COMPARATIVE EVALUATION OF PORCINE PRODUCTION PERFORMANCE IN TERMINALLY SIRED AND PUREBRED PROGENIES UNDER DIFFERENT MANAGEMENT CONDITIONS

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DECLARATION

I hereby declare that the thesis, entitled **"COMPARATIVE EVALUATION OF PORCINE PRODUCTION PERFORMANCE IN TERMINALLY SIRED AND PUREBRED PROGENIES UNDER DIFFERENT MANAGEMENT CONDITIONS"** 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.

Mannuthy
13.03.07

M.MURUGAN

CERTIFICATE

Certified that the thesis entitled **"COMPARATIVE EVALUATION OF PORCINE PRODUCTION PERFORMANCE IN TERMINALLY SIRED AND PUREBRED PROGENIES UNDER DIFFERENT MANAGEMENT CONDITIONS"** is a record of research work done independently by **M.MURUGAN** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to her.

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M.MURUGAN

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INTRODUCTION

1. INTRODUCTION

Cross breeding in pigs was started in India to upgrade the local Desi pigs with exotic pigs, initially with Large White Yorkshire breed and later Landrace, Duroc and other breeds were also introduced because of their good mothering ability and better post weaning growth performance. Purebred exotic pigs are maintained under the impression that they are well adapted to our agroclimatic conditions, but this adaptation is only under the sacrifice of their productivity and disease resistance.

The consumer demand for leaner pork has resulted in genetic selection for pigs with increased rates of muscle accretion and reduced carcass fats (Schinckel, 1999). Eventhough Large White Yorkshire and Landrace breeds are highly prolific with good mothering ability, its carcass quality is not fully Desirable to the producers and consumers due to their higher carcass fat. On the other hand Duroc is considered to be a good lean meat producer but its mothering ability is not matching with Large White Yorkshire and Landrace. The indigenous pigs due to natural selection over the years are known for its adaptation to local environment, heat tolerance, disease resistance and maintenance on low inputs. But growth performance is poor (Anon, 1997).

Hence the production of lean meat, better litter performance and sustainable pig production under tropical climate depend on the effective inheritance of Large White Yorkshire / Landrace blood, with local Desi pigs and Duroc as a terminal sire. This three breed combination is expected to give better growth rate and lean meat production.

Pigs are considered to be highly prolific amongst meat producing livestock and moreover efficient converters of feed to valuable animal protein with faster growth rate within a short span of six months. To produce pigs with better growth rate, the farmer has to maintain superior genetic group having better adaptability and quality feeding. The quality of the rations determines to a great extent the rate of growth in young pigs, the general resistance to diseases and parasites, the regularity of breeding, the size and vigour of the litter, the amount and quality of the milk, and the yield and quality of the carcass produced for the market.

In pig rearing, feed cost account for about 75 % of the total cost of production. The requirement of high grain diets for pig increases the cost of feeding as well as decreases the availability of grain for human population in developing countries (Joseph and Abolaji, 1997). Pig rearing based on a commercial pig ration with conventional feed ingredients is not profitable considering the present market values of pork, cost of feed ingredients and feed conversion efficiency. So any attempt to reduce the feed cost will be of benefit to farmers. Therefore, the most logical step of saving the grains and reducing the cost of pork production is to replace grains with an alternative source of feed. The popular feeding practice is known as swill feeding that consists of organic wastes of animal and plant origin.

In the search for cheaper sources of pig feed, the utilization of unconventional feed in the diet of pigs is receiving considerable attention in India. Several unconventional feed sources like left over food from hostels, restaurants and catering establishments, infertile eggs and chicken waste can be exploited for this purpose. Swill is the cheapest and very easily available alternate feed with crude protein ranging from eight to 22 per cent. Infertile eggs and chicken waste are rich in nutrients and are relished by pigs (Anton, 2005). The agricultural byproducts can also be used in considerable proportion in the diet of all classes of pigs.

The nutrient composition of swill feed is comparable to conventional feeds but the availability of minerals in the swill feed is not fully exploited since pigs are desperately in need of six macro minerals *viz.*, calcium, phosphorus, sodium, chlorine, magnesium and potassium which are primarily involved in the structural components and body fluids of pigs and eight micro / trace minerals *viz.*, cobalt, copper, iodine, iron, manganese, selenium, sulphur and zinc. These trace minerals play a vital role in nutrition, being part of structural materials, constituents of the soft tissues and cells, and regulate many of the vital biological processes. They occur naturally in most feed ingredients but the amount and bioavailability varies.

The possibility of dietary deficiencies of one or more minerals has increased with the confinement rearing i.e outdoor to indoor housing has eliminated the opportunity for pigs to ingest important mineral elements from soil and pasture. Hence supplementation of minerals is absolutely essential for growth and reproduction in pigs (Acda and Chae, 2002).

Although trace minerals are traditionally included in the diet at very small amount in the form of premix of inorganic salts such as sulphates, chlorides, carbonates and oxides, there are several factors that may reduce their availability when ingested by the animals. Researches in mineral nutrition have shown that the availability of trace minerals can be improved by binding them to organic ligands, usually a mixture of amino acids or small peptides. A ligand is a molecule containing an atom which has a lone pair of electrons. In the process of chelation, the ligand acts as chelating agent and encircles the metal atom to form a heterocyclic ring structure (Hynes and Kelly, 1995).

Understanding the efficacy of organic trace minerals has been increasingly important over the past few years as a result of increased customer awareness of their benefits and the increase in the number of commercial products available to the consumer. Organically bound trace minerals of interests in pig nutrition specifically include iron, copper, zinc, chromium and selenium. Organic iron, chromium and selenium have been shown to improve reproductive efficiency as measured by increased farrowing rate, reduced mortality, larger litter size and increased litter weight at birth and at weaning. Most of the research results demonstrated that organic sources of Cu and Zn at low levels could substantially decrease the concentrations of Cu and Zn excreted compared to inorganic sources at pharmacological levels.

Hence, the practical use of organic trace minerals will depend on the performance response, health status of animals and environmental impact. These responses will determine the cost effectiveness of organic trace minerals in pig production.

By considering the above information, this study was designed to assess the growth performance and adaptability of Large White Yorkshire and three breed combinations under farm and field conditions and to recommend a breed combination as well as management practices suited to the agro-climatic zone with the following objectives:

1. To study the comparative performance of Large White Yorkshire and three breed cross (genetic groups) pigs under farm and field conditions.

2. To compare the feeding regime of pigs with special reference to mineral status under farm and field conditions.

3. To compare carcass characteristics of Large White Yorkshire and three breed cross pigs under farm and field conditions.

4. To study the economics of production of Large White Yorkshire and the three breed groups.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

2.1. EFFECT OF BREED ON THE LITTER PERFORMANCE OF PIGS

Rai and Desai (1985) observed that the mean birth weight of male and female Large White Yorkshire piglets were 1.232 ± 0.01 and 1.211 ± 0.01 kg and the mean weaning weight were 10.515 ± 0.17 and 10.074 ± 0.149 kg, respectively. The sex had significant effect on weaning weight, but not on birth weight.

Dash and Mishra (1986) in Orissa, reported that the average birth weight, weaning weight of male and female crossbred piglets were significantly higher compared to Large White Yorkshire.

According to Chatterjee *et al.* (1987), the litter size at birth and weaning , litter weight at birth and weaning and average birth weight and weaning weight for the Large White Yorkshire were significantly higher than 75 per cent crossbred pigs.

Chhabra *et al.* (1989) opined that the birth weight of male and female Large White Yorkshire piglets were 1.24 kg and 1.20 kg. Sex of the piglets had significant effect on birth and weaning weight. Litter size at birth had significant effect on all body weights.

Mishra *et al.* (1990a) reported that the litter size at birth and weaning, for Large White Yorkshire pigs were significantly higher at Jabalpur farm (9.8 ± 0.25 and 8.8 ± 0.22, respectively) compared to Tirupathi farm (7.6 ± 0.32 and 7.2 ± 0.35, respectively). The litter weight at birth and weaning were also significantly higher at Jabalpur farm (12.1 ± 0.26 kg and 100.7 ± 2.71 kg, respectively) as compared to Tirupathi farm 10.2 ± 0.46 kg and 92.2 ± 4.50 kg, respectively).

Mishra *et al.* (1990b) found that in Large White Yorkshire breed the male piglets had higher birth weight (1.29 ± 0.007 kg) than female piglets (1.25 ± 0.008 kg) and significant difference was observed between the sexes.

Chhabra *et al.* (1990) stated that the litter size at birth and weaning and litter weight at birth and weaning for Large White Yorkshire were, 12.0 and 10.0, 14.9 kg and 186.3 kg, respectively. The year or season of farrowing did not have significant effect on litter size at any of the stages.

Sharma *et al.* (1990) reported that the mean birth weight of male piglets was 1.23 ± 0.02 kg and female piglets were 1.17 ± 0.03 kg for Large White Yorkshire breeds. The weaning weight of male piglets was 9.77 ± 0.18 kg and the female piglets were 9.81 ± 0.26 kg. Sex of the piglet had no significant effect on birth weight and weaning weight in Large White Yorkshire, Desi and Crossbred pigs.

In another study Lakhani (1992) found that the average weaning weight of male and females were 11.93 ± 0.11 kg and 11.38 ± 0.12 kg, respectively. The overall weaning weight was 11.54 ± 0.08 kg. The litter size at birth was found to have significant effect on weaning weight in Large White Yorkshire.

Jayarajan and Ulaganathan (1992) observed in Large White Yorkshire pigs a mean body weight of 1.26 ± 0.011 kg at birth and 10.79 ± 0.06 kg at weaning. Seasonal differences were found to have important role from birth to weaning.

According to Sharma *et al.* (1992) the Large White Yorkshire pigs had a higher weaning weight of 9.91 ± 0.28 kg than the crossbreds with 8.05 ± 0.14 kg. Litter size at weaning had significant effect on weaning weight.

Singh *et al.* (1997) found that the birth weight (1.23 ± 0.03 kg) of Large White Yorkshire piglets were significantly (P < 0.01) higher than the crossbreds (1.03 ± 0.03 kg).

Deka *et al.* (2002) conducted a trial to study the effect of non-genetic factors on pre-weaning weight in Hampshire pigs and observed a significant effect of sex on pre-weaning weight. Males were heavier than females up to weaning in their observation.

Deka *et al* (2003) recorded higher mean values for pre-weaning body weight in 75 % Hampshire + 25 % indigenous than halfbreds and indigenous pigs.

Ramesh and Sivakumar (2003) studied litter performance of Large White Yorkshire gilts under conventional system and found that litter size at birth and at weaning, average litter weight at birth and at weaning were 7.83 ± 0.17 and 7.00 ± 0.26 ; 1.14 ± 0.02 and 10.69 ± 0.21 kgs respectively.

Sudhakar and Gaur (2003) stated that pre-weaning body weights of indigenous pigs revealed an average weight ranging from 0.853 ± 0.014 kg at birth to 7.421 ± 0.135 kg at weaning. The average daily gain was 116.788 ± 2.400 g.

Arun Pradeep *et al.* (2004) reported that effect of sex showed significant difference in birth weight and weaning weight of crossbred piglets of coastal Karnataka. The corresponding values were 1.05 and 1.08 kg in birth weight and 7.41 and 7.82 kg in weaning weight for male and female piglets respectively. In contrast Punya Kumar *et al.* (2005) stated that sex had no significant effect on birth weight and weaning weight of indigenous pigs. Similar findings were also reported by Gaur *et al.* (1999) and Kalitha *et al* . (2001) in *desi* pigs and their crosses with Landrace and Hampshire pigs respectively.

Chandrahas *et al.*(2004) found that crossbred pigs (Landrace x Desi) maintained under conventional farrowing system produced 8.83 ± 0.79 piglets at birth and weaned 7.67 ± 0.62 numbers at 4 th week of age. The corresponding weight of litters was 6.98 ± 0.61 and 39.52 ± 2.27 kg respectively at birth and at weaning.

Least square analysis of litter traits of indigenous pigs and its various Large White Yorkshire grades revealed that genetic group had significant effect on body weight at all the ages except at birth. At birth males were significantly heavier than females. Desi pigs recorded lowest body weight at birth (Lakhani *et al.*, 2004).

Nandakumar *et al.* (2004) analyzed the records for data on the effect of genetic group on the litter performance of *desi*, Large White Yorkshire and their crossbred sows at University Pig Breeding Centre , Mannuthy. They found that genetic group had a highly significant effect on litter weight at birth, litter size at weaning and litter weight at weaning and suggested that this might be modulated by heterozygote superiority among crossbred piglets conferring them with better viability and fitness.

Nehru babu *et al.* (2004) studied certain reproductive parameters in Large White Yorkshire pigs maintained with garbage feeding in rural areas of nearby Tirupati . They observed that average litter size at birth and average birth weight of piglets were 8.08 ± 0.62 Vs 8.69 ± 0.52 and 1.06 ± 0.05 Vs 1.00 ± 0.04 kg in gilts and sows respectively.

Chhabra *et al.* (2005) observed that genetic group had highly significant effect on body weights from birth to weaning in desi and crossbreds. There was no difference in body weight between male and female piglets at weaning. They also reported that males were heavier than females at all the ages.

The overall least square means of indigenous pigs in Assam for litter size at birth, litter size at weaning, litter weight at birth and litter weight at weaning were 5.38 ± 0.13, 4.03 ± 0.13, 3.25 ± 0.08 kg and 23.93 ± 0.85 kg respectively (Arundhati *et al.*, 2006).

2.2. EFFECT OF ENVIRONMENT ON THE PHYSIOLOGICAL RESPONSES OF PIGS

2.2.1. Rectal Temperature

Martin (1970) concluded that rectal temperature of pigs begin to show a sharp increase when the environmental temperature rose from 60 to 80 ° F (15.6 to 26.7 ° C). He had also found that the body temperature of swine appears quite variable with a range of 101.5 to 104 ° F (38.6 to 40 ° C).

Campbell and Lasley (1977) observed the rectal temperature of swine as 102.5 ° F (39.2 ° C).

Sainsbury and Sainsbury (1979) stated that critical temperature of piglets were 35 ° C at birth, 29 ° C up to 5 kg live weight and 24 ° C at 10 kg body weight.

West (1985) also reported that pigs show a variation in body temperature between 100.9 to 104.0 ° F.

Mathur (1990) concluded that the average temperature of pigs vary from 101.7 ° F to 105.6 ° F(38.6 – 40.9 ° C).

According to Sebastian (1992) pigs showed a variation in body temperature between 101.9 to 102.6 ° F . Korthals *et at.* (1994) observed that peak body temperature occurred between 12.30 and 22.45 h during the days when environmental temperature were increased starting at 8.30 am with an average peak temperature occurring near 16.00 h . It was also found that a producer has one to five hours to take action after stressors occur in order to reduce its effect on growing and finishing pigs.

Dukes (1996) noticed that rectal temperature of the pig began to increase at an environmental temperature of 85 to 90°F (29.4 to 32.2°C). If the relative humidity was 65 per cent or above, the pig could not tolerate prolonged exposure (seven hours) to an environmental temperature of 95°F (35°C) and at an environmental temperature of 105° F (40.5 °C) the pig was unable to withstand any level of humidity.

Dinesh (2000) reported that the rectal temperature of Mannuthy Large White Yorkshire pigs was slightly higher than the three newly imported groups (Duroc, Large White Yorkshire and Landrace) and among the three imported breeds , Duroc pigs had the highest average monthly rectal temperature.

2.2.2. Respiration Rate

Increased respiratory rate was usually the visible sign of heat stress and was placed third in the sequence of adaptive reaction as the unnoticed vasodilatation and sweating usually occurred earlier (McDowell, 1972).

Mukherjee and Banerjee (1980) reported that, at high environmental temperature, body responds to it by increasing respiration rate, pulse rate and body temperature.

Black *et al.* (1993) observed that as ambient temperature increases above the zone of thermal comfort, thermoregulation could be achieved only by increasing evaporative heat loss from lungs and skin. Pigs have few sweat glands, so evaporative heat loss is achieved through increase in respiratory rate and wetting of skin.

Brown-Brandl *et al.* (2001) reported acute heat stress had significant effect on total heat production, respiratory rate and body temperature of swine and found that respiration rate was a leading stress indicator.

2.2.3. Pulse Rate

Hertz and Steinhauf (1978) concluded that the effects of heat stress on cardiac rate were inconsistent.

The pulse rate reflects primarily the homeostasis of circulation along with the general metabolic level. It increases on exposure to high environmental temperature. This increased blood flow from core to surface gives a chance for more heat to be lost by sensible and insensible ways. At high temperature, it may decrease (Yousef and Johnson, 1986) due to decrease in metabolic rate of animals under heat stress.

It was showed that pulse rate does not always change appreciably under higher environmental temperatures (Marai., *et al.* 1991).

Sebastian (1992) found that the pulse rate of Large White Yorkshire pigs was in the range of 64 to 73.

Joseph (1997) reported higher pulse rate in pigs housed in open sties with out facility for wallowing or water sprinkling than pigs housed in open sties with facility for wallowing and water sprinkling at hours of the day.

2.3. BEHAVIOUR

2.3.1. Feeding Behaviour

Mikesell and Kephart (1999) reported that separately penning barrows might have improved growth performance and the pigs appeared to become less competitive and spend less time eating, as they grew heavier and the penning arrangement did not affect feeding behaviour.

According to Bornett *et al.* (2000), group housed pigs make less frequent feeder visits of longer duration and eat at a faster rate than pigs housed individually.

Dinesh (2000) observed that during feeding time all the animals tried to displace their pen mates from the manger.

According to Sukemori *et al.* (2001) the physical condition of feed such as form and hardness will influence the feeding behaviour and feed intake of pigs.

Deepa (2004) inferred that the pigs showed great excitement and eagerness towards feed as they were housed in groups.

Anton (2005) reported that pigs fed with unconventional feed showed better feeding behavioural scores. This may be due to the palatability of unconventional feed. But statistically the differences between the treatment groups were not significant.

2.3.2. Agonistic Behaviour

Rushen (1987) observed that mutual chronic aggression affected growth rate than the intense fighting, shortly after the pigs have been mixed.

Dinesh (2000) revealed that LWY pigs were the most aggressive breed at the time of feeding while Duroc pigs were comparatively quiet at the time of feeding.

Hayne and Gonyou (2003) suggested that the trauma caused by regrouping had resulted in a generalization of fear associated with an environmental change.

Anton (2005) observed that there were no significant differences in the agonistic behaviour scores between the treatment groups. Frequent attempts of tail biting, belly nosing and ear biting were recorded at the time of feeding. The aggressive behaviour of the group housed pigs at the time of feeding throw some light on the stress level of these pigs.

2.3.3. Eliminative Behaviour

Dinesh (2000) reported that pigs marked a definite area either near the waterers or near the wallowing tank for defaecation and urination.

Deepa (2004) conducted an experiment to study the effect of water sprinkling on the eliminative behaviour of pigs and observed that among the sprinkled and non-sprinkled pigs, the non-sprinkled animals voided more quantity of dung.

Anton (2005) observed that the differences between the treatments were found to be not significant. She also noticed that the pigs fed with conventional feed voided more quantity of faeces due to the increased bulkiness (fibre content).

2.4. STRESS

Duncan (1981) suggested that separation of boars from conspecifics for any prolonged period would be stressful. The extreme aggressiveness and intractable nature of stud boars, was due to the isolated conditions in which they were all too often kept.

Sanford *et al.* (1986) reported that increased plasma levels of adrenocorticotrophic hormone and several of adrenocortical hormones have been used in the assessment of stress. Changes in plasma or cerebrospinal fluid levels of other naturally occurring neuroactive or endocrine agents may also prove to be helpful in their assessment.

Bustamate *et al.* (1996) reported that arithmetical differences in serum cortisol level for the group penned and the individually penned pigs were not different (P>0.05) suggesting that the isolation of individually penning and the competitiveness of group penning were not relatively stressful on a comparative basis and also reported that individual penning did not alter the thyroid status and feed efficiency.

Franz-Schwarzenberger *et al.* (1996) reported that the route of excretion of steroid hormone metabolites varies considerably among species, and also between steroids within the same species. Steroid concentration in faeces exhibit a similar pattern to those in plasma, but have a lag time, which depending upon the species, can be from 12 hours to more than two days.

Jensen *et al.* (1996) suggested that although adaptive,"normalization" of the activity of the Hypothalamic-Pituitary-Adrenocortical (HPA) axis during long–term stress, which was accompanied by other long-term stress responses, has to be distinguished from habituation to the stressor. Consequently, used as separate measures, the basal level of plasma cortisol and the maximal capacity may not be reliable indicators of stress.

Palme *et al.* (1996) shown that faecal steroids might be unevenly distributed in the faecal balls of horses, swine and elephants.

Ruis *et al.* (1997) examined the circadian rhythmicity of salivary cortisol in growing pigs. The cortisol values were 1.19 ± 0.05 ng/ml in 12 weeks and 1.03 ± 0.06 ng/ml in 24 weeks of age. The concentrations were 1.01 ± 0.05 ng/ml in barrows and 0.86 ± 0.04 ng/ml in gilts.

Mostl *et al.* (1999) suggested that the hormones that were most involved in the body's response to difficult conditions were glucocorticoids, which have been shown to be good indicators of stress in a wide variety of captive mammals. Although smaller amounts of these metabolites were present in faeces, Enzyme Immuno Assay (EIA) works quite well in horses and pigs. They also observed that there was a significant increase in the concentration of cortisol metabolites in bovine, equine and porcine faeces after storage for one hour, four hours and 24 hours respectively.

Palme *et al.* (1999) opined that as more time elapses between secretion in blood and excretion in faeces, faecal hormone levels were relatively unaffected by the collection of the faeces sample, making faeces the ideal excreta for measuring hormonal indicators of chronic stress. In faeces, steroid metabolites were present mainly in unconjugated form, but in blood and urine as conjugates. Mean retention time of faecal radioactivity suggested that the passage rate of digesta (duodenum to rectum) played an important role in the time course of excretion of steroids.

Beattie *et al.* (2000) observed that, pigs from enriched environment had significantly higher cortisol levels at slaughter ($P<0.001$) and it is suggested that chronic activation of the pituitary-adrenal axis in barren environments led to the suppression of cortisol responses to acute stress. The higher cortisol levels in pigs from enriched environment have resulted from greater levels of behavioural activity.

Herskin and Jensen (2001) analysed the effect of different housing conditions on the stress level in weaned piglets. Piglets were divided into three groups namely isolated from each other (two), restricted to contact through wire mesh (two), and penned together (four). They found that isolated animals showed signs of stress, while limited physical contact through the mesh made it easier for the animals to adapt to their new environment.

Klont *et al.* (2001) reported that pigs from the barren environment had a significantly higher increase in cortisol from farm to slaughter, but no differences in behaviour were observed during the lairage period.

Schatz and Palme (2001) suggested that measuring cortisol metabolites in faeces should be a useful non-invasive tool for monitoring stress in carnivores and a broad approach, including such non-invasive methods for elucidating endocrine changes, to questions such as animal welfare (housing, handling and human-animal interaction) or various stress reactions in domestic and wild carnivores should be possible.

Mostl *et al.* (2002) found that, as faecal steroids may be unevenly distributed in the faecal balls, the sample might need to be mixed. As with urine, faecal samples can be preserved at -20°C.

Geetha (2003) found the minimum and maximum salivary cortisol values in piglets under different stress conditions were from 0.52 ± 0.19 to 3.5 ± 0.63 (μg/dl) at first week and from 0.42 ± 0.18 to 2.07 ± 0.13 (μg/dl) at eighth week respectively.

2.5. PROXIMATE COMPOSITION OF FEED SAMPLES

The proximate composition of garbage was 76.29, 11.95, 1.52, 7.59, 6.95, 71.96 and 1.73 per cent for moisture, CP, CF, EE, total ash, NFE and insoluble ash respectively and in swine mash feed the corresponding values was 20,50, 3.96, 5.04, 6.52, 54.09, 9.80 per cent in respectively (Michael *et al.*, 1973).

Gloridoss and Das (1983) estimated the percentage of dry matter, CP, EE, CF, NFE, ash, acid insoluble ash, Ca, P, digestible energy (Kcal/g) were 92.85, 21.20, 3.88, 3.92, 63.73, 7.27, 1.38, 2.94, 0.08 per cent and 3229 kcal/g respectively in standard concentrate diet whereas it was 19.62, 18.01, 9.35, 3.62, 59.72, 9.28, 0.38, 2.13, 0.54 per cent and 3957 kcal/g in kitchen waste samples respectively.

Srinivas and Sagar (1991) reported that the proximate composition of concentrate (on per cent of DM basis) was 92.40, 16.90, 6.02, 3.86, 62.20, and 11.02 respectively for DM, CP, EE, CF, NFE, Ash and for garbage it was 24.60, 13.60, 11.90, 0.82, 70.43, 3.25 respectively.

Singh *et al.* (1994) reported that the proximate composition of processed garbage was 85 per cent moisture, 13.07 per cent CP, 2.13 per cent CF, 5.96 per cent ether extract and 6.98 per cent of total ash respectively. Corresponding values for the concentrate was 18.12 per cent, 5.21 per cent, 3.82 per cent and 8.62 per cent respectively.

Sarma *et al.* (1996) reported that garbage had 5.25 crude protein while the finisher mash was having 11.70 per cent crude protein on fresh matter basis.

Myer *et al.* (1996) suggested that dehydration of food residuals has the potential to produce a nutritious feedstuff for swine while offering a viable solid waste disposal option. The average composition of dehydrated food residues was 11.4 per cent moisture, 15 per cent protein, 13.8 per cent crude fat, 10.4 per cent crude fibre and 5.8 per cent ash.

Rivas *et al.* (1996) assessed dehydrated edible restaurant waste (DERW) as a feedstuff for swine by determining the nutrient composition and digestibility. The chemical composition of DERW was 92.1, 22.4, 23.2, 2.3 and 5.4 per cent for dry matter, crude protein, crude fat, crude fiber and ash respectively.

Ravi and Reddy (1997) analysed the proximate composition of the garbage kitchen waste in Andhra Pradesh and found 78.92, 9.68, 3.13, 6.96, 76.36 and 3.87 per cent respectively for moisture, CP, CF, EE, NFE and total ash.

Ravi *et al.* (1999) in Andhra Pradesh stated that proximate composition of grower ration was 18.69, 6.67, 5.32, 9.54, 59.88 and 3.78 per cent CP, CF, EE, Total ash, NFE and acid insoluble ash of respectively.

Harikumar (2001) in Kerala, reported that the proximate analysis of chicken offal was recorded a crude protein content of 35.63 per cent and ether extract of 30.9 per cent. Concentrate, restaurant waste and hostel waste were recorded a higher NFE content.

Chinnamani (2003) reported that the pigs fed with swill feed had the chemical composition of feedstuff was evaluated in terms of per cent DM, CP, CF, EE, NFE, Total ash and moisture. The corresponding values were 20.34, 14.06, 3.33, 16.17, 61.32, 5.10 and 77.65 respectively.

Ranjan *et al.* (2003) reported that crude protein value of hotel waste was 26.23 per cent and explained it may be due to the fact that hotel waste contain excellent quality feed material viz., meat, bread, panneer, vegetable, rice, pulse etc.

Proximate analysis of different feedstuffs in the field units of Thrissur district in Kerala revealed high moisture content for vegetable waste followed by hotel waste and chicken offal. Chicken offals had the highest CP followed by vegetable waste and hotel waste. The ether extract value was highest for chicken offal (40.2) followed by hotel and vegetable waste at 21.2 and 22.32 per cent respectively (Anil, 2005).Similar trend was also observed by Kannan (2006).

Anton (2005) observed the CP content of swill, chicken waste, infertile eggs, grower and finisher ration. It was 8.36, 21.30, 16.68, 18.20 and 14.10 per cent respectively.

2.6. EFFECT OF SYSTEMS OF FEEDING ON THE PRODUCTION PERFORMANCE OF PIGS

2.6.1 Concentrate *versus* Swill Feeding

2.6.1.1 Body Weight

Prabhakar (1984) recorded a live weight of 78.43±7.08 at the slaughter age in Large White Yorkshire pigs reared under intensive system in Andra Pradesh.

Kumar *et al.* (1990) reported that among three genetic groups viz., desi, Landrace x desi (Halfbred) and Landrace pigs, the body weight halfbred was in between two pure breeds (Landrace and desi).

Pradhan (1993) found that the average body weight increased from 9.00 ± 0.34 kg at weaning to 74.98 ± 1.34 kg at 32 nd week of age in Large White Yorkshire pigs.

The body weight of pigs had increased progressively from weaning (9.64 ± 0.82 kg) to eight month of age (83.48 ± 2.70 kg) indicating that as age advanced the body weight also increased (Kannan, 1995).

The body weight of indigenous pigs at the end of 32 weeks were 40.43 ± 2.70 (Izatnagar), 31.78 ± 1.39 (Jabalpur), 42.91 ± 1.04 (Tirupati), 38.05 ± 1.44

(Khannapara), 31.32 ± 0.45 (Mannuthy), 33.01 ± 1.48 kg (Kattupakkam) respectively (Anon,1997).

Joseph (1997) reported that the body weight of pigs increased from weaning (12.6 ± 0.65 kg) to fifth month of age (42.813 ± 3.75 kg).

Singh *et al.* (1997) observed that Large White Yorkshire pigs, had a slaughter weight of 114.31±1.01 kg.

Jha *et al.* (1999) observed that pigs reared on concentrates had a mean slaughter live weight value of 90.83 kg compared with pigs reared on hostel waste (86.7 kg).

Bhar *et al.* (2001) reared pigs on wheat bran based diets and deoiled rice bran diets. They found that on feeding DORB based diets all the responses were adversely affected and the animals could attain only 16.5 to 26.3 kg body weight by 112^{th} day of feeding in comparison to 35.24 to 37.15 kg in wheat bran based diets after 105 day of feeding.

Gustafson and Stern (2003) reported that there was no significant difference in body weight of pigs (110.4 Vs 114.1 kg) fed with 15 % extra metabolizable energy by increasing energy concentration or volume of a standard diet in addition to the pasture grazing. They suggested that an increment in ME intake up to 10 % can be carried out either by increasing feed volume or feed ME concentration in addition to grazing.

Ranjan *et al.* (2003) observed higher growth in growing piglets maintained on 75 % hotel waste + 25 % concentrate without grazing in comparison to 70 % rice fermented waste + paddy husk + green grasses with three to four hour grazing. They concluded that this may probably be due to the fact that hotel waste contain excellent quality feed materials *viz.*, meat, bread, paneer, vegetable, rice, pulses etc. which contain all essential amino acid and good quality of protein for better growth.

A feeding trial was conducted with feeding dusa and cashew nut testa as protein sources, to replace groundnut cake with performance of Large White Yorkshire x Landrace growing pigs. Feeding groundnut cake based concentrate feed gave significantly higher body weight than other treatment groups. It was concluded that these byproducts had a tremendous potential to alleviate shortage of protein components for feeding pigs without any adverse effect on the performance of pigs (Adesehinwa and Ogunmodede, 2004).

Devi and Singh (2004) found that replacing fish meal with soya bean meal during pre-weaning period had no significant effect on body weight, between treatment groups. They also opined that all the experimental piglets consumed more of milk and less of concentrate feed to satisfy their requirements. Therefore the synergestic effect of more milk and less feeds was responsible for exhibiting a similar gain in body weight in piglets in different experimental groups.

Lakhani *et al.* (2004) reported that genetic group had significant effect on 9^{th} month body weight of pigs. They recorded highest body weight in ¾ LWY + ¼ desi (45.541 ± 1.11) followed by ½ LWY + ½ desi interse (41.794 ± 2.44), ¾ LWY + ¼ desi interse (41.21 ± 1.91) , ½ LWY + ½ desi (39.563 ± 1.64) and desi (38.230 ± 1.91 kgs).

Pal *et al.* (2004) conducted an experiment using local and crossbred pigs that were fed with local feed alone under traditional management system compared with local feed supplemented with concentrate ration. Pigs attained body weight of 38.75 and 92.31 kgs under supplemented feeding system at one year of age in local and crossbred pigs respectively as against 20.94 and 41.17 kgs in traditional system.

Pradhan *et al.* (2004) observed that dietary supplementation of chitin in feed gave higher body weight at ten months of age than the control group which was fed with farm concentrate. This study was in Large White Yorkshire pigs.

Ravindra Kumar *et al.* (2004) observed that pigs maintained on mostly hotel waste had significantly higher body weight than other treatment groups which comprises mostly paddy husk, paddy husk and fermented rice waste fed groups.

Anil (2005) reported that Large White Yorkshire and crossbred (75 % Large White Yorkshire and 25 % Desi) pigs maintained in the field fed with swill feed attained significantly higher body weight (72.25 and 66.37 kg respectively) at slaughter (eight month) than the pigs fed with farm concentrate (60.1 and 55.4 kg respectively).

Kannan (2006) recorded body weight of 70.85 to 73.25 kg at the end of eight months of age in Large White Yorkshire pigs maintained under swill feeding.

It was inferred that the growth performance of Hampshire and Large White Yorkshire pigs was better when compared with the Mizo local pigs under Mizoram field conditions. Pigs attained body weight of 50.50 ± 0.34, 48.68 ± 0.42 and 32.88 ± 0.35 kg respectively at nine months of age. The lower body weight might be due to the feeding of pigs with low energy and high fibre diet and difference in other managemental practices adopted by the farmers (Kumaresan *et al.*, 2006).

2.6.1.2 Body Measurements

Deo and Raina (1983) stated that although the genetic correlation of body length with height at withers and barrel and chest girths were positive, it was non-significant at all ages between Large White Yorkshire and crossbred piglets.

Sahaayaruban *et al.* (1984) reported the highly positive correlation between body weight, body length, chest girth, shoulder height and hip width in pigs.

Dash and Mishra (1986) observed that there was no significant difference in body measurements between Large White Yorkshire and crossbred pigs.

Sinha *et al.* (1993) in Bihar reported that in pigs raised on hotel waste, of vegetarian and non-vegetarian composition, the body length was 81.44±1.04 and 107.88±1.70 cm chest girth 77.22 ± 5.92 and 99.56 ± 1.14cm and height at withers 59.87 ± 3.38 and 74.44 ± 0.82 cm respectively, when compared to the concentrate feeding 71.90 ± 1.56, 61.20 ± 1.61, and 54.45 ± 1.04 cm respectively.

Sinthiya (1998) recorded the body measurements such as length, girth and height which ranged from 76.8 to 82.0, 86 to 88.5 and 54.3 to 57.3 cm respectively for pigs maintained on rations containing varying proportions of carcass meal.

Bora *et al.* (2000) found that there was no significant difference in linear body measurements between boar and gilts fed with concentrate.

Ravindra Kumar *et al.*(2004) concluded that the pigs maintained mostly on hotel waste, had significantly higher body measurements viz., body length, height at withers and chest girth (cm) than other treatment groups which comprises mostly paddy husk ; paddy husk and crushed maize ; paddy husk and rice fermented waste.

Pradhan *et al.*(2004) observed that dietary supplementation of chitin fed groups had higher body length, height at withers and front girth in Large White Yorkshire pigs at ten months of age than the control group which was fed with farm concentrate.

Kannan (2006) observed that the there were no significant difference in body measurements namely body length, chest girth and height at withers of Large White Yorkshire pigs between swill feeding and pigs maintained under integrated farming.

2.6.1.3. Average Daily Gain

Kirby (1981) reported that the average daily weight gain was 0.55 kg in Large White Yorkshire pigs fed with boiled liquid swill.

A study on growth performance of Large White Yorkshire pigs fed with different feeding regimes *viz.* concentrate, kitchen waste plus fish meal, kitchen waste plus lysine, kitchen waste plus fish meal plus lysine group had a daily gain of 211,299, 210 and 259 g respectively. They concluded that kitchen waste plus 50g fishmeal evinced higher growth rate (Gloridoss and Das, 1983).

Dash and Mishra (1986) observed that there was no significant difference in weight gain between Large White Yorkshire and crossbred pigs.

It was recorded that the daily weight gain of 110, 140 and 47g in indigenous pigs reared under three different feeding regimes *viz.* concentrate, garbage feeding and scavenging respectively in Allahabad Agricultural Institute. It was concluded that the garbage fed pigs were superior in average daily weight gain than the other two groups (Srinivas and Sagar, 1991).

Average weight gain of 198.77 and 383.77g were obtained in Large White Yorkshire pigs feeding with garbage received from vegetarian and non-vegetarian hotels respectively, where as pigs fed with concentrate feed had a average daily gain of 126 g (Sinha *et al.*, 1993).

Pradhan (1993) found that the daily gain in weight increased from 131.62 ± 17 g at tenth week to a peak of 392.28 ± 9.34 g at 32nd week, and thereafter declined to 384.60 ± 6.98 g at 40th week of age.

Pigs showed progressive increase in the average daily weight gain from 137.84 ± 23.7 g at weaning to 439.28 ± 10.05 g at eight months of age (Kannan, 1995).

The average daily growth rate of Large White Yorkshire pigs fed with garbage was 238g compared to an average daily gain of 277g in pigs fed with finisher mash (Sarma *et al.,* 1996).

Mishra *et al.* (1997) reported that in piglets raised upto 24 weeks of age after weaning showed the average daily gain of 169.87 ± 9.51 g in females and 149.11 ± 21.75 g in males under Scavenging system using local breeds.

Ravi and Reddy (1997) recorded the average daily of 114 g per day in crossbred pigs (White Yorkshire x Desi pig) pigs fed with *ad libitum* garbage in growing phase.

A study conducted at the University of Florida, Gainesville by Myer *et al.* (1999) revealed that the average daily gain from concentrate feeding, dehydrated food waste in 40% and 80 % level were 0.91, 0.91 and 0.90 kg respectively.

Protein from unsalted dried fish when replaced by silk worm pupae by 50 per cent and 100 per cent level, a cumulative average daily gain of 510.1 and 495.7g respectively, obtained in Large White Yorkshire pigs (Ramamurthi, 1999).

Hati *et al.* (2000) observed that when maize from conventional feed was replaced by marva 33.3 per cent, 66.6 and 100 per cent levels there was significant improvement in weight gain of last two groups from 16th to 28th weeks of age.

However difference between maize feed and 33.3 per cent substituted by marva and between 66.6 and 100 per cent substitution were non significant at all ages.

Suraj (2000) observed the mean average daily gain in weight of Large White Yorkshire, crossbred and Desi pigs. It was 420 $\pm$ 0.63, 330 $\pm$ 0.46 and 234 $\pm$ 0.36 g respectively and the body weight of Large White Yorkshire, crossbred and Desi pigs were same from weaning to third month of age after that it varied up to slaughter age. The maximum average daily weight gain was noticed during fifth month of age in all three genetic groups.

A comparative study between pigs in the organized farm and field units in two adopted villages of Thrissur district found that the pigs reared on 40 per cent chicken offal and 60 per cent restaurant waste recorded a significantly higher weight gain than the pigs maintained under concentrate feed (Harikumar, 2001).

Yadav *et al.* (2001) studied different levels of incorporation of rice polish in pig ration. They concluded that incorporating 80 per cent of rice polish in the diet gave an average daily weight gain of 275.19 $\pm$ 10.22 g.

Gustafson and Stern (2003) reported that there was no significant difference in average daily gain of pigs (879 Vs 912 g) fed with 15 % extra metabolizable energy by increasing energy concentration or volume of a standard diet in addition to the pasture grazing.

Ranjan *et al.* (2003) studied effect of feeding different levels of hotel waste and rice fermented wastes in Tamworth and Desi crossbred pigs. They recorded average daily weight gain of 248.42 and 230.67 g for hotel waste and rice fermented waste respectively.

Adesehinwa and Ogunmodede (2004) found that feeding of LWY x LR grower pigs with groundnut cake based concentrate feed had significantly higher ADG than pigs fed with dusa and cashew nut testa as protein source.

Pradhan *et al.*(2004) observed that dietary supplementation of chitin fed groups had higher average daily gain than the control group which was fed with farm concentrate in Large White Yorkshire pigs.

Large White Yorkshire in the field fed with swill had significantly higher ($P<0.01$) average daily weight gain than in the farm fed with concentrate feed. There was no significant difference in weight gain between pure and crossbred pigs in different forms of feeding (Anil, 2005).

Kannan (2006) noticed that there was no significant difference in average daily weight gain of Large White Yorkshire pigs fed with different forms of swill feeding in the field pig production system.

Kumaresan *et al.* (2006) inferred that the average daily gain of Hampshire and Large White Yorkshire pigs was significantly higher when compared with the Mizo local pigs under Mizoram field conditions. Pigs attained daily gain of 0.184 ± 0.001, 0.170 ± 0.001 and 0.120 ± 0.01 kg respectively at nine months of age. The lower daily gain might be due to the feeding of pigs with low energy and high fibre diet and difference in other managemental practices adopted by the farmers.

2.6.1.4. Feed Intake

Ramachandran *et al.* (1992) reported that prawn waste ensiled with rice bran in equal proportion with the addition of tapioca flour at 10 per cent level could be incorporated in the pig ration.

Westendorf *et al.* (1998) observed that during the growing phase, the corn/soya meal fed group gained significantly higher than the FW plus supplement fed groups followed by groups fed with FW alone. They also suggested that pigs consume nearly four times the volume of FW to obtain the same amount of dry matter of a conventional feed.

Faustin *et al.* (2003) reported that the diet incorporation of maize or sorghum in swine ration would provide approximately 30 per cent of the pigs requirements of lysine and methionine, which were the most limiting amino acids in pig feeds. They also observed that supplementation of diet with 20 per cent from animal origin may increase the amino acid provision to about 80 per cent.

Gustafson and Stern (2003) reported that there was no significant difference in average daily feed intake of pigs (2.56 Vs 2.64 kg DM) fed with 15 % extra metabolizable energy by increasing energy concentration or volume of a standard diet in addition to the pasture grazing. They suggested that an increment in ME intake up to 10 % can be carried out either by increasing feed volume or feed ME concentration in addition to grazing.

Kuriakose *et al.* (2003) found that hatchery waste along with rice bran can be included to 50 per cent in the ration of pig after proper treatment.

Adesehinwa and Ogunmodede (2004) found that feeding of Large White Yorkshire x Landrace grower pigs with groundnut cake based concentrate feed had consumed less feed (1.44 Vs 1.69 and 1.56 kg) than other treatment groups fed with dusa and cashew nut testa as protein source. They concluded that these byproducts had a tremendous potential to alleviate shortage of protein components for feeding pigs without any adverse effect on the performance of pigs.

Pradhan *et al.* (2004) observed that dietary supplementation of chitin fed groups consumed less feed per kg weight gain at ten months of age than the control group which was fed with farm concentrate in Large White Yorkshire pigs.

On dry matter basis the difference noted in daily feed intake between the treatment groups (concentrate; swill feed) and between the breeds (Large White Yorkshire and their crossbreds) were found to be non significant (Anil, 2005). Similar findings were also reported by Anton (2005) in crossbred pigs and Kannan (2006) in Large White Yorkshire pigs under different forms of swill feeding.

2.6.1.5 Feed Efficiency

Dash and Mishra (1986) observed that there was no significant difference in feed efficiency between Large White Yorkshire and crossbreds. They also opined that feed efficiency decreased as increase slaughter age.

Kumar *et al.* (1990) reported that among three breeds of pigs viz., desi, Landrace x desi (Halfbred) and Landrace pigs, feed efficiency was better in Landrace (4.16) followed by halfbred (4.79) and desi (5.76).

Singh *et al.* (1997) observed that cumulative feed conversion ratio was 3.38 and 3.62 for Large White Yorkshire and crossbreds respectively.

Gustafson and Stern (2003) reported that there was no significant difference in feed conversion ratio of pigs fed with 15 % extra metabolizable energy by increasing energy concentration or volume of a standard diet in addition to the pasture grazing.

Adesehinwa and Ogunmodede (2004) found that feeding of Large White Yorkshire x Landrace grower pigs with groundnut cake based concentrate feed had feed conversion ratio of 3.10 which was significantly better than other treatment groups fed with dusa (5.07) and cashew nut testa (4.00) as protein source.

Pradhan *et al.* (2004) observed that dietary supplementation of chitin fed groups had better feed conversion ratio than the control group which was fed with farm concentrate in Large White Yorkshire pigs.

Large White Yorkshire and their crossbreds (75 % Large White Yorkshire x 25 % Desi) had a significantly ($P<0.01$) higher feed conversion efficiency in the field fed with swill than the animals fed on concentrate feed in the farm (Anil, 2005).

2.6.1.6 Carcass characteristics

The dressing percentage of 70.39, loin eye area 16.56 cm^2 and back fat thickness 3.10 cm. was recorded in indigenous pigs reared traditionally on food wastes and scavenging (Prabhakar, 1984).

The higher dressing percentage of 75.12 per cent was obtained in Large White Yorkshire pigs fed with non vegetarian hotel waste followed by 70.35 and 68.15 with vegetarian hostel waste and concentrate feeding group (Sinha *et al.*, 1993). A higher back fat thickness of 2.20 cm with vegetarian garbage feeding and 2.00 and 1.30 cm in non-vegetarian and concentrate feed groups in Large White Yorkshire pigs respectively were reported. The carcass length in Large White Yorkshire pigs maintained on vegetarian and non-vegetarian hotel waste as 67.15, 72.55 cm respectively compared to 59.00 cm in concentrate fed groups.

Sarma *et al.* (1996) observed that back fat thickness of Large White Yorkshire pigs fed with garbage feed was 1.80 ± 0.24 and finisher feed fed pig was 1.83 ± 0.38 cm .

Bhadoria (1996) reported a slaughter weight of 41-50, 51-60, 61-70, 71-80, 81-90 kg and corresponding carcass weight of 28.76 ± 0.21, 38.01 ± 0.33, 49.26 ± 0.86, 55.40 ± 0.71, 66.05 ± 0.67 kg, Dressing percentage of 61.58, 64.77, 68.14, 71.90, 73.38 and back fat thickness was 1.23±0.06, 1.60±0.06, 2.28±0.08, 2.48±0.07 and 2.78±0.08 cm respectively.

Jha *et al.* (1999) in Bihar observed that the back fat thickness was significantly higher in concentrate fed group (29.55 ± 1.033 mm) than hotel waste plus concentrate fed group (24.12± 0.74 mm) and kitchen waste plus grazing group (19.28 ±0.68mm). A longer carcass length in concentrate fed group as 87.16± 1.05cm followed by hotel waste plus concentrate fed group 80.21±1.10cm and the carcass length in kitchen waste plus grazing group was 63.06±1.11cm. The highest loin eye area was in concentrate fed group (27.55±0.99 cm^2) followed by hotel waste plus concentrate fed (23.29±0.91 cm^2) and kitchen waste plus grazing (15.31±0.49 cm^2) groups.

The carcass weight, loin eye area, percentage lean and back fat thickness was higher in pigs fed on complete feed than swill fed group (Chen *et al.*, 1997). It was also found that unsaturated fatty acid content was higher in swill fed pork.

Hati *et al.* (2000) observed that when maize from conventional feed was replaced by marva 33.3, 66.6 and 100 per cent. The values recorded with respect to back fat thickness, carcass length and loin eye area were non significant among groups.

Harikumar (2001) reported that pigs maintained in the field units of Thrissur district fed on 40 per cent chicken offal and 60 per cent restaurant waste were recorded a maximum value for dressing percentage (75.52±0.41). Pigs fed on concentrate ration attained a maximum of 19.36± 2.2 cm^2 for loin eye area and a minimum of 28.0±0.22 mm for back fat thickness. Meat bone ratio was the lowest in pigs fed on hostel food waste (3.53±0.19). Hot carcass weight (55.66± 2.49 kg) and carcass length (65.00 ± 0.83 cm) was more in pigs fed on 40 per cent chicken offal and 60 per cent restaurant waste.

Gustafson and Stern (2003) reported that pigs fed with 15 % extra metabolizable energy by increasing energy concentration had significantly higher dressing percentage than by increasing volume of a standard diet in addition to the pasture grazing. They suggested that an increment in ME intake up to 10 % can be carried out either by increasing feed volume or feed ME concentration in addition to grazing.

Carcass characteristics did not vary significantly among the animal fed on concentrate and swill feeding animals with respect to the carcass length, loin eye area, hot deboned meat and meat bone ratio. Swill fed animals had a significantly higher back fat thickness than the concentrate fed animals in a Kerala Agricultural University study (Anil, 2005).

Kannan (2006) reported that Large White Yorkshire pigs had slaughter weight of 69.85 to 72.43 kg , dressing percentage 73.46 to 73.52 , back fat thickness 32.46 to 36.81 mm, loin eye area 15.82 to 16.76 cm^2 and meat bone ratio 4.04 to 4.28 at eight months of age under swill feeding in the field.

Magna *et al.* (2006) showed that hot carcass weight, dressing percentage, hot boned meat yield percentage, meat: bone ratio was significantly higher in the weight group of 70-90 kg compared to above 90 kg group in Large White Yorkshire pigs. They also concluded that dressing percentage begins to show a decreasing trend above 90 kg body weight in LWY pigs.

2.6.2. Organic *versus* Inorganic Mineral Supplementation

2.6.2.1. Body Weight

Wenk (1994) evaluated multiple forms of Cr such as Cr chloride, Cr yeast and Cr picolinate and reported no performance effects of Cr in the growing period (27-60 kg), but Cr increased growth rates in the finishing period (60-106 kg).

Zhou *et al.* (1994) compared CuSO4 with Cu-lys when provided in the diet to weanling piglets over a 24 day period and found that piglets on the Cu-lys diet had significantly higher growth rates than those fed the CuSO4 diets. Similar results were reported by Coffey *et al.* (1994) who evaluated the efficacy of Cu-lys as growth promotant for weanling pigs.

There was no concrete evidence showing significant difference in growth rate of weanling pigs to organic forms of iron compared with iron sulfate (Lewis *et al.*, 1995).

Apgar and Kornegay (1996) reported that there was a significant improvement in growth rate (14.3 %) for weanling piglets fed Cu-lys than those fed with CuSO4.

Mahan and Parrett (1996) found that there was significant difference in growth rate when either inorganic or organic form of Se was added at various levels to growing/finishing cereal grain-based diets for pigs.

Ward *et al.* (1996) reported that the growth response of weanling pigs was similar between those fed 250 ppm of zinc from zinc-met complex and 2000 ppm zinc from zinc oxide, which suggests an increase in the bioavailability of zinc in zinc-met.

Close (1999) stated that pigs fed diets supplemented with organic copper recorded similar level of performance as those fed diets supplemented with inorganic Copper.

In a study Smits and Henman (2000) observed that improvement on growth rate was only in the grower stage by increasing feed intake but not at the finishing period.

Lee *et al.* (2001b) indicated that the efficacy of chelated Zn and Cu sources at low levels were not statistically different ($p>0.05$) in terms of growth performance and in maintaining serum concentrations from that of high levels of inorganic Zn and Cu sources.

Sekar *et al.* (2006) assessed the effect of chelated mineral on growth performance of Large White Yorkshire pigs and observed a body weight of 78.50, 82.33 and 88.83 kg for control diet (standard ration with 1 per cent mineral mixture), control diet supplemented with 0.5 per cent chelated minerals and control diet supplemented with 0.5 per cent mineral mixture and mineral mixture replaced with 1 per cent dicalcium phosphate at 8 months of age

2.7.2.2. Average Daily Gain

Hahn and Baker (1993) observed no improvement on ADG of weanling pigs fed 3000 ppm Zn from chelated Zn-lys and Zn-met.

Harper *et al.* (1995) examined the effect of adding 200 ppb Cr from Cr picolinate to diets of pigs weaned at 29 days of age and observed that Cr supplementation resulted to an significant improvement in daily gain ($p<0.05$).

According to Apgar and Kornegay (1996), ADG tended to be higher for weanling piglets fed Cu-lys than those fed with CuSO4 and at similar levels of feed intake growth rate was 14.3% higher for the pigs fed Cu-lys than CuSO4 .

Smith *et al.* (1997), who evaluated the potential interactive or additive effects of growth-promotional levels of Zn and Cu on weanling pig performance. They observed decreased ADG ($p<0.01$) in pigs fed the diets with 250 ppm Cu, with or without 3,000 ppm Zn compared with pigs fed either the control diet or the diet with only 3,000 ppm added Zn.

Lee *et al.* (2001a) demonstrated higher ADG in pigs fed diet with 120 ppm Zn from zinc-met than the control group (ZnSO 4).

Large White Yorkshire pigs fed with diet containing 0.5 per cent chelated minerals and mineral mixture replaced with 1 per cent dicalcium phosphate had higher ($P<0.05$) average daily gain than those fed with unsupplemented diet (Sekar *et al.*, 2006).

*2.7.2.3. **Feed Intake***

Page *et al.* (1993) found that there was a significant increase in feed intake of growing/finishing pigs fed with organic Cr from Cr picolinate (2.25 kg / d) compared to Cr from Cr chloride (2.08 kg / d) and basal diet (2.09 kg / d).

Zhou *et al.* (1994) compared CuSO4 with Cu-lys when provided in the diet to weanling piglets over a 24 day period. The piglets on the Cu-lys diet consumed more feeds than those fed the CuSO4 diets. Similar results were reported by Coffey *et al.* (1994) who evaluated the efficacy of Cu-lys as growth promotant for weanling pigs.

2.7.2.4. Feed Efficiency

Page *et al.* (1993) observed that there was a significant improvement in feed efficiency of growing/finishing pigs fed with organic Cr from Cr picolinate compared to Cr from Cr chloride and basal diet.

Harper *et al.* (1995) examined the effect of adding 200 ppb Cr from Cr picolinate to diets of pigs weaned at 29 days of age and observed that Cr supplementation resulted to an significant improvement in feed efficiency ($p<0.05$).

Large White Yorkshire pigs fed with diet containing 0.5 per cent chelated minerals and mineral mixture replaced with 1 per cent dicalcium phosphate had higher feed conversion ratio (4.04 Vs 5.17) than those fed with unsupplemented diet (Sekar *et al.*, 2006).

2.7.2.5. Carcass Characteristics

Grower / finisher pigs fed with organic Cr from Cr picolinate had reduced 10th rib fat, increased loin eye areas and percentage muscling compared to inorganic Cr from Cr chloride and basal diet. However there was no significant difference between groups in dressing percentage (Page *et al.*,1993).

The work of Lindemann *et al.* (1995) demonstrated a similar response of decreased backfat and increased loin eye area when 200 ppb of Cr from Cr picolinate was fed in diets with 100 or 120% of NRC (1998) lysine requirement for growing-finishing pigs. Similar findings were also reported by Mooney and Cromwell (1995). These beneficial effects of Cr were probably mediated through the action of the growth-promoting hormones which repartition nutrients were in favor of lean rather than fat deposition (Close, 1999).

Mahan *et al.* (1999) observed that there was significant difference in carcass characteristics resulted from either Se source or level. There was a trend for higher drip loss and increased loin paleness; low carcass quality when inorganic Se level increased.

2.8. ECONOMICS OF PRODUCTION

Feed cost formed the major component in pig production (Selvakumar *et al.*, 1993). They accounted 72.25 per cent in small units with sows less than six and 79.58 per cent in large units with sows more than six. They also observed that return per rupee of investment was Rs.1.17 for small unit and Rs.1.38 for large unit.

Ravi and Reddy (1996) reported that, compared to balanced ration, cost per kg of gain in crossbred Large White Yorkshire pigs could be reduced by 40 per cent on garbage feeding.

The total economic cost was negatively correlated and net return positively correlated with the farm size (Sharma *et al.*, 1997). The average net return for large herds (more than 75 sows) was higher than for small (less than 25 sows) and medium herds (25 to 75 sows).

Rajiv and Pandey (1998) found that in different systems of feeding pattern, the net return per pig under exclusively hotel waste feeding category was the highest in medium and large size farms. They also concluded that amongst different systems of feeding, the annual total working cost per pig was the highest under cereals-vegetables-fodder, molasses category in small farmers, cereals-vegetables-fodder in medium farmers category and exclusively hotel waste under large farmer category.

Kumar *et al.* (2000) found that the feed cost per unit gain in body weight was lowered by 9.5 per cent on diet containing soybean and 6.08 per cent on soybean supplemented with lysine and methionine compared to fish meal containing diet.

Rearing pigs entirely on concentrate feed was uneconomical, but the integration of fish and vegetable to the production could improve the productivity of such systems with the improvement in overall economic efficiency. Integration of piggery with agriculture and fish is the most economical integrated pig farming system in Kerala (Suraj *et al.*, 2000).

Yadav *et al.* (2001) reported cost per kg gain in rupees as 34.55, 34.99, 36.39 and 40.06 with conventional concentrate mixture (control), conventional concentrate mixture supplemented with GNC and soya flakes, GNC alone and soya flakes alone respectively.

Harikumar (2001) studied that higher level of productivity and feasibility of pig production under swill fed regime. The performance of pigs reared in small field unit on 40 per cent chicken offal and 60 per cent restaurant waste was found better than concentrate and hotel waste alone in field units of Thrissur district.

Ravindra Kumar *et al.* (2004) concluded that hotel waste should be utilized for better return from pig farming.

Sharma *et a*l. (2004) reported increased duck and fish production and decreased input cost on fish culture operation by integrating fish culture with duck rising in Bihar.

Anil (2005) in a Kerala Agricultural University study, reported that the average cost of production of one kg fattener pig was Rs.64.56 and Rs.66.16 for crossbred and Large White Yorkshire in the orgainsed farm and Rs.21.92 and

Rs.23.45 for Crossbred and Large White Yorkshire maintained on swill feeding in the field.

Anton (2005) reported cost of production per kg live weight in crossbred pigs namely Large White Yorkshire x Desi and Duroc x Large White Yorkshire were Rs.26.55, 30.45, 11.36 and 10.56 for concentrate and swill feeding respectively.

Cost of production per kg live weight was Rs.36.78, 33.04 and 28.35 for control diet (standard ration with one per cent mineral mixture), control diet supplemented with 0.5 per cent chelated minerals and control diet supplemented with 0.5 per cent mineral mixture and mineral mixture replaced with one per cent dicalcium phosphate in Large White Yorkshire pigs (Sekar *et al.*, 2006).

MATERIALS AND METHODS

3. MATERIALS AND METHODS

A study was conducted to assess the growth performance and adaptability of Large White Yorkshire and three breed combinations under farm and field conditions and to recommend a breed combination as well as management practices suited to the agro-climatic zone. Facilities available at the Department of Livestock Production Management, Centre for Pig Production and Research, Centre of Excellence in Meat Science and Technology (LPT) of the College of Veterinary and Animal Sciences, Mannuthy and Radio Tracer Laboratory, Kerala Agricultural University were utilised for the study.

3.1 LOCATION

This study was designed in such way that the control group was maintained at Centre for Pig Production and Research, Mannuthy and these animals were fed standard concentrate ration. For the field study, progressive farmers from the neighbouring Panchayats of Thrissur district were selected and were supplied with piglets as fatteners. These animals were fed with hotel waste, restaurant waste, chicken waste and vegetable wastes.

3.2 SELECTION OF EXPERIMENTAL ANIMALS

Twenty gilts were selected from Large White Yorkshire and also each combination of Large White Yorkshire (LWY) x Landrace (LR), Landrace x Desi and Large White Yorkshire x Desi for the study. After attaining maturity, they were bred to terminal sire (Duroc). Large White Yorkshire was maintained as pure line. The litter performance of four genetic groups viz., litter size at birth, litter weight at birth, birth weight, litter size at weaning, litter weight at weaning and weaning weight were comparatively evaluated. Twenty four piglets (males were castrated) were selected at random from each genetic combination. They were divided into four groups having six animals in each group.

3.3 MANAGEMENT

The weaned piglets from each genetic group were allotted to four treatments with respect to feeding systems. Management practices prevailing in the farm were followed throughout the experimental period with respect to control group (T1). These piglets were fed with standard concentrate ration having 18 per cent crude protein up to the age of five months and with 14 per cent crude protein during the rest of the study period. Pigs belonging to T2, T3 and T4 from each genetic group were supplied to progressive farmers from neighbouring Panchayats of Thrissur District, Kerala and the animals were fed with left over food from hotels, restaurants, slaughter house waste and waste available from agricultural fields. In addition to this, T3 group were supplemented with inorganic minerals (Ca, P, Mn, Zn, Fe, Cu, Co, Iodine, Sulphur and Fluorine) and T4 group were supplemented with organic minerals (Ca, P, Mn, Zn, Fe, Cu, Co and Iodine) @ one per cent level on dry matter basis throughout the experimental period. Two times feeding was followed every day. Monthly deworming and spraying for ectoparasite control were practised.

3.1. Allocation of Experimental Animals to Different treatments

Breeds	**T_1- Control**	**T_2-Swill alone**	**T_3- Swill + Inorganic minerals**	**T_4- Swill + Organic minerals**
Large White Yorkshire	6	6	6	6
Duroc x (LWY x LR)	6	6	6	6
Duroc x (LR x Desi)	6	6	6	6
Duroc x (LWY x Desi)	6	6	6	6

3.3. CLIMATOLOGICAL DATA

The maximum and minimum temperature (^{0}C) and relative humidity (%) in the sties were recorded daily with the help of Digital Hygrotherm (Sisedo). The relative humidity was recorded at eight am (RH_1) and at two pm (RH_2). The daily mean relative humidity was calculated. The meteorological data over a period of Sept.2005 to Jan. 2007 were obtained from the meteorological observatory unit attached to the College of Horticulture, Vellanikkara. Mean sunshine (hrs) and rainy days were collected to study the effect of macro-climatological influence on the growth of pigs.

3.4. PHYSIOLOGICAL RESPONSES

Rectal temperature, pulse and respiration rate of animals were recorded twice on a day at eight am and two pm at weekly intervals throughout the experimental period.

3.5. BEHAVIOUR

The feeding and agonistic behaviour of all the experimental animals were studied based on score sheet described in Table 3.2 and 3.3. Eliminative behaviour was quantified by recording the frequency of defaecation and the quantity of faeces voided. Behaviour sampling methods described by Martin and Bateson (1988) were used in the present study to observe each individual for a specified amount of time.

Table 3.2. Feeding Behaviour

Sl.No	Description	Score
1.	Eating greedily with drooling of saliva	3
2.	Exploring the pen and eating with grunt and drooling of saliva	2
3.	Eating calmly	1
4.	Not showing any interest towards feeding	0

Table 3.3. Agonistic Behaviour

Sl.No	Description	Score
1.	Ear biting, belly nosing and tail biting very frequently	3
2.	Ear biting, belly nosing and tail biting frequently	2
3.	Ear biting, belly nosing and tail biting occasionally	1
4.	Nil	0

3.6. RADIOIMMUNOASSAY OF FAECAL CORTISOL

To assess the stress level in different genetic groups of pigs reared in different feeding systems faecal cortisol level was estimated using radioimmunoassay (RIA).

3.6.1. Collection and Storage of Faecal Sample

Faecal samples were collected at fortnightly interval from all the animals immediately after voidance. They were kept in polythene pouches and stored at -20^{0}C till extracted for RIA (Khan *et al.*, 2002).

3.6.2. Extraction of Cortisol for Radioimmunoassay

The faecal samples stored at -20^{0}C was crushed in the polythene pouch itself and thawed. Then 0.5 gram per 50 gram of homogenized wet faeces was extracted with two ml distilled water and three ml methanol. After vortexing the mixture for 30 minutes it was centrifuged at 2500 rpm for 15 minutes. A 0.5 ml aliquot of the supernatant was taken and stored in a screw capped vial. The remaining supernatant was decanted and the faeces residue in the centrifuge tube was again extracted with three ml methanol same as before. Again 0.5 ml of the supernatant was taken and mixed with the aliquot already taken in the screw capped vial. The methanol extracts were stored at –20^{0}C until RIA analysis (Palme *et al.*, 1996).

3.6.3. Radioimmunoassay of Faecal Cortisol

Faecal cortisol concentrations were measured using Clinical Assays™ Gamma Coat ™ Cortisol ^{125}I RIA Kit (DiaSorin, Stillwater, Minnesota, USA). From the six different cortisol standards 0, 1, 3, 10, 25 and 60 (μg/dl) supplied with the kit, 10μl each were incubated with one ml tracer buffer reagent in six antibody-coated tubes (rabbit anti-cortisol serum). Similarly, 10μl of the methanol extract of faecal sample was incubated with tracer buffer reagent in antibody-coated tubes.

The antibody was immobilized onto the lower inner wall of the Gamma Coat tube. After incubation for 45 minutes at 37 ± 2^0 C in a water bath, the contents of the tube were decanted. The counts per minute (cpm) bound for each tube were counted in 1480 WIZARD ™ Automatic Gamma Counter for one minute with the window suitably adjusted for iodine-125. A standard curve was plotted with cpm values and cortisol concentration on semi logarithmic graph paper. Unknown values were interpreted from the standard curve. Results were tested by analysis of variance (ANOVA) using the model.

3.7. GROWTH STUDY

3.7.1. Monthly Body Weight

Body weight of each animal was recorded at monthly intervals. Weighing was carried out in the morning before feeding and watering. The average monthly body weight was estimated from second month to ten months of age.

3.7.2. Linear Body Measurements

Linear body measurements like body length, chest girth and height at wither were measured (cm) by using a standard measuring tape at the time of body weight recording.

3.7.2.1. Body Length

Body length was measured from top of the head in between the ears to the base of the tail.

3.7.2.2. Chest Girth

The circumference of the chest just behind the point of elbow was taken in centimetres as the girth.

3.7.2.3. Height at Wither

Height of the animal was measured in centimetres at the top of the wither to the ground level of hoof.

3.7.3. Average Daily Weight Gain of Pigs

An average daily weight gain of pigs, was calculated by the following formula (Brody, 1945).

$W = W_2 - W_1 / T_2 - T_1$, where

W_1 – Initial body weight T_1 – Initial time unit

W_2 – Final body weight T_2 – Final time unit

3.7.4. Average Daily Feed Intake

Average daily feed intake was calculated on both fresh weight and dry matter basis. The difference between the total quantity of feed given and the amount of feed left after 24 hours was taken to calculate the average daily feed intake.

3.7.5. Feed Conversion Efficiency of Pigs

Feed conversion efficiency of pigs groups were worked out on dry matter basis of feed (Banerjee, 1998).

$$\text{Feed efficiency} = \frac{\text{Feed consumed}}{\text{Body weight gain}}$$

3.8. PROXIMATE ANALYSIS

Proximate composition viz. moisture, dry matter, crude protein, crude fibre, ether extract, total ash and nitrogen free extract of the conventional and unconventional feeds namely chicken waste, hotel waste and vegetable waste were estimated as per the AOAC. (1990) using pooled sampling technique.

3.8.1. Mineral Composition

Calcium, magnesium, iron, copper, zinc, manganese, cobalt, iodine of serum and feed samples namely chicken waste, hotel waste and vegetable waste were estimated using Atomic Absorption Spectrophotometer (Perkin- Elmer model- AAS-3110) and phosphorus by colorimetric method using Spectrophotometer (Spectronic 1001 plus, Milton Roy Co., USA).

3.9. CARCASS CHARACTERISTICS

For the evaluation of carcass traits three animals from each treatment group were randomly selected at the age of eight months and slaughtered as per the procedure by Singh *et al.* (1983); at Meat Technology Unit, College of Veterinary and Animal Sciences, Mannuthy. Pigs were given sufficient rest prior to slaughter.

3.9.1. Slaughter Weight

Slaughter weight of pigs at ten months of age was measured.

3.9.2. Dressing Percentage

Dressing percentage was calculated by carcass weight divided by live weight multiplied by hundred.

3.9.3. Carcass Length

Carcass length was measured as the straight-line distance from the anterior edge of the first rib to the pubic symphysis from the shackled carcass (Krider and Carroll, 1971).

3.9.4. Loin Eye Area

The loin eye area was estimated as the area of the Longissimus dorsi muscle cut at the 10th intercostal space and traced on a transparent paper and was measured by plotting the trace surface on graph paper.

3.9.5. Back Fat Thickness

The back fat thickness was estimated as an average thickness of fat measured at first rib, last rib and last lumbar vertebral region and expressed in centimetres.

3.9.6. Meat Bone Ratio

Ratio between deboned meat and bone was measured to arrive at the meat bone ratio.

3.9.7. Gut Weight

Weight of stomach and intestine were recorded for all the animals in different treatment groups separately.

3.10. ECONOMICS

The economics of pig production under different feeding systems were calculated by taking cost of conventional and unconventional feed consumed, feed efficiency and total weight gain.

3.11. STATISTICAL ANALYSIS

The data obtained in this study were analysed statistically as per the methods suggested by Snedecor and Cochran (1994). The litter traits were analyzed by Least Square Analysis for which the standard programme LSML (Harvey, 1986) was used.

RESULTS

4. RESULTS

4.1. EFFECT OF BREED ON THE LITTER PERFORMANCE OF PIGS

The effect of different genetic groups viz., Large White Yorkshire (pure), Duroc x (Large White Yorkshire (LWY) x Landrace (LR) crossbred female), Duroc x (LR x Desi crossbred female) and Duroc x (LWY x Desi crossbred female) on the litter performance is shown in Table 4.1 and depicted in Figures 4.1- 4.4.

The average litter size at birth is 10.75, 11.05, 12.37 and 12.35 ; litter weight at birth (kg) is 13.24, 13.62, 16.31 and 17.10 ; birth weight (kg) is 1.18, 1.23, 1.38 and 1.42 ; litter size at weaning is 8.95, 9.15, 11.20 and 10.80 ; litter weight at weaning (kg) is 89.14, 87.28, 139.65 and 141.07 and weaning weight (kg) is 10.10, 10.20, 12.66 and 12.81 respectively for Large White Yorkshire, Duroc x (Large White Yorkshire x Landrace), Duroc x (Landrace x Desi) and Duroc x (Large White Yorkshire x Desi).

By least square analysis it is found that genetic group had significant effect on litter traits. The crossbred *viz.*, D x (LWY x Desi) and D x (LR x Desi) had highly significant ($P<0.01$) difference in litter size at birth, litter weight at birth, birth weight, litter size at weaning, litter weight at weaning and weaning weight compared to LWY and D x (LWY x LR) pigs. There is no significant difference between LWY and D x (LWY x LR) ; D x (LWY x Desi) and D x (LR x Desi) pigs in all these litter traits.

4.2. CLIMATIC VARIABLES

Mean ± S.E. of microclimatic changes such as maximum and minimum temperature (^{0}C) and relative humidity (%) recorded at farm and field is represented

4.1. Effect of breed on the litter performance of pigs

Litter traits	LWY	D x (LWY x LR)	D x (LR x Desi)	D x (LWY x Desi)
Litter size at birth	10.75 ^{a} ± 0.39	11.05 ^{a} ± 0.33	12.37^{b} ± 0.32	12.37^{b} ± 0.32
Litter weight at birth (kg)	13.24 ^{a} ± 0.31	13.62 ^{a} ± 0.30	16.31^{b} ± 0.30	17.10^{b} ± 0.30
Birth weight (kg)	1.18 ^{a} ± 0.03	1.23 ^{a} ± 0.03	1.38^{b} ± 0.02	1.42^{b} ± 0.02
Litter size at weaning	8.95 ^{a} ± 0.33	9.15 ^{a} ± 0.29	11.20^{b} ± 0.25	10.80^{b} ± 0.24
Litter weight at weaning (kg)	89.14 ^{a} ± 1.28	87.28 ^{a} ± 1.86	139.65^{b} ± 1.42	141.07^{b} ± 1.39
Weaning weight (kg)	10.10 ^{a} ± 0.27	10.20 ^{a} ± 0.29	12.66^{b} ± 0.31	12.81^{b} ± 0.31

4.2. Mean ± SE with range of microclimatic variables

Particulars	Farm	Field
Maximum temperature ° C	29.88 ± 0.31 (29.60 – 37.00)	30.02 ± 0.32 (29.54 – 37.20)
Minimum temperature ° C	23.00 ± 0.25 (18.10 – 24.80)	22.97 ± 0.27 (17.70 – 24.51)
Relative humidity (%)	70.25 ± 0.49 (62.10 – 85.85)	69.54 ± 0.52 (61.12 – 84.86)

Non-significant between farm and field (P>0.05)

Table 4.3. Climatic variables recorded during the period of experiment at weather station, COH, Vellanikkara

Months	Max. Temp.(° C)	Min. Temp.(° C)	RH 1 (%) 8.00 am	RH 2 (%) 2.00 pm	Mean RH (%)	Total no. of rainy days	Sun shine (hrs)	Amount of rainfall (mm)
Sept.05	29.40	23.30	92.00	78.00	85.00	23.00	4.30	416.10
Oct	31.00	23.20	91.00	68.00	80.00	16.00	5.10	178.40
Nov	30.70	22.90	81.00	63.00	72.00	2.00	5.20	11.60
Dec	31.50	22.10	81.00	51.00	66.00	1.00	7.30	3.20
Jan.06	32.50	22.60	74.00	41.00	57.00	0.00	8.20	0.00
Feb	34.30	22.30	71.00	31.00	51.00	0.00	9.60	0.00
March	34.80	23.80	86.00	49.00	68.00	8.00	7.60	95.20
April	33.40	24.70	90.00	59.00	75.00	7.00	7.00	86.20
May	31.80	24.30	91.00	66.00	79.00	14.00	5.80	675.50
June	29.90	23.60	93.00	75.00	84.00	25.00	3.80	608.60
July	29.50	23.30	95.00	76.00	85.00	20.00	2.20	519.00
August	29.80	23.10	93.00	73.00	83.00	21.00	4.20	550.60
Sept	29.60	23.00	93.00	75.00	84.00	17.00	3.90	522.20
Oct	31.00	23.00	89.00	68.00	79.00	12.00	4.80	323.70
Nov	31.70	23.70	83.00	60.00	72.00	6.00	6.50	79.50
Dec	31.50	23.60	68.00	45.00	57.00	0.00	7.80	0.00
Jan.07	32.50	22.00	70.00	37.00	54.00	0.00	8.70	0.00

Fig.1. Large White Yorkshire piglets

Fig. 2. Duroc x (LWY x Landrace) piglets

Fig. 3. Duroc x (Landrace x Desi) piglets

Fig. 4. Duroc x (LWY x Desi) piglets

in Table 4.2. The climatic data like sunshine (hours) and rainfall (monthly total, in mm) over the period from Sept 2005 to January 2007 are presented in the Table 4.3.

The mean maximum temperature observed varied between 29.60 and 37.00; 29.54 and 37.20 ^{0}C and minimum temperature varied between 18.10 and 24.80; 17.70 and 24.51 ^{0}C in the farm and field conditions respectively. The relative humidity (%) varied between 62.10 and 85.85; 61.12 and 84.86 in the farm and field conditions respectively. It is noticed that there were no significant differences (P>0.05) in microclimatic variables, viz., maximum and minimum temperature and the relative humidity between farm and field.

The changes in environmental variables all throughout the study period revealed that the animals were exposed to stress due to high humidity from April to November and high temperature from January to April. The rainfall recorded during the period varied from zero mm in December, January and February and heavy rainfall during May to October (416.10 – 675.50 mm) and sparse rainfall during November and March.

4.3. RECTAL TEMPERATURE, RESPIRATORY RATE AND PULSE RATE

The mean rectal temperature (^{0}C), respiratory rate and pulse rate (per minute) of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs in all the treatment groups are furnished in Tables 4.4 - 4.6 and Figures 4.5 - 4.7. The mean rectal temperature varied between 38.41 and 39.01; 38.61 and 39.11^{0}C respectively in the farm and field between the genetic groups. It is observed that there is no significant difference (P>0.05) in rectal temperature between treatments and genetic groups of pigs during the entire study period. Numerically higher values were recorded in the afternoon irrespective of the treatment and genetic groups of pigs.

Table 4.4. Mean rectal temperature of pigs recorded at weekly inerval, ° C

Treatment	Time	LWY	D x (LWY x LR)	D x (LR x Desi)	D x (LWY x Desi)
T1	FN	38.31	38.3	38.73	38.81
	AN	38.5	38.62	39.28	39.02
	Mean	**38.41**	**38.46**	**39.01**	**38.92**
T2	FN	38.51	38.47	38.82	38.83
	AN	38.7	38.92	39.39	39.19
	Mean	**38.61**	**38.7**	**39.11**	**39.01**
T3	FN	38.43	38.42	38.87	38.91
	AN	38.82	38.86	39.23	39.92
	Mean	**38.62**	**38.64**	**39.05**	**39.1**
T4	FN	38.53	38.54	38.75	38.85
	AN	38.97	38.91	39.19	39.28
	Mean	**38.76**	**38.73**	**38.97**	**39.07**

NS- Non-significant

Table 4.5.Mean pulse rate per minute of pigs recorded at weekly inerval

Treatment	Time	LWY	D x (LWY x LR)	D x (LR x Desi)	D x (LWY x Desi)
T1	FN	65.29	66.11	66.18	66.25
	AN	76.30	76.52	77.54	76.83
	Mean	**70.80**	**71.32**	**71.86**	**71.54**
T2	FN	65.23	65.91	65.85	66.17
	AN	77.71	77.42	78.12	77.89
	Mean	**71.47**	**71.67**	**71.99**	**72.03**
T3	FN	65.32	65.88	66.23	66.12
	AN	76.83	77.53	77.72	77.80
	Mean	**71.08**	**71.71**	**71.98**	**71.96**
T4	FN	65.52	66.02	66.15	65.99
	AN	77.08	77.52	77.88	77.88
	Mean	**71.30**	**71.78**	**72.02**	**71.94**

Mean values were non-significant irrespective of genetic group and teatment
Significant ($p < 0.01$) difference between morning and afternoon
FN- Forenoon ; AN- Afternoon

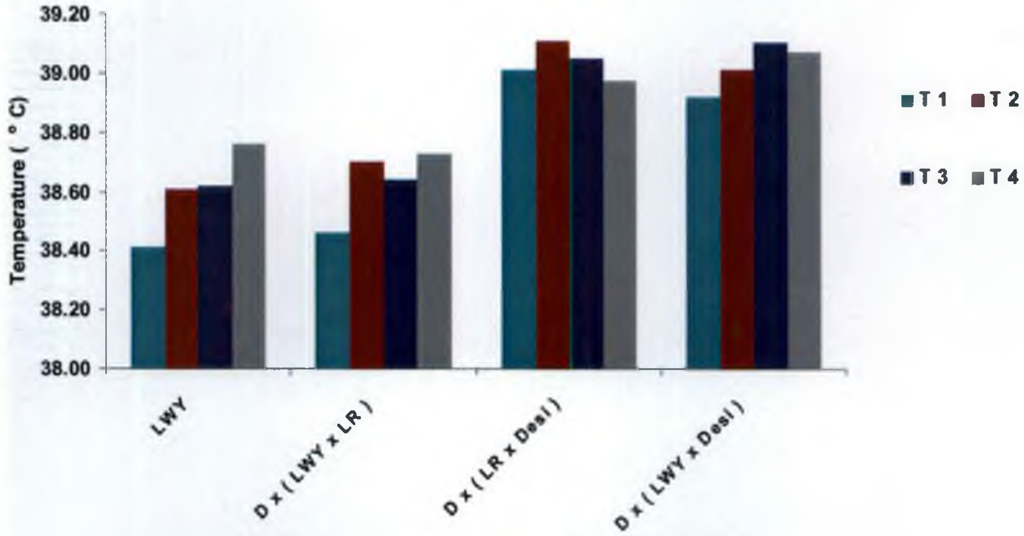

Fig. 4.5. Mean rectal temperature of pigs recorded at weekly interval

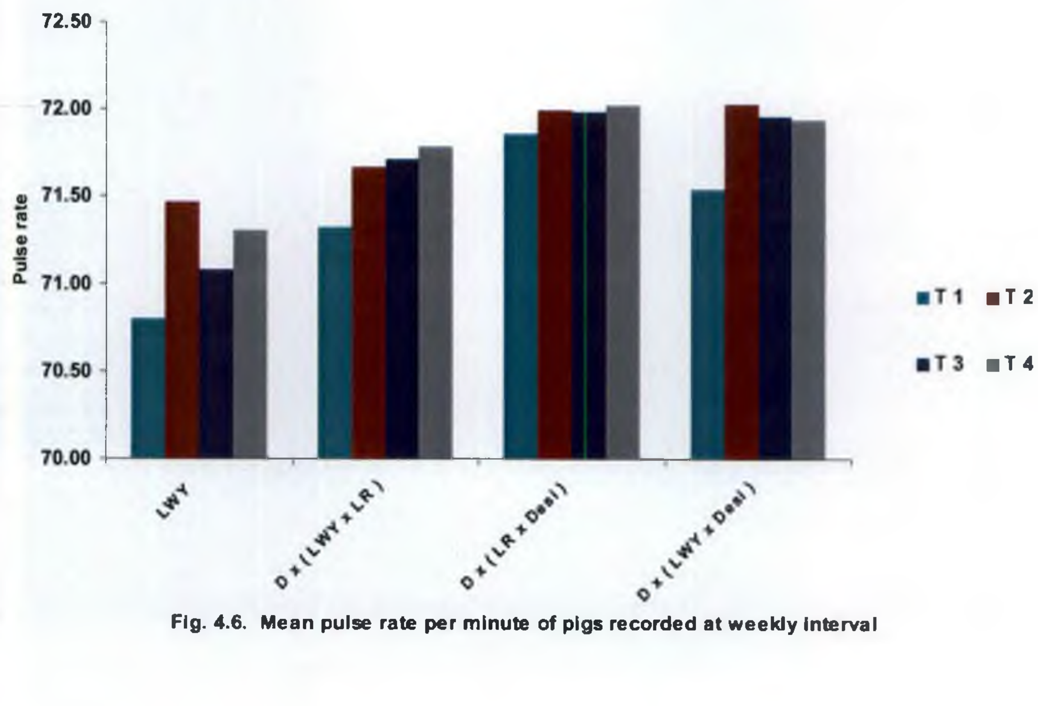

Fig. 4.6. Mean pulse rate per minute of pigs recorded at weekly interval

The mean pulse rate varied between 70.80 and 71.86; 71.47 and 72.02 respectively in the farm and field between genetic groups. Mean respiratory rate varied between 28.21 and 29.10; 28.44 and 29.28 respectively in the farm and field between genetic groups. On statistical analysis, no significant difference was observed between treatments and genetic groups.

Morning and afternoon pulse rate recorded varied between 65.29 and 66.25; 65.23 and 66.23; 76.30 and 77.54; 77.42 and 77.88 respectively in the farm and field between genetic groups. Morning and afternoon respiration rate recorded varied between 21.80 and 22.56; 22.13 and 22.78; 34.51 and 35.68; 34.74 and 35.84 respectively in the farm and field between genetic groups. Significant difference ($P<0.01$) were observed between morning and afternoon pulse and respiratory rates irrespective of treatment and genetic groups.

4.4. BEHAVIOUR

The group averages of feeding, agonistic and eliminative behavioural scores of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs in all the treatment groups are furnished in Tables 4.7, 4.8 and 4.9 respectively. The pigs in the farm which were provided with wallowing facility were found floundering during the hot hours of the day whereas the field pigs had water spraying and shady trees planted around the pens. All the four different genetic groups under different treatment were active and exhibited playful behaviour at the time of cleaning the pen.

4.4.1 Feeding Behaviour

Majority of the pigs under different treatments and genetic groups showed eating greedily with drooling of saliva followed by exploring the pen and eating with grunt and drooling of saliva and least was eating calmly at the time of feeding. None

Table 4.6. Mean respiration rate per minute of pigs recorded at weekly inerval

Treatment	Time	LWY	D x (LWY x LR)	D x (LR x Desi)	D x (LWY x Desi)
T1	FN	21.80	21.94	22.51	22.56
	AN	34.61	34.51	35.68	35.42
	Mean	**28.21**	**28.23**	**29.10**	**29.04**
T2	FN	22.13	21.99	22.61	22.57
	AN	34.74	35.11	35.82	35.69
	Mean	**28.44**	**28.55**	**29.22**	**29.13**
T3	FN	22.21	22.46	22.69	22.62
	AN	35.00	35.09	35.84	35.81
	Mean	**28.61**	**28.78**	**29.27**	**29.22**
T4	FN	22.42	22.59	22.78	22.71
	AN	35.13	35.22	35.77	35.72
	Mean	**28.78**	**28.91**	**29.28**	**29.22**

Mean values were non-significant irrespective of genetic group and teatment
Significant ($p < 0.01$) difference between morning and afternoon
FN- Forenoon ; AN- Afternoon

Table 4.7.Feeding behaviour of pigs under different feeding systems

Genetic groups	Score	T1	T2	T3	T4
LWY	3	60.42	60.42	62.50	62.50
	2	31.25	29.16	29.17	30.25
	1	8.33	10.42	8.33	8.14
	0	-	-	-	-
D x (LWY x LR)	3	58.33	56.25	60.42	62.50
	2	33.33	33.25	29.16	30.25
	1	8.34	10.50	10.42	8.14
	0	-	-	-	-
D x (LR x Desi)	3	60.42	58.33	60.42	62.50
	2	29.16	31.17	29.16	29.25
	1	10.42	10.50	10.42	9.14
	0	-	-	-	-
D x (LWY x Desi)	3	58.33	56.25	62.50	63.00
	2	33.33	33.25	29.25	28.90
	1	8.34	10.50	9.14	8.10
	0	-	-	-	-

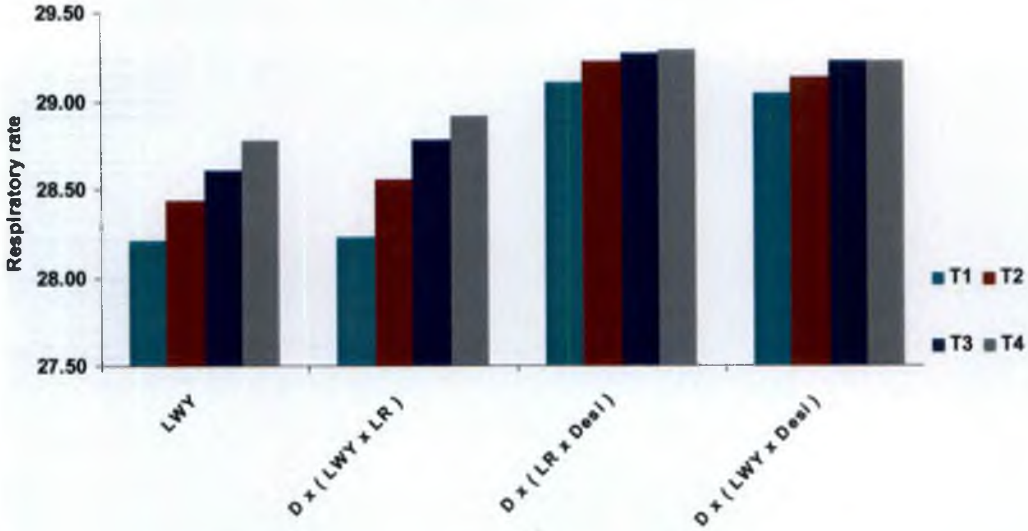

Fig.4.7. Mean respiration rate per minute of pigs recorded at weekly interval

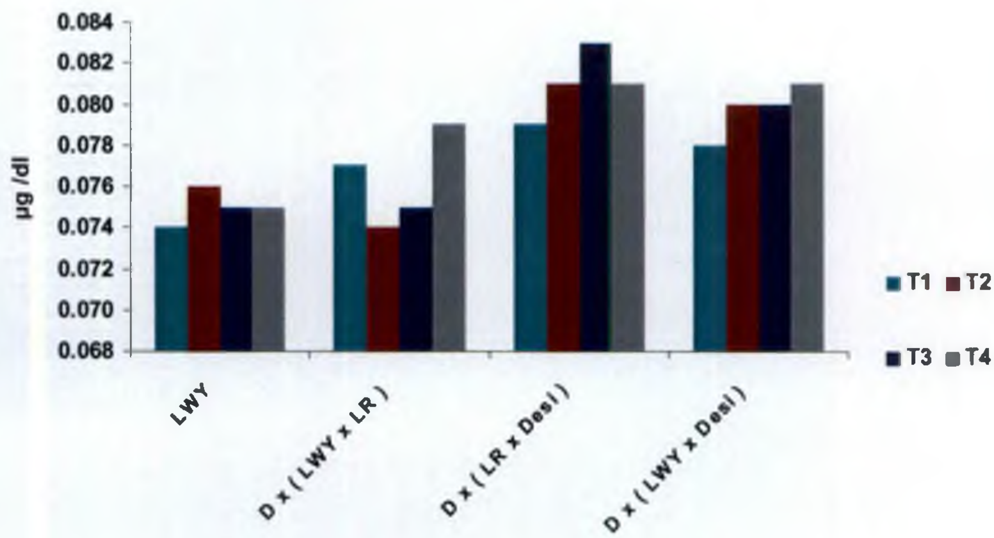

Fig.4.8. Mean fecal cortisol levels in pigs under different feeding systems, µg /dl

of the treatment group and genetic groups observed a score of not showing any interest towards feeding.

4.4.2 Agonistic Behaviour

Majority of the pigs under different treatments and genetic groups showed ear biting, belly nosing and tail biting very frequently followed by ear biting, belly nosing and tail biting frequently and least was ear biting, belly nosing and tail biting occasionally. None of the treatment group and genetic groups observed without biting at the time of feeding.

4.4.3 Eliminative Behaviour

The quantity of faeces (g) voided in T1, T2, T3 and T4 by LWY pigs was 2501.31, 2951.43, 3002.23 and 3061.22 ; D x (LWY x LR) pigs was 2714.36, 3126.67, 3236.85 and 3328.24 ; D x (LR x Desi) pigs was 2720.67, 3134.56, 3230.43 and 3334.69 and D x (LWY x Desi) pigs was 2705.87, 3138.48, 3142.32 and 3339.19.

Highly significant ($P<0.01$) difference was found between treatment in all four genetic groups. By statistical analysis it was observed LWY pigs voided significantly lesser quantity of faeces than other genetic groups within the treatment. Majority of the pigs defaecated either in the wallowing tank or near the gate of the pen in the farm and pigs maintained in the field voided either in the corner or near the gate. In the field there is no provision of run area.

Frequency of defaecation varied between 7.95 and 7.99 ; 8.07 and 8.14 ; 8.09 and 8.15 ; 8.08 and 8.15 in pigs fed with concentrate (T1) , swill (T2), swill + inorganic minerals (T3) and swill + organic minerals (T4) supplementation respectively by the different genetic groups. There is no significant difference

Table 4.8. Agonistic behaviour of pigs under different feeding systems

Genetic groups	Score	T1	T2	T3	T4
LWY	3	60.42	62.50	62.50	64.10
	2	31.25	29.17	29.17	28.90
	1	8.33	8.33	8.33	7.00
	0	-	-	-	-
D x (LWY x LR)	3	62.50	60.42	60.42	62.50
	2	29.17	31.25	29.16	29.25
	1	8.33	8.33	10.42	9.14
	0	-	-	-	-
D x (LR x Desi)	3	64.10	62.50	66.00	64.10
	2	28.90	29.17	27.00	28.90
	1	7.00	8.33	7.00	7.00
	0	-	-	-	-
D x (LWY x Desi)	3	66.00	64.10	62.50	64.10
	2	29.00	28.90	31.25	28.90
	1	5.00	7.00	7.14	7.00
	0	-	-	-	-

Table 4.9. Eliminative behaviour of pigs under different feeding systems

Parameters	Genetic groups	T1	T2	T3	T4
* Qauntity of faeces voided (g per day	LWY	2501.31^{am}	2951.43^{an}	3002.23^{ao}	3061.22^{ap}
	D x (LWY x LR)	2714.36^{bm}	3126.66^{bn}	3236.85^{bo}	3328.24^{bp}
	D x (LR x Desi)	2720.67^{bm}	3134.56^{bn}	3230.43^{bo}	3334.69^{bp}
	D x (LWY x Desi)	2705.87^{bm}	3138.48^{bn}	3142.32^{bo}	3339.19^{bp}
* Frequency of defaecation per day	LWY	7.95	8.07	8.12	8.08
	D x (LWY x LR)	7.92	8.11	8.15	8.10
	D x (LR x Desi)	7.93	8.13	8.11	8.15
	D x (LWY x Desi)	7.99	8.14	8.09	8.10

Mean values with different superscript in a row (mnop) differ significantly (P<0.01)
Mean values with different superscript in a column differ significantly (P<0.01)
* Group averages

observed between treatments and genetic groups. Among the conventional and unconventional feed fed pigs the latter group had numerically higher frequency of defaecation.

4.5. FAECAL CORTISOL LEVEL

The monthly faecal cortisol levels (μg/dl) of different genetic group of pigs under different feeding systems are shown in Table 4.10 and depicted in Figure 8 . The mean faecal cortisol concentration of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs in different treatments were 0.074, 0.076, 0.075 and 0.075; 0.077, 0.074, 0.075 and 0.079; 0.079, 0.081, 0.083, and 0.081; 0.078, 0.080, 0.080 and 0.081 respectively for T1, T2, T3 and T4. There were no significant (P>0.05) differences observed in the faecal cortisol level between the treatments and between the genetic groups of pigs.

4.6. PROXIMATE COMPOSITION OF FEED SAMPLES

The proximate composition (percentage) of feed samples on DM basis is presented in Table 4.11. The samples consisted of two types viz., farm concentrate (grower and finisher diet) fed to control group in the farm and other type is swill feed comprising of chicken offal, hotel waste and vegetable waste. Chicken waste had higher crude protein (24.13) followed by farm concentrate (17.90 and 14.15 for grower and finisher ration respectively) ,vegetable waste (10.10) and hotel waste (9.81). The pooled sample had a crude protein value of 14.69 per cent. The pooled samples are comparable to farm concentrate except ether extract (24.56; 6.05 and 4.13) which was very higher in swill feed. Total ash content was higher in the farm concentrate (10.91, 10.13; 6.61).

Table 4.10.Mean faecal cortisol level of pigs under different feeding systems, pg / dl

Genetic group	Treatment	Month								
		3	4	5	6	7	8	9	10	Mean
LWY	T1	0.118	0.104	0.103	0.082	0.058	0.050	0.041	0.036	0.074
D x (LWY x LR)		0.119	0.110	0.105	0.084	0.063	0.053	0.040	0.038	0.077
D x (LR x Desi)		0.121	0.113	0.106	0.088	0.064	0.055	0.044	0.044	0.079
D x (LWY x Desi)		0.120	0.112	0.105	0.087	0.062	0.054	0.044	0.043	0.078
LWY	T2	0.117	0.109	0.107	0.084	0.062	0.054	0.039	0.037	0.076
D x (LWY x LR)		0.118	0.101	0.104	0.082	0.061	0.052	0.038	0.039	0.074
D x (LR x Desi)		0.122	0.108	0.110	0.089	0.069	0.058	0.045	0.045	0.081
D x (LWY x Desi)		0.125	0.110	0.107	0.086	0.066	0.057	0.045	0.043	0.080
LWY	T3	0.118	0.102	0.105	0.082	0.063	0.051	0.040	0.038	0.075
D x (LWY x LR)		0.116	0.103	0.104	0.080	0.064	0.055	0.041	0.040	0.075
D x (LR x Desi)		0.130	0.114	0.109	0.089	0.070	0.059	0.047	0.045	0.083
D x (LWY x Desi)		0.124	0.111	0.107	0.087	0.066	0.058	0.042	0.042	0.080
LWY	T4	0.115	0.105	0.104	0.081	0.062	0.053	0.038	0.039	0.075
D x (LWY x LR)		0.120	0.109	0.107	0.085	0.066	0.057	0.043	0.041	0.079
D x (LR x Desi)		0.123	0.111	0.111	0.084	0.071	0.060	0.046	0.044	0.081
D x (LWY x Desi)		0.126	0.113	0.108	0.087	0.069	0.059	0.043	0.043	0.081

NS- Non-significant within and between treatment (P>0.05)

Table 4.11.proximate composition of feed samples on dry matter basis, %

proximate principle	Farm ration		Field ration			
	Grower	Finisher	Chicken waste	Hotel waste	Vegetable waste	mean
Moisture	9.79 ± 0.45	9.62 ± 0.55	70.10 ± 1.42	80.34 ± 1.84	73.57 ± 1.65	74.67 ± 1.65
Crude protein	17.90 ± 0.62	14.15 ± 0.69	24.13 ± 2.32	9.81 ± 1.02	10.10 ± 0.94	14.69 ± 1.44
Crude fibre	7.11 ± 0.67	11.21 ± 0.64	7.81 ± 0.54	6.95 ± 0.83	9.41 ± 0.65	8.07 ± 0.68
Ether extract	6.05 ± 0.72	4.13 ± 0.72	35.40 ± 2.01	19.58 ± 1.47	18.52 ± 1.67	24.56 ± 1.73
Total ash	10.91 ± 0.81	10.13 ± 0.75	7.01 ± 0.43	6.75 ± 0.24	6.05 ± 0.63	6.61 ± 0.44
N. F. E	58.03 ± 0.91	60.38 ± 0.97	25.65 ± 2.24	56.91 ± 1.75	55.92 ± 1.33	46.17 ± 1.78
Acid insoluble ash	5.49 ± 0.39	5.31 ± 0.42	2.41 ± 0.31	0.51 ± 0.16	1.05 ± 0.12	1.33 ± 0.20

4.6.1. Chemical Composition of Mineral Mixtures

The mineral composition of inorganic and organic mineral preparation fed to pigs in the field is presented in Table 4.12. Availability of minerals in inorganic form was higher than the organic form with regard to macro and micro minerals.

4.6.2. Mineral Profile of Feed Samples Fed Under Field Conditions

Mineral profile of feed samples viz., chicken waste, hotel waste and vegetable waste fed to pigs under field conditions is presented in 4.13. Mineral assay revealed that chicken waste had higher levels followed by hotel waste and vegetable waste with regard to macro and micro minerals.

4.6.3. Serum Minerals Concentration of Pigs Under Different Feeding Systems

Mean serum mineral concentration of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs under different treatment is presented in Table 4.14. It is observed that there is no significant difference between genetic groups within the treatment. The feeding system had highly significant ($P<0.01$) effect on the mineral concentration in serum samples. It was highest in T4 followed by T3 and T1 and least in T2. It was comparable between T3 and T2.

4.7. GROWTH STUDY

4.7.1. Monthly Body Weight

The monthly body weights (kg) of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs under different feeding systems are presented in Table 4.15 - 4.19 and Figures 4.9 – 4.17. At the end of tenth month, body weight of LWY pigs in T1, T2, T3, and T4 is 99.77, 100.95, 106.28 and 112.55 kg ; 104.95, 106.90, 111.10 and 117.85 ; 105.70, 107.70, 112.80 and 118.60 ; 106.23, 108.16,

Table 12.Chemical composition of mineral mixtures ,%

Minerals	Inorganic minerals	Organic minerals
Calcium	50.00	23.000
Phosphorus	25.00	12.000
Magnesium	13.00	6.500
Zinc	0.38	0.159
Iron	0.50	0.075
Copper	0.07	0.020
Manganese	0.12	0.275
Cobalt	0.01	0.005
Iodine	0.03	0.100
Fluorine	0.07	-

Table 13.Mineral profile of feed samples fed under field conditions

Minerals	Chicken waste	Hotel waste	Vegetable waste
Calcium (g %)	0.150	0.013	0.005
Phosphorus (g %)	0.049	0.004	0.002
Magnesium (g %)	0.032	0.011	0.004
Zinc (ppm)	2.53	0.22	0.15
Iron (ppm)	5.91	0.47	0.82
Copper (ppm)	1.25	0.16	0.21
Manganese (ppm)	0.87	0.19	0.22
Cobalt (ppm)	1.31	0.33	0.43
Iodine (ng)	0.22	Traces	Traces

Table 14. Mean serum minerals concentration of pigs under different feeding systems

Genetic group	Treatment	Minerals								
		Calcium (mg/dl)	phophorus (mg/dl)	Magnesium (mg/dl)	Zinc (ppm)	Iron (ppm)	Copper (ppm)	Manganese (ppm)	Cobalt (ppm)	Iodine (ng/dl)
LWY	T1	9.50^{b}	1.86^{b}	3.61^{b}	0.54^{b}	1.61^{b}	1.46^{b}	0.37^{b}	0.41^{b}	0.62^{b}
Dx(LWYxLR)		9.60^{b}	1.86^{b}	3.63^{b}	0.51^{b}	1.64^{b}	1.48^{b}	0.36^{b}	0.41^{b}	0.62^{b}
Dx(LRxDesi)		9.52^{b}	1.87^{b}	3.67^{b}	0.55^{b}	1.59^{b}	1.47^{b}	0.38^{b}	0.43^{b}	0.61^{b}
Dx (LWYx Desi)		9.50^{b}	1.87^{b}	3.68^{b}	0.52^{b}	1.61^{b}	1.49^{b}	0.38^{b}	0.43^{b}	0.61^{b}
LWY	T2	7.80^{a}	1.51^{a}	2.68^{a}	0.41^{a}	1.25^{a}	1.23^{a}	0.18^{a}	0.21^{a}	0.30^{a}
Dx(LWYxLR)		7.74^{a}	1.51^{a}	2.71^{a}	0.42^{a}	1.27^{a}	1.23^{a}	0.19^{a}	0.23^{a}	0.32^{a}
Dx(LRxDesi)		7.72^{a}	1.52^{a}	2.73^{a}	0.45^{a}	1.29^{a}	1.25^{a}	0.17^{a}	0.22^{a}	0.32^{a}
Dx (LWYx Desi)		7.78^{a}	1.51^{a}	2.69^{a}	0.47^{a}	1.26^{a}	1.22^{a}	0.18^{a}	0.21^{a}	0.31^{a}
LWY	T3	9.70^{b}	1.90^{b}	3.68^{b}	0.55^{b}	1.63^{b}	1.48^{b}	0.40^{b}	0.43^{b}	0.64^{b}
Dx(LWYxLR)		9.65^{b}	1.89^{b}	3.72^{b}	0.56^{b}	1.64^{b}	1.48^{b}	0.39^{b}	0.42^{b}	0.64^{b}
Dx(LRxDesi)		9.63^{b}	1.90^{b}	3.75^{b}	0.54^{b}	1.65^{b}	1.49^{b}	0.39^{b}	0.41^{b}	0.62^{b}
Dx (LWYx Desi)		9.61^{b}	1.88^{b}	3.71^{b}	0.54^{b}	1.63^{b}	1.49^{b}	0.38^{b}	0.43^{b}	0.63^{b}
LWY	T4	10.22^{c}	2.12^{c}	3.74^{c}	0.71^{c}	1.81^{c}	1.62^{c}	0.48^{c}	0.55^{c}	0.76^{c}
Dx(LWYxLR)		10.15^{c}	2.11^{c}	3.71^{c}	0.73^{c}	1.84^{c}	1.68^{c}	0.49^{c}	0.58^{c}	0.77^{c}
Dx(LRxDesi)		10.21^{c}	2.17^{c}	3.78^{c}	0.69^{c}	1.85^{c}	1.65^{c}	0.51^{c}	0.57^{c}	0.77^{c}
Dx (LWYx Desi)		10.20^{c}	2.18^{c}	3.76^{c}	0.71^{c}	1.86^{c}	1.61^{c}	0.52^{c}	0.59^{c}	0.76^{c}

Mean values bearing different superscript with in treatment differ significantly ($p< 0.01$)

Table 4.15. Mean monthly body weight of LWY pigs, kg

Age (Month)	T1	T2	T3	T4
2	$10.10^{a} \pm 0.34$	$10.22^{a} \pm 0.33$	$10.00^{a} \pm 0.34$	$10.10^{a} \pm 0.37$
3	$14.50^{a} \pm 0.42$	$14.67^{a} \pm 0.40$	$14.50^{a} \pm 0.45$	$14.91^{a} \pm 0.40$
4	$23.62^{a} \pm 0.54$	$23.88^{a} \pm 0.52$	$24.23^{a} \pm 0.55$	$25.81^{a} \pm 0.47$
5	$34.10^{a} \pm 0.65$	$34.60^{a} \pm 0.61$	$36.02^{ab} \pm 0.66$	$38.60^{b} \pm 0.53$
6	$46.13^{a} \pm 0.73$	$46.67^{a} \pm 0.69$	$49.90^{ab} \pm 0.76$	$53.31^{c} \pm 0.64$
7	$60.50^{a} \pm 0.79$	$61.25^{a} \pm 0.75$	$65.25^{b} \pm 0.76$	$69.43^{c} \pm 0.71$
8	$74.02^{a} \pm 0.86$	$74.87^{a} \pm 0.82$	$79.55^{b} \pm 0.78$	$84.20^{c} \pm 0.77$
9	$87.12^{a} \pm 0.92$	$88.00^{a} \pm 0.91$	$93.05^{b} \pm 0.85$	$98.70^{c} \pm 0.80$
10	$99.77^{a} \pm 1.01$	$100.95^{a} \pm 1.06$	$106.28^{b} \pm 0.97$	$112.55^{c} \pm 0.89$

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.16. Mean monthly body weight of D x (LWY x LR) pigs, kg

Age (Month)	T1	T2	T3	T4
2	$10.30^{a} \pm 0.34$	$10.20^{a} \pm 0.35$	$10.25^{a} \pm 0.34$	$10.31^{a} \pm 0.35$
3	$14.80^{a} \pm 0.39$	$14.83^{a} \pm 0.43$	$15.25^{a} \pm 0.37$	$16.07^{a} \pm 0.39$
4	$24.33^{a} \pm 0.48$	$24.60^{a} \pm 0.51$	$25.65^{ab} \pm 0.45$	$27.63^{b} \pm 0.48$
5	$35.82^{a} \pm 0.57$	$36.55^{ab} \pm 0.60$	$38.20^{ab} \pm 0.51$	$41.96^{c} \pm 0.56$
6	$49.55^{a} \pm 0.66$	$50.47^{ab} \pm 0.69$	$52.57^{ab} \pm 0.59$	$57.37^{c} \pm 0.63$
7	$64.47^{a} \pm 0.73$	$65.70^{a} \pm 0.76$	$68.35^{b} \pm 0.67$	$73.85^{c} \pm 0.71$
8	$78.20^{a} \pm 0.79$	$79.95^{a} \pm 0.83$	$83.20^{b} \pm 0.74$	$89.18^{c} \pm 0.77$
9	$91.70^{a} \pm 0.82$	$93.52^{a} \pm 0.87$	$97.50^{b} \pm 0.78$	$103.80^{c} \pm 0.80$
10	$104.95^{a} \pm 0.94$	$106.90^{a} \pm 0.91$	$111.10^{b} \pm 0.84$	$117.85^{c} \pm 0.82$

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.17.Mean monthly body weight of D x (LR x Desi) pigs, kg

Age (Month)	T1	T2	T3	T4
2	$12.84^{a} \pm 0.42$	$12.90^{a} \pm 0.48$	$12.80^{a} \pm 0.50$	$12.90^{a} \pm 0.49$
3	$17.85^{a} \pm 0.47$	$17.95^{a} \pm 0.51$	$18.12^{a} \pm 0.55$	$18.50^{a} \pm 0.52$
4	$27.02^{a} \pm 0.53$	$27.45^{a} \pm 0.61$	$28.10^{a} \pm 0.59$	$29.58^{a} \pm 0.55$
5	$38.25^{a} \pm 0.64$	$39.25^{a} \pm 0.68$	$40.78^{ab} \pm 0.62$	$43.15^{b} \pm 0.59$
6	$50.90^{a} \pm 0.68$	$52.15^{ab} \pm 0.76$	$54.80^{ab} \pm 0.62$	$58.13^{c} \pm 0.63$
7	$66.05^{a} \pm 0.79$	$67.53^{a} \pm 0.78$	$70.40^{b} \pm 0.71$	$74.40^{c} \pm 0.68$
8	$79.52^{a} \pm 0.85$	$81.35^{a} \pm 0.81$	$85.42^{b} \pm 0.79$	$89.90^{c} \pm 0.72$
9	$92.48^{a} \pm 0.93$	$94.55^{a} \pm 0.89$	$99.53^{b} \pm 0.81$	$104.82^{c} \pm 0.79$
10	$105.70^{a} \pm 0.99$	$107.70^{a} \pm 0.95$	$112.80^{b} \pm 0.88$	$118.60^{c} \pm 0.85$

Mean values bearing different superscript in a row differ significantly ($P< 0.01$)

Table 4.18.Mean monthly body weight of D x (LWY x Desi) pigs, kg

Age (Month)	T1	T2	T3	T4
2	$13.10^{a} \pm 0.39$	$13.00^{a} \pm 0.40$	$13.05^{a} \pm 0.42$	$13.03^{a} \pm 0.44$
3	$18.08^{a} \pm 0.46$	$18.12^{a} \pm 0.49$	$18.42^{a} \pm 0.47$	$18.75^{a} \pm 0.45$
4	$27.53^{a} \pm 0.56$	$27.82^{a} \pm 0.62$	$28.53^{a} \pm 0.55$	$29.57^{a} \pm 0.51$
5	$39.24^{a} \pm 0.62$	$39.90^{a} \pm 0.69$	$41.32^{ab} \pm 0.60$	$43.20^{b} \pm 0.56$
6	$51.99^{a} \pm 0.74$	$53.06^{a} \pm 0.76$	$55.55^{ab} \pm 0.67$	$58.15^{b} \pm 0.63$
7	$67.02^{a} \pm 0.82$	$68.55^{a} \pm 0.85$	$71.38^{b} \pm 0.74$	$75.12^{c} \pm 0.70$
8	$80.28^{a} \pm 0.89$	$81.85^{a} \pm 0.93$	$86.47^{b} \pm 0.85$	$90.85^{c} \pm 0.72$
9	$93.41^{a} \pm 0.92$	$95.08^{a} \pm 0.95$	$100.30^{b} \pm 0.89$	$105.08^{c} \pm 0.79$
10	$106.23^{a} \pm 0.98$	$108.16^{a} \pm 0.98$	$113.52^{b} \pm 0.91$	$119.20^{c} \pm 0.86$

Mean values bearing different superscript in a row differ significantly ($P< 0.01$)

Table 4.19. Mean monthly body weight of pigs under different feeding systems, kg

Genetic group	Treatment	Month								
		2	3	4	5	6	7	8	9	10
LWY	T1	10.10^{a}	14.50^{a}	23.62^{a}	34.10^{a}	46.13^{a}	60.50^{a}	74.02^{a}	87.12^{a}	99.77^{a}
D x (LWY x LR)		10.30^{a}	14.80^{a}	24.33^{a}	35.82^{a}	49.55^{b}	64.47^{b}	78.20^{b}	91.70^{b}	104.95^{b}
D x (LR x Desi)		12.84^{b}	17.85^{b}	27.02^{b}	38.25^{b}	50.90^{b}	66.05^{b}	79.52^{b}	92.48^{b}	105.70^{b}
D x (LWY x Desi)		13.10^{b}	18.08^{b}	27.53^{b}	39.24^{b}	51.99^{b}	67.02^{b}	80.28^{b}	93.41^{b}	106.23^{b}
LWY	T2	10.22^{a}	14.67^{a}	23.88^{a}	34.60^{a}	46.67^{a}	61.25^{a}	74.87^{a}	88.00^{a}	100.95^{a}
D x (LWY x LR)		10.20^{a}	14.83^{a}	24.60^{a}	36.55^{a}	50.47^{b}	65.70^{b}	79.95^{b}	93.52^{b}	106.90^{b}
D x (LR x Desi)		12.90^{b}	17.95^{b}	27.45^{b}	39.25^{b}	52.15^{b}	67.53^{b}	81.35^{b}	94.55^{b}	107.70^{b}
D x (LWY x Desi)		13.00^{b}	18.12^{b}	27.82^{b}	39.90^{b}	53.06^{b}	68.55^{b}	81.85^{b}	95.08^{b}	108.16^{b}
LWY	T3	10.00^{a}	14.50^{a}	24.23^{a}	36.02^{a}	49.90^{a}	65.25^{a}	79.55^{a}	93.05^{a}	106.28^{a}
D x (LWY x LR)		10.25^{a}	15.25^{a}	25.65^{a}	38.20^{a}	52.57^{b}	68.35^{b}	83.20^{b}	97.50^{b}	111.10^{b}
D x (LR x Desi)		12.80^{b}	18.12^{b}	28.10^{b}	40.78^{b}	54.80^{b}	70.40^{b}	85.42^{b}	99.53^{b}	112.80^{b}
D x (LWY x Desi)		13.05^{b}	18.42^{b}	28.53^{b}	41.32^{b}	55.55^{b}	71.38^{b}	86.47^{b}	100.30^{b}	113.52^{b}
LWY	T4	10.10^{a}	14.91^{a}	25.81^{a}	38.60^{a}	53.31^{a}	69.43^{a}	84.20^{a}	98.70^{a}	112.55^{a}
D x (LWY x LR)		10.31^{a}	16.07^{a}	27.63^{ab}	41.96^{b}	57.37^{b}	73.85^{b}	89.18^{b}	103.80^{b}	117.85^{b}
D x (LR x Desi)		12.90^{b}	18.50^{b}	29.58^{b}	43.15^{b}	58.13^{b}	74.40^{b}	89.90^{b}	104.82^{b}	118.60^{b}
D x (LWY x Desi)		13.03^{b}	18.75^{b}	29.57^{b}	43.20^{b}	58.15^{b}	75.12^{b}	90.85^{b}	105.08^{b}	119.20^{b}

Mean values bearing different superscript with in treatment differ significantly (P< 0.01)

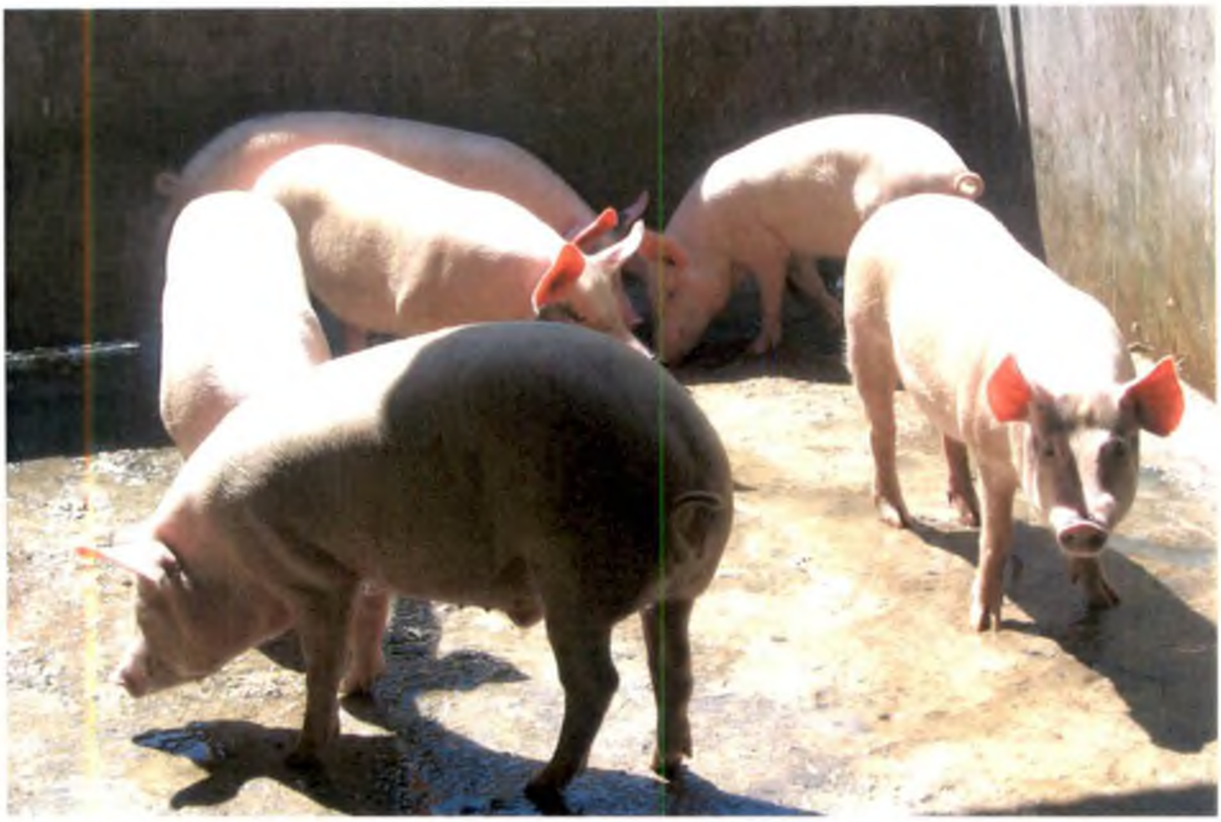

Fig. 5. Large White Yorkshire pigs at 8 months of age

Fig. 6. Duroc x (LWY x Landrace) pigs at 8 months of age

Fig. 7. Duroc x (Landrace x Desi) pigs at 8 months of age

Fig. 8. Duroc x (LWY x Desi) pigs at 8 months of age

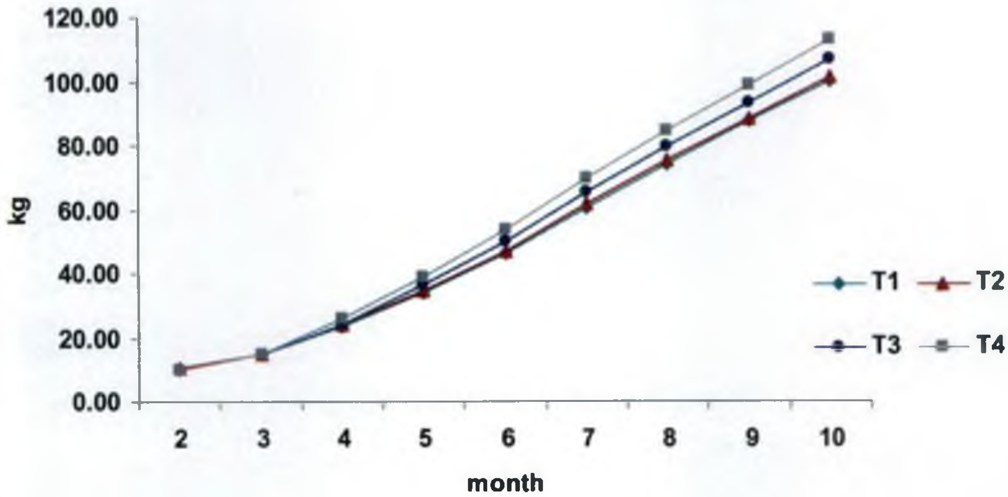

Fig. 4.13. Monthly body weight of LWY pigs

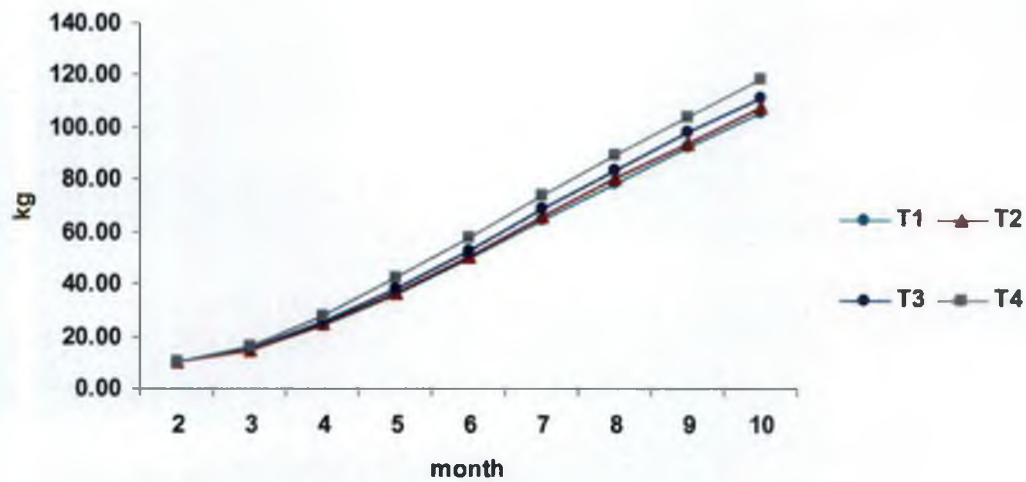

Fig. 4.14. Monthly body weight of D X (LWY X LR) pigs

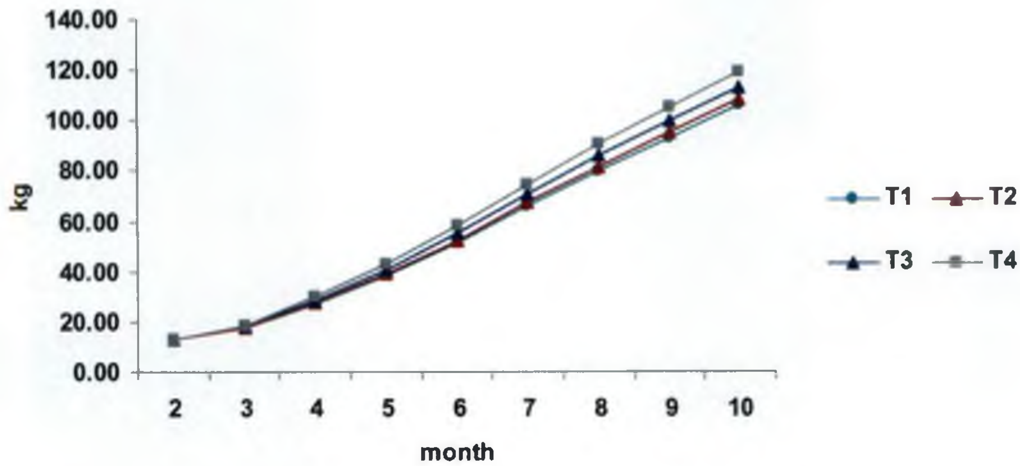

Fig. 4.15. Monthly bodyweight of D X (LR X desi) pigs

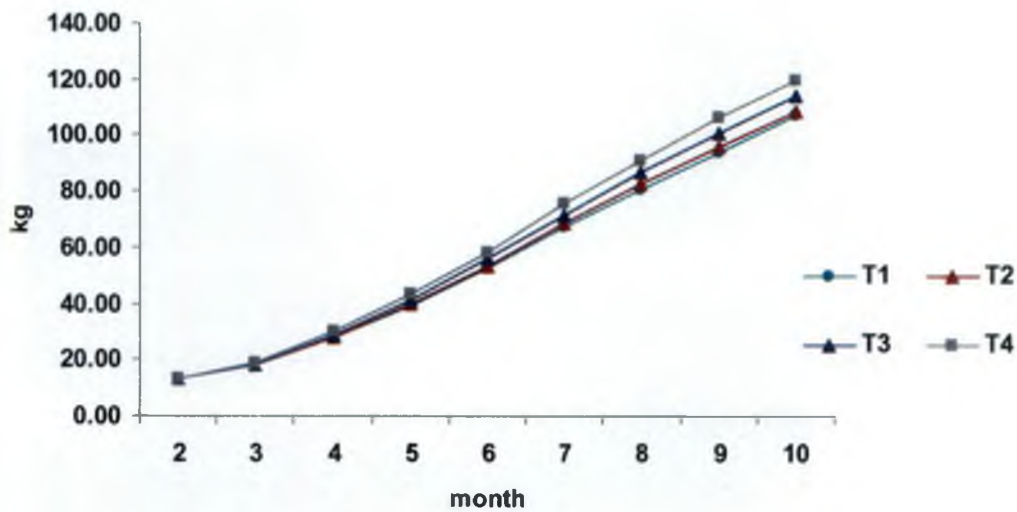

Fig. 4.16. Monthly body weight of D X (LWY X desi) pigs

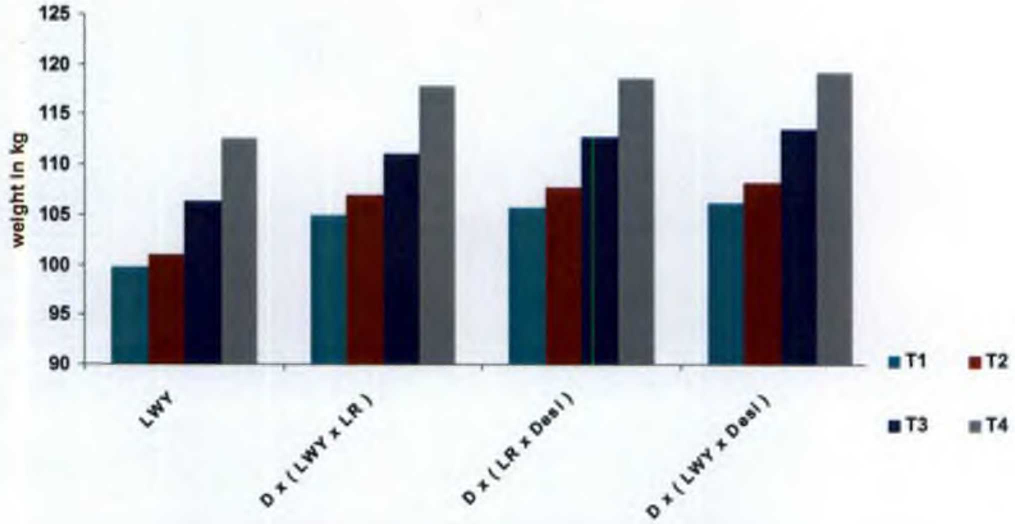

Fig. 4.17. Body weight of pigs at 10 months of age under different treatment

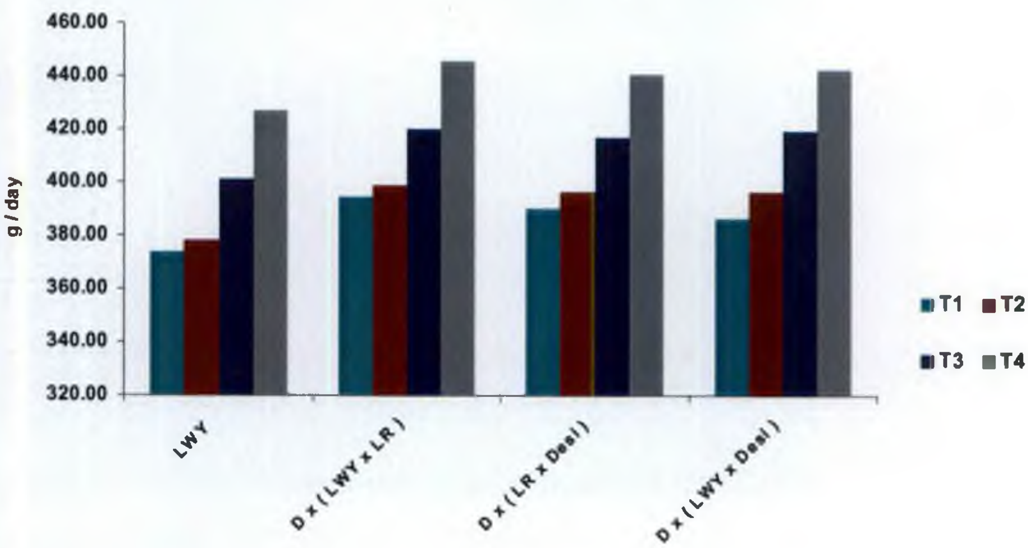

Fig.4.18. Average daily gain of pigs under different feeding systems

113.52 and 119.20 respectively for D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs .

It is observed that there is no significant difference in body weight of LWY pigs between concentrate (T1) and swill feeding (T2). Swill feed supplemented with minerals (T3 and T4) attained significantly ($P<0.01$) higher body weight than concentrate and swill feed fed groups. Organic mineral supplemented group attained significantly ($P<0.01$) higher body weight than the other treatment groups. Similar trend is also observed in D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs.

It is seen that crossbred pigs *viz.*, D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs attained significantly ($P<0.01$) higher body weight than LWY pigs within the treatment. There is no significant difference between crossbreds within the treatment.

4.7.2. Body Measurements

The effect of different feeding systems on the body measurements of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs recorded at monthly interval for the body length, girth and height are furnished in Table 4.20 - 4.34.

At the end of tenth month, body length of LWY pigs in T1, T2, T3, and T4 is 84.27, 85.15, 89.32 and 93.12 ; 87.97, 88.35, 92.50 and 95.63 ; 88.85, 89.10, 92.87 and 96.15 ; 89.20, 89.50, 92.53 and 97.03 respectively D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs . Girth of LWY pigs is 99.95, 100.32, 105.60 and 110.00 ; 108.28, 109.00, 114.08 and 117.85; 108.75, 109.15, 114.35 and 118.25 ; 109.80, 110.77, 115.10 and 119.53 respectively for D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. Height at withers of LWY pigs is 66.30, 66.65,

Table 4.20. Mean monthly body length of LWY pigs, cm

Age (Month)	T1	T2	T3	T4
2	$40.55^a \pm 0.22$	$41.30^a \pm 0.25$	$40.23^a \pm 0.29$	$40.85^a \pm 0.24$
3	$45.80^a \pm 0.26$	$47.00^a \pm 0.33$	$46.28^a \pm 0.31$	$47.45^a \pm 0.27$
4	$51.85^a \pm 0.35$	$53.20^a \pm 0.40$	$52.95^a \pm 0.37$	$55.15^b \pm 0.31$
5	$58.17^a \pm 0.41$	$60.20^a \pm 0.48$	$60.43^a \pm 0.43$	$63.25^c \pm 0.39$
6	$64.40^a \pm 0.47$	$65.00^a \pm 0.53$	$67.40^b \pm 0.48$	$70.23^c \pm 0.45$
7	$70.45^a \pm 0.53$	$71.22^a \pm 0.60$	$73.95^b \pm 0.55$	$76.90^c \pm 0.50$
8	$75.60^a \pm 0.62$	$76.90^a \pm 0.67$	$79.77^b \pm 0.61$	$83.17^c \pm 0.57$
9	$80.32^a \pm 0.70$	$80.97^a \pm 0.76$	$85.05^b \pm 0.69$	$88.35^c \pm 0.62$
10	$84.27^a \pm 0.79$	$85.15^a \pm 0.84$	$89.32^b \pm 0.77$	$93.12^c \pm 0.69$

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.21. Mean monthly body length of D x (LWY x LR) pigs, cm

Age (Month)	T1	T2	T3	T4
2	$41.35^a \pm 0.26$	$41.20^a \pm 0.28$	$41.25^a \pm 0.25$	$41.68^a \pm 0.29$
3	$47.75^a \pm 0.29$	$48.05^a \pm 0.34$	$48.38^a \pm 0.30$	$49.37^a \pm 0.32$
4	$55.41^a \pm 0.36$	$55.78^a \pm 0.38$	$56.35^a \pm 0.35$	$58.22^b \pm 0.37$
5	$60.21^a \pm 0.43$	$60.98^a \pm 0.46$	$61.87^a \pm 0.44$	$64.37^b \pm 0.39$
6	$66.91^a \pm 0.50$	$67.02^a \pm 0.52$	$69.23^b \pm 0.49$	$71.80^c \pm 0.45$
7	$73.40^a \pm 0.58$	$74.85^a \pm 0.57$	$76.25^b \pm 0.54$	$78.95^c \pm 0.49$
8	$78.90^a \pm 0.67$	$79.60^a \pm 0.65$	$82.30^b \pm 0.61$	$85.15^c \pm 0.58$
9	$83.80^a \pm 0.76$	$84.85^a \pm 0.69$	$87.78^b \pm 0.67$	$90.75^c \pm 0.63$
10	$87.97^a \pm 0.80$	$88.35^a \pm 0.77$	$92.50^b \pm 0.72$	$95.63^c \pm 0.69$

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.22. Mean monthly body length of D x (LR x Desi) pigs, cm

Age (Month)	T1	T2	T3	T4
2	$43.40^{a} \pm 0.29$	$43.52^{a} \pm 0.28$	$43.13^{a} \pm 0.26$	$43.55^{a} \pm 0.27$
3	$49.05^{a} \pm 0.33$	$49.20^{a} \pm 0.33$	$49.35^{a} \pm 0.28$	$50.20^{a} \pm 0.30$
4	$53.72^{a} \pm 0.39$	$53.95^{a} \pm 0.40$	$55.25^{a} \pm 0.34$	$57.13^{b} \pm 0.33$
5	$61.55^{a} \pm 0.47$	$61.88^{a} \pm 0.46$	$62.85^{a} \pm 0.39$	$65.20^{b} \pm 0.37$
6	$67.48^{a} \pm 0.54$	$67.92^{a} \pm 0.52$	$70.10^{b} \pm 0.48$	$72.48^{c} \pm 0.42$
7	$74.27^{a} \pm 0.59$	$74.72^{a} \pm 0.60$	$76.40^{b} \pm 0.57$	$79.50^{c} \pm 0.49$
8	$79.72^{a} \pm 0.63$	$80.45^{a} \pm 0.65$	$83.05^{b} \pm 0.59$	$85.68^{c} \pm 0.54$
9	$84.65^{a} \pm 0.71$	$85.55^{a} \pm 0.72$	$87.45^{b} \pm 0.66$	$91.30^{c} \pm 0.59$
10	$88.85^{a} \pm 0.78$	$89.10^{a} \pm 0.77$	$92.87^{b} \pm 0.71$	$96.15^{c} \pm 0.67$

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.23. Mean monthly body length of D x (LWY x Desi) pigs, cm

Age (Month)	T1	T2	T3	T4
2	$44.10^{a} \pm 0.30$	$43.95^{a} \pm 0.31$	$44.27^{a} \pm 0.29$	$44.20^{a} \pm 0.30$
3	$49.70^{a} \pm 0.34$	$49.75^{a} \pm 0.33$	$50.42^{a} \pm 0.31$	$50.40^{a} \pm 0.35$
4	$54.42^{a} \pm 0.40$	$54.65^{a} \pm 0.38$	$55.40^{a} \pm 0.36$	$57.98^{b} \pm 0.38$
5	$61.33^{a} \pm 0.46$	$61.90^{a} \pm 0.45$	$62.90^{a} \pm 0.41$	$66.00^{b} \pm 0.42$
6	$68.27^{a} \pm 0.50$	$68.05^{a} \pm 0.51$	$70.25^{b} \pm 0.48$	$73.17^{c} \pm 0.45$
7	$75.08^{a} \pm 0.55$	$75.37^{a} \pm 0.54$	$77.30^{b} \pm 0.58$	$80.20^{c} \pm 0.49$
8	$80.55^{a} \pm 0.63$	$80.75^{a} \pm 0.65$	$83.35^{b} \pm 0.66$	$86.40^{c} \pm 0.55$
9	$85.52^{a} \pm 0.72$	$85.97^{a} \pm 0.74$	$87.80^{b} \pm 0.75$	$92.10^{c} \pm 0.60$
10	$89.20^{a} \pm 0.80$	$89.50^{a} \pm 0.75$	$92.53^{b} \pm 0.84$	$97.03^{c} \pm 0.67$

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.24. Mean monthly body length of pigs under different feeding systems, cm

Genetic group	Treatment	Month								
		2	3	4	5	6	7	8	9	10
LWY	T1	40.55^{a}	45.80^{a}	51.85^{a}	58.17^{a}	64.40^{a}	70.45^{a}	75.60^{a}	80.32^{a}	84.27^{a}
D x (LWY x LR)		41.35^{a}	46.75^{ab}	53.41^{ab}	60.21^{b}	66.91^{b}	73.40^{b}	78.90^{b}	83.80^{b}	87.97^{b}
D x (LR x Desi)		43.40^{b}	49.05^{c}	53.72^{bc}	61.55^{b}	67.48^{b}	74.27^{b}	79.72^{b}	84.65^{b}	88.85^{b}
D x (LWY x Desi)		44.10^{b}	49.70^{cd}	54.42^{bc}	61.33^{b}	68.27^{b}	75.08^{b}	80.55^{b}	85.52^{b}	89.20^{b}
LWY	T2	41.30^{a}	47.00^{a}	53.20^{a}	60.20^{a}	65.00^{a}	71.22^{a}	76.90^{a}	80.97^{a}	85.15^{a}
D x (LWY x LR)		41.20^{a}	48.05^{ab}	55.78^{b}	60.98^{a}	67.02^{b}	74.85^{b}	79.60^{b}	84.85^{b}	88.35^{b}
D x (LR x Desi)		43.52^{b}	49.20^{bc}	53.95^{a}	61.88^{a}	67.92^{b}	74.72^{b}	80.45^{b}	85.55^{b}	89.10^{b}
D x (LWY x Desi)		43.95^{b}	49.75^{bc}	54.65^{a}	61.90^{a}	68.05^{b}	75.37^{b}	80.75^{b}	85.97^{b}	89.50^{b}
LWY	T3	40.23^{a}	46.28^{a}	52.95^{a}	60.43^{a}	67.40^{a}	73.95^{a}	79.77^{a}	85.05^{a}	89.32^{a}
D x (LWY x LR)		41.25^{a}	48.38^{b}	56.35^{b}	61.87^{ab}	69.23^{b}	76.25^{b}	82.30^{b}	87.78^{b}	92.50^{b}
D x (LR x Desi)		43.13^{b}	49.35^{bc}	55.25^{b}	62.85^{b}	70.10^{b}	76.40^{b}	83.05^{b}	87.45^{b}	92.87^{b}
D x (LWY x Desi)		44.27^{b}	50.42^{bc}	55.40^{b}	62.90^{b}	70.25^{b}	77.30^{b}	83.35^{b}	87.80^{b}	92.53^{b}
LWY	T4	40.85^{a}	47.45^{a}	55.15^{a}	63.25^{a}	70.23^{a}	76.90^{a}	83.17^{a}	88.35^{a}	93.12^{a}
D x (LWY x LR)		41.68^{a}	49.37^{b}	58.22^{b}	64.37^{ab}	71.80^{ab}	78.95^{b}	85.15^{b}	90.75^{b}	95.63^{b}
D x (LR x Desi)		43.55^{b}	50.20^{bc}	57.13^{b}	65.20^{b}	72.48^{b}	79.50^{b}	85.68^{b}	91.30^{b}	96.15^{b}
D x (LWY x Desi)		44.20^{b}	50.40^{bc}	57.98^{b}	66.00^{b}	73.17^{b}	80.20^{b}	86.40^{b}	92.50^{b}	97.03^{b}

Mean values bearing different superscript with in treatment differ significantly($P < 0.01$)

Table 4.25. Mean monthly girth of LWY pigs, cm

Age (Month)	T1	T2	T3	T4
2	$44.85^{a} \pm 0.31$	$45.25^{a} \pm 0.33$	$44.65^{a} \pm 0.34$	$45.20^{a} \pm 0.30$
3	$52.90^{a} \pm 0.35$	$53.50^{a} \pm 0.37$	$52.75^{a} \pm 0.36$	$53.75^{a} \pm 0.32$
4	$60.98^{a} \pm 0.40$	$61.75^{a} \pm 0.41$	$62.55^{a} \pm 0.39$	$64.35^{b} \pm 0.37$
5	$70.15^{a} \pm 0.46$	$71.45^{a} \pm 0.49$	$72.40^{a} \pm 0.44$	$74.90^{b} \pm 0.41$
6	$77.50^{a} \pm 0.53$	$78.10^{a} \pm 0.56$	$80.43^{b} \pm 0.49$	$83.45^{c} \pm 0.45$
7	$84.60^{a} \pm 0.58$	$85.70^{a} \pm 0.63$	$88.20^{b} \pm 0.55$	$91.63^{c} \pm 0.47$
8	$90.87^{a} \pm 0.64$	$91.25^{a} \pm 0.71$	$95.10^{b} \pm 0.61$	$98.80^{c} \pm 0.53$
9	$95.70^{a} \pm 0.75$	$96.43^{a} \pm 0.79$	$100.45^{b} \pm 0.68$	$104.60^{c} \pm 0.60$
10	$99.95^{a} \pm 0.86$	$100.32^{a} \pm 0.83$	$105.60^{b} \pm 0.73$	$110.00^{c} \pm 0.64$

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.26. Mean monthly girth of D x (LWY x LR) pigs, cm

Age (Month)	T1	T2	T3	T4
2	$45.32^{a} \pm 0.28$	$45.17^{a} \pm 0.29$	$45.38^{a} \pm 0.31$	$45.60^{a} \pm 0.28$
3	$54.50^{a} \pm 0.33$	$54.57^{a} \pm 0.34$	$55.08^{a} \pm 0.32$	$55.55^{a} \pm 0.30$
4	$63.92^{a} \pm 0.38$	$64.25^{a} \pm 0.37$	$65.02^{ab} \pm 0.36$	$66.50^{b} \pm 0.33$
5	$75.48^{a} \pm 0.43$	$76.07^{a} \pm 0.44$	$78.42^{ab} \pm 0.42$	$80.80^{b} \pm 0.38$
6	$83.27^{a} \pm 0.54$	$84.10^{a} \pm 0.57$	$86.05^{b} \pm 0.48$	$88.23^{c} \pm 0.45$
7	$90.67^{a} \pm 0.61$	$91.92^{a} \pm 0.65$	$94.37^{b} \pm 0.57$	$96.95^{c} \pm 0.49$
8	$97.35^{a} \pm 0.67$	$98.85^{a} \pm 0.72$	$102.25^{b} \pm 0.66$	$105.15^{c} \pm 0.57$
9	$103.60^{a} \pm 0.75$	$104.45^{a} \pm 0.75$	$109.25^{b} \pm 0.69$	$112.50^{c} \pm 0.59$
10	$108.28^{a} \pm 0.82$	$109.00^{a} \pm 0.78$	$114.08^{b} \pm 0.73$	$117.85^{c} \pm 0.64$

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.27. Mean monthly girth of D x (LR x Desi) pigs, cm

Age (Month)	T1	T2	T3	T4
2	50.12^{a} ± 0.30	50.25^{a} ± 0.29	50.20^{a} ± 0.32	50.45^{a} ± 0.30
3	58.35^{a} ± 0.34	58.70^{a} ± 0.32	58.98^{a} ± 0.35	59.45^{a} ± 0.32
4	66.88^{a} ± 0.38	67.38^{a} ± 0.39	67.98^{ab} ± 0.40	69.48^{b} ± 0.36
5	76.52^{a} ± 0.45	77.25^{a} ± 0.43	78.03^{ab} ± 0.44	80.70^{b} ± 0.39
6	84.38^{a} ± 0.52	85.40^{a} ± 0.49	87.23^{b} ± 0.49	89.42^{c} ± 0.44
7	91.90^{a} ± 0.59	92.30^{a} ± 0.57	95.75^{b} ± 0.53	98.28^{c} ± 0.47
8	98.67^{a} ± 0.68	99.35^{a} ± 0.62	103.68^{b} ± 0.57	106.55^{c} ± 0.52
9	104.00^{a} ± 0.73	105.07^{a} ± 0.69	109.82^{b} ± 0.64	112.97^{c} ± 0.56
10	108.75^{a} ± 0.80	109.15^{a} ± 0.77	114.35^{b} ± 0.69	118.25^{c} ± 0.58

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.28. Mean monthly girth of D x (LWY x Desi) pigs, cm

Age (Month)	T1	T2	T3	T4
2	50.72^{a} ± 0.32	50.60^{a} ± 0.30	50.82^{a} ± 0.32	50.87^{a} ± 0.33
3	58.93^{a} ± 0.36	59.05^{a} ± 0.35	59.62^{a} ± 0.35	59.90^{a} ± 0.36
4	67.32^{a} ± 0.41	67.78^{a} ± 0.43	68.67^{ab} ± 0.37	70.03^{b} ± 0.39
5	77.00^{a} ± 0.47	77.68^{a} ± 0.50	78.18^{ab} ± 0.42	80.27^{b} ± 0.41
6	85.03^{a} ± 0.55	85.83^{a} ± 0.58	88.07^{b} ± 0.49	90.15^{c} ± 0.44
7	92.67^{a} ± 0.59	93.75^{a} ± 0.63	96.67^{b} ± 0.55	98.82^{c} ± 0.48
8	99.50^{a} ± 0.66	100.90^{a} ± 0.68	104.65^{b} ± 0.62	107.17^{c} ± 0.54
9	104.92^{a} ± 0.70	105.65^{a} ± 0.76	110.90^{b} ± 0.64	113.75^{c} ± 0.57
10	109.80^{a} ± 0.77	110.77^{a} ± 0.82	115.10^{b} ± 0.71	119.53^{c} ± 0.61

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.29. Mean monthly girth of pigs under different feeding systems, cm

Genetic group	Treatment	Month								
		2	3	4	5	6	7	8	9	10
LWY	T1	44.85^{a}	52.90^{a}	60.98^{a}	70.15^{a}	77.50^{a}	84.60^{a}	90.87^{a}	95.70^{a}	99.95^{a}
D x (LWY x LR)		45.32^{a}	54.50^{a}	63.92^{b}	75.48^{b}	83.27^{b}	90.67^{b}	97.35^{b}	103.60^{b}	108.28^{b}
D x (LR x Desi)		50.12^{b}	58.35^{b}	66.88^{c}	76.52^{b}	84.38^{b}	91.90^{b}	98.67^{b}	104.00^{b}	108.75^{b}
D x (LWY x Desi)		50.72^{b}	58.93^{b}	67.32^{c}	77.00^{b}	85.03^{b}	92.67^{b}	99.50^{b}	104.92^{b}	109.80^{b}
LWY	T2	45.25^{a}	53.50^{a}	61.75^{a}	71.45^{a}	79.10^{a}	86.70^{a}	93.25^{a}	98.43^{a}	103.10^{a}
D x (LWY x LR)		45.17^{a}	54.57^{a}	64.25^{b}	76.07^{b}	84.10^{b}	91.92^{b}	98.85^{b}	104.45^{b}	109.00^{b}
D x (LR x Desi)		50.25^{b}	58.70^{b}	67.38^{c}	77.25^{b}	85.40^{b}	92.30^{b}	99.35^{b}	105.07^{b}	109.15^{b}
D x (LWY x Desi)		50.60^{b}	59.05^{b}	67.78^{c}	77.68^{b}	85.83^{b}	93.75^{b}	100.90^{b}	105.65^{b}	110.77^{b}
LWY	T3	44.65^{a}	52.75^{a}	62.55^{a}	72.40^{a}	80.43^{a}	88.20^{a}	95.10^{a}	100.45^{a}	105.60^{a}
D x (LWY x LR)		45.38^{a}	55.08^{b}	65.02^{b}	78.42^{b}	86.05^{b}	94.37^{b}	102.25^{b}	109.25^{b}	114.08^{b}
D x (LR x Desi)		50.20^{b}	58.98^{c}	67.98^{c}	78.03^{b}	87.23^{b}	95.75^{b}	103.68^{b}	109.82^{b}	114.35^{b}
D x (LWY x Desi)		50.82^{b}	59.62^{c}	68.67^{c}	78.18^{b}	88.07^{b}	96.67^{b}	104.65^{b}	110.90^{b}	115.60^{b}
LWY	T4	45.20^{a}	53.75^{a}	64.35^{a}	74.90^{a}	83.45^{a}	91.63^{a}	98.80^{a}	104.60^{a}	110.00^{a}
D x (LWY x LR)		45.60^{a}	55.55^{a}	66.50^{b}	80.80^{b}	88.23^{b}	96.95^{b}	105.15^{b}	112.50^{b}	117.85^{b}
D x (LR x Desi)		50.45^{b}	59.45^{b}	69.48^{c}	80.70^{b}	89.42^{b}	98.28^{b}	106.55^{b}	112.97^{b}	118.25^{b}
D x (LWY x Desi)		50.87^{b}	59.90^{b}	70.03^{c}	80.27^{b}	90.15^{b}	98.82^{b}	107.17^{b}	113.75^{b}	119.53^{b}

Mean values bearing different superscript with in treatment differ significantly ($P < 0.01$)

Table 4.30. Mean monthly height of LWY pigs, cm

Age (Month)	T1	T2	T3	T4
2	$27.50^{a} \pm 0.24$	$27.95^{a} \pm 0.22$	$27.40^{a} \pm 0.24$	$27.65^{a} \pm 0.23$
3	$31.65^{a} \pm 0.28$	$32.30^{a} \pm 0.25$	$31.85^{a} \pm 0.27$	$32.60^{a} \pm 0.26$
4	$36.65^{a} \pm 0.35$	$37.50^{a} \pm 0.32$	$37.63^{a} \pm 0.29$	$38.60^{b} \pm 0.30$
5	$43.16^{a} \pm 0.41$	$43.45^{a} \pm 0.39$	$44.02^{a} \pm 0.34$	$46.32^{b} \pm 0.33$
6	$50.20^{a} \pm 0.46$	$51.00^{a} \pm 0.43$	$50.80^{b} \pm 0.38$	$53.40^{c} \pm 0.36$
7	$56.20^{a} \pm 0.50$	$57.17^{a} \pm 0.47$	$58.05^{b} \pm 0.45$	$60.08^{c} \pm 0.39$
8	$60.75^{a} \pm 0.56$	$61.20^{a} \pm 0.52$	$62.50^{b} \pm 0.49$	$64.18^{c} \pm 0.45$
9	$63.90^{a} \pm 0.63$	$64.70^{a} \pm 0.57$	$66.30^{b} \pm 0.52$	$68.13^{c} \pm 0.47$
10	$66.30^{a} \pm 0.69$	$66.65^{a} \pm 0.66$	$69.70^{b} \pm 0.57$	$71.63^{c} \pm 0.51$

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.31. Mean monthly height of D x (LWY x LR) pigs, cm

Age (Month)	T1	T2	T3	T4
2	$28.02^{a} \pm 0.21$	$27.92^{a} \pm 0.21$	$28.10^{a} \pm 0.20$	$28.20^{a} \pm 0.20$
3	$33.20^{a} \pm 0.26$	$33.22^{a} \pm 0.24$	$33.62^{a} \pm 0.23$	$33.22^{a} \pm 0.22$
4	$39.40^{a} \pm 0.33$	$39.55^{a} \pm 0.31$	$40.08^{ab} \pm 0.28$	$41.32^{b} \pm 0.25$
5	$49.05^{a} \pm 0.37$	$49.32^{a} \pm 0.35$	$49.93^{ab} \pm 0.34$	$51.28^{b} \pm 0.29$
6	$57.73^{a} \pm 0.42$	$58.08^{a} \pm 0.41$	$58.80^{b} \pm 0.38$	$60.23^{c} \pm 0.35$
7	$64.20^{a} \pm 0.48$	$64.65^{a} \pm 0.46$	$65.68^{b} \pm 0.40$	$67.05^{c} \pm 0.37$
8	$68.98^{a} \pm 0.53$	$69.47^{a} \pm 0.52$	$71.45^{b} \pm 0.47$	$73.15^{c} \pm 0.42$
9	$72.58^{a} \pm 0.59$	$73.17^{a} \pm 0.57$	$74.28^{b} \pm 0.50$	$76.18^{c} \pm 0.46$
10	$75.75^{a} \pm 0.64$	$76.30^{a} \pm 0.62$	$77.75^{b} \pm 0.58$	$79.80^{c} \pm 0.49$

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.32. Mean monthly height of D x (LR x Desi) pigs, cm

Age (Month)	T1	T2	T3	T4
2	$33.95^{a} \pm 0.22$	$34.13^{a} \pm 0.21$	$33.90^{a} \pm 0.23$	$34.15^{a} \pm 0.20$
3	$38.22^{a} \pm 0.29$	$38.47^{a} \pm 0.27$	$38.52^{a} \pm 0.25$	$39.25^{a} \pm 0.24$
4	$43.50^{a} \pm 0.34$	$43.87^{a} \pm 0.33$	$44.08^{ab} \pm 0.30$	$45.45^{b} \pm 0.28$
5	$51.22^{a} \pm 0.40$	$51.70^{a} \pm 0.38$	$52.02^{ab} \pm 0.35$	$53.40^{b} \pm 0.31$
6	$57.90^{a} \pm 0.48$	$58.52^{a} \pm 0.44$	$59.90^{b} \pm 0.39$	$61.40^{c} \pm 0.37$
7	$64.42^{a} \pm 0.53$	$65.20^{a} \pm 0.49$	$66.67^{b} \pm 0.42$	$68.25^{c} \pm 0.40$
8	$69.45^{a} \pm 0.57$	$70.10^{a} \pm 0.55$	$71.77^{b} \pm 0.48$	$73.40^{c} \pm 0.43$
9	$72.85^{a} \pm 0.62$	$73.03^{a} \pm 0.58$	$74.65^{b} \pm 0.51$	$76.50^{c} \pm 0.48$
10	$75.80^{a} \pm 0.69$	$76.15^{a} \pm 0.64$	$78.18^{b} \pm 0.57$	$80.20^{c} \pm 0.51$

Mean values bearing different superscript in a row differ significantly ($P< 0.01$)

Table 4.33. Mean monthly height of D x (LWY x Desi) pigs, cm

Age (Month)	T1	T2	T3	T4
2	$34.58^{a} \pm 0.20$	$34.22^{a} \pm 0.22$	$34.33^{a} \pm 0.20$	$34.50^{a} \pm 0.21$
3	$38.90^{a} \pm 0.25$	$38.62^{a} \pm 0.26$	$38.93^{a} \pm 0.23$	$39.60^{a} \pm 0.24$
4	$44.25^{a} \pm 0.29$	$44.05^{a} \pm 0.32$	$44.53^{ab} \pm 0.28$	$45.78^{b} \pm 0.27$
5	$52.02^{a} \pm 0.36$	$52.90^{a} \pm 0.37$	$52.47^{ab} \pm 0.34$	$53.82^{b} \pm 0.32$
6	$58.77^{a} \pm 0.41$	$58.78^{a} \pm 0.44$	$59.43^{b} \pm 0.39$	$60.85^{c} \pm 0.37$
7	$65.32^{a} \pm 0.49$	$65.48^{a} \pm 0.51$	$66.90^{b} \pm 0.41$	$68.75^{c} \pm 0.39$
8	$70.22^{a} \pm 0.55$	$70.45^{a} \pm 0.58$	$72.38^{b} \pm 0.44$	$73.92^{c} \pm 0.43$
9	$73.25^{a} \pm 0.64$	$73.58^{a} \pm 0.62$	$75.32^{b} \pm 0.49$	$77.02^{c} \pm 0.45$
10	$76.42^{a} \pm 0.68$	$77.01^{a} \pm 0.63$	$78.43^{b} \pm 0.56$	$80.70^{c} \pm 0.49$

Mean values bearing different superscript in a row differ significantly ($P< 0.01$)

Table 4.34. Mean monthly height of pigs under different feeding systems, cm

Genetic group	Treatment	Month								
		2	3	4	5	6	7	8	9	10
LWY	T1	27.50^{a}	31.65^{a}	36.65^{a}	44.00^{a}	50.20^{a}	56.20^{a}	60.75^{a}	63.90^{a}	66.30^{a}
D x (LWY x LR)		28.02^{a}	33.20^{b}	39.40^{b}	49.05^{b}	57.73^{b}	64.20^{b}	68.98^{b}	72.58^{b}	75.75^{b}
D x (LR x Desi)		33.95^{b}	38.22^{b}	43.50^{b}	51.22^{b}	57.90^{b}	64.42^{b}	69.25^{b}	72.85^{b}	75.80^{b}
D x (LWY x Desi)		34.58^{b}	38.90^{b}	44.25^{b}	52.02^{b}	58.77^{b}	65.32^{b}	70.22^{b}	73.25^{b}	76.42^{b}
LWY	T2	27.95^{a}	32.30^{a}	37.50^{a}	44.95^{a}	51.30^{a}	57.47^{a}	62.20^{a}	65.70^{a}	68.80^{a}
D x (LWY x LR)		27.92^{a}	33.22^{a}	39.55^{b}	49.32^{b}	58.08^{b}	64.65^{b}	69.47^{b}	73.17^{b}	76.30^{b}
D x (LR x Desi)		34.13^{b}	38.47^{b}	43.87^{c}	51.70^{c}	58.52^{b}	65.20^{b}	70.10^{b}	73.03^{b}	76.15^{b}
D x (LWY x Desi)		34.22^{b}	38.62^{b}	44.05^{c}	52.90^{c}	58.78^{b}	65.48^{b}	70.45^{b}	73.58^{b}	77.01^{b}
LWY	T3	27.40^{a}	31.85^{a}	37.23^{a}	43.93^{a}	50.80^{a}	58.05^{a}	62.50^{a}	66.30^{a}	69.70^{a}
D x (LWY x LR)		28.10^{a}	33.62^{b}	40.08^{b}	49.93^{b}	58.80^{b}	65.68^{b}	71.45^{b}	74.28^{b}	77.75^{b}
D x (LR x Desi)		33.90^{b}	38.52^{c}	44.08^{c}	52.02^{c}	59.90^{b}	66.67^{b}	71.77b	74.65^{b}	78.18^{b}
D x (LWY x Desi)		34.33^{b}	38.93^{c}	44.53^{c}	52.47^{c}	59.43^{b}	66.90^{b}	72.38b	75.32^{b}	78.43^{b}
LWY	T4	27.65^{a}	32.60^{a}	38.60^{a}	46.32^{a}	53.40^{a}	60.08^{a}	64.18^{a}	68.13^{a}	71.63^{a}
D x (LWY x LR)		28.20^{a}	33.22^{a}	41.32^{b}	51.28^{b}	60.23^{b}	67.05^{b}	73.15^{b}	76.18^{b}	79.80^{b}
D x (LR x Desi)		34.15^{b}	39.25^{b}	45.45^{c}	53.40^{c}	61.40^{b}	68.25^{b}	73.40^{b}	76.50^{b}	80.20^{b}
D x (LWY x Desi)		34.50^{b}	39.60^{b}	45.78^{c}	53.82^{c}	60.85^{b}	68.75^{b}	73.92^{b}	77.02^{b}	80.70^{b}

Mean values bearing different superscript with in treatment differ significantly ($P< 0.01$)

69.70 and 71.63; 75.75, 76.30, 77.75 and 79.80; 75.80, 76.15, 78.18 and 80.20; 76.42, 77.01, 78.43 and 80.70 respectively for D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs.

It is found that there is no significant difference in body length, girth and height of LWY pigs between concentrate and swill feeding. Swill feed supplemented with minerals attained significantly (P<0.01) higher body measurements than concentrate and swill feed fed groups. Organic mineral supplemented group attained significantly (P<0.01) higher body measurements than the other treatment groups. Similar trend is also observed in D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs.

It is also noticed that crossbred pigs *viz*., D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs attained significantly (P<0.01) higher body length, girth and height than LWY pigs within the treatment. Among the three crossbreds, no significant difference was observed in body measurements within the treatment.

4.7.3. Average Daily Weight Gain

The average daily gains (g) of different genetic groups of pigs under different feeding systems are presented in Tables 4.35 – 4.39 and Figure 4.18. LWY pigs had an average daily weight gain of 373.82, 378.00, 401.18 and 426.87 g respectively for T1, T2, T3, and T4. Similarly D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs had an average daily weight gain of 394.38, 398.82, 420.21 and 445.52; 390.25, 396.45, 416.67 and 440.42 and 386.29, 396.10, 419.10 and 442.40 g respectively for T1, T2, T3, and T4. The maximum average daily weight gain was noticed during seventh month of age in four different genetic groups.

It is found that differences in average daily weight gain of LWY pigs in concentrate and swill feeding is not statistically significant. Swill feed supplemented

Table 4.35. Average daily weight gain of LWY pigs, g

Age (Month)	T1	T2	T3	T4
3	$146.67^a \pm 9.56$	$148.33^a \pm 7.57$	$150.00^b \pm 8.96$	$160.33^c \pm 9.53$
4	$303.89^a \pm 13.90$	$307.22^a \pm 8.37$	$324.45^b \pm 10.38$	$363.33^c \pm 12.27$
5	$349.44^a \pm 15.02$	$357.22^a \pm 14.68$	$392.78^b \pm 14.15$	$426.33^c \pm 15.26$
6	$401.11^a \pm 14.92$	$402.22^a \pm 13.07$	$462.78^b \pm 13.30$	$490.33^c \pm 14.61$
7	$478.89^a \pm 13.85$	$486.11^a \pm 17.97$	$511.67^b \pm 17.45$	$537.45^c \pm 15.17$
8	$452.22^a \pm 11.04$	$453.89^a \pm 12.46$	$476.67^b \pm 13.33$	$492.22^c \pm 14.09$
9	$436.67^a \pm 8.42$	$437.78^a \pm 11.65$	$450.00^b \pm 15.05$	$483.33^c \pm 15.81$
10	$421.67^a \pm 10.56$	$431.67^a \pm 11.07$	$441.11^b \pm 13.09$	$461.67^c \pm 16.19$
Mean ±SE	$371.63^a \pm 14.34$	$378.06^a \pm 15.40$	$401.18^b \pm 16.11$	$426.87^c \pm 15.24$

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.36. Average daily weight gain of D x (LWY x LR) pigs, g

Age (Month)	T1	T2	T3	T4
3	$150.00^a \pm 9.56$	$154.45^a \pm 10.14$	$166.67^b \pm 11.14$	$191.95^c \pm 11.50$
4	$317.78^a \pm 13.32$	$325.56^a \pm 11.89$	$346.67^b \pm 15.04$	$382.22^c \pm 13.93$
5	$382.78^a \pm 15.73$	$398.33^a \pm 13.53$	$418.33^b \pm 15.29$	$476.11^c \pm 14.70$
6	$457.78^a \pm 16.08$	$463.89^a \pm 14.83$	$478.89^b \pm 16.20$	$512.22^c \pm 14.04$
7	$497.22^a \pm 16.33$	$492.22^a \pm 17.65$	$526.11^b \pm 15.93$	$539.44^c \pm 15.08$
8	$457.78^a \pm 14.88$	$456.67^a \pm 15.32$	$495.00^b \pm 16.96$	$509.44^c \pm 10.98$
9	$450.00^a \pm 11.00$	$453.33^a \pm 15.70$	$476.67^b \pm 16.46$	$491.67^c \pm 14.07$
10	$441.67^a \pm 12.41$	$446.11^a \pm 14.14$	$453.33^b \pm 13.76$	$461.11^c \pm 10.59$
Mean ±SE	$394.38^a \pm 16.23$	$398.82^a \pm 17.30$	$418.12^b \pm 18.22$	$445.52^c \pm 16.75$

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.37. Average daily weight gain of D x (LR x Desi) pigs, g

Age (Month)	T1	T2	T3	T4
3	172.5^{a} ± 8.24	168.28^{a} ± 7.76	177.23^{a} ± 8.93	186.67^{b} ± 9.81
4	305.56^{a} ± 14.63	316.67^{a} ± 14.00	332.78^{b} ± 13.93	369.45^{c} ± 12.97
5	383.89^{a} ± 12.23	393.33^{a} ± 15.20	422.78^{b} ± 14.67	452.22^{c} ± 13.63
6	496.67^{a} ± 14.18	441.67^{a} ± 12.15	467.22^{b} ± 13.26	499.44^{c} ± 15.82
7	455.00^{a} ± 10.62	512.78^{a} ± 13.02	520.00^{b} ± 14.22	542.22^{c} ± 14.28
8	433.89^{a} ± 10.17	460.56^{a} ± 11.27	500.56^{b} ± 10.42	516.67^{c} ± 14.52
9	433.89^{a} ± 9.21	440.00^{a} ± 10.72	470.56^{b} ± 13.36	497.22^{c} ± 12.73
10	440.56^{a} ± 12.74	438.34^{a} ± 13.66	442.22^{b} ± 13.71	459.45^{c} ± 14.85
Mean ±SE	390.24^{a} ± 15.21	396.45^{a} ± 16.04	416.67^{b} ± 18.67	438.75^{c} ± 16.18

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.38. Average daily weight gain of D x (LWY x Desi) pigs, g

Age (Month)	T1	T2	T3	T4
3	166.11^{a} ± 8.85	170.56^{a} ± 9.41	178.89^{a} ± 9.75	190.83^{b} ± 9.39
4	314.73^{a} ± 10.60	320.00^{a} ± 11.52	337.22^{b} ± 10.97	360.56^{c} ± 11.26
5	390.56^{a} ± 11.67	402.78^{a} ± 12.80	426.11^{b} ± 12.30	454.45^{c} ± 13.70
6	425.00^{a} ± 11.80	438.78^{a} ± 13.57	474.45^{b} ± 13.67	498.33^{c} ± 12.34
7	495.28^{a} ± 14.64	516.38^{a} ± 14.17	527.78^{b} ± 14.07	565.56^{c} ± 15.04
8	442.22^{a} ± 13.95	443.33^{a} ± 13.03	502.78^{b} ± 13.95	524.45^{c} ± 10.56
9	437.50^{a} ± 11.69	441.11^{a} ± 11.98	461.11^{b} ± 10.39	474.45^{c} ± 13.09
10	418.89^{a} ± 11.06	435.83^{a} ± 11.11	444.44^{b} ± 12.46	470.56^{c} ± 13.13
Mean ±SE	386.28^{a} ± 15.74	396.10^{a} ± 15.68	418.47^{b} ± 19.20	442.40^{c} ± 16.79

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.39. Average daily weight gain of pigs under different feeding systems, g

Genetic group	Treatment	Month								
		3	4	5	6	7	8	9	10	Mean
LWY	T1	146.67^{a}	303.89^{a}	349.44^{a}	401.11^{a}	478.89^{b}	452.22^{c}	436.67^{a}	421.67^{a}	373.82^{a}
D x (LWY x LR)		150.00^{a}	317.78^{b}	382.78^{b}	457.78^{c}	497.22^{c}	457.78^{c}	450.00^{b}	441.67^{b}	394.38^{b}
D x (LR x Desi)		172.50^{c}	305.56^{a}	383.89^{b}	496.67^{d}	455.00^{a}	433.89^{a}	433.89^{a}	440.56^{b}	390.25^{b}
D x (LWY x Desi)		166.11^{b}	314.73^{b}	390.56^{c}	425.00^{b}	495.28^{c}	442.22^{b}	437.50^{a}	418.89^{a}	386.29^{b}
LWY	T2	148.33^{a}	307.22^{a}	357.22^{a}	402.22^{a}	486.11^{a}	453.89^{b}	437.78^{a}	431.67^{a}	378.06^{a}
D x (LWY x LR)		154.45^{b}	325.56^{c}	398.33^{bc}	463.89^{c}	492.22^{b}	456.67^{bc}	453.33^{b}	446.11^{c}	398.82^{b}
D x (LR x Desi)		168.28^{c}	316.67^{b}	393.33^{b}	441.67^{b}	512.78^{c}	460.56^{c}	440.00^{a}	438.34^{b}	396.45^{b}
D x (LWY x Desi)		170.56^{d}	320.00^{b}	402.78^{c}	438.78^{b}	516.39^{c}	443.33^{a}	441.11^{a}	435.83^{b}	396.10^{b}
LWY	T3	150.00^{a}	324.45^{a}	392.78^{a}	462.78^{a}	511.67^{a}	476.67^{a}	450.00^{a}	441.11^{a}	401.18^{a}
D x (LWY x LR)		166.67^{b}	346.67^{c}	418.33^{b}	478.89^{b}	526.11^{c}	495.00^{b}	476.67^{d}	453.33^{c}	420.21^{b}
D x (LR x Desi)		177.23^{c}	332.78^{b}	422.78^{c}	467.22^{a}	520.00^{b}	500.56^{c}	470.56^{c}	442.22^{b}	416.67^{b}
D x (LWY x Desi)		178.89^{c}	337.22^{b}	426.11^{c}	474.45^{b}	527.78^{c}	502.78^{c}	461.11^{b}	444.44^{b}	419.10^{b}
LWY	T4	160.33^{a}	363.33^{a}	426.33^{a}	490.33^{a}	537.45^{a}	492.22^{a}	483.33^{b}	461.67^{b}	426.87^{a}
D x (LWY x LR)		191.95^{b}	382.22c	476.11^{c}	512.22^{c}	539.44^{a}	509.44^{b}	491.67^{c}	461.11^{b}	445.52^{b}
D x (LR x Desi)		186.67^{b}	369.45^{b}	452.22^{b}	499.44^{b}	542.22^{a}	516.67^{c}	497.22^{d}	459.45^{a}	440.42^{b}
D x (LWY x Desi)		190.83^{b}	360.56^{a}	454.45^{b}	498.33^{b}	565.56^{b}	524.45^{d}	474.45^{a}	470.56^{c}	442.40^{b}

Mean values bearing different superscript with in treatment differ significantly (P< 0.01) with minerals attained significantly ($P<0.01$) higher average daily weight gain than concentrate and swill feed fed groups. Organic mineral supplemented group attained significantly ($P<0.01$) higher average daily weight gain than the other treatment groups. Similar trend is also observed in D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs.

It is also noticed that crossbred pigs *viz.*, D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs had significantly ($P<0.01$) higher average daily weight gain than LWY pigs within the treatment. Among the three crossbreds there is no significant difference observed in average daily gain.

4.7.4. Average Daily Feed Intake

The average daily feed intakes (g) of different genetic groups of pigs under different feeding systems are presented in Tables 4.40 – 4.44. LWY pigs had average daily intake of 1486.54, 1712.96, 1796.48, and 1848.95 g respectively for T1, T2, T3, and T4. Similarly D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs had average daily feed intake of 1575.37, 1814.66, 1878.61 and 1938.04 ; 1579.03, 1825.05, 1876.63 and 1935.40 and 1545.99, 1828.12, 1875.95 and 1938.01 g respectively for T1, T2, T3, and T4.

It is found that differences in average daily feed intake of LWY pigs in concentrate and swill feeding is statistically significant. Swill feed supplemented with minerals had significantly ($P<0.01$) higher average daily feed intake than concentrate and swill feed fed groups. Organic mineral supplemented group had significantly ($P<0.01$) higher average daily feed intake than the other treatment groups. Similar trend is also observed in D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs.

Table 4.40. Average daily feed intake of LWY pigs, g

Age (Month)	T1	T2	T3	T4
3	469.36^{a} ± 18.50	516.23^{b} ± 19.52	513.01^{b} ± 18.18	545.13c ± 19.34
4	1036.25^{a} ± 21.25	1121.36^{b} ± 22.39	1168.00^{b} ± 20.88	1315.26^{c} ± 22.16
5	1244.03^{a} ±25.07	1346.13^{b} ± 25.46	1488.62^{c} ± 23.69	1590.23^{d} ± 20.52
6	1476.10^{a} ± 28.65	1637.04^{b} ± 30.42	1855.73^{c} ± 25.31	1912.13^{d} ± 26.85
7	1819.62^{a} ± 32.73	2114.58^{b} ± 31.31	2205.27^{c} ± 29.22	2300.26^{d} ± 29.21
8	1921.94^{a} ± 26.94	2178.67^{b} ± 33.78	2259.41^{c} ± 31.18	2313.44^{d} ± 25.63
9	1943.17^{a} ± 27.48	2342.11^{b} ± 30.28	2389.49^{c} ± 29.91	2368.33^{d} ± 27.38
10	1981.83^{a} ± 29.63	2447.56^{b} ± 28.77	2492.27^{c} ± 30.95	2446.83^{d} ± 28.09
Mean ±SE	1486.55^{a} ± 29.10	1712.96^{b} ± 30.14	1796.48^{c} ± 31.45	1848.95^{d} ± 31.73

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.41. Average daily feed intake of D x (LWY x LR) pigs, g

Age (Month)	T1	T2	T3	T4
3	481.48^{a} ± 17.15	545.19^{b} ± 16.49	595.02^{c} ± 17.52	656.45^{d} ± 18.51
4	1067.73^{a} ± 22.99	1207.81^{b} ± 19.47	1282.68^{c} ± 20.74	1418.05^{d} ± 22.64
5	1378.00^{a} ± 25.22	1553.50^{b} ± 23.67	1610.57^{c} ± 23.51	1818.77^{d} ± 23.17
6	1693.79^{a} ± 27.48	1856.95^{b} ± 24.92	1891.61^{c} ± 26.67	2013.05^{d} ± 25.20
7	1914.32^{a} ± 28.89	2165.78^{b} ± 27.65	2262.28^{c} ± 24.40	2319.60^{d} ± 26.84
8	1922.67^{a} ± 30.48	2174.58^{b} ± 29.47	2326.50^{c} ± 27.57	2379.14^{d} ± 31.26
9	2025.00^{a} ± 27.48	2470.67^{b} ± 30.90	2521.56^{c} ± 27.63	2409.29^{d} ± 28.87
10	2120.00^{a} ± 24.58	2542.83^{b} ± 27.29	2538.67^{c} ± 24.65	2490.00^{d} ± 27.17
Mean ±SE	1575.37^{a} ± 31.55	1813.62^{b} ± 32.48	1878.61^{c} ± 36.10	1938.04^{d} ± 30.24

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.42. Average daily feed intake of D x (LR x Desi) pigs, g

Age (Month)	T1	T2	T3	T4
3	555.45[a] ± 18.52	614.22[b] ± 17.31	638.00[c] ± 18.17	644.00[c] ± 19.47
4	1020.57[a] ± 22.84	1203.33[b] ± 20.81	1247.92[c] ± 20.99	1366.95[d] ± 21.58
5	1382.01[a] ± 24.03	1541.86[b] ± 21.35	1648.83[c] ± 24.53	1746.91[d] ± 25.65
6	1837.66[a] ± 28.36	1757.83[b] ± 28.44	1868.89[c] ± 33.04	1972.80[d] ± 32.47
7	1911.00[a] ± 30.59	2230.58[b] ± 31.45	2288.02[c] ± 34.58	2336.98[d] ± 33.11
8	1930.80[a] ± 31.92	2246.42[b] ± 35.09	2377.81[c] ± 30.22	2402.50[d] ± 27.55
9	1956.84[a] ± 28.52	2420.01[b] ± 31.45	2467.11[c] ± 29.75	2486.12[d] ± 23.63
10	2037.94[a] ± 25.04	2586.18[b] ± 23.62	2476.45[c] ± 26.78	2526.96[d] ± 24.69
Mean ±SE	1579.03[a] ± 34.81	1825.05[b] ± 33.08	1878.71[c] ± 35.32	1937.49[d] ± 29.28

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.43. Average daily feed intake of D x (LWY x Desi) pigs, g

Age (Month)	T1	T2	T3	T4
3	536.56[a] ± 18.90	614.00[b] ± 19.47	644.01[c] ± 20.72	669.82[d] ± 20.96
4	1060.63[a] ± 21.52	1228.80[b] ± 20.23	1247.73[c] ± 22.49	1298.00[d] ± 23.14
5	1445.05[a] ± 27.29	1631.25[b] ± 26.45	1661.84[c] ± 24.58	1690.53[d] ± 25.83
6	1566.44[a] ± 29.72	1895.53[b] ± 30.33	1978.44[c] ± 28.75	1893.67[d] ± 29.89
7	1906.82[a] ± 30.22	2272.11[b] ± 32.36	2269.51[c] ± 36.06	2431.89[d] ± 32.01
8	1923.67[a] ± 28.52	2283.17[b] ± 27.09	2363.04[c] ± 25.57	2464.89[d] ± 29.62
9	1960.00[a] ± 25.48	2337.88[b] ± 24.10	2420.83[c] ± 28.73	2467.17[d] ± 24.07
10	1968.78[a] ± 32.02	2362.21[b] ± 30.54	2422.22[c] ± 27.92	2588.07[d] ± 25.22
Mean ±SE	1545.99[a] ± 28.95	1828.12[b] ± 31.14	1875.95[c] ± 31.70	1938.00[d] ± 32.13

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.44. Average daily feed intake of pigs under different feeding systems, g

Genetic group	Treatment	Month								
		3	4	5	6	7	8	9	10	Mean
LWY	T1	469.36^{a}	1036.25^{b}	1244.03^{a}	1476.10^{a}	1819.62^{a}	1921.94^{a}	1943.17^{a}	1981.83^{b}	1486.54^{a}
D x (LWY x LR)		481.48^{b}	1067.73^{c}	1378.00^{b}	1693.79^{c}	1914.32^{b}	1922.67^{a}	2025.00^{b}	2120.00^{d}	1575.37^{c}
D x (LR x Desi)		555.45^{d}	1020.57^{a}	1382.01^{b}	1837.66^{d}	1911.00^{b}	1930.80^{a}	1956.84^{a}	2037.94^{c}	1579.03^{c}
D x (LWY x Desi)		536.56^{c}	1060.63^{c}	1445.05^{c}	1566.44^{b}	1906.82^{b}	1923.67^{a}	1960.00^{a}	1968.78^{a}	1545.99^{b}
LWY	T2	516.23^{a}	1121.36^{a}	1346.13^{a}	1637.04^{a}	2114.58^{a}	2178.67^{a}	2342.11^{a}	2447.56^{b}	1712.96^{a}
D x (LWY x LR)		545.19^{b}	1207.81^{b}	1553.50^{b}	1856.95^{c}	2165.78^{b}	2174.58^{a}	2470.67^{c}	2542.83^{c}	1814.66^{b}
D x (LR x Desi)		614.22^{c}	1203.33^{b}	1541.86^{b}	1757.83^{b}	2230.58^{c}	2246.42^{b}	2420.01^{b}	2586.17^{d}	1825.05^{b}
D x (LWY x Desi)		614.00^{c}	1228.80^{c}	1631.25^{c}	1895.53^{d}	2272.11^{d}	2283.17^{c}	2337.88^{a}	2362.21^{a}	1828.12^{b}
LWY	T3	513.01^{a}	1168.00^{a}	1488.62^{a}	1855.73^{a}	2205.28^{a}	2259.41^{a}	2389.49^{a}	2492.27^{c}	1796.48^{a}
D x (LWY x LR)		595.02^{b}	1282.68^{c}	1610.57^{b}	1891.61^{c}	2262.28^{b}	2326.50^{b}	2521.56^{d}	2538.67^{d}	1878.61^{b}
D x (LR x Desi)		638.00^{c}	1247.92^{b}	1648.83^{c}	1868.89^{ab}	2288.02^{c}	2377.81^{c}	2467.11^{c}	2476.45^{b}	1876.63^{b}
D x (LWY x Desi)		644.01^{c}	1247.73^{b}	1661.84^{c}	1978.44^{bc}	2269.51^{b}	2363.04^{c}	2420.83^{b}	2422.22^{a}	1875.95^{b}
LWY	T4	545.13^{a}	1315.26^{b}	1590.23^{a}	1912.13^{b}	2300.27^{a}	2313.44^{a}	2368.33^{a}	2446.83^{a}	1848.95^{a}
D x (LWY x LR)		656.45^{b}	1418.05^{d}	1818.77^{d}	2013.05^{d}	2319.60^{b}	2379.14^{b}	2409.29^{b}	2490.00^{b}	1938.04^{b}
D x (LR x Desi)		644.00^{b}	1366.95^{c}	1746.91^{c}	1972.80^{c}	2336.98^{c}	2402.50^{c}	2486.12^{d}	2526.96^{c}	1935.40^{b}
D x (LWY x Desi)		669.82^{c}	1298.00^{a}	1690.53^{b}	1893.67^{a}	2431.89^{d}	2464.89^{d}	2467.17^{c}	2588.07^{d}	1938.01^{b}

Mean values bearing different superscript with in treatment differ significantly ($P< 0.01$)

It is also noticed that crossbred pigs *viz.*, D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs had significantly ($P<0.01$) higher average daily feed intake than LWY pigs within the treatment. Among the three crossbreds there is no significant difference in average daily feed intake except in concentrate feeding. In concentrate feeding, D x (LWY x Desi) crossbred consumed significantly ($P<0.01$) less feed than the other crossbred pigs.

4.7.5. Feed Efficiency

The effect of different feeding systems on the feed efficiency of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs recorded at monthly interval are furnished in Table 4.45 - 4.49 and Figure 4.19.

At the end of tenth month arrived a feed efficiency 3.88, 4.40, 4.35 and 4.23 in LWY pigs respectively for T1, T2, T3, and T4. Similarly is 3.90, 4.43, 4.37 and 4.27; 3.95, 4.51, 4.40 and 4.30 and 3.94, 4.51, 4.38 and 4.29 respectively D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs.

By statistical analysis it is found that there is a significant ($P<0.01$) difference in feed efficiency of LWY pigs between concentrate and swill feeding. Swill feed supplemented with minerals and without supplementation had no significant difference. Similar trend also observed in D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. It is also noticed that there is no significant difference between LWY and crossbred pigs within the treatment. But there is a trend for better feed efficiency in animals supplemented with organic minerals.

4.8. CARCASS CHARACTERISTICS

The carcass characteristics *viz.*, slaughter weight (kg), hot carcass weight,(kg), dressing percentage, carcass length (cm), back fat thickness (mm), loin

Table 4.45. Feed efficiency of LWY pigs

Age (Month)	T1	T2	T3	T4
3	$3.20^{a} \pm 0.09$	$3.48^{b} \pm 0.09$	$3.42^{b} \pm 0.09$	$3.40^{b} \pm 0.07$
4	$3.41^{a} \pm 0.10$	$3.65^{b} \pm 0.09$	$3.60^{b} \pm 0.10$	$3.62^{b} \pm 0.10$
5	$3.56^{a} \pm 0.11$	$3.84^{b} \pm 0.12$	$3.79^{b} \pm 0.14$	$3.73^{b} \pm 0.14$
6	$3.68^{a} \pm 0.11$	$4.07^{b} \pm 0.13$	$4.01^{b} \pm 0.14$	$3.90^{b} \pm 0.11$
7	$3.80^{a} \pm 0.14$	$4.35^{b} \pm 0.14$	$4.31^{b} \pm 0.15$	$4.28^{b} \pm 0.13$
8	$4.25^{a} \pm 0.11$	$4.80^{b} \pm 0.12$	$4.74^{b} \pm 0.13$	$4.70^{b} \pm 0.14$
9	$4.45^{a} \pm 0.13$	$5.35^{b} \pm 0.11$	$5.31^{b} \pm 0.11$	$4.90^{b} \pm 0.11$
10	$4.70^{a} \pm 0.12$	$5.67^{b} \pm 0.16$	$5.65^{b} \pm 0.17$	$5.30^{b} \pm 0.14$
Mean ±SE	$3.88^{a} \pm 0.11$	$4.40^{b} \pm 0.12$	$4.35^{b} \pm 0.13$	$4.23^{b} \pm 0.12$

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.46. Feed efficiency of D x (LWY x LR) pigs

Age (Month)	T1	T2	T3	T4
3	$3.21^{a} \pm 0.11$	$3.53^{b} \pm 0.08$	$3.57^{b} \pm 0.08$	$3.42^{b} \pm 0.06$
4	$3.36^{a} \pm 0.12$	$3.71^{b} \pm 0.09$	$3.70^{b} \pm 0.10$	$3.71^{b} \pm 0.09$
5	$3.60^{a} \pm 0.14$	$3.85^{b} \pm 0.13$	$3.85^{b} \pm 0.13$	$3.82^{b} \pm 0.13$
6	$3.70^{a} \pm 0.11$	$4.00^{b} \pm 0.11$	$3.95^{b} \pm 0.10$	$3.93^{b} \pm 0.10$
7	$3.85^{a} \pm 0.13$	$4.40^{b} \pm 0.13$	$4.30^{b} \pm 0.13$	$4.30^{b} \pm 0.13$
8	$4.20^{a} \pm 0.12$	$4.76^{b} \pm 0.11$	$4.70^{b} \pm 0.14$	$4.67^{b} \pm 0.14$
9	$4.50^{a} \pm 0.12$	$5.45^{c} \pm 0.14$	$5.29^{bc} \pm 0.12$	$4.90^{ab} \pm 0.12$
10	$4.80^{a} \pm 0.11$	$5.70^{b} \pm 0.11$	$5.60^{b} \pm 0.12$	$5.40^{b} \pm 0.11$
Mean ±SE	$3.90^{a} \pm 0.12$	$4.43^{b} \pm 0.11$	$4.37^{b} \pm 0.12$	$4.27^{b} \pm 0.11$

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.47. Feed efficiency of D x (LR x Desi) pigs

Age (Month)	T1	T2	T3	T4
3	$3.22^{a} \pm 0.10$	$3.65^{b} \pm 0.10$	$3.60^{b} \pm 0.09$	$3.45^{b} \pm 0.07$
4	$3.34^{a} \pm 0.11$	$3.80^{b} \pm 0.11$	$3.75^{b} \pm 0.11$	$3.70^{b} \pm 0.11$
5	$3.60^{a} \pm 0.12$	$3.92^{b} \pm 0.13$	$3.90^{b} \pm 0.13$	$3.86^{b} \pm 0.14$
6	$3.70^{a} \pm 0.10$	$3.98^{b} \pm 0.11$	$4.00^{b} \pm 0.08$	$3.95^{b} \pm 0.09$
7	$4.20^{a} \pm 0.12$	$4.35^{b} \pm 0.14$	$4.40^{b} \pm 0.12$	$4.31^{b} \pm 0.13$
8	$4.40^{a} \pm 0.10$	$4.94^{c} \pm 0.11$	$4.75^{bc} \pm 0.14$	$4.65^{b} \pm 0.13$
9	$4.51^{a} \pm 0.09$	$5.50^{c} \pm 0.13$	$5.20^{bc} \pm 0.12$	$5.00^{b} \pm 0.10$
10	$4.62^{a} \pm 0.11$	$5.90^{c} \pm 0.12$	$5.60^{bc} \pm 0.11$	$5.50^{b} \pm 0.12$
Mean ±SE	$3.95^{a} \pm 0.11$	$4.51^{b} \pm 0.12$	$4.40^{b} \pm 0.11$	$4.30^{b} \pm 0.11$

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.48. Feed efficiency of D x (LWY x Desi) pigs

Age (Month)	T1	T2	T3	T4
3	$3.23^{a} \pm 0.10$	$3.60^{b} \pm 0.10$	$3.60^{b} \pm 0.10$	$3.51^{b} \pm 0.09$
4	$3.37^{a} \pm 0.12$	$3.84^{b} \pm 0.11$	$3.70^{b} \pm 0.11$	$3.60^{b} \pm 0.12$
5	$3.70^{a} \pm 0.15$	$4.05^{b} \pm 0.12$	$3.90^{b} \pm 0.11$	$3.72^{a} \pm 0.11$
6	$3.80^{a} \pm 0.08$	$4.32^{b} \pm 0.10$	$4.17^{b} \pm 0.09$	$3.80^{a} \pm 0.10$
7	$3.85^{a} \pm 0.13$	$4.40^{b} \pm 0.11$	$4.30^{b} \pm 0.13$	$4.30^{b} \pm 0.11$
8	$4.35^{a} \pm 0.12$	$5.15^{c} \pm 0.13$	$4.70^{b} \pm 0.12$	$4.70^{b} \pm 0.14$
9	$4.48^{a} \pm 0.11$	$5.30^{b} \pm 0.14$	$5.25^{b} \pm 0.11$	$5.20^{b} \pm 0.13$
10	$4.70^{a} \pm 0.12$	$5.42^{b} \pm 0.12$	$5.45^{b} \pm 0.13$	$5.50^{b} \pm 0.15$
Mean ±SE	$3.94^{a} \pm 0.12$	$4.51^{b} \pm 0.12$	$4.38^{b} \pm 0.11$	$4.29^{b} \pm 0.12$

Mean values bearing different superscript in a row differ significantly ($P < 0.01$)

Table 4.49. Feed efficiency of pigs under different feeding systems

Genetic group	Treatment	Month								
		3	4	5	6	7	8	9	10	Mean
LWY	T1	3.20	3.41	3.56	3.68	3.80	4.25	4.45	4.70	3.88
D x (LWY x LR)		3.21	3.36	3.60	3.70	3.85	4.20	4.50	4.80	3.90
D x (LR x Desi)		3.22	3.34	3.60	3.70	4.20	4.40	4.51	4.62	3.95
D x (LWY x Desi)		3.23	3.37	3.70	3.80	3.85	4.35	4.48	4.70	3.94
LWY	T2	3.48	3.65	3.84	4.07	4.35	4.80	5.35	5.67	4.40
D x (LWY x LR)		3.53	3.71	3.85	4.00	4.40	4.76	5.45	5.70	4.43
D x (LR x Desi)		3.65	3.80	3.92	3.98	4.35	4.94	5.50	5.90	4.51
D x (LWY x Desi)		3.60	3.84	4.05	4.32	4.40	5.15	5.30	5.42	4.51
LWY	T3	3.42	3.60	3.79	4.01	4.31	4.74	5.31	5.65	4.35
D x (LWY x LR)		3.57	3.70	3.85	3.95	4.30	4.70	5.29	5.60	4.37
D x (LR x Desi)		3.60	3.75	3.90	4.00	4.40	4.75	5.20	5.60	4.40
D x (LWY x Desi)		3.60	3.70	3.90	4.17	4.30	4.70	5.25	5.45	4.38
LWY	T4	3.40	3.62	3.73	3.90	4.28	4.70	4.90	5.30	4.23
D x (LWY x LR)		3.42	3.71	3.82	3.93	4.30	4.67	4.90	5.40	4.27
D x (LR x Desi)		3.45	3.70	3.86	3.95	4.31	4.65	5.00	5.50	4.30
D x (LWY x Desi)		3.51	3.60	3.72	3.80	4.30	4.70	5.20	5.50	4.29

Non- significant within the treatment (P>0.05)

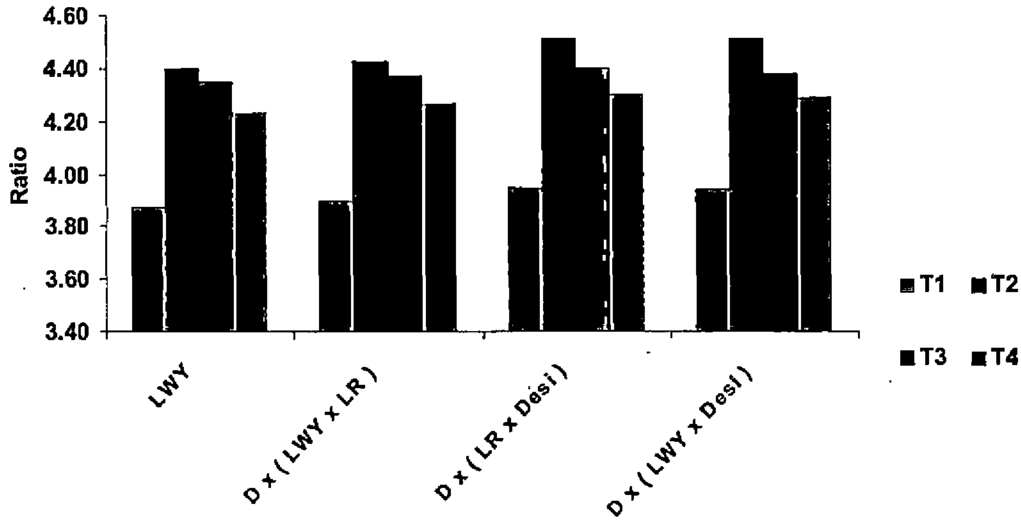

Fig. 4.19. Feed efficiency of pigs under different feeding systems

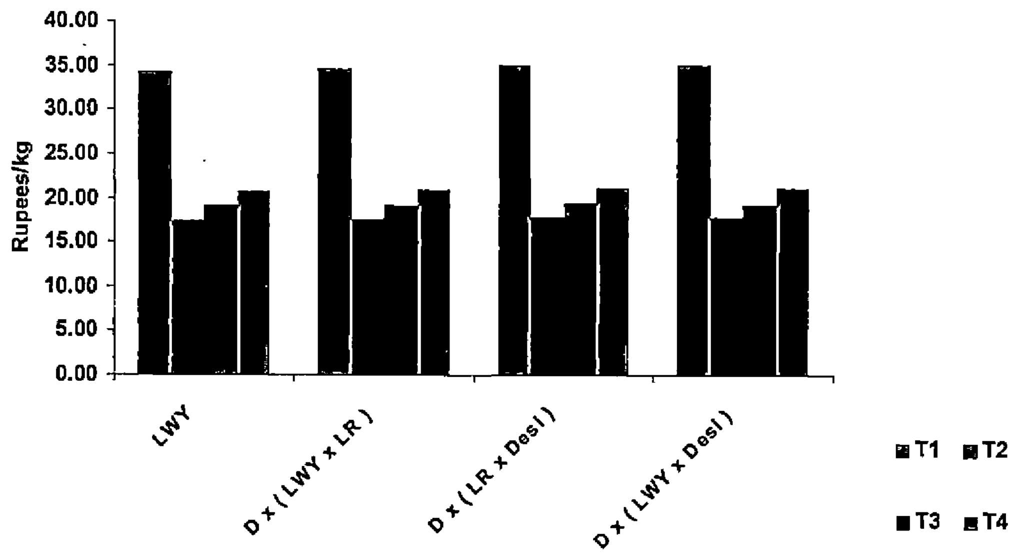

Fig.4.20. Cost of production per kg live weight on feed basis

eye area (cm^2), meat-bone ratio and gut weight (kg) of different genetic groups of pigs under different feeding systems are presented in Tables 4.50 – 4.54.

The slaughter weight of LWY pigs in T1, T2, T3 and T4 is 97.90, 98.85, 104.72 and 111.20 respectively. Similarly 106.40, 106.90, 111.40 and 119.90; 106.80,107.50, 112.30 and 120.20 and 108.00, 108.50, 113.50 and 121.50 respectively for D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. It is observed that pigs fed in the group supplemented with organic mineral (T4) attained significantly ($P<0.01$) higher slaughter weight than the other treatment groups. Pigs fed with inorganic mineral supplemented swill feed (T3) attained significantly ($P<0.01$) higher slaughter weight than the T2 and T1 treatment groups. There is no significant difference between concentrate feed (T1) and swill feed fed groups (T2).

Hot carcass weight of LWY pigs in T1, T2, T3 and T4 is 73.60, 70.90, 75.80 and 80.10 respectively. Similarly 79.00, 76.70, 81.20 and 86.90 ; 79.20, 76.90, 81.40 and 87.30 and 79.39, 77.70, 82.54 and 87.10 respectively for D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. It is revealed that there is a significant ($P<0.01$) difference in hot carcass weight between the treatments.

Dressing percentage of LWY pigs in T1, T2, T3 and T4 is 75.18, 71.72, 72.38 and 72.03 respectively. Similarly 74.25, 71.75, 72.89 and 72.48 ; 74.16, 71.54, 72.48 and 72.63 and 74.89, 71.61, 72.72 and 72.51 respectively for D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. By statistical analysis , it is revealed that pigs fed concentrate feed (T1) had significantly ($P<0.01$) higher dressing percentage than other treatment groups. However, there is no significant difference observed between swill feed (T2) and mineral supplemented swill feed fed groups (T3 and T4).

Carcass length of LWY pigs in T1, T2, T3 and T4 is 73.15, 73.86, 78.25 and 83.10 respectively. Similarly 79.55, 79.80, 83.35 and 87.80 ; 79.80, 80.40, 84.00 and

88.10 and 80.70, 81.10, 84.90 and 89.00 respectively for D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. It is observed that pigs fed with organic mineral supplements attained significantly (P<0.01) higher carcass length than the other treatment groups. Pigs fed with inorganic mineral supplement (T3) had attained significantly (P<0.01) higher carcass length than the T2 and T1 treatment groups. There is no significant difference between T1 and T2.

Back fat thickness of LWY pigs in T1, T2, T3 and T4 is 32.90, 37.80, 38.35 and 39.30 respectively. Similarly 24.64, 31.31, 30.30 and 30.78 ; 24.76, 31.52, 30.55 and 30.87 and 25.10, 31.91, 30.94 and 31.27 respectively for D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. By statistical analysis, it is revealed that pigs fed with concentrate feed (T1) had significantly (P<0.01) lesser back fat thickness than other treatment groups. However, there is no significant difference observed between T2 and mineral supplemented swill feed fed groups (T3 and T4).

Loin eye area of LWY pigs in T1, T2, T3 and T4 is 21.64, 18.80, 21.90 and 22.10 respectively. Similarly 23.41, 19.75, 23.72 and 25.04 ; 23.50, 19.91, 23.91 and 25.10 and 23.87, 20.10, 24.17 and 25.30 respectively for D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. By statistical analysis, it is revealed that pigs fed with swill feed (T2) had significantly (P<0.01) lesser loin eye area than other treatment groups. However, there is no significant difference between concentrate feed (T1) and mineral supplemented swill feed fed groups (T3 and T4).

Meat-bone ratio of LWY pigs in T1, T2, T3 and T4 is 4.20, 3.91, 4.42 and 4.50 respectively. Similarly 4.30, 3.94, 4.50 and 4.56; 4.34, 3.96, 4.46 and 4.54 and 4.32, 3.91, 4.51 and 4.52 respectively for D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. By statistical analysis, it is revealed that pigs fed with swill feed (T2) had significantly (P<0.01) lesser meat-bone ratio than other treatment groups.

Table 4.50. Carcass characteristics of LWY pigs

Parameters	T1	T2	T3	T4
Slaughter weight (kg)	97.90^{a}	98.85^{a}	104.72^{b}	111.20^{c}
Hot carcass weight (kg)	73.60^{b}	70.90^{a}	75.80^{c}	80.10^{d}
Dressing percentage	75.18^{b}	71.72^{a}	72.38^{a}	72.03^{a}
Carcass length (cm)	73.15^{a}	73.86^{a}	78.25^{b}	83.10^{c}
Back fat thickness (mm)	32.90^{a}	37.80^{b}	38.35^{b}	39.30^{b}
Loin eye area (cm^2)	21.64^{b}	18.80^{a}	21.90^{b}	22.10^{b}
Meat-bone ratio	4.20^{b}	3.91^{a}	4.42^{b}	4.50^{b}
Gut weight (kg)	8.10^{a}	10.90^{b}	11.70^{b}	12.05^{b}

Mean values bearing different superscript in a row differ significantly ($P< 0.01$)

Table 4.51. Carcass characteristics of (D x LWY x LR) pigs

Parameters	T1	T2	T3	T4
Slaughter weight (kg)	106.40^{a}	106.90^{a}	111.40^{b}	119.90^{c}
Hot carcass weight (kg)	79.00^{b}	76.70^{a}	81.20^{c}	86.90^{d}
Dressing percentage	74.25^{b}	71.75^{a}	72.89^{a}	72.48^{a}
Carcass length (cm)	79.55^{a}	79.80^{a}	83.35^{b}	87.80^{c}
Back fat thickness (mm)	24.64^{a}	31.31^{b}	30.30^{b}	30.78^{b}
Loin eye area (cm^2)	23.41^{b}	19.75^{a}	23.72^{b}	25.04^{b}
Meat-bone ratio	4.30^{b}	3.94^{a}	4.50^{b}	4.56^{b}
Gut weight (kg)	8.32^{a}	11.19^{b}	11.90^{b}	12.21^{b}

Mean values bearing different superscript in a row differ significantly ($P< 0.01$)

Table 4.52. Carcass characteristics of (D x LR x Desi) pigs

Parameters	T1	T2	T3	T4
Slaughter weight (kg)	106.80^{a}	107.50^{a}	112.30^{b}	120.20^{c}
Hot carcass weight (kg)	79.20^{b}	76.90^{a}	81.40^{c}	87.30^{d}
Dressing percentage	74.16^{b}	71.54^{a}	72.48^{a}	72.63^{a}
Carcass length (cm)	79.80^{a}	80.40^{a}	84.00^{b}	88.10^{c}
Back fat thickness (mm)	24.76^{a}	31.52^{b}	30.55^{b}	30.87^{b}
Loin eye area (cm^2)	23.50^{b}	19.91^{a}	23.91^{b}	25.10^{b}
Meat-bone ratio	4.34^{b}	3.96^{a}	4.46^{b}	4.54^{b}
Gut weight (kg)	8.35^{a}	11.25^{b}	12.00^{b}	12.24^{b}

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.53. Carcass characteristics of (D x LWY x Desi) pigs

Parameters	T1	T2	T3	T4
Slaughter weight (kg)	108.00^{a}	108.50^{a}	113.50^{b}	121.50^{c}
Hot carcass weight (kg)	79.39^{b}	77.70^{a}	82.54^{c}	87.10^{d}
Dressing percentage	74.89^{b}	71.61^{a}	72.72^{a}	72.51^{a}
Carcass length (cm)	80.70^{a}	81.10^{a}	84.90^{b}	89.00^{c}
Back fat thickness (mm)	25.10^{a}	31.91^{b}	30.94^{b}	31.27^{b}
Loin eye area (cm^2)	23.87^{b}	20.10^{a}	24.17^{b}	25.30^{b}
Meat-bone ratio	4.32^{b}	3.91^{a}	4.51^{b}	4.52^{b}
Gut weight (kg)	8.50^{a}	11.30^{b}	12.20^{b}	12.25^{b}

Mean values bearing different superscript in a row differ significantly (P< 0.01)

Table 4.54. Carcass characteristics of different genetic groups of pigs under different feeding systems

Genetic group	Treatment	Slaughter weight (kg)	Hot carcass weight	Dressing percentage	Carcass length (cm)	Back fat thickness (mm)	Loin eye area (cm^{2})	Meat-bone ratio	Gut weight (kg)
LWY	T1	97.90^{a}	73.60^{a}	75.18^{a}	73.15^{a}	32.90^{b}	21.64^{a}	4.20^{a}	8.10^{a}
D x (LWY x LR)		106.40^{b}	79.00^{b}	74.25^{a}	79.55^{b}	24.64^{a}	23.41^{b}	4.30^{a}	8.32^{a}
D x (LR x Desi)		106.80^{b}	79.20^{b}	74.16^{a}	79.80^{b}	24.76^{a}	23.50^{b}	4.34^{a}	8.35^{a}
D x (LWY x Desi)		108.00^{b}	79.39^{b}	74.89^{a}	80.70^{b}	25.10^{a}	23.87^{b}	4.32^{a}	8.50^{a}
LWY	T2	98.85^{a}	70.90^{a}	71.72^{a}	73.86^{a}	37.80^{b}	18.80^{a}	3.91^{a}	10.90^{a}
D x (LWY x LR)		106.90^{b}	76.70^{b}	71.75^{a}	79.80^{b}	31.31^{a}	19.75^{b}	3.94^{a}	11.19^{a}
D x (LR x Desi)		107.50^{b}	76.90^{b}	71.54^{a}	80.40^{b}	31.52^{a}	19.91^{b}	3.96^{a}	11.25^{a}
D x (LWY x Desi)		108.50^{b}	77.70^{b}	71.61^{a}	81.10^{b}	31.91^{a}	20.10^{b}	3.91^{a}	11.30^{a}
LWY	T3	104.72^{a}	75.80^{a}	72.38^{a}	78.25^{a}	38.35^{b}	21.90^{a}	4.42^{a}	11.70^{a}
D x (LWY x LR)		111.40^{b}	81.20^{b}	72.89^{a}	83.35^{b}	30.30^{a}	23.72^{b}	4.50^{a}	11.90^{a}
D x (LR x Desi)		112.30^{b}	81.40^{b}	72.48^{a}	84.00^{b}	30.55^{a}	23.91^{b}	4.46^{a}	12.00^{a}
D x (LWY x Desi)		113.50^{b}	82.54^{b}	72.72^{a}	84.90^{b}	30.94^{a}	24.17^{b}	4.51^{a}	12.20^{a}
LWY	T4	111.20^{a}	80.10^{a}	72.03^{a}	83.10^{a}	39.30^{b}	22.10^{a}	4.50^{a}	12.05^{a}
D x (LWY x LR)		119.90^{b}	86.90^{b}	72.48^{a}	87.80^{b}	30.78^{a}	25.04^{b}	4.56^{a}	12.21^{a}
D x (LR x Desi)		120.20^{b}	87.30^{b}	72.63^{a}	88.10^{b}	30.87^{a}	25.10^{b}	4.54^{a}	12.24^{a}
D x (LWY x Desi)		121.50^{b}	87.10^{b}	72.51^{a}	89.00^{b}	31.27^{a}	25.30^{b}	4.52^{a}	12.25^{a}

Mean values bearing different superscript within the treatment differ significantly ($P<0.01$)

However, there is no significant difference between concentrate feed (T1) and mineral supplemented swill feed fed groups (T3 and T4).

Gut weight of LWY pigs in T1, T2, T3 and T4 is 8.10, 10.90, 11.70 and 12.00 respectively. Similarly 8.32, 11.19, 11.90 and 12.70 ; 8.35, 11.25, 12.00 and 12.80 and 8.38, 11.27, 12.11 and 12.25 respectively for D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. It is observed that gut weight is significantly (P<0.01) lesser in pigs fed with concentrate feed (T1) than other treatment groups. However, there is no significant difference between swill feed (T2) and mineral supplemented swill feed fed groups (T3 and T4).

Statistically significant (P<0.01) difference is observed between LWY and crossbreds (D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs) in terms of slaughter weight, hot carcass weight, carcass length, back fat thickness and loin eye area within the treatment. There is no significant difference is noticed between dressing percentage, meat-bone ratio and gut weight within the treatment.

4.8. ECONOMICS OF PRODUCTION

Costs of production (Rs.) per kg live weight on feed basis in different genetic groups of pigs under different feeding systems are presented in Tables 4.55 and Figure 4.20.

Cost of production per kg live weight on feed basis is high in pigs fed with concentrate (34.40, 34.56, 34.96 and 34.87) followed by organic minerals supplemented swill feed (20.71, 20.91, 21.06 and 21.00), inorganic minerals supplemented swill feed (19.06, 19.15, 19.28 and 19.19) and the least was swill feed without supplementation (17.37, 17.49, 17.80 and 17.80) respectively for LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs.

Table 4.55.Cost of production of pigs under different feeding systems,Rs

Genetic group	Treatment	Number of pigs	Total initial body weight (kg)	Total final body weight (kg)	Total weight gain (kg)	Total feed inkake (kg)	Total feed cost (Rs.) including cost of minerals in T3 and T4	Cost of feed per kg (Rs.)	Feed conversion ratio	Cost of production on feed basis (FCR x cost of feed / kg (Rs.)
LWY	T1	6	60.60	598.62	538.02	2370.82	18966.56	8.00	4.30	34.40
D x (LWYxLR)		6	61.80	629.70	567.90	2512.49	20099.94	8.00	4.32	34.56
D x (LRxDesi)		6	77.04	634.20	557.16	2518.33	20146.67	8.00	4.37	34.96
D x (LWYx Desi)		6	78.60	637.38	558.78	2465.66	19725.24	8.00	4.36	34.87
LWY	T2	6	61.32	605.70	544.38	9738.10	9738.10	1.00	17.37	17.37
D x (LWYxLR)		6	61.20	641.40	580.20	10316.27	10316.27	1.00	17.49	17.49
D x (LRxDesi)		6	77.40	646.20	568.80	10375.33	10375.33	1.00	17.80	17.80
D x (LWYx Desi)		6	78.00	648.96	570.96	10392.79	10392.79	1.00	17.80	17.80
LWY	T3	6	60.00	637.68	577.68	10212.91	11323.06	1.11	17.17	19.06
D x (LWYxLR)		6	61.50	666.60	605.10	10679.83	11897.17	1.11	17.25	19.15
D x (LRxDesi)		6	76.80	676.80	600.00	10668.56	11884.62	1.11	17.37	19.28
D x (LWYx Desi)		6	78.30	681.12	602.82	10664.70	11880.15	1.11	17.29	19.19
LWY	T4	6	60.60	675.30	614.70	10511.21	12986.87	1.24	16.70	20.71
D x (LWYxLR)		6	61.86	707.10	645.24	11017.68	13613.11	1.24	16.86	20.91
D x (LRxDesi)		6	77.40	711.60	634.20	11002.68	13594.57	1.24	16.98	21.06
D x (LWYx Desi)		6	78.18	715.20	637.02	11017.51	13612.89	1.24	16.94	21.00

Additional expenses towards cost of minerals per kg feed are 11 and 24 paisa respectively for inorganic and organic minerals. Additional expense per kg weight gain is Rs. 1.69, 1.66, 1.48 and 1.38 for swill feeding supplemented with inorganic minerals and 3.34, 3.42, 3.26 and 3.20 for swill feeding supplemented with organic minerals respectively for LWY, (D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. Additional weight gain (kg) attained by pigs fed with inorganic minerals supplemented swill feed was 31.98, 25.00, 30.60 and 32.16 and pigs fed with organic mineral supplemented swill feed was 69.60, 65.50, 65.40 and 66.24 respectively by LWY, (D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. It is inferred that swill feed supplemented with minerals is absolutely essential to increase the profit margin of the field fattener pig production.

4.8.1. Economic Gain in Different Treatment Group

The economic gain of pigs under different group is presented in Table 4.56. It is observed that the economic gain in pigs fed with swill alone is highest followed by inorganic and organic minerals supplemented group and the least is concentrate feed fed group.

Table 4.56. Economic gain in different treatment group,Rs

Genetic group	Treatment	Number of pigs	Total weight gain (kg)	Value of gain (Rs.)*	Total feed cost (Rs.) including cost of minerals in T3 and T4	Economic gain (Rs.)
LWY	T1	6	538.02	21520.80	18966.56	2554.24
D x (LWYx LR)		6	567.90	22716.00	20099.94	2616.06
D x (LR x Desi)		6	557.16	22286.40	20146.67	2139.73
D x (LWYx Desi)		6	558.78	22351.20	19725.24	2625.96
LWY	T2	6	544.38	21775.20	9738.10	12037.10
D x (LWYx LR)		6	580.20	23208.00	10316.27	12891.73
D x (LR x Desi)		6	568.80	22728.00	10375.33	12352.67
D x (LWYx Desi)		6	570.96	22838.40	10392.79	12445.61
LWY	T3	6	577.68	23107.20	11323.06	11784.14
D x (LWYx LR)		6	605.10	24204.00	11897.17	12306.83
D x (LR x Desi)		6	600.00	24000.00	11884.62	12115.38
D x (LWYx Desi)		6	602.82	24112.80	11880.15	12232.65
LWY	T4	6	614.70	24588.00	12986.87	11601.13
D x (LWY x LR)		6	645.24	25809.60	13613.11	12196.49
D x (LR x Desi)		6	634.20	25368.00	13594.57	11773.43
D x (LWYx Desi)		6	637.02	25480.80	13612.89	11867.91

* Value of gain calculated at the rate of Rs. 40 per kg live body weight

DISCUSSION

5. DISCUSSION

5.1. EFFECT OF BREED ON THE LITTER PERFORMANCE OF PIGS

The effect of different genetic groups *viz.*, Large White Yorkshire, Duroc x (Large White Yorkshire x Landrace), Duroc x (Landrace x Desi) and Duroc x (Large White Yorkshire x Desi) on the litter performance (Table 4.1) revealed that genetic group had significant effect on litter traits. The crossbred viz., D x (LWY x Desi) and D x (LR x Desi) had significantly ($P<0.01$) higher values in terms of litter size at birth, litter weight at birth, birth weight, litter size at weaning, litter weight at weaning and weaning weight compared to LWY and D x (LWY x LR) pigs. This may be due to heterozygote superiority (hybrid vigour) among the crossbred piglets conferring them with better viability and fitness which had been boosted by the incorporation of Desi blood in these two genetic groups and as revealed by a numerically higher value obtained by D x (LWY x LR) crossbred over pure LWY though not significant. These results are in agreement with reports of Dash and Mishra (1986), Deka *et al.*(2003) and Nandakumar *et al.* (2004). However, contrast results were observed by Chatterjee *et al.* (1987), Sharma *et al.* (1992) and Singh *et al.* (1997).

Litter traits had no significant difference between D x (LWY x Desi); D x (LR x Desi) pigs indicating adaptability of these crossbreds under hot-humid climate region. However there was no significant improvement in litter traits of pigs. Since three purebred pigs were used in this cross, the quantum of hybrid vigour may not as great as that of crossbreeding with Desi germplasm. These results indicate the importance of incorporation of Desi germplasm in the crossbreeding strategies of pigs.

5.2. CLIMATIC VARIABLES

Mean ± S.E. of microclimatic variables such as maximum and minimum temperature (^{0}C) and relative humidity (%) recorded at farm and field (Table 4.2) revealed that there were no significant differences (P>0.05) in microclimatic variables, viz., maximum and minimum temperature and the relative humidity between farm and field. This indicates the existence of homo-climate in the experimental area. It is also inferred that the animals were subjected to same degree of stress during the experiment.

5.3. RECTAL TEMPERATURE, RESPIRATORY RATE AND PULSE RATE

The mean rectal temperature (^{0}C), respiratory rate and pulse rate (per minute) of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs under different treatment (Tables 4.4 - 4.6) found that there were no significant differences (P>0.05) between treatments and genetic groups of pigs during the entire study period. This might be due to the fact that these piglets were able to acclimatize to this climate. These results are in accordance with the reports of Mathur (1990) and Sebastian (1992).

There was a significant difference (P<0.01) between morning and afternoon pulse and respiratory rates irrespective of treatment and genetic groups. This may probably be due to the compensatory physiological responses shown by the pigs towards high ambient temperature during hot hours. This result concurs with the findings of Mukherjee and Banerjee (1980) and Black *et al.* (1993). As ambient temperature increases above the zone of thermal comfort, thermoregulation could be achieved only by increasing evaporative heat loss from lungs and skin. Pigs have few sweat glands, so evaporative heat loss is achieved through increase in respiratory rate and wetting of skin.

5.4. BEHAVIOUR

Observations as feeding, agonistic and eliminative behaviour of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs in all the treatment groups (Tables 4.7, 4.8 and 4.9 respectively) indicated that the pigs in the farm provided with wallowing facility were found floundering during the hot hours of the day whereas the field pigs had water spraying and tree shades around the pens. All the four different genetic groups under different treatment were active and exhibited playful behaviour at the time of cleaning the pen.

5.4.1 Feeding Behaviour

Majority of the pigs under different treatment and genetic groups showed eating greedily with drooling of saliva followed by exploring the pen and eating with grunt and drooling of saliva and least was eating calmly at the time of feeding. None of the animals in the treatment group and genetic groups observed a score of not showing any interest towards feeding. This indicates that pigs had interest in swill feed on par with concentrate feed. The logical reason may be due to the fact that both forms of feeds had better palatability and fed twice a day and moreover they were in small groups that resulted in active participation at the time of feeding to meet their daily requirements. This finding is in agreement with reports of Deepa (2004).

5.4.2 Agonistic Behaviour

Majority of the pigs under different treatments and genetic groups showed ear biting, belly nosing and tail biting very frequently followed by ear biting, belly nosing and tail biting frequently and least was ear biting, belly nosing and tail biting occasionally. None of the treatment group and genetic groups observed without biting at the time of feeding. This result indicates that feeding regimes adapted here had no apparent influence on the agonistic behaviour of pigs. These findings are in line with Anton (2005).

5.4.3 Eliminative Behaviour

Highly significant ($P<0.01$) difference was found between treatment in all four genetic groups. This may probably be due to pigs fed with swill feed had significantly higher DM take than the concentrate feed. This is in line with observations of Westendorf *et al.* (1998). However, these results are in contrast with Anton (2005) who noticed that the pigs fed with conventional feed voided more quantity of faeces due to the increased bulkiness. By statistical analysis it was observed that LWY pigs voided significantly lesser quantity of faeces than other genetic groups within the treatment. This might be due to higher average daily DM intake by the crossbred pigs than LWY pigs under different treatment. It was also observed that majority of the pigs defaecated either in the wallowing tank or near the gate of the pen in the farm and pigs maintained in the field voided either in the corner or near the gate. In the field there was no provision of run area.

There was no significant difference in frequency of defaecation observed between treatments and genetic groups. Among the conventional and unconventional feed fed pigs the latter group had numerically higher frequency of defaecation. This may probably be due to quantity of faeces voided by these pigs were significantly higher than the concentrate feed fed pigs.

5.5. FAECAL CORTISOL LEVEL

Based on the Table 4.10 and Figure 9 it can be seen that there were no significant differences ($P>0.05$) in the faecal cortisol level between the treatments and between the genetic groups of pigs. This finding is in agreement with that of Anton (2005). These observations indicating that the variations in the feeding and recorded a very low EE (7.63) per cent for hotel waste. Chicken waste in the present study includes alimentary tract and subcutaneous fat of the skin and this might be the reason for a higher ether extract.

NFE for all the swill feed were more than 50 per cent except for chicken waste 25.65. Acid insoluble ash was highest 2.41 for the chicken waste and lowest for hotel waste 0.51.These values were with in the normal limits given by various authors (Gloridoss and Das 1983; Ravi and Reddy 1997 and Chinnamani, 2003).

From this analysis it was concluded that even though the proximate composition of the different feed components varies, the pigs were ultimately fed with the combination of different sources provided the required nutrients and hence the swill feed found to be equally effective for better growth of the fattener pigs.

5.6.1. Chemical Composition of Mineral Mixtures

The mineral composition of inorganic and organic mineral preparation fed to pigs in the field (Table 4.12) found that the availability of minerals in inorganic form was higher than the organic form. Since the bioavailability is more in organic form might be possible reason for this variation in composition.

5.6.2. Mineral Profile of Feed Samples Fed Under Field Conditions

Mineral profile of feed samples viz., chicken waste, hotel waste and vegetable waste fed to pigs under field conditions (Table 4.13) revealed that chicken waste had higher levels followed by hotel waste and vegetable waste with regard to macro and micro minerals. This may probably be due to the fact that chicken waste contains offal, alimentary tract, subcutaneous fat and bones which are responsible for the higher mineral levels than the hotel waste and vegetable wastes.

management conditions prevailing in the farm and field were not sufficient to impose any appreciable stress in the animals reared under different treatment.

5.6.PROXIMATE COMPOSITION OF FEED SAMPLES

The proximate composition (percentage) of feed samples on DM basis (Table 4.11) revealed that farm concentrate (grower and finisher diet) had 17.90 and 14.15 per cent crude protein in grower and finisher ration respectively. This result is comparable with the findings of Anton (2005).

The moisture content of hotel waste was found to be the highest (80.34) followed by vegetable waste (73.57), chicken waste (70.10) and pooled samples (74.67). The crude protein content of chicken waste was the highest (24.13). Vegetable waste had a slightly higher CP (10.10) than hotel waste (9.81). The pooled sample had a CP of 14.69. This finding is in agreement with report of Harikumar (2001). But crude protein per cent reported by him was higher (35.63). Low CP per cent of hotel waste may probably be due to presence of cooked rice as the major ingredient of hotel waste in this study. In contrast, Rivas *et al.* (1996) reported a high CP of 22.40 per cent for dehydrated edible restaurant waste.

The crude fibre content in this study was 7.81 for chicken waste and 6.95, 9.41 and 8.07 respectively for hotel waste, vegetable waste and pooled samples. These values are in agreement with observations of (Harikumar, 2001, Ranjan, *et al.*, 2003 and Anil, 2005). However Rivas *et al.* (1996) has reported a much lower per cent (2.3) crude fibre for dehydrated restaurant waste.

The ether extract value obtained in the present study was highest for chicken waste (35.40) followed by hotel waste (19.58), vegetable waste (18.52) and 24.56 per cent for pooled sample. Harikumar (2001) has reported EE of 30.90 per cent for chicken waste and 18.34 per cent in hotel waste. In contrast, Ranjan *et al.* (2003)

recorded a very low EE (7.63) per cent for hotel waste. Chicken waste in the present study includes alimentary tract and subcutaneous fat of the skin and this might be the reason for a higher ether extract.

NFE for all the swill feed were more than 50 per cent except for chicken waste 25.65. Acid insoluble ash was highest 2.41 for the chicken waste and lowest for hotel waste 0.51.These values were with in the normal limits given by various authors (Gloridoss and Das 1983; Ravi and Reddy 1997 and Chinnamani, 2003).

From this analysis it was concluded that even though the proximate composition of the different feed components varies, the pigs were ultimately fed with the combination of different sources provided the required nutrients and hence the swill feed found to be equally effective for better growth of the fattener pigs.

5.6.1. Chemical Composition of Mineral Mixtures

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Mineral profile of feed samples viz., chicken waste, hotel waste and vegetable waste fed to pigs under field conditions (Table 4.13) revealed that chicken waste had higher levels followed by hotel waste and vegetable waste with regard to macro and micro minerals. This may probably be due to the fact that chicken waste contains offal, alimentary tract, subcutaneous fat and bones which are responsible for the higher mineral levels than the hotel waste and vegetable wastes.

5.6.3. Serum Minerals Concentration of Pigs Under Different Feeding Systems

Mean serum mineral concentration of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs under different treatment (Table 4.14) indicated that there was no significant difference between genetic groups within the treatment. The feeding system had highly significant ($P<0.01$) effect on the mineral concentration in serum samples. It was highest in T4 followed by T3 and T1 and least in T2. It was comparable between T3 and T2.

In the T4 treatment group, swill feed was supplemented with organic minerals leading to better bioavailability which may be responsible for the higher mineral concentration than the other treatment groups. These results are in accordance with the report of Acda and Chae, (2002) who have reported that the availability of trace minerals can be improved by binding them to organic form in the pig feed.

There was no significant difference in serum mineral concentration between T3 and T2. This might be due to both treatment groups were supplemented with inorganic form in the feed. T2 had no supplementation in their feed which attributed for the significantly lower serum mineral concentration in different genetic groups of pigs.

5.7. GROWTH STUDY

5.7.1. Monthly Body Weights

The monthly body weights (kg) of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs under different feeding systems (Table 4.15, 4.16, 4.17, 4.18 and 4.19) revealed that up to 4^{th} month in LWY, D x (LR x Desi) and D x (LWY x Desi) pigs and up to 3rd month in D x (LWY x LR) pigs there was no significant difference in monthly body weight. This indicates a variation in adaptation to different feeding system between the genetic groups. From 5th month onwards in LWY, D x (LR x Desi) and D x (LWY x Desi) pigs and 4th month onwards in D x (LWY x LR) pigs minerals supplemented group attained significantly higher body weight than T1 and T2 groups.

It was also observed that there was a linear increase in body weight from 2nd month to ten months of age. This is in agreement with the findings of Kannan, (1995). These results indicate that the feeding system adapted in different treatment group has not affected the standard growth pattern in pigs.

At the end of tenth month, it was observed that there was no significant difference in body weight of pigs between concentrate (T1) and swill feeding (T2). This indicates that swill feed was equally effective in promoting growth of the pigs. These results are in accordance with the findings of Gustafson and Stern (2003). In contrast to this Anil (2005) reported a significantly higher body weight in pigs maintained in the field fed with swill feed compared to concentrate feed fed group in the farm.

Swill feed supplemented with minerals (T3 and T4) attained significantly ($P<0.01$) higher body weight than T2 and T1. Organic mineral supplemented group attained significantly ($P<0.01$) higher body weight than the other treatment groups. This may probably be due to variation in bioavailability of minerals for the metabolic process in the system. These results are in agreement with Sekar *et al.*(2006).

It was seen that crossbred pigs *viz.*, D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs attained significantly ($P<0.01$) higher body weight than LWY pigs within the treatment. This result concurs with Lakhani *et al.*(2004). There was no significant difference between crossbreds within the treatment. This indicates that these crossbreds were equally effective in growth promotion and adapted to hot-humid climatic conditions.

5.7.2. Body Measurements

The effect of different feeding systems on the body measurements of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs recorded at monthly interval for the body length, girth and height (Table 4.20 - 4.34) revealed that up to 3rd month there was no significant difference observed between the treatment groups. From 4th month onwards minerals supplemented groups began to show significant difference in body measurements. There was a positive relationship between body weight and measurements under different treatments. By statistical analysis it was found that there was no significant difference in body length, girth and height of pigs (LWY, D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs) between concentrate and swill feeding. This indicates that swill feed was equally effective in promoting growth of the pigs.

Swill feed supplemented with minerals attained significantly ($P<0.01$) higher body measurements than concentrate and swill feed fed groups. Organic mineral supplemented group attained significantly ($P<0.01$) higher body measurements than the other treatment groups. This can be explained based on the body weight and body measurements. Pigs fed with mineral supplemented diet had significantly ($P<0.01$) higher body weight might be attributed for the higher body measurements in T3 and T4 pigs.

It was also noticed that crossbred pigs *viz.*, D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs attained significantly ($P<0.01$) higher body length, girth and height than LWY pigs within the treatment. This result explains that crossbred pigs are relatively more adapted to different feeding system than the LWY. However contrary results were reported by Dash and Mishra (1986) observed no significant difference in body measurements between Large White Yorkshire and crossbred pigs (LWY x Desi). The better body measurements in the present study were attributed by incorporation of Duroc blood in these cross as terminal sire.

Among the three crossbreds there was no significant difference in body measurements within the treatment. This may be due to the fact that the feeding system had relatively lesser influence in different genotype on body measurements under identical feeding and management conditions.

5.7.3. Average Daily Weight Gain

The average daily weight gains (g) of different genetic groups of pigs under different feeding systems (Tables 4.35 – 4.39) revealed that there was no significant difference between concentrate and swill feeding. This is in agreement with findings of Gustafson and Stern (2003). In contrast, Anil (2005) who found that LWY in the field had significantly higher ($P<0.01$) average daily weight gain than LWY in the farm.

Swill feed supplemented with minerals attained significantly ($P<0.01$) higher average daily gain than concentrate and swill feed fed groups. Organic mineral supplemented group attained significantly ($P<0.01$) higher average daily gain than the other treatment groups. This observation is in line with that of Sekar et *al.* (2006)

It was also noticed that crossbred pigs *viz.*, D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs had significantly ($P<0.01$) higher average daily gain than LWY pigs within the treatment. This result explains that crossbred pigs were relatively more adapted to different feeding system than the pure LWY due to the buffering effect of crossbreds i.e. its ability to withstand a wide range of environmental fluctuation and better genetic combinations. However, contrary results were reported by Dash and Mishra (1986) and Anil (2005) as they used the cross of LWY x Desi.

Among the three crossbreds there was no significant difference observed in average daily gain. This may be due to the fact that the feeding system had relatively lesser influence in different genotype on average daily weight gain with identical feeding and management conditions.

5.7.4. Average Daily Feed Intake

The average daily feed intakes (g) of different genetic groups of pigs under different feeding systems (Tables 4.40 – 4.44) found that average daily feed intake in pigs between concentrate and swill feeding was statistically significant. Swill feed supplemented with minerals had significantly ($P<0.01$) higher average daily feed intake than other treatment groups. Higher moisture content and palatability of the swill feed might have favoured higher feed intake than concentrate feed. This is in agreement with the findings of Adesehinwa and Ogunmodede (2004). Contrary results were reported by Anil (2005), Anton (2005) in crossbred pigs and Kannan (2006) in Large White Yorkshire pigs.

It was also noticed that crossbred pigs *viz.*, D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs had significantly ($P<0.01$) higher average daily feed intake than LWY pigs within the treatment. This may probably be due to the fact that feed intake could be improved by terminal sire system and incorporation of Desi germplasm. Among the three crossbreds there was no significant difference in average daily feed intake except in concentrate feeding. In concentrate feeding, D x (LWY x Desi) crossbred consumed significantly ($P<0.01$) less feed than the other crossbred pigs. This might be due to inclusion two adapted breeds in this climate viz., LWY and Desi in the terminal sire system breeding favoured lesser feed intake than other crossbreds.

5.7.5. Feed Efficiency

The observations on the effect of different feeding systems on feed efficiency of pigs (LWY, D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi)) recorded at monthly interval (Table 4.45 - 4.49) revealed that there was a significant ($P<0.01$) difference in feed efficiency between concentrate and swill feeding (T2, T3 and T4). Swill feed supplemented with minerals and without supplementation had no significant difference. But there was a trend for better feed efficiency in animals supplemented with organic minerals. This is in accordance with Adesehinwa and Ogunmodede (2004). However, Large White Yorkshire and their crossbreds (75 % Large White Yorkshire x 25 % Desi) had a significantly higher ($P<0.01$) feed conversion efficiency in the field fed with swill than the animals fed on concentrate feed in the farm (Anil, 2005).

It was also noticed that there was no significant difference between LWY and crossbred pigs within the treatment. This result indicate that both pure and crossbreds were efficient converter under different forms of feeding. This is line with report of Dash and Mishra (1986) who have observed that there was no significant difference in feed efficiency between Large White Yorkshire and crossbreds. They also opined that feed efficiency decreased as increase slaughter age.

5.8. CARCASS CHARACTERISTICS

The carcass characteristics *viz.*, slaughter weight (kg), hot carcass weight,(kg), dressing percentage, carcass length (cm), back fat thickness (mm), loin eye area (cm^2), meat-bone ratio and gut weight (kg) of different genetic groups of pigs under different feeding systems (Tables 4.50 – 4.54) revealed that slaughter weight and carcass length had no significant difference between concentrate (T1) and swill feed (T2). This is in agreement with report of Anil (2005) who reported that carcass length did not vary significantly between concentrate and swill feeding.

Swill feed supplemented with minerals fed groups (T3 and T4) attained higher slaughter weight than concentrate feed fed groups. This may probably be due to pigs fed with swill had better palatability over concentrate feed contributed for the higher slaughter weight. This result concurs with findings of Anil (2005). However there was no significant difference observed between treatments by Kannan (2006).

Pigs fed with concentrate feed had significantly ($P<0.01$) higher hot carcass weight, dressing percentage and loin eye area, meat-bone ratio and lesser back fat thickness and gut weight than swill feed. This is in agreement with reports of Sinha *et al.*(1993) with regard to back fat thickness, and Harikumar (2001) who observed that pigs fed on concentrate ration attained a maximum of 19.36 ± 2.2 cm^2 for loin eye area and a minimum of 28.0 ± 0.22 mm for back fat thickness. Meat bone ratio was the lowest in pigs fed on hostel food waste (3.53 ± 0.19). However contrast results were shown with regard to dressing percentage (Harikumar, 2001; Chen *et al.*,1997 and Sinha *et al.*, 1993) and back fat thickness (Sarma *et al.*, 1996 and Jha *et al.*, 1999).

Among swill feed fed groups (T2, T3 and T4) there was no significant difference in gut weight, back fat thickness and dressing percentage. This is in agreement with the findings of Kannan (2006) who observed that there was no significant difference between treatments under different forms of swill feeding in LWY pigs. However meat-bone ratio and loin eye area was improved in mineral supplemented groups and this may probably due to the addition of minerals which might have enhanced the metabolic process in the system by virtue of their bioavailability.

Statistically significant ($P<0.01$) difference was observed between LWY and crossbreds (D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs) in terms of slaughter weight, hot carcass weight, carcass length, back fat thickness and loin eye area within the treatment. This may probably be due to Duroc pigs which was used as terminal sire and moreover it is suppose to be the lean meat producer responsible for the better carcass quality. There was no significant difference noticed between dressing percentage, meat-bone ratio and gut weight within the treatment. This might be due to higher body weight attained by crossbred pigs in the same age. This is in agreement with report of Magna *et al.* (2006) who concluded that dressing percentage begins to show a decreasing trend above 90 kg body weight in LWY pigs.

5.9. ECONOMICS OF PRODUCTION

Costs of production (Rs.) per kg live weight on feed basis in different genetic groups of pigs under different feeding systems (Tables 4.55) revealed that cost of production per kg live weight on feed basis was high in pigs fed with concentrate (34.40, 34.56, 34.96 and 34.87 respectively for LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs.). This is in line with Yadav *et al.* (2001).

Cost of production per kg gain was nearly 40-50 per cent less compared to concentrate feeding in pigs i.e. pigs fed with organic minerals supplemented swill feed had Rs. 20.71, 20.91, 21.06 and 21.00 per kg live weight , inorganic minerals supplemented swill feed (19.06, 19.15, 19.28 and 19.19) and swill feed without supplementation (17.37, 17.49, 17.80 and 17.80) respectively for LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs.

The overall result indicates that feeding of pigs with swill can increase economic return with higher body weight. This is in agreement with the findings of Ravindra Kumar *et al.* (2004) who concluded that hotel waste should be utilized for better return from pig farming.

Feeding of pigs with minerals supplemented swill feed involve higher price (Rs. 1.38 - 1.69 and 3.20-3.42 per kg gain respectively T3 and T4) than T2.

Additional gain was 25.00 - 32.16 and 65.40 - 69.60 kg respectively for T3 and T4. This indicates that weight gain from swill feeding can be increased by mineral supplementation @ 1 % on dry matter basis.

5.9.1. Economic Gain in Different Treatment Group

The economic gain of pigs under different group (Table 4.56) revealed that the economic gain in pigs fed T2 was highest followed by T3 and T4 and the least was T1. It indicates that the fattener pigs maintained on concentrate feed is not economical. Even though pigs in the group supplemented with minerals had a higher body weight gain than other treatment group, cost of organic minerals limits the economic return (Rs. 93 per kg). Hence it is inferred that economic return from swill feeding can be increased by mineral supplementation provided a cheaper substitute for the organic mineral presently available in the market is absolutely essential.

It is concluded that swill feed was found to be equally effective compared to concentrate feed in promoting growth of the fattener pig production exist under field conditions. Carcass characteristics and growth promotion can be improved by supplementation of minerals in the diet of fattener pigs. Crossbred pigs excelled over pure LWY in terms of post weaning growth performance and carcass characteristics in terminally sired pigs. The crossbreds *viz.*, D x (LR x Desi) and D x (LWY x Desi) had better litter performance than D x (LWY x LR) and LWY pigs. Considering both litter performance and post weaning growth performance, it is recommended that D x (LR x Desi) and D x (LWY x Desi) crossbreds are best suited for the field fattener pig production in the hot-humid climatic conditions.

SUMMARY

6. SUMMARY

The growth performance and adaptability of Large White Yorkshire and three breed combinations under farm and field conditions were studied. A breed combination as well as management practices suited to the agro-climatic zone was recommended.

Twenty gilts were selected from Large White Yorkshire and also each combination of Large White Yorkshire x Landrace, Landrace x Desi and Large White Yorkshire x Desi . After attaining maturity, they were bred to terminal sire (Duroc). Large White Yorkshire was maintained as pure line. The litter performance of four genetic groups viz., litter size at birth, litter weight at birth, birth weight, litter size at weaning, litter weight at weaning and weaning weight were comparatively evaluated. Twenty four piglets (males were castrated) were selected at random from each genetic combination. They were divided into four groups having six animals in each group.

The weaned piglets from each genetic group were allotted to four treatments with respect to feeding systems. Management practices prevailing in the farm were followed throughout the experimental period with respect to control group (T1). These piglets were fed with standard concentrate ration having 18 per cent crude protein up to the age of five months and with 14 per cent crude protein during the rest of the study period. Pigs belonging to T2, T3 and T4 from each genetic group were supplied to progressive farmers from neighbouring Panchayat of Thrissur District, Kerala and the animals were fed with left over food from hotels, restaurants, slaughter house waste and waste available from agricultural fields. In addition to this, T3 group were supplemented with inorganic minerals and T4 group were supplemented with organic minerals @ one per cent level on dry matter basis throughout the experimental period.

The parameters studied in pigs were physiological responses viz., rectal temperature, pulse and respiration rate at weekly interval, behavioural traits viz., feeding behaviour, agonistic behaviour and eliminative behaviour, faecal cortisol level to assess the stress in fattener pigs, monthly body weights, linear body measurements like body length, chest girth and height at wither, average daily gain, average daily feed intake, feed conversion efficiency, proximate analysis of feed sample, mineral profile of feed samples fed to pigs and carcass characteristics viz., slaughter weight, dressing percentage, carcass length, loin eye area, back fat thickness, meat bone ratio and gut weight. The economics of fattener pig production under different feeding systems were analysed.

By least square analysis it was found that genetic group had significant effect on litter traits. The crossbred *viz.*, D x (LWY x Desi) and D x (LR x Desi) had highly significant ($P<0.01$) difference in litter size at birth, litter weight at birth, birth weight, litter size at weaning, litter weight at weaning and weaning weight compared to LWY and D x (LWY x LR) pigs. There was no significant difference between LWY and D x (LWY x LR) ; D x (LWY x Desi) and D x (LR x Desi) pigs in all these litter traits.

The changes in environmental variables all throughout the study period revealed that the animals were exposed to stress due to high humidity from April to November and high temperature from January to April.

The mean maximum temperature observed varied between 29.60 and 37.00; 29.54 and 37.20 ^{0}C and minimum temperature varied between 18.10 and 24.80; 17.70 and 24.51 ^{0}C in the farm and field conditions respectively. The relative humidity (%) varied between 62.10 and 85.85; 61.12 and 84.86 in the farm and field conditions respectively. It was noticed that there were no significant differences

(P>0.05) in microclimatic variables, viz., maximum and minimum temperature and the relative humidity between farm and field.

The mean rectal temperature varied between 38.41 and 39.01 ; 38.61 and 39.11^{0}C respectively in the farm and field between the genetic groups. It was observed that there was no significant difference (P>0.05) in rectal temperature between treatments and genetic groups of pigs during the entire study period. Numerically higher values were recorded in the afternoon irrespective of the treatment and genetic groups of pigs.

The mean pulse rate varied between 70.80 and 71.86; 71.47 and 72.02 respectively in the farm and field between genetic groups. Mean respiratory rate varied between 28.21 and 29.10 ; 28.44 and 29.28 respectively in the farm and field between genetic groups. On statistical analysis, no significant difference between treatments and genetic groups was observed.

Morning and afternoon pulse rate recorded varied between 65.29 and 66.25; 65.23 and 66.23; 76.30 and 77.54; 77.42 and 77.88 respectively in the farm and field between genetic groups. Morning and afternoon respiration rate recorded varied between 21.80 and 22.56; 22.13 and 22.78; 34.51 and 35.68; 34.74 and 35.84 respectively in the farm and field between genetic groups. Significant differences (P<0.01) were observed between morning and afternoon pulse and respiratory rates irrespective of treatment and genetic groups.

Majority of the pigs under different treatments and genetic groups showed eating greedily with drooling of saliva followed by exploring the pen and eating with grunt and drooling of saliva and least was eating calmly at the time of feeding. None of the treatment group and genetic groups observed a score of not showing any interest towards feeding.

Majority of the pigs under different treatments and genetic groups showed ear biting, belly nosing and tail biting very frequently followed by ear biting, belly nosing and tail biting frequently and least was ear biting, belly nosing and tail biting occasionally. None of the treatment group and genetic groups observed without biting at the time of feeding.

Quantity of faeces voided had a highly significant ($P<0.01$) difference between treatment in all four genetic groups. By statistical analysis it was observed that LWY pigs voided significantly lesser quantity of faeces than other genetic groups within the treatment. Majority of the pigs defaecated either in the wallowing tank or near the gate of the pen in the farm and pigs maintained in the field voided either in the corner or near the gate. In the field there was no provision of run area.

Frequency of defaecation varied between 7.95 and 7.99 ; 8.07 and 8.14 ; 8.09 and 8.15 ; 8.08 and 8.15 in pigs fed with concentrate (T1) , swill (T2), swill + inorganic minerals (T3) and swill + organic minerals (T4) supplementation respectively by the different genetic groups. There was no significant difference observed between treatments and genetic groups. Among the conventional and unconventional feed fed pigs the latter group had numerically higher frequency of defaecation.

The monthly faecal cortisol levels (μg/dl) of different genetic group of pigs under different feeding systems revealed that there were no significant differences ($P>0.05$) in the faecal cortisol level between the treatments and between the genetic groups of pigs.

The proximate composition (percentage) of feed samples on DM basis revealed chicken waste had higher crude protein (24.13) followed by farm concentrate (17.90 and 14.15 for grower and finisher ration respectively) ,vegetable waste (10.10) and hotel waste (9.81). The pooled samples are comparable to farm concentrate except ether extract (24.56; 6.05 and 4.13) which was very higher in swill feed. Total ash content was higher in the farm concentrate (10.91, 10.13; 6.61).

Availability of minerals was higher in inorganic form compared to organic form of preparation. Mineral assay revealed that chicken waste had higher levels of minerals followed by hotel waste and vegetable waste. It was observed that there was no significant difference between genetic groups within the treatment in serum mineral concentration. The feeding system had highly significant ($P<0.01$) effect on the mineral concentration in serum samples. It was highest in T4 followed by T3 and T1 and least in T2. It was comparable between T3 and T2.

The monthly body weights (kg), monthly body measurements *viz.* body length, girth and height, average daily weight gain, average daily feed intake of LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs under different feeding systems revealed that there was no significant difference in LWY pigs between concentrate (T1) and swill feeding (T2). Swill feed supplemented with inorganic (T3) and organic minerals (T4) attained significantly ($P<0.01$) higher body weight, body measurements viz., body length, girth and height, average daily weight gain and average daily feed intake than concentrate and swill feed fed groups. Organic mineral supplemented group attained significantly ($P<0.01$) better than the other treatment groups. Similar trend was also observed in D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs.

It was also noticed that crossbred pigs *viz.*, D x (LWYx LR), D x (LR x Desi) and D x (LWY x Desi) pigs had significantly ($P<0.01$) higher monthly body weight, linear body measurements, average daily gain and average daily feed intake than LWY pigs within the treatment. Among the three crossbreds there was no significant difference observed in monthly body weight, linear body measurements, average daily gain and average daily feed intake except in concentrate feeding. In concentrate feeding, D x (LWY x Desi) crossbred consumed significantly ($P<0.01$) less feed than the other crossbred pigs.

By statistical analysis it was found that there was a significant ($P<0.01$) difference in feed efficiency of LWY pigs between concentrate and swill feeding. Swill feed supplemented with minerals and without supplementation had no significant difference. Similar trend also observed in D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. It was also noticed that there was no significant difference between LWY and crossbred pigs within the treatment.

It was observed that pigs fed with organic mineral supplemented group (T4) attained higher slaughter weight than the other treatment groups significantly ($P<0.01$). Pigs fed with inorganic mineral supplemented (T3) group attained higher slaughter weight than the T2 and T1 treatment groups. There was no significant difference between concentrate feed (T1) and swill feed fed groups (T2).

It was revealed that pigs fed concentrate feed (T1) had significantly ($P<0.01$) higher dressing percentage than other treatment groups. However, there was no significant difference between swill feed (T2) and mineral supplemented swill feed fed groups (T3 and T4).

Carcass length was significantly ($P<0.01$) higher in organic mineral supplemented swill feed fed groups groups than the other treatment groups. Pigs fed with inorganic mineral supplemented (T3) group attained significantly ($P<0.01$) higher carcass length than the T2 and T1 treatment groups. There was no significant difference between concentrate feed (T1) and swill feed fed groups (T2).

By statistical analysis, it was revealed that pigs fed with concentrate feed (T1) had significantly ($P<0.01$) lesser back fat thickness than other treatment groups.

However, there was no significant difference between swill feed (T2) and mineral supplemented swill feed fed groups (T3 and T4).

It was found that pigs fed with swill feed (T2) had significantly ($P<0.01$) lesser loin eye area and meat-bone ratio than other treatment groups. However, there was no significant difference between concentrate feed (T1) and mineral supplemented swill feed fed groups (T3 and T4).

It was observed that gut weight was significantly ($P<0.01$) lesser in pigs fed with concentrate feed (T1) than other treatment groups. However, there was no significant difference between swill feed (T2) and mineral supplemented swill feed fed groups (T3 and T4).

Statistically significant ($P<0.01$) difference was observed between LWY and crossbreds (D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs) in terms of slaughter weight, hot carcass weight, carcass length, back fat thickness and loin eye area within the treatment. There was no significant difference between dressing percentage, meat-bone ratio and gut weight within the treatment.

Cost of production per kg live weight on feed basis was higher in pigs fed with concentrate (34.40, 34.56, 34.96 and 34.87) followed by organic minerals supplemented swill feed (20.71, 20.91, 21.06 and 21.00), inorganic minerals supplemented swill feed (19.06, 19.15, 19.28 and 19.19) and swill feed without supplementation (17.37, 17.49, 17.80 and 17.80) respectively for LWY and D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs.

Additional expense per kg weight gain was Rs. 1.69, 1.66, 1.48 and 1.38 for swill feeding supplemented with inorganic minerals and 3.34, 3.42, 3.26 and 3.20 for swill feeding supplemented with organic minerals respectively for LWY, (D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. Additional weight gain (kg) attained by pigs fed with inorganic minerals supplemented swill feed was 31.98, 25.00, 30.60 and 32.16 and pigs fed with organic mineral supplemented swill feed was 69.60, 65.50, 65.40 and 66.24 respectively by LWY, (D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) pigs. It was inferred that supplementation of minerals in the swill feed can increase the weight gain of field fattener pig production. It was inferred that the economic gain in pigs fed with swill alone was highest followed by inorganic and organic minerals supplemented group and the least was concentrate feed fed group.

It was concluded that swill feed was found to be equally effective compared to concentrate feed in promoting growth of the fattener pig production existing under field conditions. Carcass characteristics and growth promotion can be improved by supplementation of minerals in the diet of fattener pigs. Crossbred pigs excelled over pure LWY in terms of post weaning growth performance and carcass characteristics in terminally sired pigs. The crossbreds viz., D x (LR x Desi) and D x (LWY x Desi) had better litter performance than D x (LWY x LR) and LWY pigs. Considering both litter performance and post weaning growth performance, it was recommended that D x (LR x Desi) and D x (LWY x Desi) crossbreds were best suited for the field fattener pig production in the hot-humid climatic conditions.

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COMPARATIVE EVALUATION OF PORCINE PRODUCTION PERFORMANCE IN TERMINALLY SIRED AND PUREBRED PROGENIES UNDER DIFFERENT MANAGEMENT CONDITIONS

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ABSTRACT

A study was conducted to evaluate the production performance of terminally sired and purebred progenies under different management conditions. Twenty gilts were selected from Large White Yorkshire and also each combination of Large White Yorkshire x Landrace, Landrace x Desi and Large White Yorkshire x Desi . After attaining maturity, they were bred to terminal sire (Duroc). Large White Yorkshire was maintained as pure line. Litter performance of LWY and three breed combinations *viz.*, D x (LWY x LR), D x (LR x Desi) and D x (LWY x Desi) were comparatively evaluated.

Twenty four weaned piglets were selected at random from each genetic combination and they were divided into four groups having six animals in each group. Piglets T1 were fed with concentrate feed and T2, T3 and T4 from each genetic group were fed with left over food from hotels, restaurants, slaughter house waste and waste available from agricultural fields. In addition to this, T3 group were supplemented with inorganic minerals and T4 group were supplemented with organic minerals @ one per cent level on dry matter basis from third month to ten months of age.

The crossbreds *viz.*, D x (LWY x Desi) and D x (LR x Desi) had highly significant ($P<0.01$) difference in litter size at birth, litter weight at birth, birth weight, litter size at weaning, litter weight at weaning and weaning weight compared to LWY and D x (LWY x LR) pigs. There was no significant difference between LWY and D x (LWY x LR) ; D x (LWY x Desi) and D x (LR x Desi) pigs in all these litter traits.

There were no significant differences ($P>0.05$) in maximum and minimum temperature and relative humidity between farm and field. There was no significant difference ($P>0.05$) in mean rectal temperature, pulse and respiration rate between

treatments and genetic groups. Significant difference (P<0.01) were observed between morning and afternoon pulse and respiratory rates irrespective of treatment and genetic groups.

At the time of feeding, majority of the pigs in different treatments and genetic groups showed eating greedily with drooling of saliva and ear biting, belly nosing and tail biting very frequently. Quantity of faeces voided had a highly significant (P<0.01) difference between treatment in all four genetic groups. LWY pigs voided significantly lesser quantity of faeces than other genetic groups within the treatment. Frequency of defaecation had no significant difference, between treatments and genetic groups. There were no significant differences (P>0.05) in the faecal cortisol level between the treatments and genetic groups of pigs.

The proximate composition (percentage) of pooled swill feed samples are comparable to farm concentrate except ether extract (24.56; 6.05 and 4.13) which was very higher in swill feed. Total ash content was higher in the farm concentrate (10.91, 10.13; 6.61). Availability of minerals was higher in inorganic form compared to organic form. Mineral assay revealed that chicken waste showed higher levels of minerals followed by hotel waste and vegetable waste. There was no significant difference between genetic groups within the treatment in serum mineral concentration. The feeding system had highly significant (P<0.01) effect on the mineral concentration. It was highest in T4 followed by T3 and T1 and least in T2. It was comparable between T3 and T2.

There was no significant difference in monthly body weights (kg), body measurements viz., body length, girth and height (cm), average daily weight gain and average daily feed intake (g) of pigs between concentrate (T1) and swill feeding (T2). T4 significantly (P<0.01) better than other treatment groups. T3 was significantly (P<0.01) better than T2 and T1.

Crossbred pigs had significantly (P<0.01) higher monthly body weight, linear body measurements, average daily weight gain and average daily feed intake than LWY pigs within the treatment. Among the three crossbreds there was no significant difference observed in monthly body weight, linear body measurements, average daily gain and average daily feed intake except in concentrate feeding. In concentrate feeding, D x (LWY x Desi) crossbred consumed significantly (P<0.01) less feed than the other crossbred pigs.

There was significant (P<0.01) difference in feed efficiency between T1 and T2. No significant difference was observed between T2, T3 and T4. There was no significant difference between LWY and crossbred pigs within the treatment.

T4 attained significantly (P<0.01) higher slaughter weight (kg), hot carcass weight (kg) and carcass length (cm) than the other treatment groups. T3 group attained significantly (P<0.01) higher slaughter weight, hot carcass weight and carcass length than the T2 and T1 treatment groups. No significant difference between T1 and T2 was noticed.

T1 had significantly (P<0.01) higher dressing percentage than other treatment groups. T1 had significantly (P<0.01) lesser back fat thickness. There was no significant difference between T2, T3 and T4 in dressing percentage and back fat thickness. T2 had significantly (P<0.01) lesser loin eye area and meat-bone ratio than other treatment groups and there was no significant difference between T1 and T3 and T4. Gut weight was significantly (P<0.01) lesser in T1 than other treatment groups. There was no significant difference between T2, T3 and T4.

There was significant (P<0.01) difference between LWY and crossbreds in terms of slaughter weight, hot carcass weight, carcass length, back fat thickness and loin eye area, within the treatment. There was no significant difference noticed between dressing percentage, meat-bone ratio and gut weight within the treatment.

Cost of production per kg live weight on feed basis was high in T1 followed by T4, T3 and T2. It was inferred that swill feed supplemented with minerals can increase the profit margin provided a cheaper substitute for the organic minerals presently available in the market is absolutely essential for the field fattener pig production.

Swill feed was found to be equally effective compared to concentrate feed in promoting growth of the fattener pig production existing under field conditions. Growth performance and carcass characteristics can be improved by supplementation of minerals in the diet of fattener pigs. Crossbred pigs excelled over pure LWY in terms of post weaning growth performance and carcass characteristics under terminally sired pigs. The crossbreds *viz.*, D x (LR x Desi) and D x (LWY x Desi) had better litter performance than D x (LWY x LR) and LWY pigs. Considering both litter performance and post weaning growth performance, the recommendation is that D x (LR x Desi) and D x (LWY x Desi) crossbreds are best suited for the field fattener pig production in the hot-humid climatic conditions.