EFFECT OF DEEPLITTER HOUSING ON MANAGEMENT OF RABBIT (*Oryctolagus cuniculus*)

A Thesis

Submitted to the

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in

ANIMAL PRODUCTION AND MANAGEMENT

BY

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Certificate

This is to certify that the work recorded in the thesis entitled ***"Effect of deeplitter housing on management of rabbit (Oryctalagus cuniculus)"***, submitted by ***Kunal Chakraborty,*** in partial fulfilment of the requirements for the Degree of Master of Veterinary Science in ***Animal Production and Management*** of the ***West Bengal University of Animal and Fishery Sciences, West Bengal,*** is the faithful and bonafide research work carried out under my personal supervision.

The research findings presented in the thesis have not so far been submitted for any other degree or diploma. The assistance and help received during the course of investigation have been duly acknowledged.

Dated : Mohanpur, West Bengal
The 9th September 2007

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We, the undersigned, having been satisfied with the performance of Dr. Kunal Chakraborty, in the viva-voce examination, conducted today, the 14th November 2012, recommended that the thesis be accepted for the award of the Degree.

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Dedicated to

my beloved

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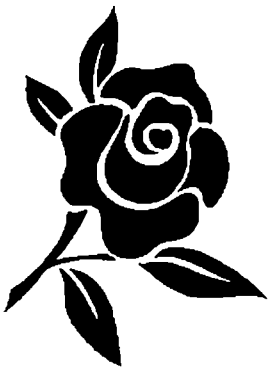

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INTRODUCTION

CHAPTER - 1 INTRODUCTION

The term rabbit generally refers to small running animals with relatively short ears and legs which give birth to blind, naked young. Rabbits are chiefly nocternal, although they are some times seen in the daytime. They have acute sense of smell and hearing. They feed on a wide variety of vegetation. All have large eyes situated on the side of head and moderately long ears that they frequently move and with which they can detect even faint sound. They have keen sense of smell and frequently twitch their nose. Rabbit also have a split in the middle of upper lip and a pair of chisel like front teeth similar to those of roddents. Unlike rodents rabbit have an extra pair of small teeth behind the front ones for a total of six incisors as opposed to four in rodents. It has also a short and fluffy tail and a thick coat that varies in colour.

Most rabbit live in holes they dig under logs or rocks or in the holes made and abandoned by other animal. Rabbit can tolerate wide range of climates from cold and wet to hot and dry. They can with stand temperatures as low as 10° F (- 12°C). Usually they avoid high temperatures by remaining in their burrows (tunnel dug in the ground). Hot humid climate is worst for them.

Rabbit have a habit of passing food twice through G.T. tract Caecotrophy. Dried faecal pellets are produced only during the day. At the night soft pellets covered with mucus are formed in the caecum and are

immediately taken from the anus by lips. They are stored in stomach and later mixed with further food taken. This practice is known as Coprophagy.

The rabbit (*Oryctolagus cuniculus*) was domesticated rather recently as compared to other farm animals. They were kept in captivity in Western Europe for meat and fur production since Roman times but were not actually domesticated until the middle age (Zeuner 1963). The animals might have its original home either in Africa, Spain, France, Belgium, or in Rome. It is believed that wild rabbits were used for meat in Africa at least 3000 years ago.

In search of newer resources in Animal Kingdom the science of rabbit husbandry came to light only recently to the animal scientists of the world. Rearing rabbits was an age old practice but its exploitation on commercial basis was started in beginning of present century specially in developed European countries of the West.

The erstwhile USSR (principally Russia, Ukraine) are the leading producers of rabbit in the world followed by France, Italy and Spain. But 85% of the total world output is from Europe. Other European countries producing rabbits are Hungary, Poland, Germany, Romania, etc. Other rabbit producing countries are in Central America, a few countries of Africa and also Republic of Korea and China. In the United States of America rabbit production of is concentrated mainly in three specific states. The rabbit production in Canada is modest, mainly concentrated in Quebea province where it is subsidized by the provincial government. In Mexico and Caribbean Island rabbit production is basically family style but some

commercial units present in Maxico. In South America the biggest producer are Brazil and Uruguay. In these countries commercial units are large and rabbits are raised extensively and fed locally manufactured balanced concentrate feeds.

The production of Rabbits does not seems to have developed much within Asia except in China, Republic of Korea and small extent in Japan. In China about 20 million Angora rabbits are farmed. They are slaughtered very young after the second and third clipping at most. Therefore they are produced both for Angora wool and meat.

In African sub-continent main producers are Ghana and Egypt, both with 7000 – 8000 tones of carcasses a year. Far behind comes Algeria and Sudan with 1000 – 2000 tones a year. The production of rabbit is virtually nil in most of the Arab countries and Australia.

In India the rabbit production is still in a very dormant stage. But the introduction of German Angora Breeds in early sixties brought a revolution in the popularization of rabbit farming in India, although it has been confined cooler hill areas mostly. It has generated tremendous interest among farmers to adopt rabbit faming as a fulltime vocation or sometimes as a supplementary enterprise. In 1985 the total wool production in India was about 5 tones, where as the world production was 2,750 tones a year. In India rabbit farming is gaining popularity mostly in the cooler and temperate parts of the country such as Jammu and Kashmir, Himachal Pradesh, parts of Uttar Pradesh etc.

Breeds Of Rabbits :

Wool Type

The Angora breed of rabbit is mainly raised for their wool and meat as a by- product. Angora rabbit are of many types depending upon the amount of wool produced and the percentage of guard hair in the wool. The German Angora's are the best and animal yield 1000 to 2000 gm. of wool with a very low amount of guard hair. The most popular is white Angora, while there are several coloured Angora's which produced wool variety of natural colours. Such wool has very limited marked values. Angora rabbit normally weigh about 2.5 to 3 kgs.

Meat Type

Most of the other of rabbits are maintained for the meat purpose, their fur being by-product. There are about 35 internationally recognized meat and fur type breeds. The main differences are in the final or adult body weights and the type of fur they produce. Some of the breeds of rabbits are described on Table 1.1.

Table 1.1. Breeds and breed description of rabbit :

Name of the breeds	Origin	Physical Characteristics	Used for
New Zealand White	UK	Excellent breeding quality. Mature rabbit weighs 4.07 – 5.44 kg. Fur colour white.	Meat purpose
New Zealand Red	America	High desirable growth rate. Excellent breeding quality. Attain weight more than 2 kg in 8 wks.	Meat
Alaska	Belgium	Stocky, compact breed with black silky fur. Mature weighs 3.17 – 4.07 kg.	Meat and fur

Name of the breeds	Origin	Physical Characteristics	Used for
Flemish	**UK**	**Largest breed of rabbit. Mature weighs near about 5.5 kg.**	**Meat, pelt, exhibition**
Himalayan	**Russia, China**	**Oldest fancy breed of Asia. Can thrive well in cold climate. Mature weight4.07-4.54 kg.**	**Meat**
Californian	**America**	**Crossbreed of NZ White & Himalayan. Recognized in two colour normal & chocolate. Weight is about 3.63 – 4.77 kg.**	**Meat**
Chinchilla	**Russia**	**Crosses of wild rabbits. Large graceful rabbits with a good meat and pelt qualities. Steel grey colour. Weight is 4.97 kg.**	**Meat, Pelt**
Havana	**Holland**	**Crosses b/w black & white scrub rabbit with unknown sire. Carcass small (2.27 kg)**	**Fur & Pelt**
Angora	**Europe (Germany, UK , Russia)**	**Usually white in colour. Mature weighs 2.5 – 3.5 kg & annual yield ranges from 100 – 400 gm**	**Wool**
Grey Giant	**U.S.S.R**	**Adult – 3.5 kg Fur colour – Greyish brown Quite compact & meaty joint.**	**Meat/Broiler Fur-by product.**
White Giant	**U.S.S.R**	**Adult – 4 kg. Fur – White**	**Meat & Fur**

Importance of rabbit farming :

Quoting an FAO Expert Consultation on Rural Poultry and Rabbits, held in Rome in 1981, Lebas (1983) emphasized that if the high rate of growth in meat consumption in future year was to be met, much of the increase in production would have to come from short cycle animals such as rabbits.

According to Rao *et al.* (1977) and Reddy *et al.* (1977) rabbits grow rapidly and their growth rate is similar to those of broiler fowls. Also meat quality of rabbit is similar to that of the fowl and meat yield are high. Schlolaut (1981) stated that the meat of rabbits has also been shown to be very high in protein, low in fat and to have a mineral percentage higher than all other meats.

Certain unique features make the rabbits particularly suitable as meat producing small livestock in developing countries like India. The small body size of the animal provides a small carcass that can be consumed by a family at a time, eliminating the need for meat storage and refrigeration. The meat is stored on live animal until needed. Cheeke (1986) termed the rabbits a "biological refrigerators".

Rabbit meat is wholesome and tasty product with high biological value compared to most other meat. It is high in protein (20.8 %) and low in fat, cholesterol and sodium. Cholesterol content of rabbit meat 39 mg/100g fresh meat (Rao et al: 1979) as compare to 91, 60, 70, 70 and 65 mg/100gm fresh chicken, pork, veal, mutton and beef of respectively (Reiser, 1975). The fat of rabbit carcass contain less stearic (6.3%) and oleic acids (31.2%) then other species and higher proportion of essential polyunsaturated fatty acid. The meat is white, fme-grained, delicately, flavoured, nutritious and appetizing, (Cheeke *et al.* 1982). Thus it is not only highly nutritious but also suitable as special diets for heart disease patient and aged people (Rao et al 1979) .

The very value of rabbit milk explain the rapid early growth of the animal. The milk of the rabbit is richest of all domestic animals. Davies *et al.* (1964) reported that the rabbit milk contains total solids 32.8, fat 18.3, protein 13.9, lactose 2.1 and ash 1.8 in percent The gross energy is about 1000 Kcal per lb and this compare with about 350 calories per lb for cow's milk and 750 calories per lb for milk from bitch as stated by Sanford (1986).

In India, the present availability of meat is 6 – 8 gm/day as well as the projected availability of 16.6 gm/day for 70% of non-vegetarian population by 2000 A.D. (Agnihotri and Pal, (1994). It is far below the Indian Council of Medical Research (ICMR) recommendation of 34 gm/day. Rabbit can play a crucial role in meeting the critical meat shortage in developing countries owing to its potential in producing quality meat. Besides, the small body size, short generation interval, high reproductive potential, rapid growth rate, genetic diversity and ability to utilize for age and by products as major diet components make rabbits suitable as meat producing small livestock in developing countries as a promising alternative source to common meat.

The rabbit has a short generation and high reproductive capability besides potential for year round production. Although 10 to 11 crops from a doe is possible in a year, 5 to 6 of them easily available. Rabbits are capable of utilizing the non-competitive feeds such as grain free diets, based on forages and by products. The unique feature of coprophagy facilitate such utilization. Acceptable performance can be obtained using greens such as weeds, tree leaves, legumes and forages, vegetable tops, waste fruits and vegetables and by products such as rice bran.

The potential for genetic improvement is vast in rabbits. There is high degree of diversity in the rabbit genetic resource pool. Mature body weight ranges from less than 1 kg to over 10 kg while there is variability in traits such as natural ability, fecundity, resistance to heat stress etc. Thus it should be possible, by selection and use of breed diversity, to make rapid improvement in animal performance.

Another major advantage in Indian condition is that there are hardly any cultural biases or religions prohibitions against consumption of rabbit meat.

Besides high quality meat, fur and wool rabbits produce one of the most valuable manures of all livestock. Sandford (1986) stated that on dry matter basis the manure contains approximately nitrogen 2.7, phosphoric acid 1.5 and potash 1.0 percent.

The domestic rabbit has been found to be extremely useful in the field or medical and biological research. Much of the early work on animal genetics was conducted on the rabbit, as also was work on artificial insemination. It is however, in the field of human medicine that the rabbit has been of greatest use. The use of rabbit as a test animal for pharmaceutical products is well known and it is now frequently used as a pilot test animal prior to the use at the much more expensive large animal.

Rabbit perform well under maximum temperatures ranging between 25 and 32°C with 60 – 80 percent relative humidity, but they are comfortable within 20°C to 22°c and humidity being 30 to 70 percent. But in most parts

in India the ambient temperature remain higher than this range in maximum period of the year. Thus the performance of rabbits especially the exotic ones are affected to a great extent. But the local breeds are more adopted to such environment extremes then the imparted breeds although they exhibit a poorer productive performance. However before recommending the improved exotic rabbits to the former level extensive studies need to the taken up in the different geo agroclimatic regions of the country.

Rabbits grow rapidly and their growth rate is comparable to that of broiler chicken. The period taken to reach slaughter weight is much less than for other livestock such as cattle, sheep and goats. In respect of nutrition, the rabbit occupies a midway between ruminants and mono-gastric animals. Rabbits can convert 20 percent of proteins they eat into edible meat as compared to 22 – 23 percent by broiler chicken,16 – 18 percent in pigs and 8 – 12 percent of by beef cattle (Lebas *et al.* 1986). Rabbit has been therefore, rightly described as "Poor man's pig". Rabbits are also termed as "micro-livestock", since housing and small quantity of feed. From one animal can be consumed without need for storage due to small size carcass.

Realizing its importance in India commercial rabbit meat production has been taken only in the last two decades. In India broiler rabbit production started by I.C.A.R. importing New Zealand White rabbits from UK and White Giant, Grey Giant, Soviet Chinchilla from USSR at 1978. Avikanagar and Garsa under CSWRI started supplying rabbit germplasm for various research station, Agricultural Universities, State Animal Husbandry Departments and private sectors to promote production of rabbit meat and wool in our country.

For commercial meat production, the New Zealand White is the principal breed as it has number of desirable traits including rapid growth rate, good carcass quality, good prolificacy and good mothering ability. In India, rabbit rearing is being brought forward only recently as a new form of animal husbandry. Therefore system research works on feeding of rabbits based locally available unconventional feed including forest by products are still awaited for efficient meat production at lower cost.

In West Bengal rabbit farming is still not popular, though Govt. of West Bengal constructed small scale rabbit farm at Kalyani, Midnapur, Bankura and Gobordanga. Lower popularity perhaps due to minimal attention by scientific community, pet appearance or rabbit, social taboos regarding meat consumption etc. But broiler rabbit production seems to be potential source of cost effective production of animal protein for human nutrition. So the performance of rabbit under different agroclimatic zones of India should be scientifically investigated for extension, wide exploitation of rabbit germplasm and wide adoption of rabbit farming as it is now gaining momentum in India.

In the state West Bengal the exotic breeds of rabbits are still not being reared in this state as a meat-producing animal under intensive system of management. Thus the viability, performance, carcass quality in this area of West Bengal (i.e. hot humid condition) is indeed a subject of research.

Rabbit production management under deep litter system is a new concept. Under this system of management the space requirement, labour orientation can be minimized. This system ensures the efficient collection of

animal wastes. Deep litter may be used as valuable organic manure in crop production and agriculture. It soaks up urine, makes manure easier to handle and absorbs plant nutrient fixing both ammonia and potash in relatively insoluble form, thus protecting them against losses by leaching (Sastry *et al.* 1983). Well managed deep litter kept in dry condition with no wet spots around waterer has a sterilizing action and the level of coccidiosis and worm infestation is much lower in this system of management (Banerjee, 1991).

Again deep litter requires small investment, ensure no injuries to the legs or hocks, no additional heating arrangement even in temperature and cold climatic condition.

An attempt has been made in the present investigation to study the performance of crosses Grey Giant and Soviet Chinchilla in hot humid condition of West Bengal under deep litter system of housing with different feeding schedule. The study included the following performance.

- **Average dry matter intake of the animals.**
- **Difference in dry matter intake between animals.**
- **Average body weight of animals.**
- **Relationship of feed intake and body weight of animals.**
- **Relationship of the body weight in respect of moisture content of deep litter.**
- **Relationship of the body weight in respect of pH content of deep litter.**

REVIEW OF LITERATURE

CHAPTER - 2 REVIEW OF LITERATURE

Rabbit is a monogastric and herbivorous animal with the speciality of "coprophagic" physiological nature. Besides its fancy utilization its husbandry and commercial utilization has received great attention in most of the developed nation of the world since long time. Though rabbit husbandry has been introduced in recent years in the developing countries it has become very popular enterprise for its great potential in various aspect.

Though rabbits have been very extensively used in biomedical research and other related purpose in many countries. There is relatively little research work that has been conducted on the various productive performances.

Although backyard rabbit farming has been practiced in Indian village condition for a few decades, scientific rabbit rearing on commercial lines is relatively a new concept in India. It is only recently that the subject has caught the attention of farm researchers. Thus various findings have come up in respect of socioeconomic aspect, benefit cost analysis technical management and the alike.

In this chapter an attempt has been made to review available literature pertaining to the work done on various aspect of rabbit rearing in India as well as abroad. The review assist in defining the research problem in clear comprehensive manner, suggests suitable methodology to be adopted on analysing the problem and helps in verification of results. But before

reviewing the important research finding a study of historical background of rabbit domestication, breeds and classification of breeds has been made.

2.1. Taxonomical classification of Rabbit :

The domestic rabbit is derived from the European rabbit, *Oryctolagus cuniculus* which falls under the following taxonomical classification.

Class	–	Mammalia
Super order	–	Glires
Order	–	Lagomorpha
Family	–	Leporidae (Hares and rabbits)
Sub family	–	Leporinae
Genus	–	Oryctolagus.

Rabbits are reared in different countries for different purpose, like for meat production, for exhibition, for biochemical research as laboratory animal, for pelt production, sometime simply as pet animal. Though in European countries the rabbit industry for meat and fur production has been established for few decades past, but the commercial utilization of rabbit for meat production has been being initiated in the recent year in the developing countries like India.

2.2. Historical back ground of rabbit domestication and rabbit industry :

According to Lebas and Matheron (1982) the domestication of the

major livestock species (cattle, sheep, pigs) and the small species (poultry) is lost in the dawn of prehistory but rabbit domestication dates no further then the present millenium.

Indeed, the wild rabbit (*Oryctolagus cuniculus*) of Southern Europe and North Africa is thought to have been discovered by Phoenicians when they reached the shores of Spain about 1000 B.C. In Roman times the rabbit was still emblematic of Spain. The Romans apparently spread the rabbit throughout the Roman Empire as a game animal. Like the Spanish people of the time, they ate foetus or newborn rabbits which they called " Laurices ".

Rabbit had still not been domesticated, but Varron (46-27 B.C.) suggested that rabbits be kept in 'leporaria' stoned walled pens or parks with hares and other wild species for hunting. These leporaria were the origin of the warrens or game park that subsequently developed in the middle of ages. It is known that monks were in the habits of eating laurices during lent as they were "an aquatic dish ". In France it became the sole right of the lord of the manor to keep warrens. Rabbit were hunted little and were captured with snares, nooses or nets.

Several breeds of rabbit were known in the 16th century and this is the first record we have of controlled breeding. Domestication can therefore be traced to the late middle ages. This was probably the work mainly of monks. Since it provides them with a more delicious dish than the tougher wild rabbit.

In the 16th century breeding seems to have spread across France, Italy, Flanders and England. In 1595, Agricola mentioned the existence of grey brown (wild), white black, peibald (black and white), grey rabbit. In 1606, Oliver de Serres classified three types of rabbit (1) The wild rabbit, (2) Semi wild rabbit or Warren rabbits raised inside the wall or ditch and (3) Domesticated or hutch-bred rabbit. The meat of the last is described as delicate.

At the beginning of the 19th century, after the abolition of scigneurial privileges rabbit rearing in hutches sprang up all over rural Western Europe and also in city subarbs. During the same period, European colonial expansion was the introduction of the rabbit in many countries where it was unknown such as Australia and New Zealand.

In Europe, breeders usually had a few does and a stock of fattening animals from which they took according to their need as form of a larder.

The animals were fed mainly on green forages picked daily. In winter the breeders supplemented forages with hey, beetroots and even grains often from the stock intended for large livestock. Rabbit were kept in the back yard, with poultry. Reproduction was intensive (2-3 litters a year).

From the time as there is frequent mention of the fur as a by-product (the breed now called Champogne d' Artgente was described as rich) and the already long existing Angora mutant was recorded.

2.3. Breeds of rabbit and classification of breeds:

There are nearly 35 internationally recognized breeds. Lebas *et al.* (1986) classified the rabbit breeds according to origin and adult body size.

2.3.1 According to origin he classified rabbit breeds mainly in four groups :

i) Primitive or primary and geographic from which all other breeds have come up.

ii) Breeds obtained through artificial selection from primitive or primary breeds e.g. Burgundy Fawn, New Zealand White and Red Champogne d' Argente.

iii) Synthetic breeds obtained by planned crossing of several breeds e.g. Blanc du Bouscat, Californian etc.

iv) Mendelian breeds obtained by the fixation of a new characters of simple genic determination appeared by mutation, such as Casterrex Satin, Japanese etc.

2.3.2. According to adult body size :

Breeds are conveniently classified by adult body size which is also related to production characters such as procoity, prolificacy, growth rate

and age at maturity. According to its adult body size the breeds of rabbits may be classified into four categories.

i) Heavy Breeds Adult weight exceeds 5 kg. The growth potential of the heavy breeds can be exploited specially in cross breeding. The Bouscat Giant White, France Lop, Flemish Giant and France Giant Papileon are the major example of this groups. All these are utilized as meat producing breed for its body build. But France Lop may be used as show rabbits as its various colour like white, agouti, iron grey or black. Adult body weight of a Flemish Giant may be on an average 7 kg.

ii) Average Breeds : Adult weight varies from 3.5 kg to 4 kg. These are basic stock of breeds used for intensive rabbit production for meat in Western Europe and the most numerous example of these breeds are Silver Rabbit like English Silver German Silver etc. Burgundy Fawn, Champogne d' Argente, New Zealand White, New Zealand Red, Chinchilla etc.

iii) Light Weight Breeds : These breeds have an adult weight of 2.5 kg. to 3 kg. They include the Himalayan, the Small Chinchilla, the Dutch and the France Havana.

iv) Small Breeds : The breeds weight about 1 kg. at maturity. They are chiefly represented by Polish rabbits, with its many variations of coat colour. Selection for small size has led to very low fertility and a marked decreased in growth rate. These

breeds can not be used for meat production. But these breeds are used as the laboratory animals and as pets.

Biswas *et al.* (1989) broadly classified domestic rabbit into three division viz. fur and meat type (White Giant, Grey Giant, New Zealand White, Californian, Soviet Chinchilla etc.), wool type (Angora White or Albino) and ornamental type (Netherland Dwarf, Polish, Himalayan etc.).

2.4. Body weight :

Titarev (1970) studied on comparative growth intensity in White giants, Grey Giant and Soviet Chinchilla rabbits. Daily gain from 21 days to weaning (45 days) was 17.07, 15.0, 16.5 gm and daily gain for 45-90 days was 31.6, 18.2 and 28.7 and from 90-120 days was 15.20, 21.30 and 15.90 gm respectively.

Chen *et al.* (1978) studied on the effect of weaning and slaughter ages upon New Zealand White rabbit production. They found that average body weight ranged from 1388 to 2117 gm at 8 weeks, 2129 to 2825 gm at 12 weeks and 2634 to 3284 gm at 16 weeks of age.

DeBlas *et al.* (1979) reported on the use of Sodium hydroxide treated straw pellets in diets for growing Spanish Giant rabbits. The growth rate was 33.0 gm per day from weaning till attaining 2.25 kg body weight. The overall growth rate for males was significantly higher ($P>0.001$) than females.

DeBlas *et al.* (1981) worked on the effect of diet on growth of Spanish Giant rabbits from weaning to slaughter at different ages and weights. They observed that body weight at 35,49 and 77 days averaged 0.75 ± 0.01,1.18 ± 0.02 and 2.00 ± 0.02 kg respectively for weaning at 25days. For weaning at 35 days body weight at 35,49 and 77 days averaged 0.87 ± 0.01, 1.28 ± 0.02 and 2.01 ± 0.2kg respectively. They concluded that weaning age did not affect daily gain or weight at 77 days.

Kosko (1981) reported the broiler performance of Californian White (CW), German Giant (GG), GG x CW and CW x GG rabbits upto 12 week of age. The litter size of the different genetic groups at 12 week of age were 4.7, 9.6, 7.3 and 9.2 and their body weight at the same age averaged 2208, 2704, 2505 and 2649 gm respectively.

Stephan (1981) studied the effect if 3 temperate regimes viz. 5°, 18° and 30°C (with 80, 70, 60% RH) on the performance of New Zealand white rabbit, Silver and their reciprocal crosses. Weekly gain in body weight were 246, 262 and 178 gm for the three breeds.

In an investigation with 7 genetic group of rabbits viz., New Zealand White (NZW), Danish White Land (DWL), Californian White (CW), DWL x NZW, NZW x DWL, DWL x CW and CW x DWL Niedzwiadek and Kawinsks (1982) noted their performance. The body weight of the offerings at 12 weeks of age were 2.10, 1.95, 2.09, 1.83, 1.91 and 2.16 kg respectively.

Mgheni *et al.* (1982) in a study with New Zealand White rabbits in Tanzania recorded the average body weight of the animals as 1180 ± 202 gm at 12th week of age.

Mahajan and Lahari (1983) recorded the live weight at slaughter at 185.79 ± 5.37 days in New Zealand white rabbits. The value was observed to be 2.19 ± 0.03 kg.

Champe and Maurice (1983) studied on the response of early weaned rabbits to source of dietary fiber. They observed that body weight at 28 and 56 days for alfalfa fed rabbits was 725.5 ± 7.44 and 1299.6 ± 50.59 gm and for Bermuda fed rabbits it was 717.8 ± 7.44 and 1076 ± 52.94 gm respectively. Average daily gain was 20.5 ± 1.75 gm for alfalfa fed animals and 11.9 ± 1.86 gm for Bermuda fed rabbits.

Butcher *et al.* (1983) studied on the mean daily live weight gain during the post-weaning period for Californian rabbits fed low and high-energy diets. Weaning took place at 32 days of age. After weaning rabbits were given either low or high-energy diet until 2kg live weight is attained. Mean daily live weight gain was 24.3 and 29.8 gm for low and high-energy diets respectively.

Lukefahr *et al.* (1983a) recorded the litter weight at 28 and 56 days of age in four doe genetic groups viz., New Zealand White (NN), California (CC) straight breed and their crosses CN and NC . Mean litter weight at 28 days was 3.66 ± 0.20, 2.55 ± 0.22, 3.73 ± 0.21 and 3.12 ± 0.29 kg and at 56 days was 9.06 ± 0.50, 7.70 ± 0.63, 9.77 ± 0.49 and 8.03 ± 0.71 kg

respectively in NN, CC, CN and NC doe genetic groups. Litter gain from 28 to 56 days was recorded to be 5.5 ± 0.40, 4.9 ± 0.51, 6.1 ± 0.39 and 4.72 ± 0.57 kg respectively.

Lobley *et al.* (1983) recorded the live weight gain per day in New Zealand White and Californian young female rabbits from a body weight of 800 gm till attaining a body weight of 2.3 to 2.4 kg . They observed that live weight gain per day averaged 35.4 ± 0.8 gm.

Lukefahr *et al.* (1983) recorded average birth weight & litter daily gain in New Zealand White, Flemish Giant (FG) and Terminal crossbreed (TX) rabbits. They recorded litter daily gain up to weaning were 144 ± 9.6, 146 ± 13 and 123 ± 8.9 gm. respectively.

Jiabi *et al.* (1985) recorded data on kit production and growth over 3 generations are tabulated for 200 Californian and New Zealand White (NZW) rabbits imported from the USA. At 13 weeks of age, body weight averaged 1.65 and 1.81 kg for the Californian and NZW rabbits resp. For 25 Californian and 7 NZW rabbits from the 2nd generation, carcass weight averaged 1.0 and 1.1 kg.

Joy *et al.* (1985) recorded the live weight of 21 male and 19 female American Chinchilla crossbreds at 12 week of age as 1636.19 and 1667.89 gm on average, the difference being non significant.

Roedecha and Chanpongsang (1986) studied on preweaning growth characteristics of crossbreed rabbits from California , Thainative

and New Zealand White rabbits . Body weight at birth at 1,2,3,4,5,6 week of age and at weaning (48 days) were 55.26, 130.61, 217.28, 315.72, 657.63, 850 and 1000 gm. respectively. Daily gain from birth to weaning, from birth to 21days, from 21 days to weaning were 19.45, 12.27 and 25.48 gm respectively.

Poismans and Wittouck (1986) obtained daily gains of 29 and 35 gm in rabbits from 31 to 120 days of age in two diets containing 18.9 and 27.0 percent protein respectively.

Bawmier and Retailleau (1986) analysed the data on 190 rabbits in 23 litters from a strain selected for growth and carcass traits. Up to 3 week of age, daily gain averaged 12-15 gm it reached 30 gm at 4th week, 50 gm at 7th week and decreased to 26-27 gm at 77-80 days of age.

Lebas *et al.* (1987) studied effect of feeding, temperature and season on growth and carcass traits of New Zealand White (NZW), and NZW x Californian rabbits. They recorded overall mean daily gain was 31.7gm and slaughter weight (77 days) were 2190 gm and there were significant higher body weight gain in rabbits those days raised in winter than for those raised in summer.

Radwan *et al.* (1987) studied on the use of treated straws in diets for growing rabbits. They concluded that the small improvements in growth performance achieved by straw treatment in unlikely to warrant the extra cost incurred.

Zimmeramann *et al.* (1988) observed the average body weight in New Zealand White at 8 and 12 weeks as 1766 $\pm$ 308 and 2770 $\pm$ 316 gm in males respectively. The value for females for the respective weeks were 1702 $\pm$ 285 and 2718 $\pm$ 324 gm.

Rastogi (1988) reported the performance of 210 litters from a rabbitary in Trinidad where the average body weight of the off springs at 12 week of age were 1536 gm.

Singh *et al.* (1988) reported from Avikannagar a body weight of 1.41 kg at 12 weeks of age in New Zealand White rabbits.

Bhasin *et al.* (1988) reported that body weight of 1.30, 1.50, 1.10 and 1.10 kg at 12 weeks of age in New Zealand White, Soviet Chinchilla, Grey Giant and White Giant breeds respectively.

Singh *et al.* (1988) reported from Avikannagar that at 12 weeks of age White Giant, Grey Giant and Soviet Chinchilla rabbits attained body weight of 1.44, 1.41 and 1.31 kg respectively.

Gopikrishna *et al.* (1988) observed 1.28, 1.23 and 1.29 kg at 12 weeks of age in White Giant, Grey Giant and Soviet Chinchilla rabbits respectively.

Bhasin *et al.* (1989) reported that in a sub-temperate Himalayan region Soviet Chinchilla, Grey Giant, White Giant and New Zealand White

breeds of rabbits attained a body weight of 2.39, 2.49, 2.37 and 2.34 kg respectively at 24 weeks of age.

In study of Soviet Chinchilla rabbits Salroo *et al.* (1989) observed the body weight of the males at 12 weeks of age were 1.72 ± 0.04 kg.

Hamouda *et al.* (1990) studied on the growth performance in the first generation of local Tunisian rabbits crossed the Hyla strain. They observed that in straight – bred Hyla females, local males crossed with Hyla females, straight – bred local females and Hyla males crossed with local female, body weight at 77 days was 2087, 2066, 1746 and 1979 gm respectively. Daily gain between weaning (30days) and 77 days was 31.1, 32.0, 25.7 and 31.8 gm respectively. Hyla males had significant positive genetic effects on body weight at 77 days. There was 6 percent heterosis for body weight at 77 days in crosses with Hyla males.

Opoku and Lukefahr (1990) reported rabbit production and development in Ghana. In various breeds imported from Switzerland, individual body weight at 90 days averaged 1355 ± 23.8 gm.

Mishra (1990) recorded some production performance of two strains of New Zealand White viz., NZW-SH and NZW-Sc in Sikkim. Body weight at 12 weeks of age averaged 972.0 ± 54.21and 1008.08 ± 70.51 gm respectively. At 16 weeks of age body weights averaged 1134.0 ± 79.07 and 1273.94 ± 60.01 gm while at 24 weeks it was found to be 2379.0 ± 150.77 and 1812.16 ± 52.11 gm respectively. Body weight gain from 8 to 12 weeks was 10.37 ± 1.20 and 8.47 ± 0.94gm while weight gains from 12 to 16

weeks was observed to be 7.23 ± 1.71 and 12.19 ± 1.51 gm respectively in the above strains. They also observed in a strain of English Albino breed at Sikim that body weight at 12 weeks of age was 990.00 ± 37.84gm. At 16 and 24 weeks of age body weights were 1150 ± 81.24 and 1575.00 ± 139.75gm respectively. Body weight from 8 to 12 weeks was 10.50 ± 1.44gm from 12 to 16 weeks it was 7.59 ± 1.31gm.

Gopikrishna *et al.* (1991) reported from Mannavanur that New Zealand White rabbits attained a body weight of 1.30 kg at 12 weeks of age.

Roiron, *et al.* (1992) discussed for 125 hybrid rabbits slaughtered at. 70 days of age at a body weight of 2.2, 2.4 or 2.6 kg, the av. carcass yield was 55.6, 55.6 and 57.2% resp. vs. 55.8, 56.9 and 57.4 for rabbits slaughtered at 77 days at the same body weights, the differences between rabbits slaughtered at 2.2 kg and those slaughtered at 2.4 or 2.6 kg being significant.

Parigi-Bini *et al.* (1992) reported from 9 weeks of age, 6 ♂ and 6 ♀ commercial hybrid rabbits were killed at weekly intervals on 5 occasions. At 62, 69, 76, 83 and 90 days of age, body weight at slaughter averaged 2071, 2336, 2605, 2874 and 3076 g resp.for ♂♂ and ♀♀, body weight at slaughter averaged 2599 and 2570 g resp.

Gupta *et al.* (1992)described birth weight and body weight at 3, 4, 6, 8, 12, 18 and 24 weeks of age recorded for 973 White Giant (W.G.), Grey Giant (G.G.), Soviet Chinchilla (S.C.) and New Zealand White rabbits. There are significant differences among breeds for birth weight and body

weight for all ages. It is concluded that W.G. and S.C. are more suitable for meat production than other 2 breeds.

Bronet *et al.* (1993) compared fattening performance of rabbits of rabbits in cage rearing under Semi-open sheds and close sheds. For rabbits kept in cages in semi-open sheds daily weight gain from 28 to 70 days of age averaged 37.43 gm vas 37.06 gm for rabbits in close sheds.

Marai *et al.* (1994) studied fattening performance in NZW and California rabbits from 5-6 weeks of age upto 3 months of age at summer and winter. Daily gain averaged 24.4 and 17.8 gm respond daily solid gain 9.5 and 4.0 gm respectively.

Koehl (1994) described number of rabbit borned, weaned and reared per female averaged 66.4, 54.1 and 47.8 respectively and body weight at slaughter age 2.36 kg.

Reiad *et al.* (1995) reported for 66 New Zealand White (NZW), 44 Californian, 98 NZW x Californian and 114 Californian x NZW rabbits, 12-week body weight averaged 2045.7, 2084.7, 2189.6 and 2084.3 g respectively ($P<0.01$). There was no significant sex difference in body weight.

Remeris *et al.* (1996) studied body weight of rabbits affected by season of weaning and environment temperature. They recorded daily gain in body weight averaged 40.1, 41.7, 42.5 and 43.9 gm for 4 different (144 –

168/group) groups. They also concluded rabbits weaned in November – March performance is better than those weaned in July – August.

Duperray *et al.* (1996) studied performance of rabbits (68 days of age) housed at temperature 18° C and at 28°C during the day and 22°C at night. The recorded daily gain in weight averaged 43.48 vs 41.7 gm respectively.

2.5. Feed intake :

Literatures available on feed intake indifferent breeds of rabbits are chronologically reviewed below.

Chen *et al.* (1978) used 270 young New Zealand White rabbits in a 32 factorial arrangement of treatments to study the effect of weaning at 4, 6 and 8 weeks and of slaughtering at 8, 12 and 16 week of age on rabbit production.

DeBlas *et al.* (1979) studied on the use of Sodium hydroxide treated straw pellets in diets of growing Spanish Giant rabbits.

DeBlas *et al.* (1981) studied on the effect of diet of feed intake in Spanish Giant rabbits from weaning to slaughter at different ages and weights. They found that weaning age influenced dry matter intake at 49 and 63 days. Weaning at 25 days induced dry matter intake of 90.45 $\pm$ 0.93 gm while weaning at 35 days induced dry matter intake at body weight of 2,

2.25 and 2.5 kg was 87.31 ± 1.13, 92.77 ± 1.18 and 99.04 ± 1.17 gm per day respectively.

Parillo and Vasenina (1981) recorded the fettening performance of 551 Soviet Chinchilla, 375 White Giant and 750 Californian White rabbits where he found the consumption of dry matter per kg gain to be 4.16, 4.21 and 2.82 kg for the different respectively.

In a trial with New Zealand White (NZW), Danish White Land (DWL), Californian White (CE), DWL x NZW, NZW x DWL, DWL x CW and CW x DWL broiler rabbits, Niedzwiadek and Kawinska (1982) recorded feed consumption/kg gain as 3.9, 3.9, 3.8, 3.9, 4.1, 4.2 and 3.8 kg respectively.

Jensen and Rasmussen (1982) tested 9 White land, 2 Burgundy, 3 Californian, 2 Silver, 3 Chinchilla, 8 French Giant and 5 Flemish Giant litters in Denmark. Feed consumption per kg gain from 32 – 38 to 80 – 85 day of age averaged 3.52, 3.62, 3.53, 4.56, 3.58, 3.88 and 3.49 kg respectively.

Niedzwiadek *et al.* (1983) reported the performance of White Termonde rabbits upto 90 days of age. The consumption of feed per kg gain in body weightwas found to be 3.90 kg.

Champe and Maurice (1983) observed that early weaned rabbits daily feed intake was 66.7 ± 5.72 gm for alfalfa grass diet and 54.1 ± 5.72 gm for Bermuda grass diet.

Butcher *et al.* (1983) studied the effect of dietary metabolizable energy concentration upon the pre and post weaning performance of growing Californian rabbits. They observed that milk intake per offspring per day ranged from 19.7 to 22.8 gm with an error of 3.09 gm. Weaning took place at 32 days of age. Total dry matter consumption per young during the pre-weaning period ranged from 89 to 150 gm with a standard error of 29.1 gm. The dry matter intake during the post weaning period was 122.1 and 107.6 gm per day for the low and high energy diets respectively.

Lukefahr *et al.* (1983) recorded for New Zealand White and Californian straightbreds that litter milk efficiency was 0.519 $\pm$ 0.02 and 0.503 $\pm$ 0.02 respectively. For crossbreds of Californian and New Zealand White and their reciprocals the litter milk efficiency was 0.508 $\pm$ 0.02 and 0.543 $\pm$ 0.03 respectively.

Lukefahr *et al.* (1983a) recorded the little feed intake and efficiency from 28 to 56 of age in rabbits of four doe genetic group viz., New Zealand White (NN), Californian (CC) Straightbred and their crossbreeds CN and NC. Litter feed intake for the above genetic groups was 22.2 $\pm$ 1.1, 19.8 $\pm$ 1.3, 25.6 $\pm$ 1.0 and 23.6 $\pm$ 1.5 kg. respectively during the 28 days.

Lee and Huang (1984) studied the effects of mash and pellet feeds on the performance of rabbit. The group given mash mixed with 30 % water had the poorest performance. All rabbits were of 1 kg. body weight initially and the trial was conducted for 48 days.

Baumier and Retaelleua (1986) studied on the food consumption and dressing percentage in rabbits from a strain selected for meat production. They found that feed conversion ratio ranged from 1.83 at 28 to 35 days of age to 5.58 at 77 to 80 days of age. Dressing percentage at 70, 77 and 80 days of age averaged 55.0, 56.6 and 57.2 percent respectively.

Poisemens and Wittouck (1986) studied on the effects of a ratio rich in protein and poor in cellulose on growth performance of Termode White rabbits. They observed that feed conversion ratios were 3.78 and 3.22 in two diets containing 18.9 and 27.0 per cent protein respectively.

Abou-Ashour and Ahmed (1986) studied on the effects of dietary fibre levels on digestibility and performance of young Baladi rabbits from 5 to 15 weeks of age. Rabbits giving more fibre ate more daily, 64 gms. than did rabbits on a fibre poor diet which ate only 56 gms. with the same feed efficiency of 5.3.

Koehl (1986) recorded the technical-economic evaluation of meat rabbit from 84 enterprises in the country. For the 9 most productive and 9 least productive enterprises.

Raharjo *et al.* (1986) recorded in New Zealand White rabbits the doe body weight at kindling to be 4.74 $\pm$ 0.112 kg. Feed intake from 1 to 21 day post partum was 9.99 $\pm$ 0.297 kg.

Aduku *et al.* (1986) reported that weaning NZW rabbits fed on diets containing 50 per cent wheat bran, cowpea and groundnut haulms ate 48.76, 78.24 and 67.00 gm feed/day respectively.

Rao *et al.* (1986) reported that DM intake per kg gain in Russian Grey Giant was higher with hedge luceren (3.40 gm) tan with barseem, sunhemp, groundnut and gliricidis leaves (2.62 – 3.07 kg) containing mash rations.

Feodecha and Kijaparkorn (1988) studied the growth characteristics of New Zealand White (NZW), and Thai native rabbits and reciprocal crosses of the 2 breeds.

Biro *et al.* (1988) studied on the effect of body weight on reproduction in New Zealand White female rabbits. They observed that litter size was highest for females weighing 4.0 to 4.4 kg. Litter weight at birth was highest for females weighing 4.0 to 4.8 kg. Body weight of does was 0.14 to 0.45 kg higher on day 21 of lactation than at parturition.

MoNitt and Moody (1990) recorded the daily milk intake by rabbit kits of Californian, New Zealand White, Palomino and White Satin breeds. Daily milk intake was highest in Californian kits and lowest in White Satin kits. Californian kits consumed 152.4 $\pm$ 3.29 gm milk per day White Satin kits consumed 115.2 $\pm$ 2.79 gm milk per day. The milk intake : Litter weight ratio was highest for New Zealand White (0.137 $\pm$ 0.004) and lowest for the Palomino litter (0.121 $\pm$ 0.003). Milk intake increased from 53.0 $\pm$ 4.35

to 197.1 $\pm$ 6.44 gm per day litter size increased from 2 to 9. Litter size had a variable effect on the milk intake, litter weight ratio.

Raharjo *et al.* (1990) reported that the feed consumption was best in rabbits given diet containing 10 percent rice hulls.

Sreemannaryana *et al.* (1993) reported that DM intake/day by NZW and Russian Grey Giant rabbits feed on pelleted feed mixture containing 0, 10, 15 and 20 percent Azolla were 72.3, 79.3, 678.6 and 83.2 gm respectively.

Ngodigha *et al.* (1994) studied the effect replacement of commercial rabbit concentrate with groundnut haulms by 0, 25, 50, 75 and 100 percent observed significant ($P<0.05$) difference in feed (79.30, 81.31, 73.80, 71.85 and 56.23 g/day).

Sreemannarayana et al. (1995) found 102.60, 95.55, 96.02 and 95.81 gm DM intake per day in 5 groups of rabbits receiving diets containing 0, 5, 10 and 15 percent *Ulva fasciata*, a marine algae found in the costal areas of India.

Gupta *et al.* (1995) observed that the feed consumption (g/day) was 94.12, 90.64 and 91.40 in 3 groups of growing NZW rabbits receiving selected diets containing 0, 15 and 30 percent Job's tears grain respectively.

Singh *et al.* (1999) observed that in Soviet Chinchilla rabbits fed on Robinia leaves and Kikuya grass in the Kumaon hills of Uttar Pradesh that

dry matter intake was 99.8 ± 1.05 and 133.6 ± 1.39 respectively in both the feeding groups.

Das *et al.* (1999) observed that cross-breed rabbits (i.e. Soviet Chinchilla and New Zealand White) the total dry matter intake in five different groups of rabbits as 85.17 ± 1.63, 84.00 ± 1.68, 80.86 ± 1.38, 86.05 ± 1.52, 86.00 ± 1.62 gm respectively in the hills of Meghalaya being fed with concentrate mixture.

2.6. Performances Of Animals Under Deep Litter System Of Housing :

Generally deep litter or bedding is used for keeping animals clean and comfortable.

Rabbits way is to lay down a hot bed of accumulated droppings, which absorbs and evaporates the moisture in the urine and renders in offensive the urine's nitrogen content. The straw used in deeplitter, when composed of droppings and liquid manure in to valuable fertilizer for use on the holdings or for sale the straw can be a very good enterprise (Mackenzie, 1990).

Deeplitter also soaks up urine, make manure easier to handle and absorbs plant nutrient fitting both ammonia and potash in relatively insoluble from, thus protecting them against losses by leaching. (Sastry *et al.* 1983)

Literatures on animal performances under deep litter system are very limited. However available information of different species is given below :

Goat :

Trimarchi *et al.* (1982) reported that 10 Saanen kids were kept closed housing on permanent litter, while 10 kids were kept open housing on permanent litter with access to a yard. Both groups were weaned at 45 days of age and were fed adlibitum to slaughter at 90 on 127 days. There were no significant difference between housing groups in average daily gain as food conversion efficient.

Bartocci *et al.* (1986) recorded that for 31 twin kids ♀ ♀ slaughtered at 35 or 48 days of age, after rearing in cages or in deep litter, daily gain averaged 225 and 194g respectively, dry matter consumption per kg. gain 1.25 and 1.56kg. and dressing percentage 65.06 and 65.32. In cages and on deep litter, daily gain averaged 214.55 and 204.95g respectively and dry matter consumption per kg gain 1.40 & 1.43kg.

Terzano *et al.* (1988) studied on 112 Chamois coloured and 43 Saanen goats which were reared in metal pens (68 x 21 x 55cm^3) or in boxes on litter, and were slaughtered at 35 or 50 days of age. For 2 breeds respectively (over all data), daily gain averaged 207.5 and 191.2g ($P<0.05$), feed conversion index 1.17 and 11.26, & carcass weight 8.91 and 7.76 kg ($P<0.05$). Dressing percentage at 35 & 50 days averaged 66.9 and 70.0 respectively ($P<0.05$). Carcass weight & dressing percentage did not differ

significantly between two rearing methods. The best over all performance was for Chamois coloured goats reared on litter and slaughtered at 50 days of age.

PIG :

Matayas *et al.* (1993) in order to test deep litter having technology in Hungarian Condition, 15 pigs were fattened in each at two $16m^2$ boxes in 80 cm thick sawdust litter. In order for the manure to be decomposed on the spot, the litter was treated with SEF-C and Envistim Bioactive litter addetive agents. Litter was regularly rotated manually. Automatic feeders combined with nipple drinkers were used for feeding and drinking. As a controlled 8 animals were fattened in $8m^2$ boxes in a traditional liquid manure system. In a course of the July – August first fatting cycle, the results of both the experimental stock and the control stock were worse then expected due to several unfavorable effects. In Sept – Dec production cycle the daily weight gain was 652 and 641 g on average in the experimental groups, while in 2 control groups it was 621g. Thus the weight gain by the deep litter group was 5 and 3.3 % higher than central group.

Rabbit :

Crimella *et al.* (1988) conducted two trials, each involving 574 rabbits, either commercial hybrids or New Zealand Whites, were carried out over a 12 month period, and involved monitoring daily weight gain, food conversion and slaughter performance. Rabbits were monitored from housing on day 32 to day 59 and from day 59 to slaughter (usually on day

80). Animals were housed in cages (10, 14, 17 or 20 / m^2) or on deep oat straw litter. At day 59, animals on deep litter were transferred to cages. Housing to 59 days of age did not affect gain significantly, being 25.50 and 26.91 g in trials 1 and 2 resp. for rabbits in cages vs. 25.91 and 27.54 g for those on litter, but rabbits maintained in cages to day 80 performed better than those transferred from litter to cages (42.28 vs. 35.04 g in trial 1 and 29.74 vs. 28.32 g in trial 2). Food conversion in the 1^{st} of the fattening periods was better on deep litter than in cages, possibly because of ingestion of straw as well as feed, but this advantage was offset by the stress of adaptation following transfer to cages at 59 days. The slaughter performance of rabbits in cages was slightly, but not significantly, better than that of animals on litter followed by cages.

Lebas *et al.* (1992) described that traditional European rabbitries use straw litter. This material can be replaced by any other dry fibrous product which is not rough to the touch (soft shavings, hay, industrial cotton waste and so on). The cages are either of concrete (lasting 15 to 30 years) or wood (lasting not more than two years). Cages for breeding animals usually have at least a 60 to 70 cm x 80 to 100 cm floor space and are 50 to 60 cm high. Identical cages are often used for fattening five or six young rabbits (to 2.5 to 2.8 kg). The litter should be replaced weekly to control parasitism.

A variation called "deep litter" is used in slightly taller cages. The floor is covered with a bed (minimum thickness 15 to 20 cm) of absorbent material (turf, wood shavings) evenly covered with straw. Every six or seven weeks the whole lot, absorbing layer plus accumulated straw, has to be replaced. This system saves labour in cleaning and has the advantage of

the comfort provided by the straw, but it does use a great deal of absorbent material so it is only applicable where this material is both readily available and cheap.

Zajac *et al.* (1994) described about deep litter housing in the meat rabbit husbandry.

Gupta (2001) explained about cage floors (hutches) with beddings. Cage floors with bedding require small investment ensuring no in juries to the legs or hocks, no additional heating arrangement even in temperate and cold climatic conditions, and sometimes even nest box is also not required. Its draw-backs are that it requires higher expenses on prophylactic treatment (coccidiosis, worms etc.) gives low stocking density and lower labour performance. Variety of locally available material like straw, jute, hay can be used as litter material. Again young fattening animals may be kept together in a large groups (over 200) in one room (max. 8-10 animals sq. m. floor space). Feeders and waterers are fixed where they can be survived without entering in to the pen. Floor space can be littered with dry bedding and excreta removal done after 2-3 months or with change of lot. Its advantage is low initial investment because the existing buildings are used. Deep litter allows comfortable shed temperature. Automatic feeder and waterers can be used for group feeding / watering and its disadvantage is higher incidence of infection (coccidiosis, worms) and more expenditure on prophylactic treatment. Reduced feed conversion (by about 10%) efficiency through increased mobility, lower stocking density, proneness to injuries due to group fighting.

MATERIALS AND METHODS

CHAPTER - 3 MATERIALS AND METHODS

3. 1. The Experiment :

The experiment was performed to study the **"Effect of deep litter housing on management of rabbit (*Oryctolagus cuniculus*)".**

3. 2. Location of experimental site :

The experiment was conducted at the experimental rabbit rearing shed of the Department of Animal Production and Management, West Bengal University of Animal and Fishery Science, Mohanpur, Dist. – Nadia, West Bengal. The place is located at 23° North latitude and 89° East longitude and 9.75 meters above mean sea level.

3. 3. Period of Study :

The trial was conducted during the month of November 2001 to June 2002 with average temperature ranging from 18°c to 30°c relative humidity 72 to 78 percent.

3. 4. Breeds Used :

Breeds of rabbits used in the investigation were Soviet Chinchilla and Grey Giant Crossbreed.

3. 5. Number of Rabbits :

Three rabbits D_{10}, D_7 and D_{11} were housed initially in deep litter then on third week two other rabbits D_3 and D_9 were introduced and finally on seventh week two rabbits numbering 235 and F_4 were introduced. The age of rabbits were almost same (8 weeks at the beginning of experiment).

3.6. Management and feeding of experimental animals :

The management practices which were adapted during the trial are as follows :

3. 6. 1. Housing of animals :

In a large room the animals were kept in deep litter system of housing for experimented purpose. Room was well lighted and ventilated having a door.

Floor space area of deep litter was (121.92 cm x 121.92 cm) i.e. 14865 sqcm. The wall of deep litter was wire neeting with 60 cm high. The thick ness of deeplitter was 16 cm.

Floor space provided per rabbit –

Phase I	(for 0 – 2nd weak)	– 4955 sqcm.
Phase II	(for 3rd – 6th weak)	– 2973 sqcm.
Phase III	(for 7th – 24th weak)	– 2124 sqcm.

Preparation of deeplitter :

The system of rearing rabbits in deeplitter housing is not popular . For preparation for this deep litter, paddy straw and saw dust were used . Before spreading the litter materials in the floor these were air dried to reduce the source of infection. Straw acts as a heat insulated agent & saw dust was used to absorb some portion of urine.

At first chopped straw and saw dust was mixed uniformly and spread over the floor to make the thickness of litter 16 cm. So the volume of deep litter was 121.99 cm X 121.92cm X 16cm. The total requirement at paddy straw and saw dust initially 10 kg & 15kg respectively

Management of Deep litter:

The litter materials act as a nidus in the propagation and spread of very many diseases like coccidioses, internal parasites and ectoparasites. So special attention has to be paid in management of deep litter.

Deep litter being stirred every alternate day, so that uniform moisture and texture was maintained during the experiment. At every one month interval hydrated lime was thoroughly mixed up with litter. Hydrated lime was used to prevent the Caking up of the deep litter, removal of odour, reduction of intensity of infective agents, maintenance of dryness of litter etc.

At every week interval the moisture and pH of deep litter was measured. Also depth of deep litter was measured. If the depth of deep litter is below their initial level then it is adjusted by adding sawdust. Moisture at deep litter was maintained to prevent animal from respiratory at harmful organism in the litter.

3. 6. 2. Feeding :

The rabbits were maintained basically on the following combination –

i) Roughages (mixed green grass)
ii) Roughages (mixed green grass) and concentrated mixture
iii) Roughages (mixed green grass) and pellets

i. Concentrated mixture :

Concentrated mixture was prepared with following items :

Ground Maize	–	55 %
Gram	–	23 %
Ground nut cake	–	20 %
Mineral Mix (Concimin)	–	2 %
Total		100 %

Each 250 gm. mineral mixture and vitamins consists of the following ingredients : Vitamin – 5 lakh I.U., Vitamin D_3, 1 lakh I. U., Vitamin B_2 – 0.2 gms., Vitamin E – 75 units, Vitamin K – 0.1 gms., Calcium Pantothenate

– 0.25 gm., Nicotinamide – 0.1 gms., Vitamin B_{12} – 0.6 mg., Choline chloride –m 15 gram, Calcium-7sqm, Iodine – 0.1gm, Iron – 0.75gm, Zinc – 1.5gm, Copper – 0.2gm and Cobalt – 0.045gm.

Concentrate mixture is given 30gms/head/day.

Processing of gram and maize :

The maize were grounded in the grinder where as green grain was given as a whole. The gram were soaked overnight and washed and spread over a net to drain out excess water. Then the maize and gram were weighed and mixed with mineral mixture, ground nut cake according to the mentioned proportions and fed to the animal accordingly.

ii. Pellet :

Composition of Pellet :

Maize	-	50 parts.
Gram	-	20 parts.
Ground nut cake	-	20 parts.
Cement	-	08 parts.
Mineral mixture (Concimin)	-	02 parts.
Total	-	100 parts.

Pellet diameter	-	3 to 5 mm
Pellet length	-	8 to 10 mm
Drying temp.	-	65°C ± 5°C

1 kg of pellet ingredients is mixed with 800 ml of water. Mixing is done properly. Pellet is made up according to the above mentioned size and keep in the hot air oven (65°C ± 5°C) for 4 hours. Pellet is given 30gm/head/day.

iii. Green feeds :

Locally available green grass like paragrass (*Brachiaria muticastop*) dhub grass, cabbege (*Brassica alerancca*), alligator grass and aquatic plants. Before supplying the green feeds were air dried over night and fed to animals.

$$\text{Moisture \% of green grasses} = \frac{W_1 - W_2}{W_1} \times 100$$

- W_1 = Before drying
- W_2 = After drying

Feeding Status :

From 1st weak to 15th weak all the animals were give only green grass. From the 16th weak they were grouped in to three up to 24th week.

1st group	- D_3 & 235	-	Only green grass (roughages)
2nd group	- D_7 & D_9	-	Green grass and concentrated mixture
3rd group	- D_{10}, D_{11} & F_4	-	Green Grass and pellet

3.7. Other Managemental practices :

3.7.1. Identification

For identification of individual animal tattooing was done on inner ear flap at weaning. The ears were punched with tattooing forceps and tattooing ink was put on the both sides of ear.

3.7.2. Nail cutting

The trimming of nails were done to some animals, which had visibly long nail to prevent injury to each other.

3.7.3. Stool Management

Superficially stool was taken out from deep litter.

3.7.4. Health Management

Rabbit is very hardy little mammals. They become ill due to breakdown of husbandry management.

Amprolium (cocidiostat) was given to the animals for five successive days along with water once in every three months.

Diarrhoea was occasionally observed in certain animals. They were administered with antidiarrhoeal liquid (i.e. Diaba) to which they responded.

Occasionally scabies were also observed in certain animals which were treated with ascabiol lotion with Ivermectin (Ivomac) injection was done subcutaneously.

3.7.5. Body Weight

Individual body weight of animals were recorded at two weeks intervals. The body weight were recorded by using at 20 kg. spring balance. When spring balance was used, animals were kept in a nylon bag and total weight was taken and from this weight of bag was subtracted to get animals body weight.

3.7.6 Feed Intake

Records of feed intake were taken on the daily basis in individual animals. Measured quantities of feed was given to individual animal and residual were collected on the next morning and weighed. The difference in the weight of feed was accounted as feed intake for 24 hours. The feed and refusals were weighed by using a 2kg. unipan balance. Amount of feed consumed by animals were converted into dry matter.

3.8 Statistical analysis :

The data were analysed statistically using standard statistical method (Snedecor and Cochran 196 8)

Photo 1. Experimental animals under deep litter system of farming

Photo 2. Feeding of greens to the experimental animals

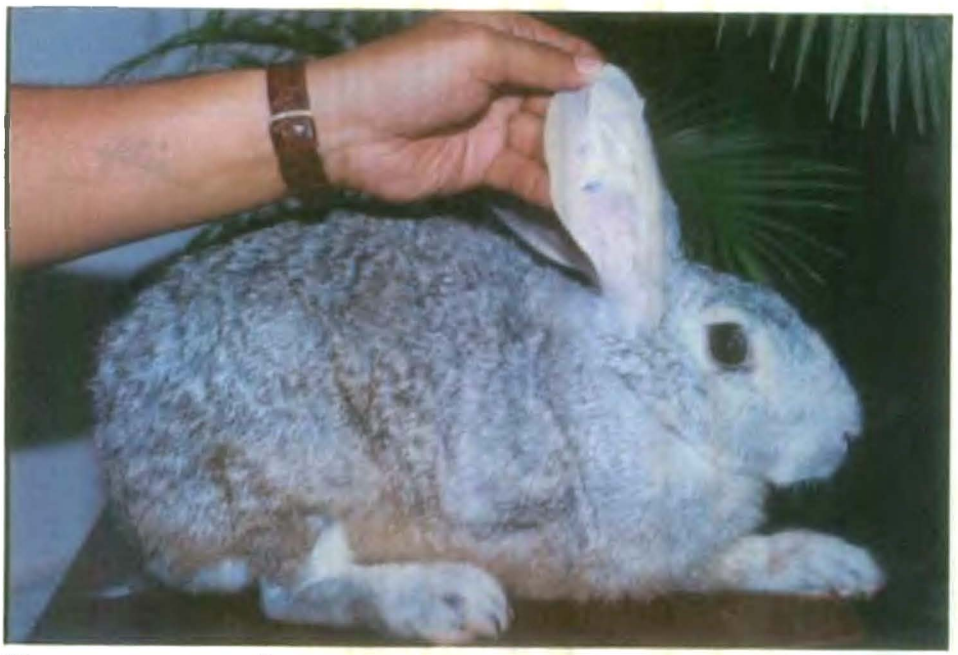


Photo 3. A well-made tattoo (F4) as individual indentification

Photo 4. Handling of rabbit

Photo 5. Different type of feeds

Photo 6. Sexing of rabbit : The doe

RESULTS AND DISCUSSION

CHAPTER - 4 RESULTS AND DISCUSSION

4.1. Feed intake :

4.1.1. Weekly feed intake of individual rabbit with different stocking density –

The average weekly feed intake (on dry-matter basis in g/week) of three different group of animals (Group I – D_{10}, D_7, D_{11}, Group II – D_3 D_9, and Group III – 235, F_4) were recorded at different phases (for 0 – 24 wks., for 3 – 24 wks. and for 7 – 24 wks.) of the total experimental period. The recorded data are represented on Table – 4.1.

Table – 4.1. Weekly feed intake (dry-matter basis g/week) of different animals at different periods :

Animals		For 0-24 wks.	For 3-24 wks.	For 7-24 wks.	For 7-24 wks.
Group-I	D_{10}	380.358			386.044
	D_7	351.854			356.328
	D_{11}	341.758			346.344
Group-II	D_3		332.072		334.300
	D_9		342.459		345.461
Group-III	235			374.072	374.072
	F_4			385.456	385.456
CD at 5%		2.530	6.354	8.494	5.284

From the Table – 4.1. it is observed that in Group I, feed intake (dry-matter basis in g/week) is maximum in case of D_{10} and minimum in D_{11} animal throughout the experimental period (24 wks.). The feed intake of D_{10} animal is significantly higher than D_7 and D_{11} animals and also D_7 animal take significantly more amount of feed than D_{11} animal.

In case of Group II, for a period of 3-24 wks., D_9 animal take more feed than D_3 animal and the amount is conspicuously higher.

Similarly, within the period of 7-24 wks. animal 235 and F_4 (Group III) differ significantly in their amount of feed intake and F_4 take more feed than animal 235.

Among all the animals, average intake of feed is maximum in animal D_{10} and minimum in animal D_3 within a period of 7-24 wks. Though D_{10} animal takes more amount of feed than F_4 animal but their feed intake is at par. The intake of feed at D_{10} and F_4 animal are differ significantly than 235, D_7, D_{11}, D_9 and D_3 respectively.

4.1.2. Average weekly feed intake of rabbit in group basis with different stocking density :

The average weekly feed intake (on dry matter basis in g/week) of three different group (Group – I, Group – II and Group – III) were recorded and represented on Table 4.2.

Table – 4.2. Feed intake (DM basis in g/week) of three different group of animals at different weeks:

Age (in weeks)	Exp. period (in weeks)	Group - I For D_{10}, D_7, D_{11}	Group - II For D_3, D_9	Group - III For 235 & F_4	For all
		Average	*Average*	*Average*	*Average*
Week 8	Week 1	332.400			
Week 9	Week 2	334.200			
Week 10	Week 3	343.800	324.000		
Week 11	Week 4	348.467	325.800		
Week 12	Week 5	350.200	331.200		
Week 13	Week 6	350.400	329.800		
Week 14	Week 7	348.000	334.500	369.000	350.143
Week 15	Week 8	345.333	333.600	373.500	350.029
Week 16	Week 9	352.667	336.000	372.600	353.600
Week 17	Week 10	352.200	336.600	376.200	354.600
Week 18	Week 11	354.800	332.500	375.300	354.286
Week 19	Week 12	355.467	331.800	367.700	352.200
Week 20	Week 13	354.600	334.500	372.700	354.029
Week 21	Week 14	354.400	336.600	379.300	356.429
Week 22	Week 15	354.600	338.100	378.000	356.571
Week 23	Week 16	355.800	338.100	378.000	357.086
Week 24	Week 17	375.667	346.450	387.600	370.729
Week 25	Week 18	376.567	349.350	385.400	371.314
Week 26	Week 19	374.567	347.350	388.700	370.829
Week 27	Week 20	373.567	349.450	383.900	369.629
Week 28	Week 21	374.567	345.250	385.400	369.286
Week 29	Week 22	375.633	344.200	387.450	370.029
Week 30	Week 23	377.200	341.600	390.500	370.829
Week 31	Week 24	376.667	341.900	384.500	368.971
	CD at 5%	7.158	*N.S.	*N.S.	8.474

* N.S. = Not Significant

From the Table 4.2. it is observed that the average feed intake of Group-I animals (D_{10}, D_7 and D_{11}) is maximum at 23rd week and minimum at 1st week. Average feed intake by Group-I animals is conspicuously higher

in 23rd week than the other weeks (1 to 16 weeks) except 17th, 18th, 19th, 20th, 21st, 22nd and 24th week. Although the average feed uptake by Group-I animals differ in 17th, 18th, 19th, 20th, 21st, 22nd and 24th week but they are not significant.

From the Table 4.2. it is observed that the average feed intake of Group-II animals (D_3, D_9) is maximum at 20th week and minimum at 3rd week of the experiment. Thought the average feed intake differs between the weeks but they are at par.

In case of Group-III it is observed that the average feed intake of Group-III animal (235, F_4) is highest at 23rd week and lowest at 7th week of the experiment. But the average feed intake of the animal between weeks is not significant.

Among all the animal average feed intakes is maximum at 18th weeks and minimum at 8th weeks. The average feed intake is conspicuously higher at 18th weeks than other week i.e. 7th to 16th week. The average feed intake differ in 17th, 18th, 19th, 20th, 21st, 22nd, 23rd, and 24th weeks but they are not significant.

Das *et al.* (1999) observed that daily dry matter in take in cross breed of New Zealand White and Soviet Chinchilla rabbits in five different groups of feeding as 85.17 $\pm$ 1.63, 84.00 $\pm$ 16.8, 80.86 $\pm$ 1.36, 86.05 $\pm$ 1.52 and 86.00 $\pm$ 1.62 gm respectively.

DeBlas *et al.* (1981) in Spanish Giant rabbits observed that dry matter intake at body weight of 2, 2.25 and 2.5 kg were 87.31 ± 1.31, 92.77 ± 1.18 and 99.04 ± 1.17 gm per day respectively. This report is slightly higher than present findings as there may be seasonal or environmental variation and breed differences from the present findings.

Champe and Maurie (1983) reported almost similar results of dry matters intake in rabbits i.e. 66.7 ± 5.72 gm for Alfalfa grass diet and 54.1 ± 5.72 for Bermuda grass diet.

Butcher *et al.* (1983) observed dry matter intake as 122.1 and 107.6 gm per day of Californian rabbits with low and high energy diets respectively. This report is higher than present findings due to may be above-mentioned reasons.

Aduku *et al.* (1986) reported that NZW rabbits fed on diet containing 50 percent wheat bran cowpea and groundnut haulms etc. consumed 48.78, 78.24 and 67.00 gm feed / day which is almost similar to present findings.

Singh *et al.* (1998) observed that the daily feed consumption in Soviet Chinchilla rabbit as 99.8 ± 1.03 gm in Kumaun Hills of Uttar Pradesh, which is higher than present findings, may be due to environmental variation.

Table 4.3. : Analysis of variance for feed intake on dry matter basis :

Table 4.3.1.

Source of variance	*df*	*SS*	*MS*	*F – value*	*F - tab*
Weeks	23	13467.32986	585.53608	30.929289	1.7668036
Animals	2	19234.98694	9617.4935	508.01692	3.1995881
Error	46	870.8463889	18.931443		
Total	71	33573.16319			

Table 4.3.2.

Source of variance	*df*	*SS*	*MS*	*F – value*	*F - tab*
Weeks	21	2228.553864	106.12161	1.0277682	2.0841888
Animals	1	1010.882045	1010.882	9.7902054	4.3247894
Error	21	2168.342955	103.25443		
Total	43	5407.778864			

Table 4.3.3.

Source of variance	*df*	*SS*	*MS*	*F – value*	*F - tab*
Weeks	17	1719.178056	101.12812	0.6933393	2.2718929
Animals	1	1166.2225	1166.2225	7.9956777	4.4513229
Error	17	2479.5625	145.85662		
Total	35	5364.963056			

Table 4.3.4.

Source of variance	*df*	*SS*	*MS*	*F – value*	*F - tab*
Weeks	17	8700.635635	511.8021	7.8219999	1.7238335
Animals	6	46565.98159	7760.9969	118.61326	2.1887629
Error	102	6673.972698	65.431105		
Total	125	61940.58992			

Fig.1. Weekly average feed intake (gm.) on dry matter basis of different rabbits at different periods:

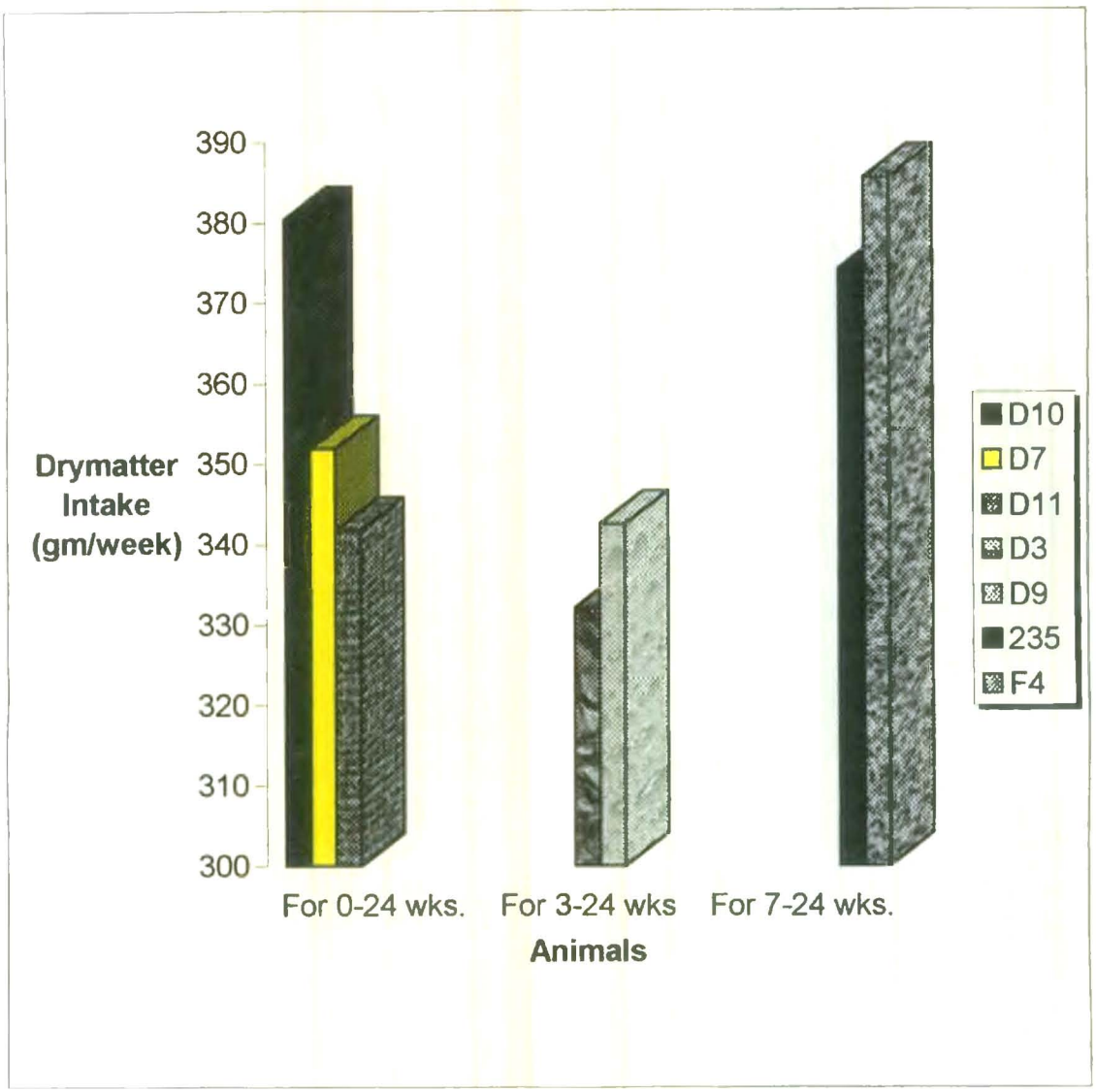
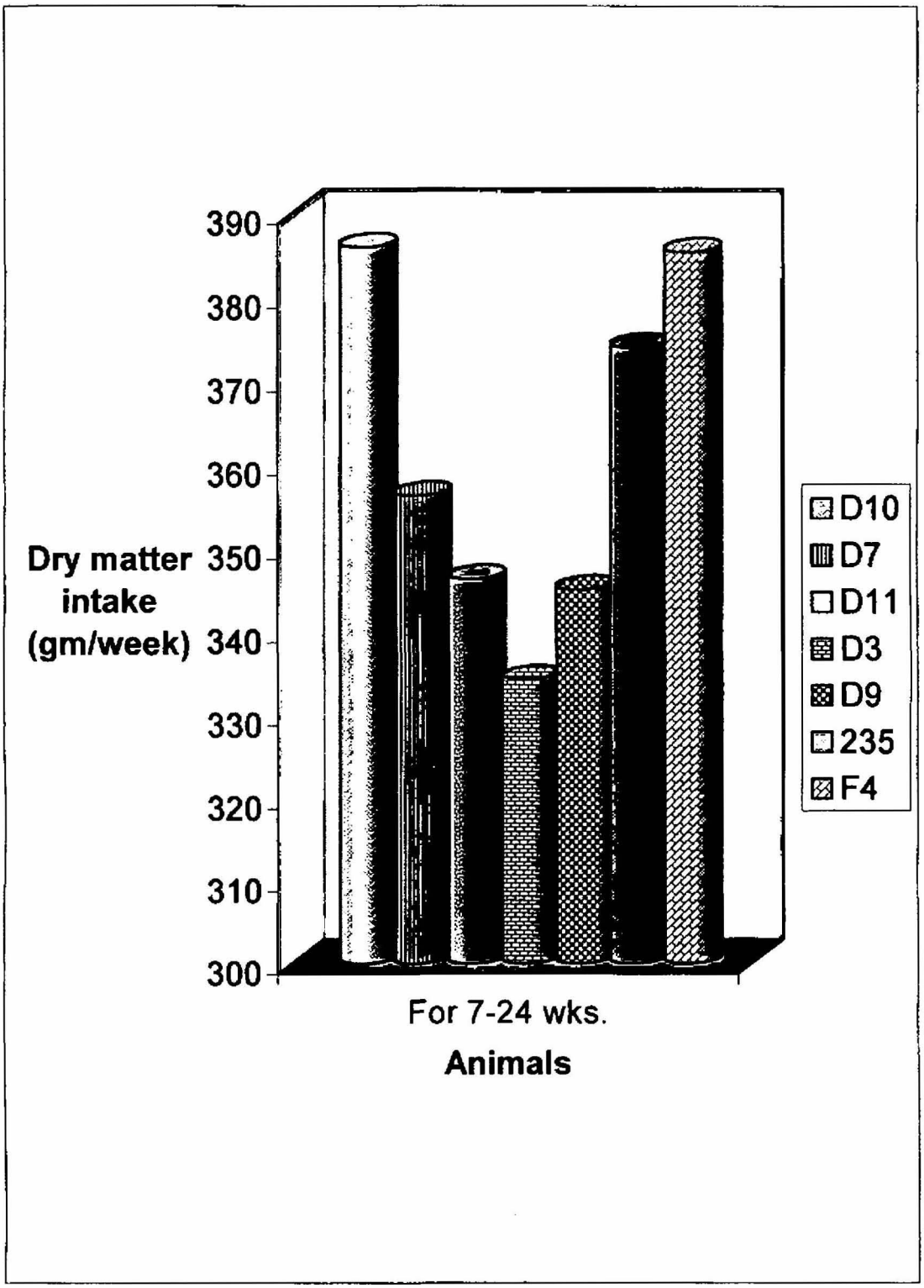


Fig.2. Average feed intake (gm./wk) on dry matter basis of different rabbits:



4.2.Body Weight:

4.2.1. Average weekly body weight of individual rabbit with different stocking density :

The average body weight of three different group of animal (Group-I – D_{10}, D_7, and D_{11} Group-II - D_3, D_9 and Group-III – 235, F_4) were recorded at different weeks (0-24 weeks, 3-24 weeks and 7-24 weeks) of total experimental period. The recorded date are represented on Table 4.4

Table 4.4 : Body weight of different animal at different period :

Animals		For 0-24 wks.	For 3-24 wks.	For 7-24 wks.	For 7-24 wks.
Group-I	D_{10}	2.484			2.518
	D_7	2.267			2.289
	D_{11}	1.933			2.011
Group-II	D3		1.923		1.928
	D_9		2.073		2.117
Group-III	235			2.078	2.078
	F_4			2.594	2.594
CD at 5%		0.05725	0.135604	0.168222	0.11164

From the table 4.4 it is observed that body weight is maximum in case of D_{10} animal and minimum in D_{11} animal. Body of D_{10} is significantly higher than D_7 and D_{11} Body weight of D_7 is also significantly higher than D_{11}

Similarly in case of Group-II for a period of 3-24 weeks D_9 weight is more than D_3 and the body weight is significantly higher.

Similarly in case of Group-III for a period of 7 to 24 week F_4 body weight is significantly higher than 235 animal.

Among all the animals for the period of 7 to 24 weeks the body weight is maximum in case of F_4 and minimum in case of D_3 animal. Though body weight of F_4 animal is more than D_{10} animal but their body weight is at par. The body weight of F_4 and D_{10} animal differ significantly from the other animals (D_7, D_9, 235, D_{11}, D_3) respectively.

4.2.2. Average weekly body weight of rabbit in group basis with different stocking density :

The average body weight at three different group (Group I, Group II, Group III) were recorded and represented on Table 4.5.

Table – 4.5. : Body weight (kg) of different groups of animal at different weeks :

Age	Exp. Period	Group – I	Group – II	Group – III	
(in weeks)	(in weeks)	For D_{10}, D_7, D_{11}	For D3, D9	For 235, F4	For all
		Average	*Average*	*Average*	*Average*
Week – 8	Week – 1	1.967			
Week – 9	Week – 2	2.033			
Week – 10	Week – 3	2.100	1.800		
Week – 11	Week – 4	2.167	1.850		
Week – 12	Week – 5	2.167	1.900		
Week – 13	Week – 6	2.133	2.000		
Week – 14	Week – 7	2.233	2.050	2.300	2.200
Week – 15	Week – 8	2.233	2.050	2.300	2.200
Week – 16	Week – 9	2.140	2.100	2.300	2.174
Week – 17	Week – 10	2.200	2.100	2.300	2.200
Week – 18	Week – 11	2.200	2.100	2.400	2.229
Week – 19	Week – 12	2.167	2.150	2.450	2.243
Week – 20	Week – 13	2.200	2.050	2.400	2.214
Week – 21	Week – 14	2.167	2.100	2.350	2.200
Week – 22	Week – 15	2.133	2.050	2.200	2.129
Week – 23	Week – 16	2.133	1.950	2.300	2.129
Week – 24	Week – 17	2.233	1.950	2.350	2.186
Week – 25	Week – 18	2.200	1.900	2.300	2.143
Week – 26	Week – 19	2.300	2.000	2.350	2.229
Week – 27	Week – 20	2.333	1.950	2.300	2.214
Week – 28	Week – 21	2.367	1.950	2.250	2.214
Week – 29	Week – 22	2.500	1.950	2.350	2.300
Week – 30	Week – 23	2.533	2.000	2.400	2.343
Week – 31	Week – 24	2.633	2.000	2.450	2.400
CD at 5%		0.1619	N. S.	N. S.	N. S.

N. S. = Not Significant

From the Table 4.5 it is observed that the average body weight in case of Group-I (D_{10}, D_7, and D_{11}) is maximum in case of 24^{th} week and minimum is case of 1^{st} week. Average body weight of Group-I animals is conspicuously higher in 24^{th} week than the other weeks (1^{st} to 21^{st} week)

except 22^{nd} ,23^{rd} week. Although the average body weights of Group I animals differ in 22^{nd} and 23^{rd} week but they are not significant.

From the Table 4.5 it is observed that average body weight of Group II animals (D_3, D_9) is maximum at 12^{th} week and minimum at 3^{rd} week of the experiment. Though the average body weight differs among the weeks but they are at par.

Similarly in case of Group III (235, F_4) it is observed that the average weight is highest at 12^{th} and 24^{th} week & lowest at 7^{th} , 8^{th}, 9^{th},10^{th},16^{th},18^{th} and 20^{th} week. But the average body weight among the weeks is not significantly different.

Among all the animal the average body weight is maximum in case of 24^{th} week and minimum in case of 15^{th} and 16^{th} week. Although the average body weight is differ between but their relation is at par.

Chen et al. (1978) observed the average body weight ranged from 1388 to 2117 gm. at 8^{th} weeks, 2129 to 2825 gm. at 12 weeks and 2634 to 3284 gm. at 16 weeks at age, which is almost similar to present findings.

Kosko (1981) reported that in Californian White (C.W.), German Giant (G.G.), GG x CW and CW x GG average body weight at 12 weeks were 2208, 2704, 2505 and 2649 gm. respectively which is higher than the present findings. This difference may be due to the climatic variations and breeds of rabbit.

Niedzwiadek and Kawinsks (1982) noted the average body weight at 12 weeks of age of 7 genetic Group of rabbits viz, New Zealand White (NZW), Danish White land (DWL), Californian White (CW), DWL x NZW, NZW x DWL, DWL x CW and CW x DWL were 2.10, 1.95, 2.09, 1.83, 1.91 and 2.16 respectively which is similar to present findings.

Ngheni *et al.* (1982) in a study recorded that New Zealand White rabbits average body weight of animals as 1180 $\pm$ 202 g at 12^{th} weeks of age which is lesser than present findings probably due to climatic variations and breeds of rabbit.

Joy *et al.* (1985) recorded the average live weight at female American Chinchilla cross breeds at 12 weeks of age as 1667.89 g which is lower than present findings due to above mentioned cause.

Bhasin *et al.* (1989) reported that in a sub temperate Himalayan region Soviet Chinchilla, Grey Giant, White Giant and New Zealand White breed of rabbit attained body weight of 2.39, 2.49, 2.37 and 2.34 kg respectively at 24 weeks of age, which is similar to present findings.

Mishra (1990) recorded in Sikkim that average body weight at NZW – SH and NZW – SC at 16 weeks of age was 1134.0 $\pm$ 79.07 and 1273.94 $\pm$ 60.01 gm. while at 24 weeks of age it was found 2379.0 $\pm$ 150.77 and 1812.16 $\pm$ 52.11 gm. respectively. Which is almost similar to present findings.

Roiron *et al.* (1990) reported that 125 hybrid rabbits average live weight at 70 days of age was 2.2, 2.4 or 2.6 kg which is similar to present findings.

Parigi *et al.* (1992) recorded average body weight of commercial hybrid rabbit from 9 weeks of age at weekly internal (5 occasions) were 2071, 2336, 2605, 2874 and 3076 gm. respectively which is slightly higher than present findings due to climatic variation and due to breed differences.

Table 4.6. : Analysis of variance for body weight of different animals :

Table 4.6.1.

Source of variance	*df*	*SS*	*MS*	*F – value*	*F - tab*
Weeks	23	1.627461111	0.070759179	7.30476523	1.76680359
Animals	2	3.694677778	1.847338889	190.7085006	3.19958815
Error	46	0.445588889	0.00968715		
Total	71	5.767727778			

Table 4.6.2.

Source of variance	*df*	*SS*	*MS*	*F – value*	*F - tab*
Weeks	21	0.334772727	0.015941558	0.339010357	2.08418882
Animals	1	0.2475	0.2475	5.263291139	4.32478942
Error	21	0.9875	0.04702381		
Total	43	1.569772727			

Table 4.6.3.

Source of variance	*df*	*SS*	*MS*	*F – value*	*F - tab*
Weeks	17	0.148055556	0.00870915	0.152242217	2.2718929
Animals	1	2.4025	2.4025	41.99742931	4.45132287
Error	17	0.9725	0.057205882		
Total	35	3.523055556			

Table 4.6.4.

Source of variance	*df*	*SS*	*MS*	*F – value*	*F - tab*
Weeks	17	0.575292063	0.03384071	1.158834538	1.72383352
Animals	6	7.083987302	1.18066455	40.43044235	2.18876295
Error	102	2.97864127	0.029202365		
Total	125	10.63792063			

Fig.3. Weekly average body weight (kg.) of different rabbits at different periods:

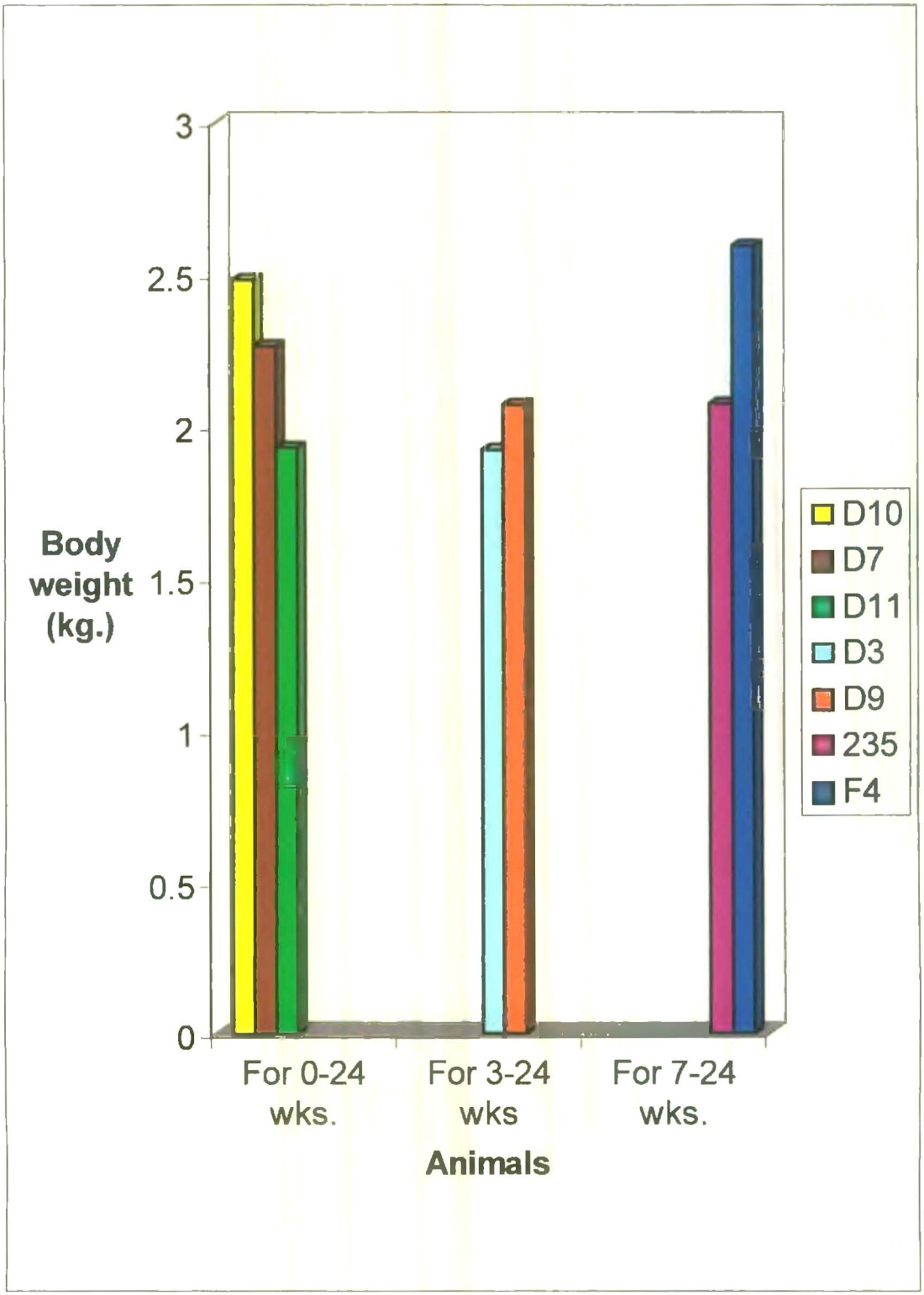
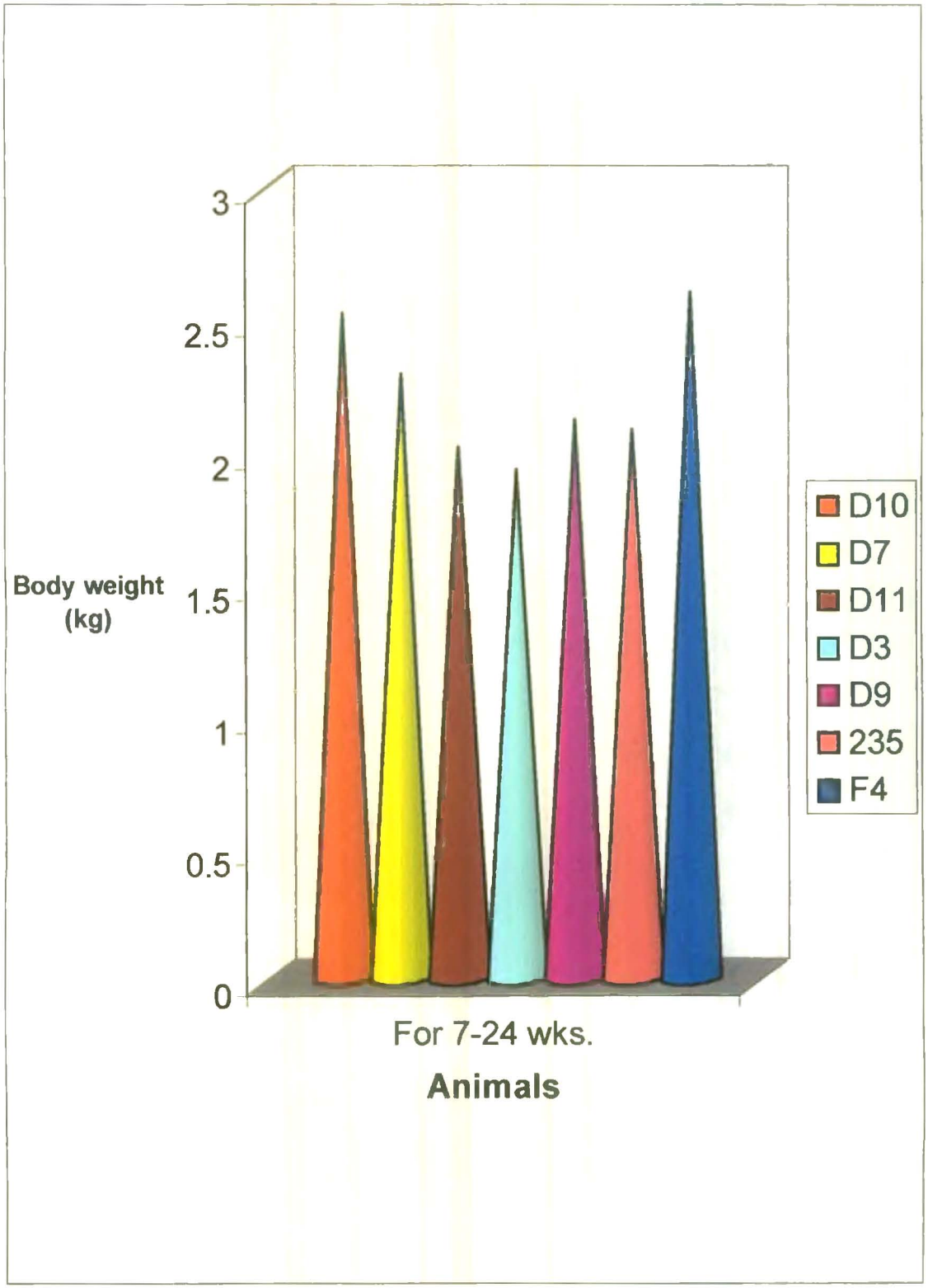


Fig.4. Average body weight (kg.) of different rabbits :



4.3.Relation between body weight and feed intake (D.M basis) of the animal :

The average body weight and average feed intake of individual animals were co-related by regression and represented on Table 4.7.

Table 4.7. : Individual relationship between body weight (kg) and feed intake (D.M. basis – gm) of the animals :

Animal	R^2	Relationship
D_{10}	R^2 = 0.571 *	Y - 1.073055 + 0.00935 DM (0.6575) (0.002)
D_7	R^2 = 0.355 **	Y - 0.59954657 + 0.006612459 DM (0.668) (0.002)
D_{11}	0.379 **	Y - 0640486 + 0.007531 DM (0.702) (0.002)
D_3	R^2 R^2 = = 0.195 *	Y - 3.053675 + 0.01495 DM (2.200) (0.007)
D_9	R^2 = 0.451 **	Y - 0.711244 + 0.008129 DM (0.686) (0.002)
235	R^2 = 0.08 (NS)	Y - 1.607992 + 0.009853 DM (3.124) (0.008)
F_4	R^2 = 0.599 **	Y - 1.250613 + 0.009975 DM (0.785799) (0.002)

NS = Not Significant

DM = Dry matter

Y = Body Weight.

** = Significant at 1 % level

* = Significant at 5 % level

Figures in the parenthesis are the respective SE.

From the Table 4.7. it is observed that except animal No. 235 all the animals have a significant relationship between dry matter intake and body weight of the animal. i.e. there is a definite relationship so that we can predict the body weight of the animal by giving certain quantity of dry matter.

D_7, D_{11}, D_9 and F_4 animals have highly significant relationship (both 1% and 5% level) between body weight and feed intake (D.M. basis) and D10 and D3 animals have also significant relationship (only 5% level) between body weight and feed intake of animal.

Fig. 5. Relationship between body weight (kg.) and feed intake (gm./week) of D_7 :

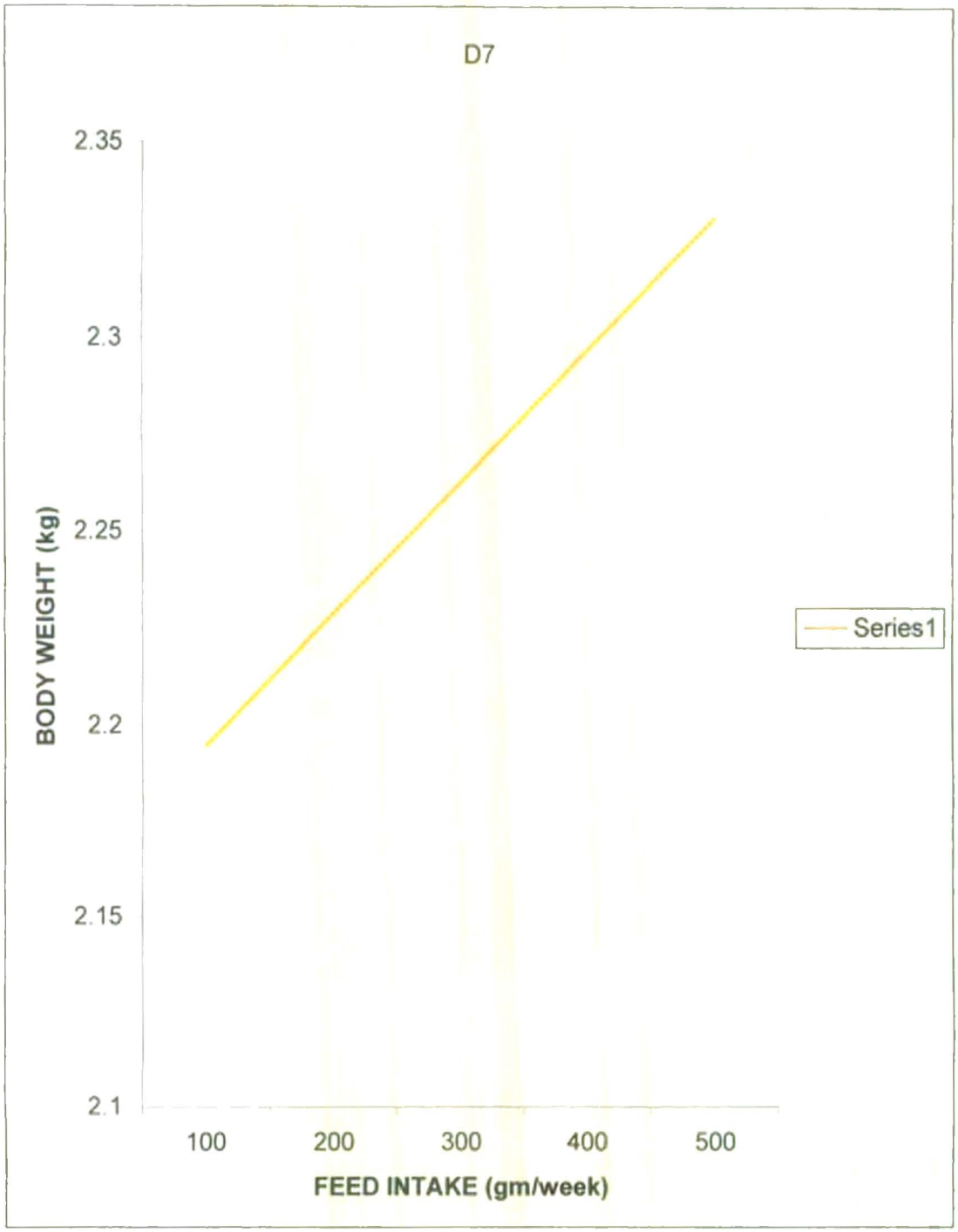


Fig. 6. Relationship between body weight (kg.) and feed intake (gm./week) of D_{11} :

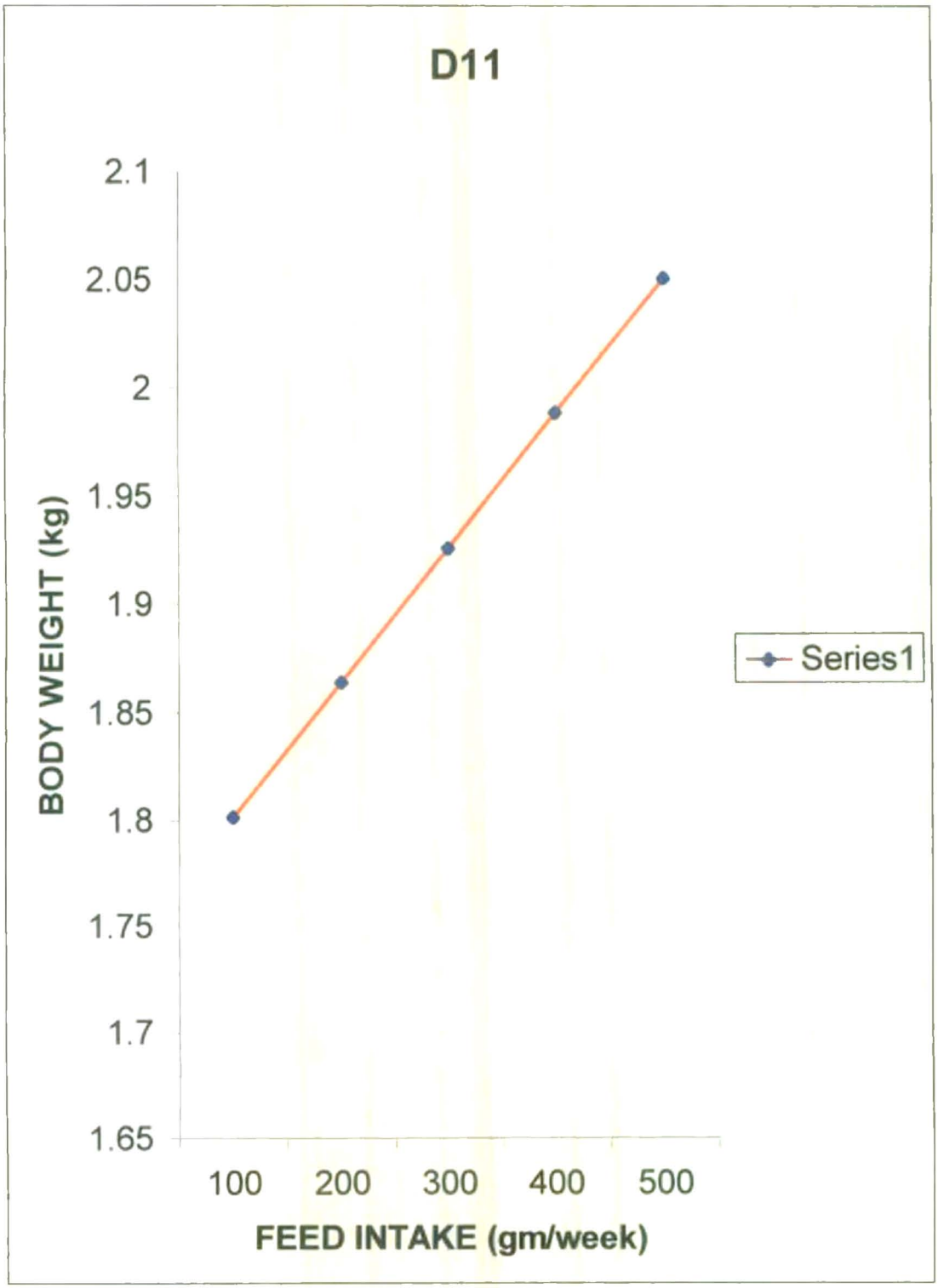
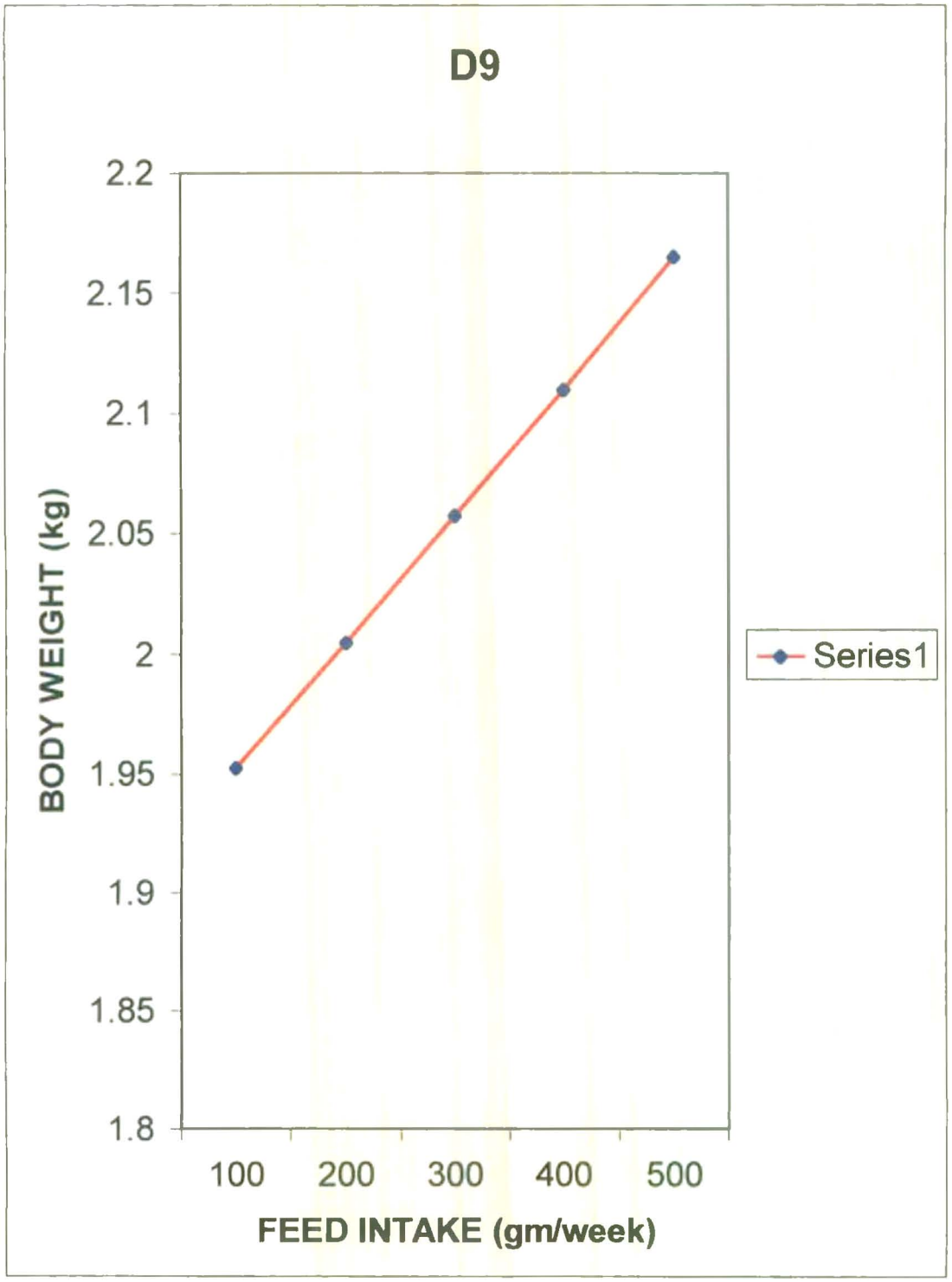


Fig. 7. Relationship between body weight (kg.) and feed intake (gm./week) of D_9 :



4.4.Relationship of body weight in respect of moisture % contain of deep litter :

The average body weight (kg) and moisture percentage of deep litter (weekly interval) co-related by regression method and represented on Table 4.8.

Table 4.8. : Individual relationship between body weight and moisture percentage of deep litter :

Animal	R^2	Relationship
D_{10}	$R^2 = 0.115$ (NS)	Y = 0.004 M + 2.23 (0.002) (0.149)
D_7	$R^2 = 0.165$ *	Y = 0.003401 M + 2.058488 (0.001) (0.103)
D_{11}	$R^2 = 0.275$ **	Y = 0.006243 M + 1.551211 (0.002) (0.136)
D_3	$R^2 = 0.0066$ (NS)	Y = - 0.001006 M + 1.986014 (0.002) (0.178)
D_9	$R^2 = 0.260$ **	Y = 0.005259 M + 1.741897 (0.001) (0.128202)
235	$R^2 = 0.177$ (NS)	Y = - 0.008843 M + 2.667306 (0.004) (0.319)
F_4	$R^2 = 0.088$ (NS)	Y = 0.007074 M + 2.122822 (0.005) (0.381)

NS = Not Significant

Y = Body Weight

M = Moisture

** Significant at 1 % level

* Significant at 5 % level

Figures in the parenthesis are the respective SE.

From the Table it is observed that D_7, D_{11} and D_9 have a significant relationship between body weight and moisture % of the deep litter. But D_{10}, D_3, 235 and F_4 have no significant relationship between body weight and moisture % of deep litter(R^2 not significant).

D_{11} and D_9 animal has highly significant relationship (both 5% and 1% level) between moisture percentage of deep litter and body weight of animal and D_7 has also significant relationship (only 5% level) between moisture percentage of deep litter and body weight of the animal.

Fig. 8. Relationship between body weight (kg.) and moisture percentage of deep litter of D_{11} :

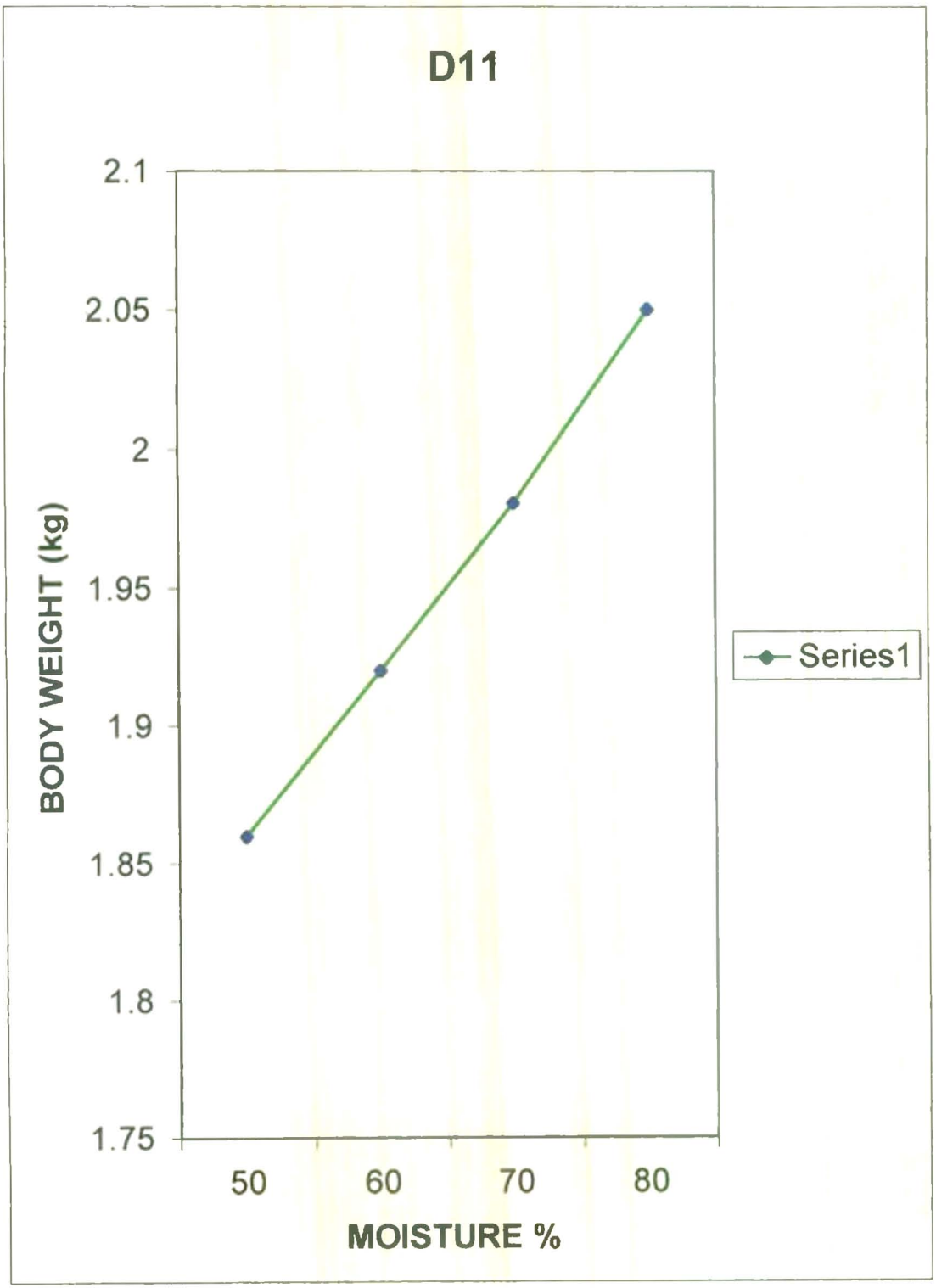
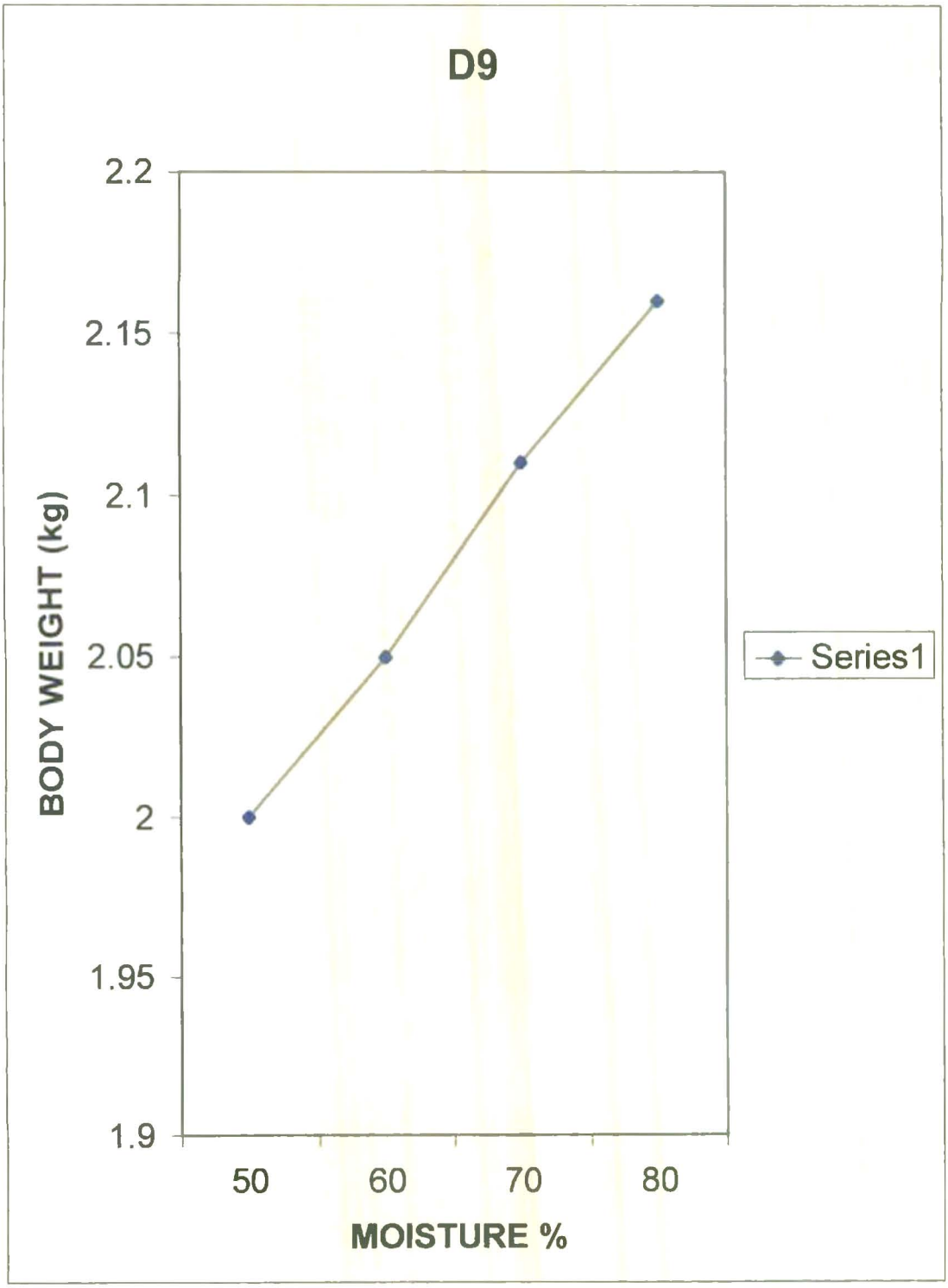


Fig. 9. Relationship between body weight (kg.) and moisture percentage of deep litter of D_9 :



4.5.Relationship of body weight in respect of pH content of deep litter :

The relationship between body weight (kg) and pH content of deep litter is made by regression method and represented on Table 4.9.

Table 4.9. : Individual relationship between body weight and pH content of deep litter :

Animal	R^2	Relationship
D_{10}	$R^2 = 0.084$ (NS)	Y = 0.117919 P + 1.313329 (0.082) (0.821)
D_7	$R^2 = 0.175$ **	Y = 0.1199575 P + 1.075594 (0.055) (0.551)
D_{11}	$R^2 = 0.275$ **	Y = 0.190208 P + 0.044727 (0.076) (0.762)
D_3	$R^2 = 0.024$ (NS)	Y = - 0.078457 P + 2.708366 (0.109) (1.1)
D_9	$R^2 = 0.169$ *	Y = 0.171074 P + 0.359659 (0.084) (0.849)
235	$R^2 = 0.080$ (NS)	Y = - 0.133333 P + 3.422222 (0.112) (1.136)
F_4	$R^2 = 0.088$ (NS)	Y = 0.053184 P + 2.058177 (0.132) (1.334)

NS = Not Significant

Y = Body Weight

P = pH of deep litter

** = Significant at 1 % level

* = Significant at 5 % level

Figures in the parenthesis are the respective SE.

From the table it is observed that D_7, D_{11} & D_9 have a significant relationship between body weight & pH of deep litter. But D10, D3, 235 and F4 have no significant relationship between body weight and pH of deep litter (R2 not significant). D7 and D11 have highly significant relationship (both 5% and 1% level) between body weight and pH of deep litter and D9 has also significant relationship (only 5% level) between body weight and pH content of deep litter.

Fig.10. Relationship between body weight (kg.) and pH content of deep litter of D_{11} :

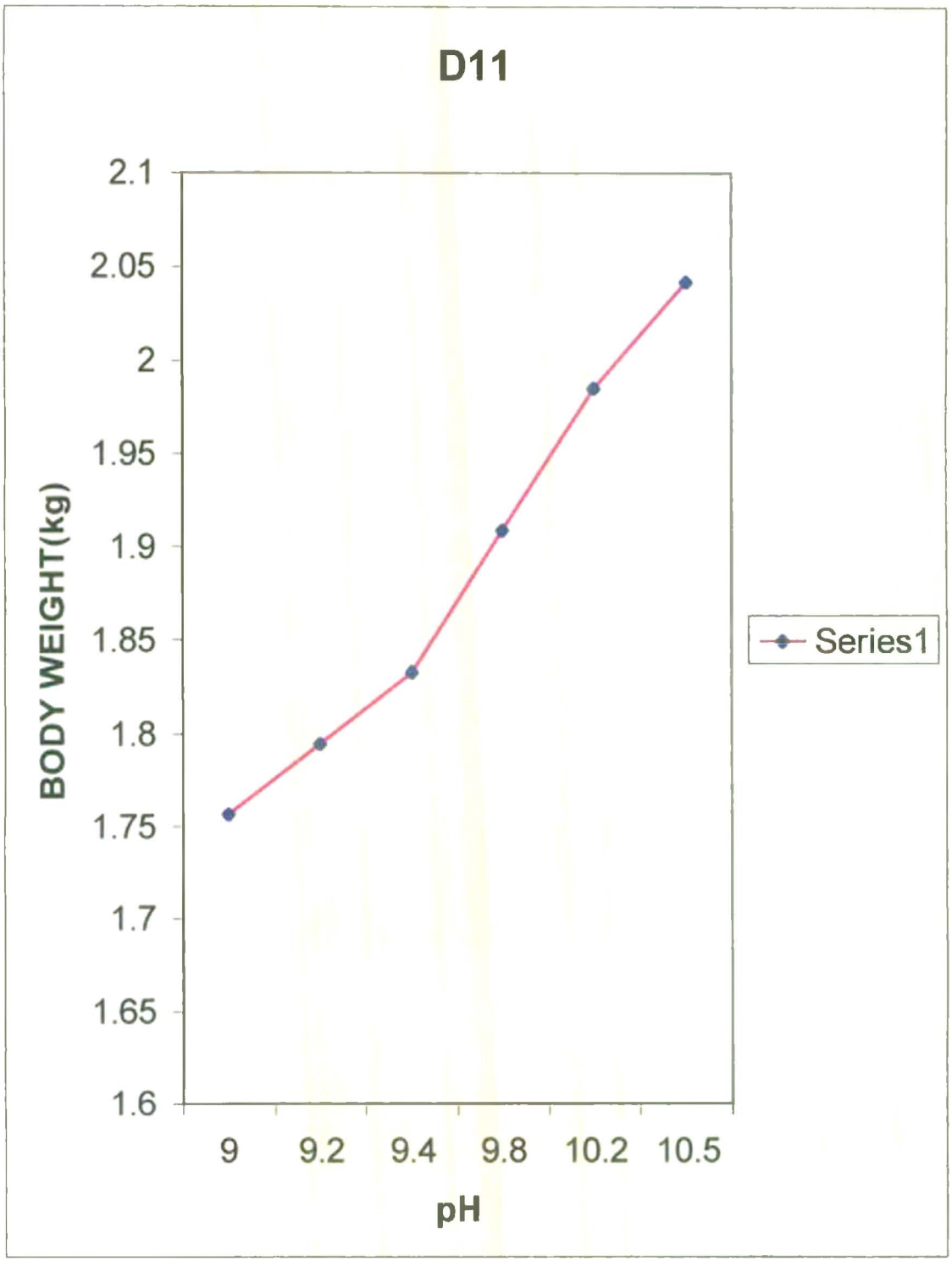
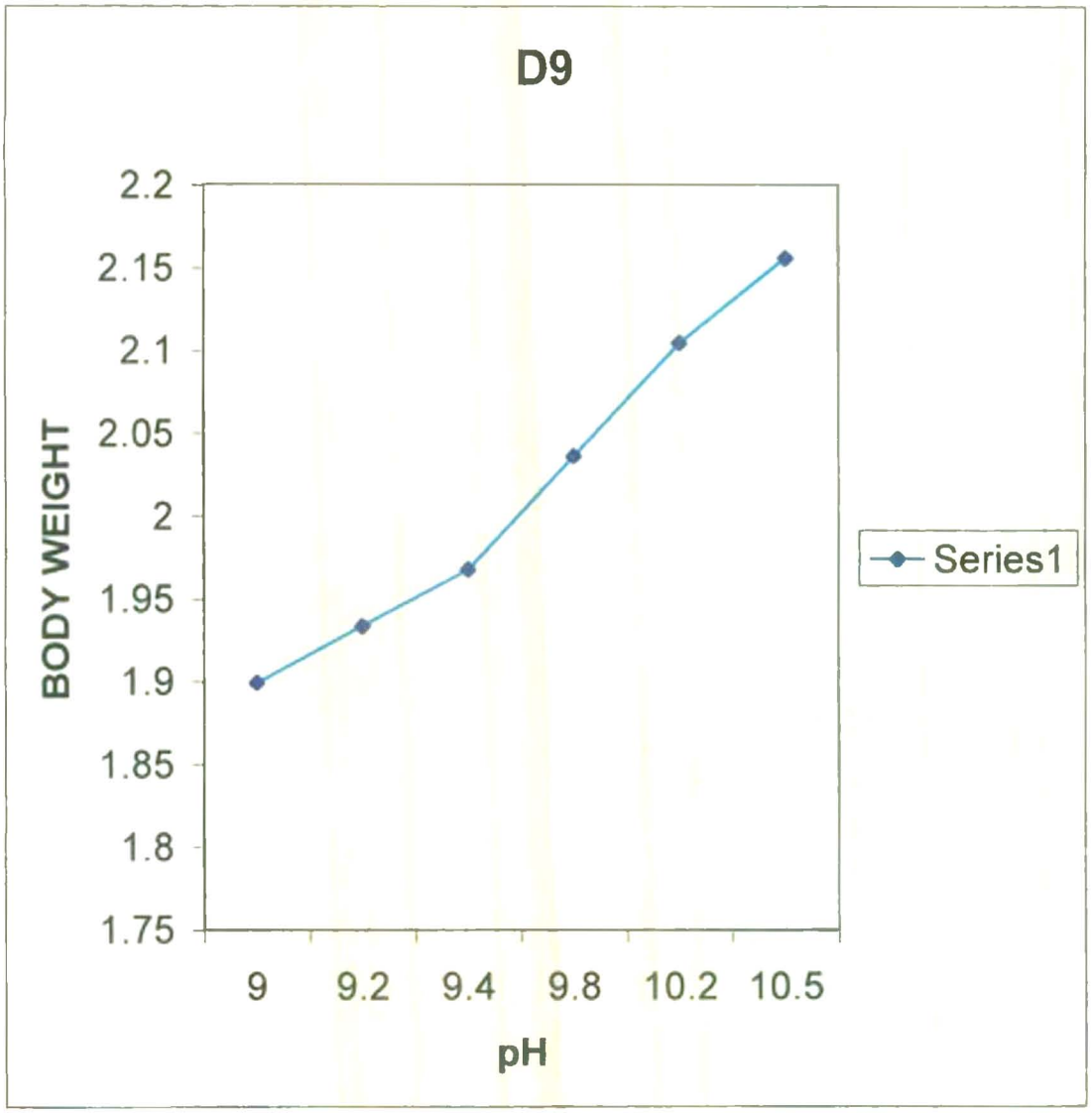


Fig.11 Relationship between body weight (kg.) and pH content of deep litter of D_{11} :



SUMMARY AND CONCLUSION

CHAPTER - 5 SUMMARY AND CONCLUSION

The present investigation entitled "Effect of deep litter housing on management of rabbit (*Oryctolagus cuniculus*) was carried out in the Department of Animal Production and Management, West Bengal University of Animal and Fishery Sciences, Mohanpur Campus. The breed of rabbit was Grey Giant and Soviet Chinchilla cross. The trial was conducted during the month of November 2001 to June 2002.

Altogether seven rabbits of almost same age were included in the study. They were kept in deep litter with 14865 sqcm. floor space. The wall of deep litter was wire netted with 60 cm height. The thickness of deep litter was 16 cm. Deep litter were stirred every alternate day manually. Moisture percentage and pH of deep litter was noted every week. The rabbit were fed with combination of mixed green grass, concentrated mixture and pellet during the experimental period. Individual body weight of animals were recorded at weekly intervals. Records of feed in take were taken on the daily basis for individual rabbit.

The rabbits were also evaluated for average dry matter intake of animals, difference in dry matter intake between animals, average body weight of animals, relationship of feed intake and body weight of animals, relationship of body weight in respect of moisture content of deep litter and relationship of body weight in respect to pH content of deep litter.

1. Feed Intake :

Average weekly feed intake of Soviet Chinchilla Grey Giant cross was maximum in case D_{10}, (386.044 gm) and minimum in case of D_3 (334.300 gm). The intake of feed of D_{10} and F_4, (385.456 gm) were significantly higher than 235 (374.072 gm), D_7(356.328 gm), D_{11} (346.344 gm), D_9 (345.461 gm), D_3 (334.30 gm) respectively.

2. Body Weight :

Average body weight of rabbit at 8 week, 12 week, 16 week, 20 week, 24 week, 28 week and 31 week of age were 1.967 kg, 2.0335 kg, 2.174 kg, 2.214 kg, 2.186 kg, 2.214 kg and 2.4 kg respectively.

3. Relationship between body weight and feed intake :

There was a definite relationship between dry matter intake and body weight of the animal. So that we can predict the body weight of animal by given certain quantity of feed.

4. Relationship between body weight and pH or moisture percentage of deep litter :

pH and moisture percentage of deep litter did not hamper much of normal growth rate of rabbit in this experiment.

Conclusion :

The study indicates the feasibility and tremendous potentiality in the existing system of management. Under the prevailing agroclimatic conditions Soviet Chinchilla and Grey Giant cross rabbits thrived well. So these two breed can be exploited for wide adoption of rabbitary as broiler use. All the economic parameters of Soviet Chinchilla and Grey Giant obtained in this study are almost similar and in conformity with observation reported by various workers in India and abroad. Under intensive or deep litter management system rabbit growth and feed intake is almost similar to cage system. Deep litter system is cost effective. Under this system the space requirement, labour orientation can be minimized. In this system animal wastes can be utilized as a organic manure in agriculture. It requires little investment and ensures no injury to the legs and hocks, no additional heating arrangement is necessary even in temperate and cold climatic condition.

Therefore in this region rabbitary since to be a potential source of cost effective production of animal protein for human nutrition. The present investigation points out the fact that Soviet Chinchilla and Grey Giant cross breed of rabbits under deep litter system can successfully be propagated for commercial utilization for economic upliftment of the poorer section of society. From the above experiment it can be concluded the cross breed rabbits of Soviet ChinChilla and Gray Giant can be reared in deep litter system of housing with out any adverse effect on growth of animals in this agroclimatic condition. The present author fills that before recommending for deep litter housing for rabbits more experimental works are to be done with large number of animals for a longer period of time.

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CHAPTER - 6 BIBLIOGRAPHY

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