1}$) compared to the control. Therefore, secondary plant compounds used in the study can be utilized at a level of 20% as an alternative to antibiotic growth promoters to improve broiler performance to reduce the serum cholesterol.

**Keywords:** Antibiotic growth promoter, Broilers, Growth performance, Secondary plant compound, Serum lipid profile
EFFECT OF GLIRICIDIA LEAF MEAL OR HYBRID NAPIER CO3 GRASS LEAF MEAL INCORPORATED RATIONS ON GROWTH OF YOUNG TURKEY BIRDS

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There is no specific feed ration for turkey birds reared in Sri Lanka. They are fed with boiler rations. Therefore, an experiment was undertaken to study the effect of feeding two low cost rations on growth performance of turkey birds. Day old poults were randomly assigned into three treatments in a Randomized Complete Block Design (RCBD) with nine replicates of ten birds for each. Treatments were as follows; Treatment 1 (T1) – Ration incorporated with Gliricidia (Gliricidia sepium) leaf meal, Treatment 2 (T2) – Ration incorporated with hybrid Napier CO3 grass (Pennisetum puerperium x Pennisetum americarnum) leaf meal, Treatment 3 (T3 – Control) commercial broiler grower ration. Birds were weighed weekly. At the end of the three months study period a sample of birds were slaughtered to obtain the carcass data. Feed and meat samples were analyzed for nutrient content. There was no difference ($p>0.05$) in crude protein content in all three rations. Ash content was higher ($p<0.05$) in T2 compared to T1 and T3. Crude fiber content was higher ($p<0.05$) in T3 compared to T1 and T2. The lowest ($p<0.05$) feed intake was recorded in T2 compared to T1 and T3. The highest ($p<0.05$) average body weight was recorded in T3 compared to T2 which in turn was higher ($p<0.05$) than T1. Live weight gain was higher ($p<0.05$) in T2 and T3 compared to T1. The carcass weight, dressing out percentage and feed conversion ratio were not significantly different among treatments. A profit of LKR 457.95/bird was obtained from T2. The profits from T3 and T1 were LKR 355.05/bird and LKR 112.35/bird respectively. Hence, it can be concluded that the ration incorporated with hybrid Napier CO3 grass leaf meal (T2) can be effectively used to replace commercial broiler grower ration for feeding turkey birds in Sri Lanka. And it is profitable than feeding commercial broiler grower ration.

Keywords: Feeding trial, Growth of Turkey birds, Low cost leaf meal rations